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NITZSCH'S

PTERYLOGRAPHY.

EDITED BY

PHILIP LUTLEY SCLATER, M.A., PH.D., F.R.S.

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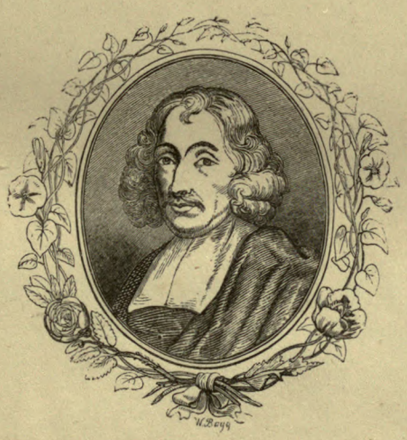

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LONDON:

MDCCCLXVII.

Christian Ludwig.

NITZSCH'S

PTERYLOGRAPHY,

TRANSLATED FROM THE GERMAN.

EDITED BY

PHILIP LUTLEY SCLATER, M.A., PH.D., F.R.S.,
SECRETARY TO THE ZOOLOGICAL SOCIETY OF LONDON.

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PREFACE OF THE ENGLISH EDITOR.

It was with no litttle satisfaction that I obtained the consent of the Council of the Ray Society to undertake the publication of an English translation of the present work, believing as I do that it is one of the most valuable and suggestive works on pure Ornithology ever published. Ever since I became acquainted with the important nature of Nitzsch's researches as here given, I have not ceased to wonder that the subject has not been taken up by succeeding Ornithologists. How this may have occurred in England it is not difficult to understand. But that not one of the many German Ornithologists, having this excellent basis to start from, should have continued the investigations of their illustrious compatriot, is indeed surprising. I trust, however, that the republication of Nitzsch's Memoir in its present form may induce some of the many enterprising Naturalists of the present day, either in this country or abroad, to follow up the work, as, until this is fully accomplished, we can never hope to arrive at a correct knowledge of the affinities of this very difficult class of Vertebrates.

The original edition of Nitzch's Pterylography was edited from the manuscripts of the deceased Naturalist by Dr. Herman Burmeister, his successor in the professorial chair, under circumstances which are fully explained in the second preface. The present translation has been executed for the Ray Society by Mr. W. S. Dallas, F.L.S., whose well-known name is a sufficient guarantee for the general accuracy of the work. A certain number of Germanisms and foreign modes of expression will be found in it; but these will be readily intelligible, and it has been thought better to make a slight sacrifice of freedom of expression to a faithful rendering of the original text. In one or two instances Nitzsch appears to have used certain terms rather loosely, and there is, of course, a corresponding vagueness in the translation. But it must be recollected that the work was left in MS. by the author himself, and edited by another, who, although one of the most eminent Naturalists of the present day, and in every way highly qualified for the task, may not, perhaps, have thought himself justified in making such alterations as would have been certainly introduced by the Author upon re-perusal of his own work.

My share in the present volume has been small, having been confined to a careful perusal of the sheets as they passed through the press, and a comparison of them with the original in doubtful cases. I have likewise added a few foot-notes, indicated by my initials, and an Appendix containing two papers from the Zoological Society's 'Proceedings' which have immediate reference to the present subject, a list of Nitzsch's published works, and a reprint of his Memoir on the Carotid Artery of Birds. The latter is of special importance, as giving the outline of the system of classification which he adopted, and which will, I believe, eventually be found to be much more nearly correct than many schemes which have been subsequently proposed.

P. L. S.

11, Hanover Square, London;
Jan. 24th, 1867.

PREFACE OF THE ORIGINAL EDITOR.

It is certainly the duty of the editor of another person's writings to inform his readers of their contents, and to state the reasons which have induced him to give them the form and arrangement he has selected for them. For this purpose, I must necessarily begin with some account of the studies of the author of the present work, the general circumstances of his life having been already published elsewhere by a friendly hand.[1] Christian Ludwig Nitzsch was one of those fortunate natures which recognise early and definitely their vocation in life, and follow it out to the end. But he was also one of those difficult individualities which are not satisfied with the most careful use of all the materials available to them, and which, therefore, never look upon their works as completed until the last fragment of the whole subject-matter has been investigated as carefully as the rest of it. The unavoidable consequences of such attempts (which generally exceed the power of man) are the arrestation of the work itself, the paralysis of the personal forces by the mass of constantly increasing material, and, finally, the arrival of death at a time when the work is still far from finished. And this was the fate of our friend. Addicted from his youth—indeed, from the days of his childhood—to the study of Birds, he commenced it in his earlier years without any definite plan, and investigated just what struck him as remarkable in these animals. Then, on comparing the collected observations of former days, he soon found presented to him three directions of investigation which still lay untouched, whilst the other branches of the subject appeared to be, if not exhausted, already more or less carefully treated. These were the internal structure, the plumage from certain points of view not then touched upon by systematic Ornithologists, and the parasites. At the commencement of his labours Nitzsch only partially examined the internal structure—at first, merely the skeleton and the viscera contained in the cavity of the trunk. In this earlier period he also frequently described only the numerical

[1] In the preface to the ninth volume of Naumann's 'Naturgeschichte der Vögel Deutschlands,' in which a good likeness of Nitzsch is given as a frontispiece.

proportions of the remiges and rectrices, leaving all the rest unnoticed. So also as regards the parasites: these were at first hardly more than ballast, which, from the want of other lading, he would not at once throw overboard; but subsequently finding them present so many points of interest, he occupied himself with them specially for a time. This mode of investigation he appears to have continued from the commencement of the present century, when it was begun (for I have now before me manuscripts of the year 1800) to about the year 1812 or 1813. During this period, his memoirs in 'Voigt's Magazin' and his 'Osteographische Beiträge' were published, the only samples of his investigations which he laid before the public. But from this time, and especially after his establishment in Halle, his activity acquired a different character. Becoming now better acquainted with the recent progress of Zoology, and with the requirements of that department which he had particularly selected for his own study, he saw that every special and exact investigation only attains a permanent and true value when it stands, not merely as an isolated contribution to the enlargement of our knowledge of the subject, but when it is at the same time brought into its proper connection with the totality of the other properties of the objects investigated, and the precise limits are indicated within which it is a criterion of form, furnishes a modification of the typical fundamental idea, and thus assists in characterising the method of modification. From this moment, every partial publication of this or that peculiarity lost all value in his eyes; and when he could not at once say precisely where it occurred, how far it extended, and what was indicated and excluded by it, he preferred leaving it entirely unpublished. We find him, therefore, scarcely ever coming forward except when compelled, either to extend one of these isolatedly published facts to its natural limits, or to refer back to their proper connection phenomena which had been drawn away from it. Only once afterwards did he surprise the zoological public with a work which stands perfectly complete within itself, was entirely elaborated by himself, and appears altogether so thoroughly worked out, that no results remain for his successors to add to it. This publication was his work on the insects parasitic on animals, contained in the third volume of Gennar's 'Magazin der Entomologie,' which furnishes an astonishing proof of the care and perseverance with which he had studied the parasites of his favorites, although these could only have been of subordinate interest to him. In its condensed brevity, it is the best and most comprehensive monograph to which the literature of Entomology can point.

When he had thus, as it were, despatched the third part of his task, and freed himself from it, he was able to devote himself with so much the more energy to the two remaining parts. And this he did completely, only noticing the parasites when a new bird brought him a new form. These he subsequently described, although in very few words, but never figured nor examined particularly. With regard to the anatomical and pterylographical portions of his ornithological studies, it was at first by no means Nitzsch's intention to elaborate them separately. In his view both of these were merely means by which one of the highest objects was to be attained, namely,

the truly natural system of birds. This idea he frequently expressed to me, when I still resided in his immediate vicinity, but at the same time indicated that he by no means regarded the natural sequence as the highest problem of the systematist, but rather the correct limitation of the natural groups. To discover the latter was the aim of his investigations; and with this view everything was henceforward carried on, and every part of the bird's body carefully examined. Nevertheless, he had always many deficiencies, especially as regards the muscular structure of birds, which he only took up at a later period, and in the case of rare exotic species, could investigate only on favorable occasions; and the nervous system, upon which he left behind him scarcely any observations, except a few outlines of the form of the brain. On the other hand, he very accurately investigated the vascular system, especially after the year 1825. Of this his Memoir on the Carotid Artery of Birds furnishes a proof. But as it is much more difficult to procure materials for these anatomical observations after the indigenous species have been examined than to investigate the skins, the purchase of which is necessary for the prescribed increase of a zoological collection, the pterylographic side of his studies soon acquired a preponderance over the anatomical. This first appears to have led him to the idea of treating it by itself, and of once more making a subject known in its entirety which had hitherto escaped the notice of all ornithologists. Moreover, as he had passed his fiftieth year, the publication of his materials might well appear to be the more necessary—especially as frequent indispositions had begun to shake his previously good health; and these were reasons enough for his determination to select a description of the arrangement of the feathers of birds as the subject of an academic thesis which he had to prepare for the year 1833. This was completed under the title of '*Pterylographiæ Avium pars prior*,' and was sent to several of his friends in single copies. Nitzsch had already, no doubt, formed the plan of the whole work, and apparently had so arranged it that a second part, containing the specialities, should be added to the first, the whole being elaborated in Latin. He agreed upon this beforehand with the publisher, and arranged to have several hundred additional copies of the first part printed at once. Indeed, he actually went to work on the preparation of the second part, and made the drawings from which the last nine plates of this work have been engraved. During the two years which were thus occupied, the pterylographic materials, to which he now almost exclusively devoted all his spare time, had considerably increased, and many of the statements already made in his published work had thus come to require modification. This circumstance obstructed the completion of the work. Nitzsch saw distinctly that it was not possible to attain accurate results from existing materials, and therefore thought it necessary to increase the latter at once. By this means he fell into a condition of great hesitation, to which, indeed, he was always much inclined; and just as he could never decide upon having the first plate engraved, although the other nine had long been ready, so he could never prevail upon himself to bring together the results of his observations and to announce them as final. In such a frame of mind any elaboration of the text was, of course,

never thought of, especially as even the part already published contained certain errors and required first of all to be remodelled. These errors he carefully noted in an interleaved copy, and thus materially facilitated my revision of them. In this way two more years passed away, and with them all inclination to proceed with the work he had so vigorously commenced. The man who appeared still to have plenty of time for mature consideration was at the end of his activity. In the midst of his endeavours to procure fresh materials for the completion of his task, death surprised him. Thus were solved at once all the doubts that still prevailed in his mind, almost exclusively and constantly occupied with scientific meditations. His last thoughts were in accordance with this state of mind: he fervently regretted his indecision, and looked upon all the labour of his life as lost!

But that this should not be the case, were my first thoughts when I came to Halle in his place. Well acquainted with the rich treasures which his manuscripts contained, it was my most important business to search through and make myself familiar with them. I succeeded beyond expectation; although Nitzsch himself, when dying, had doubted whether it were possible that another person could introduce his work to the world. On examination, I quickly saw that an abundance of materials existed for the completion of the Pterylography, if it were resolved to limit it to what Nitzsch had investigated; but that, on the contrary, the anatomical portion of his works, although very rich in details, was far too imperfect to allow a uniform whole to be prepared from it; and, finally, that his studies of the Epizoa, as Nitzsch called all parasitic insects, certainly presented matter enough for a very copious, if not perfect, representation of that group of animals. Thus it appeared certain that the Pterylography must be undertaken first. I therefore began to work it up in the manner traced out for me by Nitzsch in the Latin text of the general part and in the finished copper-plates; but thought it desirable, both for facility of description and for the sake of more general diffusion, to adopt German in place of Latin for the expression of the results.

In this form the complete work is now presented to the friends of science, in the hope that its rich and almost unknown contents may astonish all zoologists, keep permanently alive the memory of its author, and also procure for its editor a favorable judgment. May it assist in the attainment of the chief object of its author, namely, a better insight into the true natural differences of the structure of birds, which is apparently so uniform. But may it also induce ornithologists to give to their future systematic investigations an extension and depth, without which, least of all in this department of Zoology, can the final problem be solved, as, indeed, has been shown, as it seems to me, by the one-sided, and for this very reason unsuccessful, attempts which have hitherto been made with this object.

H. BURMEISTER.

Halle; *20th May*, 1840.

CONTENTS.

PTERYLOGRAPHY.

FIRST PART.

GENERAL PTERYLOGRAPHY.

Preliminary Remarks.

The information which I propose to communicate in the present work, the result of many years' careful investigation of the subject, relates to a department of zoological observation which appears to me to be of the highest importance, but which has never been treated as its great significance deserves. Although the general laws of position of the dermal coverings of animals have occasionally been discussed, no observer has taken the trouble to say anything more about them than may be learnt by a passing glance. This, however, only shows that the bodies of most fishes and amphibians are usually clothed with scales arranged in rows, and generally of equal size, and that mammals and birds have been endowed with a similar but more external[1] horny covering. From the universal and homogeneous distribution of the scaly clothing of the former, it was concluded that the arrangement and composition of the plumage of birds was similar; and thus, misled by external appearances, observers have overlooked one of its peculiarities, certainly not the least important zoological character of this group of animals, which appears to present but little variety in its subordinate differences. The desire to analyse this remarkable uniformity in external form (which has driven the majority of zoologists and even the greatest among them to adopt a defective classification of birds) by a careful and thorough study of that class of animals, and to ascertain the true multiplicity of form in them, has been my guiding principle from my youth in my ornithological investigations, and the discovery of the laws of the relative position of the feathers which I have now to communicate, is one of the interesting systematic results with which more than thirty years' occupation in the study of birds has made me acquainted.

[1] I have called attention on several occasions (*e. g.*, in my 'Naturgeschichte,' p. 664) to the essential difference in the covering of cold and warm-blooded animals; in the former all such structures are bones, which lie in pouches of the epidermis, but beneath it; in the latter, they are horny processes which project from the pouches.—B.

We may, however, justly wonder that a subject so readily accessible, and furnishing such beautiful results as the plumage of birds, has hitherto been so remarkably neglected by zoologists. And yet feathers (to which with the other horny dermal appendages I should prefer to give the name of *skin-plants* or dermatophytes [*dermatophyta*], inasmuch as they are all products of the skin which take root therein after the manner of plants) are not only easy of investigation, but also extremely agreeable subjects of examination, because they present a greater variety and multiplicity than can be met with elsewhere within the same limits. All the allied structures, such as hairs, bristles, spines, &c., are exceeded by feathers, not only in the number and variety of their constituent parts, inasmuch as they generally possess no branches, and these, when present, are always simple, but also in the complicated structure of these parts, and, consequently, of the whole. Feathers also exceed the allied structures in their comparatively very large size, and in the part which they take in the movements of birds, for the wings without the feathers would be useless for flight; again, the feathers both protect and warm the body, without greatly adding to its weight. Besides these properties it must be mentioned also that birds are indebted chiefly, if not entirely, to their feathery covering for the elegant and pleasing form which procures them so many friends and admirers. It is certain that the greater part of that public which does not follow out scientific objects in the study of zoology would detest birds if they were featherless animals, as much as naked batrachians and lizards, which now excite almost universal aversion, however beautiful they may be in their colours. Now, if even the masses are attracted by these properties of the plumage of birds, how much more should the scientific observer be excited to the most industrious investigation, when he perceives the almost innumerable differences which birds' feathers present in every possible respect; when besides the most multifarious form and structure he detects an equally complicated arrangement and grouping upon definite regions of the body, and observes these differences not merely in the numerous species, genera, and families, but also in different ages and sexes of the same species, and even at different seasons of the year, on one and the same individual. In all these and several other respects the feathers of birds will present him with distinctions highly deserving of his notice.

After hearing these assertions, the correctness of which is confirmed by the experience of many years, my reader will share with me in the surprise expressed at starting, that so rich a material for scientific labour can have remained so long unused. But it is still more astonishing that, notwithstanding the great problem which it presents, this subject has been so superficially touched upon by all the writers who have treated of it. For although statements with regard to the feathers of birds are not entirely wanting,[1] and many good observations occur amongst those which have been published, yet these investigations have been made less by ornithologists than by

[1] See especially Heusinger's 'System der Histologie,' I, 2, 207, and, besides the writings of Malpighi, Hooke, Leeuwenhoek, Camper, Baster, Poupart, the two Wenzels, Blainville, Audebert, and others therein cited, the following works:—Cuvier, 'Leçons d'Anat. Comparative;' Tiedemann's 'Zoologie,' II, 129; Alb. Meckel, "Uber die Federnbildung," in 'Reil's Archiv fur die Physiol.,' xii, 1; Carus, 'Lehrbuch der Zootomie,' p. 441; Dutrochet, "De la Structure et de la Régénération des Plumes," in the 'Journ. de Phys.,' lxxxviii, p. 333; F. Cuvier, "Obs. sur la Structure et le Développement des Plumes," in the 'Mém. du Muséum, 1826;' Macgillivray, in Jameson's 'Edinburgh New Philosophical Journal,' III, p. 253; Carus, 'Erlaüterungstafeln zur vergleich. Anat.,' II, p. 11, taf. ii, figs. 14—18; and also Eble, 'Die Lehre von den Haaren,' I, p. 128.

others; and the object of the observers has been by no means to elucidate the multiplicity of the plumage in individual cases, but rather to explain the structure of feathers in general.

I may, therefore, flatter myself with the hope of awakening the interest of naturalists by the announcement of my new results, and, by the enumeration and detailed description of the feathered regions of the bodies of birds, to which I give the name of *feather-tracts* (*pterylæ*, Federnfluren), of proving that these, new[1] and surprising as they may appear to many on the first glance at my figures, really furnish equally significant and important characters for the certain and natural discrimination of the families of birds. Since I have recognised this truth I have never ceased employing all the means at my command for its further demonstration, being convinced that the correct and natural limitation of the subordinate groups is one of the chief problems of the naturalist, the solution of which is not to be attained by a schematic treatment, often simply in accordance with this or that property, but only by the most laborious investigation of the species from every point of view.

[1] I have myself hitherto only mentioned these feather-tracts in passing (for example, in Naumann's 'Vögeln Deutschlands,' 2nd ed., I, p. 32; and in Ersch und Gruber's 'Allgem. Enzyklop.,' xxi, p. 147, Art. *Certhia*, and xxiv, p. 207, Art. *Dermorhynchi*). But M. Jacquemin has recently made some communications of a similar nature to the Academy of Sciences in Paris, of which I know nothing further (see Froriep's 'Notizen &c.,' 1837, p. 170). An academical thesis published by me under the title 'Pterylographiæ Avium pars prior:' Halæ, 1833-4, was only communicated to a few friends; it forms the foundation of the first section of the present work.

FIRST SECTION.

OF THE STRUCTURE OF FEATHERS AND THEIR PRINCIPAL DIFFERENCES.

Before I commence the description of the feather-tracts themselves, it appears to me to be necessary to say something of the parts of which feathers are composed, and of the kinds of feathers of which the tracts consist. Indeed, as soon as we begin to examine closely into the law of position of the feathers, we soon find that in certain tracts perfectly definite kinds of feathers occur, whilst in others several sorts are intermixed, and that if we are to distinguish the tracts in accordance with these circumstances we must be acquainted with the different kinds of feathers. But the exact characterisation of these kinds of feathers is impossible without an accurate knowledge of the parts of which feathers consist, and, as even in the description of these I find many material inaccuracies in the writings of authors, I consider it necessary to speak, in the first place, of the parts of feathers. I may, however, remark, beforehand, that I shall only do this in a general way, and shall not enter into details upon the numerous and often extremely different forms which many of these parts present to the observer. The parts of feathers will only be treated of here so far as is necessary for the comprehension of the laws of their position.

CHAPTER I.

Of the Parts of Feathers.

In every perfect feather, furnished with all the parts that it can possess, I distinguish:—1. The *stem* (*scapus*, Kiel); 2. The *aftershaft* (*hyporrhachis*, Afterschaft); 3. The *barbs* (*Rami*, Aeste); 4. The *barbules* (*radii*, Strahlen); 5. The *barbicels* (*cilia*, Wimpern); and 6. The *hooklets* (*hamuli*, Häkchen). These all agree in this respect, that their principal extension is in the direction of their length, so that they form, without exception, elongated structures.[1]

[1] It appears to me that it will not be out of place if I insert here some observations that I have

1. The Stem (Plate I, fig. 1, *a*), forms the main stalk of the feather, and bears all the other external parts. It usually resembles a greatly elongated cone, or a spindle. At the lower part, which is inserted in the skin, it is cylindrical, hollow, and transparent; higher up, it is filled with a cellular pith. But even the hollow part, which bears the name of the Tube (*calamus*, Spuhle), is not quite empty, but contains some large cells adhering to each other in a row, which

made on the gradual development of these parts, with the view of completing Nitzsch's description of the constituents of feathers.

A young feather, before it passes beyond the limits of the skin, forms a cylindrico-conical follicle pointed above, which is completely closed, and contains the whole of the constituent parts of the feather. If it be opened about this time, that is to say, before it has passed the outer surface of the skin, the tolerably firm, leathery follicle is found to contain a second membranous follicle, filled with a gelatinous fluid, the axis of which is permeated by blood-vessels, *viz.*, a vein and an artery, of which the latter is distinguished by its greater fineness and its lighter colour. These blood-vessels penetrate from the fatty layer of the bird beneath the skin into the inferior extremity of the feather-follicle, where they perforate both the outer and inner sacs. Between the two follicles there is a peculiar layer, formed of a soft, pasty, finely granular substance, which coats the inner follicle, in the same way that it lines the inner surface of the outer one. The whole three layers of the feather-germ may be explained as follows:

1. The outer follicle is the envelope within which the true feather is formed; it does not enter into the substance of the feather, and consists of large, thick, epithelial cells, so that it must be regarded as a continuation of the epidermis, an inversion of the latter within the cavity which contains the feather. In Plate I, fig. 17, I have represented a portion of this follicle under a magnifying power of 500 diameters; the large epithelial cells, and the cell-nuclei on their walls, are easily seen here. From the fact that several (often from four to six) other similar nuclei of subjacent cells shimmer through each cell, I think I may conclude, that the rather thick and firm follicle is formed of from five to seven layers of such cells. For the sake of distinctness I have not represented the nuclei and cell-walls seen through the others, but only those of the uppermost layer.

2. The intermediate, finely granular layer is the formative material of the feather, and its granules are nothing but cell-nuclei, which, in proportion as they are situated more towards the upper part of this layer, become more distinct and acquire a clear space (the future cell), in the midst of which they may be seen as oval granules of a yellowish colour. In many of these nuclei may also be detected a dark point, and sometimes two; these are the so-called nuclear corpuscles, which I regard as a central cavity, only formed at a later period, when the nucleus itself has become enlarged to its normal size.

3. The interior or central follicle, which consists of a very thick, spongy membrane filled with a gelatinous mass and also contains the blood-vessels already mentioned, is the focus for the formative material of the feather,—its so-called *matrix*, which evidently forms the gelatinous matter (perhaps albumen) from the blood, and subsequently converts it into cell-nuclei. With a high magnifying power, indeed, I found an innumerable quantity of granules of unequal size, precipitated upon the outer surface of the sac; these, when mixed with water, were in part dissolved, lay upon the slide, and were of very unequal size. By far the greater part of them were smaller than the cell-nuclei; but many were larger. In the sac itself I could detect no cellular structure.

In the progress of the formation of the feather the intermediate layer undergoes a very essential alteration and transformation, whilst the other two remain unchanged, pretty much as I have just described them.

The first thing that takes place when the epithelial follicle (which I shall hereafter indicate

are attached below to the base of the tube, and above to the pith of the stem. The parenchymatous portion of the stem is called, in opposition to the tube, the SHAFT (*rhachis*, Schaft), and it is from the flattened sides of this that the barbs issue. On its entire outer surface the shaft acquires a horny coat, evidently a continuation of the tube, the arched surface of which it retains on the outer side, whilst the posterior side of the shaft, which is turned towards the body

merely by the name of the *follicle*) passes beyond the limit of the cutaneous pouch in which it is inserted, is its opening at the superior extremity. As soon as this has occurred, the apex of the feather issues from the opening in the form of a pencil of fine rays, and spreads out into a tuft at the end (Plate I, fig. 10). As the pencil rises it becomes larger and stronger, the opening becomes wider, and the follicle is then seen open in its whole width. Still the feather exhibits no change; it is exactly like a pencil, and roundish and cylindrical throughout. But as it grows larger, a somewhat stronger branch makes its appearance beneath the others, which are all of equal size, on the anterior surface, and on that side which, of all parts of the feather, is most averted from the body. This stronger branch is the upper extremity of the stem, and it is easily seen that the other branches which are next to it on each side, do not descend parallel to it into the follicle, but are attached to it, and are therefore to be regarded as its branches. I find, however, at least in the feathers of the trunk, that in the first place two branches of equal size always unite in a fork, and form the commencement of the stem, and that then the two following lateral branches meet the stem of the first fork at the same height. The same structure is also exhibited in the filoplumes (Plate I, figs. 7 and 8), but with this difference, that only a few branches occur at the extremity of the shaft. Just as in these feathers (see further on) the uppermost part of every feather is perfectly destitute of pith, clear and transparent; and it is only lower down, beyond the fourth or fifth pair of branches, that it becomes more opaque and parenchymatous. If we trace the course of the stem further, we find that it penetrates, with the finer branches lying close to it, into the follicle, and loses itself with them in the granular layer within the follicle upon the surface of the matrix. This granular layer, which I shall call *feather-material*, forms a complete cylinder, coating the matrix on all sides, and emitting the already-formed extremities of the branches from its superior free margin. This cylindrical primitive form, which is consequently possessed by all young feathers, is easily recognised even in the fully-developed feather. It is very distinctly shown in the tube up to the point where it passes into the shaft. This point is characterised by the umbiliciform pit described by Nitzsch; and this pit is properly nothing but the superior orifice of the tube, narrowed by the inferior end of the thick shaft. The correctness of this view is still more distinctly seen in feathers with a large aftershaft, but most clearly in those of the Cassowary, in which both shafts are of equal size. The shaft of the feather is to a certain extent a prolongation, combined with thickening, of the upper margin of the tube at its outermost point, and the aftershaft a second prolongation of the same kind, at the innermost and precisely opposite point. Even in the remiges, which never have an aftershaft, the original cylindrical arrangement is still recognisable in the fact, that the whole of their barbs form a closed curve, an ellipse, which descends on both sides of the shaft, and passes below round the umbiliciform pit, so that, in this way, both series of barbs are connected. The figure of such a wing-feather (Plate I, fig. 18) shows, how both series of barbs (*d* and *e*) gradually approach each other as they descend, and would run round the pit (placed just below *a*), if a portion of the upper margin of the quill, with the small and almost down-like barbs, were not removed by the incision which opens the tube.

If we now trace the barbs as they descend to the base of the feather between the follicle and the matrix (Plate I, fig. 11), it soon appears that they are at first still completely separate, and that their two rows of barbules adhere closely to the sides of the barb. Further down these barbules merely present oblique lines on the sides of the barbs, and at last completely disappear, so that from this point

of the bird, has a furrow throughout its whole length; this is more or less obliterated below towards the tube, where it terminates in an umbiliciform pit, which leads into the interior of the tube. But in the fresh feather a small process of the series of cells occupying the tube projects from this pit (fig. 18, *a*), and thus closes the opening which penetrates into the interior of the

the entire barb forms a narrow band-like strip, which is at first distinctly, but afterwards only imperfectly separated from its neighbours, and finally loses itself in a perfectly homogeneous and uniformly granular mass. We will now trace a single strip upwards, from the point at which it is clearly recognisable as such, to its full evolution into a perfect barb.

In figure 14 I have shown the inferior extremity of one of these strips under the same magnifying power of 500 diameters. The figure shows distinctly enough that it consists entirely of equal-sized, loosely united cells, the perfectly similar elliptical nuclei of which show no trace of a nuclear corpuscle, a circumstance which has led me to suppose that these nuclear corpuscles are only formed at a later period, and are probably to be regarded as cavities of the nucleus. At this inferior extremity the strip appears to be perfectly flat, but higher up it becomes curved, and still higher triangularly prismatic. In this form one sharp edge of the prism is directed outwards towards the follicle, and by the two others each prism is applied to its two neighbours. The flatter side, which in this position is turned towards the matrix, is not really flat, but somewhat hollowed, and into this cavity a membranous fold penetrates, which at the first glance appears to be a fold of the matrix itself, but is really derived from a peculiar membrane situated between the matrix and the feather-material. In some cases I have seen blood-vessels in this membrane; in others I have distinctly recognised cellular structure, and indeed cells similar in formation to those seen in the strip. The latter condition belongs probably to an early, and the vascular condition to a later period of the membrane. As soon as the formation of the barb is completed, however, it separates from the membrane, and the latter remains, in the form of a perfectly close dry sac, with its surface finely lined, in the cylinder of the feather above the matrix. From it originate the dry membranous structures, which are perceptible above the upper extremity of the matrix (Plate I, fig. 11, *dd*), and which project from the umbiliciform pit at the upper end of the tube (fig. 18, *a*). These parts acquire the aspect of cells, or rather saccules, apparently in the following manner:—as soon as they begin to become dry above, the matrix forms a new layer beneath the old ones, and pushes this into the others. These membranes are therefore never true closed sacs, but merely caplike pouches, partly stuck one into the other like conical sugar-papers. The "*soul*" (*Seele*) or pith in the interior of the tube (fig. 18, *c*) is formed in the same manner, from which it follows that this also is to be regarded as the partially thrown-off outer layer of the matrix. The reason why no striation is observed on the surface of these pouches of the pith is perfectly clear, the cylinder of the tube being smooth, and not striated. We must now return to the examination of the barb.

If the prismatic strip be spread out upon a flat surface, at a point where it already possesses the above-mentioned oblique lines on each side, we obtain the appearance shown in fig. 15. I must, however, remark, that the preceding figure (14) was taken from the colourless feather of a goose, and this from a gray pigeon's feather. In the colourless barb of a feather neither the dark spots in the middle of the future central stem, nor the sharply circumscribed dark spots upon the barbules are to be seen; both are unquestionably accumulations of pigment, and in those of the central part I could very distinctly recognise the branch-like excrescences emitted by every pigment-cell, which, moreover, is much larger than one of the primitive cells. If the feather be colourless the oblique striæ on each side of the barb are much less distinctly seen, but at the same time it shows all the more clearly that each stria is produced by the separation of a series of cells running obliquely across the lateral surfaces of the prism, and that this separation becomes more and more complete, the nearer the position of the

tube. Moreover, in all the larger feathers, the shaft is nearly quadrangular, although sometimes quite flat, as in *Aptenodytes*.

2. The Aftershaft (Plate I, fig. 1, *b*), originates from the underside of the feather beneath the umbiliciform pit, and, indeed, pretty nearly at the same place where this penetrates the main

stria approaches the superior extremity of the barb. But if the feather be coloured, an accumulation of pigment is formed on each of the oblique striæ above each of its individual cells, and this is larger the nearer the cell is to the main stem of the barb. This accumulation of pigment is the cause of the spotted appearance of the barbules. It is, however, unequal on the two series of barbules, and is stronger on that which subsequently becomes the anterior series and bears the hooklets, but weaker on the opposite one, which is shown to the left in our figure. The portion here represented is, moreover, from a portion of the barb in which the separation of the barbules from each other has not yet taken place, and the different series of cells are still attached together by their walls. Higher up this union is dissolved, and the striæ become perfectly isolated barbules. Each barbule has now a necklace-like appearance, each joint of which, however, is not round, but much compressed, and consequently possesses narrow upper and lower sides, and broad right and left sides. On the former the barbule very soon undergoes its principal change, which consists in the gradual formation by one-sided thickening of the cell-membrane on the narrow sides, of elevated combs, which soon increase into large teeth. Each cell forms its own processes, which only become amalgamated with those of the neighbouring cells at a later period. At the basal portion of the barbule this amalgamation is complete, but towards the middle it is only partial, so that here the teeth may be seen still separate even on nearly perfect barbules (fig. 12, from the left, and fig. 13, from the right side). This, however, is the case especially at the lower edge, where the barbule forms a very thin lamella; on the upper edge, such excrescences never occur in the barbules of the left side, nor in those of the right side at the base; but the barbule becomes thickened here, and forms a ridge, which is the strongest part of the barbule. Where this ridge ceases, the teeth commence. Fig. 13 shows, that at first each cell still furnished with a nucleus, only forms a tooth beneath, and that this becomes elongated, and curved and hooked at the end; and also, that a remarkable abbreviation of the cells in a longitudinal direction, is associated with this formation of hooks. Where the hook-formation ceases, excrescences at the ends of the cells make their appearance on the upper edge of the barbule also, and these become larger in proportion as those of the opposite side are less hooked. Simultaneously with this the cells again increase in length, and afterwards form thin, cylindrical joints, which emit from their extremities a little point above and below,—the barbicels of the perfect barbule (fig. 4). The barbs of all down-feathers and filoplumes are formed in the same way; all exhibit a very distinct knotted structure, which indicates their origin from series of cells, and that each cell has formed peculiar and very differently formed excrescences at its extremity. If the barbules be still young, the original cells are distinctly seen in it (figs. 9 and 12); but if it be older, the cells disappear, and it appears homogeneous (figs. 4-5, 19-25). I must also remark, that the dark streaks seen in figs. 12 and 13, are enlargements of the pigment spots situated immediately above the cells, and are wanting in all colourless barbules (figs. 4 and 5). The downy barbule also, when it is coloured, does not usually show a homogeneous, but most frequently an interrupted coloration (figs. 21, 22, and 24.)

In this way the exceedingly multifarious barbules, with their appendages, knots, barbicels and hooks, are formed from the simple series of cells; but at the same time the barb itself which bears these barbules, undergoes a gradual alteration, which consists especially in a transformation of its cells. Even in fig. 15, when compared with fig. 14, we find these more angular and less regular, and on the whole somewhat larger. In this mode of development they gradually advance, becoming still larger,

stem. It resembles the main shaft, and like it emits two series of barbs, thus forming along with the shaft an apparently double feather. It is found on the feathers of very many birds, but is always deficient on the remiges and rectrices. It is largest in the two Cassowaries, in which it attains the same length as the main shaft, and is exceedingly similar to the latter in the general form of the vane. In other birds, it is shorter, and merely supports downy barbs. This is especially the case in the gallinaceous birds,[1] the structure of the feathers in which may be learnt from the figure of a dorsal feather of *Argus giganteus*, shown in Plate I, fig. 1. I find it similar in the Swifts (*Cypselus*). It is smaller in the diurnal rapacious birds, with the exception of the genus *Pandion;* and also in *Caprimulgus*, *Prodotes* (*Indicator*, Auctt.), *Musophaga*, *Psittacus*, most Wading birds, and amongst the Natatores in the *Longipennes*, the *Nasutæ* or *Tubinares* (but with the exception of *Diomedea*), and the *Pygopodes*. I find a small, soft, and very weak aftershaft in most passerine birds (in some of which, indeed, it seems to be wanting), and in the genus *Picus*. There are, however, a great many birds in which it is deficient, and in its place a few isolated barbs occur,—amongst these, are the genus *Pandion*, the nocturnal rapacious birds, the genera *Cuculus*, *Centropus*, *Coracias*, *Merops*, *Upupa*, *Alcedo*, *Rhamphastus*, *Columba*, and *Pterocles*, some species of *Crypturus*, and the natatorial families of the *Unguirostres* and *Steganopodes*.[2]

more unequal, and more angular. During this process their nucleus continues visible, and the larger the cell is, the more distinctly can we recognise in its nucleus one or two nuclear corpuscles or cavities. In its form each barb, like the barbules, is a lamella, terminating above and below in a sharp edge. (Fig. 3 *a* shows the section of six barbs from the outer half of the vane of the primary of a goose.) The lower margin of the barb is thinner and more delicate, and finally quite membranous without cellular contents, and is therefore certainly produced like the barbule, by one-sided extension of the walls of the last series of cells. The upper margin, on the contrary, has an oblique terminal surface, which bears the anterior, hooklet-bearing series of barbules near its upper edge, and the posterior, hookless series near its lower one. (These conditions are shown very distinctly in the section of six barbs, with their barbules, in fig. 3.) This upper margin, which might more correctly be called the upper surface, undergoes a change in its texture; that is to say, the cell-structure disappears in it, and in its place a very distinct longitudinal striation, a sort of fibrillation, makes its appearance. This is likewise caused by a modification of the cells originally situated here, and appears to be produced by each cell becoming elongated and fusiform, and amalgamated by its pointed extremities with the cells placed before and behind it. The cells then also form filaments inflated into knots, as is shown in fig. 16 magnified 500 diameters, and still exhibit the cell-nuclei very distinctly in their knots as the origin of the cells. The same structure is visible distinctly enough, although on a smaller scale in fig. 6, both in the shaft and in the barbs issuing from it. I have not detected any other fibrification of the cells except this, but indeed I have not sought for it, so that it is quite possible that the formation of fibres described and figured by Schwann ('Mikroskospische Untersuchungen,' Berlin, 1839, p. 87, tab. ii, fig. 13), as detected by him in the uppermost cells of the main shaft of a raven's feather, may be a peculiarity of the solid horny substance of the shaft and tube.

These are my observations on the formation of feathers; they appear to me to explain the genesis and metamorphosis of these interesting structures quite sufficiently for our purpose.—B.

[1] In the limitation and arrangement of the families I follow the system, founded mainly upon anatomical characters, proposed in my memoir *De Avium Arteria Carotide* (Halæ, 1829, 4to).

[2] In *Anas clangula* and *A. fuligula* there is an aftershaft, which, although small, is still rigid. Does it occur in all Plunging Ducks (*Hydrobates*, Temm.)?

3. The Barbs (Plate I, fig. 1, *c*) issue in rows on both sides of the main shaft, and also of the aftershaft when the latter is present; they form, with the parts seated upon them, the so-called Vane (*vexillum*, Fahne). They are usually compressed lamellæ of lanceolate form, which are seated on the shaft in such a manner, that one of the two edges is directed upwards and outwards, and the other downwards and inwards towards the body of the bird. These barbs attain their greatest depth in the outer half of the vane of the remiges; in other respects they exhibit very great diversities in different birds as regards their form, length, and thickness.

4. The Barbules (Plate I, fig. 3, *b*, *c*), are similarly emitted in two rows from the upper margin of the barbs, anteriorly towards the apex and posteriorly towards the base of the feather. But it must be noted, that barbules spring from the apex of both the mainshaft and the aftershaft where the formation of barbs ceases, and that they sometimes occur even in the interspaces of the barbs[1] when the latter stand wide apart. In this case they are extremely similar to those of the barbs, and must, therefore, be indicated by the same term. The barbules, which might be compared to the leaves of a tree, just as the stem to its trunk, are much more numerous than the barbs, and are distinguished among the constituent parts of the feather by the great variety which they present in form, length, and delicacy. Commonly, however, their base is compressed, and their superior extremity somewhat filiform. Moreover, the anterior row of barbules on each barb, or that which is directed towards the apex of the feather, is very frequently distinguished from the posterior series, not only by the form, but also by the parts which in turn issue from the barbules.

5. The Barbicels (Plate I, fig. 4, *a*), when they occur, are the most numerous of all the parts of feathers, and originate, like the hooklets, almost solely from the barbules of the anterior series. They form, as it were, their branches, and are simple, filiform, straight, or nearly so, and stand either in a single or double series. They never occur on the lower part of the barbule (unless we are to regard the broader lobes (fig. 4, *c*), which are sometimes met with there as representing them), and even on the upper part they are not always present; in this case, however, they are entirely wanting. When the barbules are downy in form, small knots, alternating with thin interspaces, appear to take the place of the barbicels, especially if the knots, as is not unfrequently the case, are produced into opposite points, and thus represent barbicels (figs. 9, 20, and 23).

6. The Hooklets (Plate I, fig. 4, *b*), like the barbicels, are only perceptible under the microscope, and likewise constitute lateral processes of the barbules, but they only occur on the anterior series of the latter, never on the posterior, and also only on one side of each barbule, namely, the lower side. They appear to differ from the barbicels only by their hooked curvature and their peculiar purpose. The hooklets of the anterior series of barbules of each barb interlock with the posterior series of barbules of that which immediately follows it (see Plate I, fig. 2), in such a manner that each hooklet of one barbule lays hold of a barbule of the next barb, and

[1] This is the case, for example, in the feather represented in fig. 1 at the part of the shaft where the barbs of the basal half stand somewhat wider apart. With regard to the remarkable structure of this part see the explanation of figure 6.

the whole of the hooklets of each barbule thus grasp as many barbules of the following series as are crossed by the hamuliferous barbule of the preceding series. An examination of the drawing given in Plate I, fig. 2, will render this relation easily intelligible. It is seen, at once, that each barbule of the anterior series crosses over eight or nine barbules of the posterior series of the following barb, and when the enlarged figure of the hamuliferous barbule (fig. 4), is compared with the equally magnified representation of the barbule destitute of hooklets (fig. 5), it will be easily understood how a hooklet of one barbule must catch in each of the little pits visible in the other (fig. 12).[1] It is to this peculiar and ingenious arrangement alone that we must ascribe the faculty of the vanes of serving as an apparatus for flight.[2]

[1] I give Nitzsch's notion of this matter, although I do not believe that it is the correct one. In the first place, these so-called "pits" are very often wanting in old barbules (fig. 5). But if the curvature of the hooklets in the barbule correctly figured by me be compared with the position of the pits in another barbule (fig. 12), it will easily be seen that the curvature is much too small to enable them to reach down over the upper margin of the barbule to the pit. Nor do I believe that these spots regarded by Nitzsch as pits are really depressed, but I consider them merely as the still existent cavities of the primitive cells of which the barbule is composed. (See my observations on the genesis of feathers, p. 4 et seq.) Lastly, I have noticed in all barbules a strongly thickened superior margin, which is precisely of such a size that the hooklets can just grasp it. It is behind this margin, and not in the pits, that the hooklets take hold, and thus fix the posterior barbules much more securely, because when a pressure is applied to this connexion by the force of the air during flight, the hooklet need not let go its hold of the margin, as must necessarily often occur if the hooklet was inserted into a pit so wide, and situated so far below the upper margin, over which moreover the hooklets must extend themselves.—B.

[2] It is certainly remarkable, that the true relations of these barbules and barbs, which were well indicated even by Perrault and Hooke ('Microgr. Rest.,' p. 32, fig. 19), have remained quite unknown to most writers of the present day, so that, in attempting to explain them, they put forward the most preposterous notions, and do not take any notice of the hooklets.

CHAPTER II.

Of the Principal Forms of Feathers.

The feathers of birds, and especially their barbules, exhibit a great number of different modes of structure. Nevertheless, one form passes into another, and not unfrequently several forms are found combined in the same feathers, and even in the same parts. For this reason I do not intend, nor indeed, is it possible, to give a complete discrimination and definition of the forms of feathers. However, I consider the definite indication of some of the chief forms to be necessary, and I distinguish three of them under the names of pennaceous (*pennacea*), downy (*plumulacea*), and filoplumous (*filoplumacea*).

1. The *pennaceous* structure is recognised by its complete and strong stem, parenchymatous shaft, rigid barbs and barbules, and by the compressed, or, as in the case of metallic and irridescent feathers, flattened form of the barbules, the anterior rows of which usually possess barbicels and hooklets.

2. The *downy* structure is produced when the stem is weak and short, and the shaft (where it occurs) and barbs remain soft; the barbules are very fine, very mobile, and commonly very long, but compressed only at the base, and afterwards round and filiform. With this the above-mentioned interrupted dilatation into dark knots with two points, and a complete deficiency of hooklets is always combined.[1]

3. The *filoplumous* structure is distinguished from the two others by a very thin, rigid stem, usually a translucent shaft in which the pith is wanting, very fine, rigid, round barbs, and short, somewhat rigid, filiform barbules. Neither hooklets nor knots occur in this form.

CHAPTER III.

Of the Different Kinds of Feathers.

Although the *four* kinds of feathers formed upon the primary types above described cannot be separated by any determinate boundaries, I believe that only these four can be admitted. I have endeavoured to distinguish them by the names of Contour-feathers or Surface-feathers

[1] See my observations on the variegation of the downy plumage, in Voigt's 'Magazin für den neuest. Zustand der Naturkunde,' Band xi, p. 393, tab. vi, 1866.

(*pennæ*, Kontur- or Lichtfedern); Down-feathers (*plumulæ*, Dunen); Semiplumes (*pennoplumæ*, Halbdunen); and Filoplumes, (*filoplumæ*, Fadenfedern). To the latter I formerly gave the name of *arrested feathers* (Kümmerfedern).

1. *Contour-feathers* may be the name given to the feathers furnished with a stiff and perfect stem, which, being exposed to the action of light on the surface, form the external outlines of the feathered body. The upper part, at least, of their vanes consists, to a greater or less extent, of barbs, and usually also of barbules of *pennaceous* structure, whilst the lower part, which is nearer the tube, and concealed, has these parts usually *downy*, especially on the sides. The most perfect contour-feathers, or those in which the pennaceous vane is largest and the downy part smallest, are the remiges of the wings and the rectrices of the tail. In the other contour-feathers, which are often provided with an aftershaft, the greater part usually belongs to the downy structure, and it is precisely in these that we find exhibited the greatest variety in the different families, genera, and species of birds, and also in birds of different ages, and even of different sexes. There are also contour-feathers which are imperfect in various degrees. Thus, for example, some, which have the upper part pennaceous, have no barbicels and hooklets, such as those of the Ostrich (*Struthio*) and Nandu (*Rhea*); others have no barbicels on the pennaceous barbs, as in the two Cassowaries (*Casuarius* and *Dromæus*). Nay, there are some contour-feathers which are even destitute of barbs, either on the parts most exposed to the light, as in the bristles of the angles of the mouth and of the chin and the eyelashes (in which, however, a sort of vane occurs at the lowest part), or throughout the whole shaft, as in the so-called wing spurs of the Indian Cassowary, which I regard as feathers, although they possess no barbs, and depart from the regular form in other respects.[1]

2. The *down-feathers* are recognised by the downy structure of all their parts; they are always found at a distance from the external outlines formed by the plumage, withdrawn from the light and covered by contour-feathers, or by the folded wings. They frequently stand between the contour-feathers, namely, one in the midst of the space enclosed by four of the latter, so as to form, with them, a quincunx. This arrangement I have met with especially in *Dysporus*, *Podoa*, and others. But we by no means always find a single down-feather between the four contour-feathers, but frequently several of them; as, for example, in the *Unguirostres*, in which large and small ones occur together, and sometimes great numbers of them, as on the neck of the Eagle. They are also found on spots which bear no contour-feathers; or they occur on such spots only, but are then more scattered. In this case they are certainly free from the usual covering formed by the contour-feathers, and constitute the external outlines of the plumage, as, for example, on the head and neck of certain Vultures; but then the superior barbs possess compressed

[1] I cannot here suppress the observation, that to complete the character of the contour-feathers we must notice their capability of being moved by peculiar muscles concealed beneath the skin. These muscles start from the skin, and are inserted upon the portion of the tube which projects within the skin, or more properly upon its sheath. It is true that these muscles, which are wanting to all downy feathers, are sometimes so small, as not to be easily detected. But in some birds, especially in members of the families *Steganopodes* and *Unguirostres*, I have distinguished them very readily on the trunk, and indeed *four*, or more rarely *five*, of them to each feather, so that the total number of these muscles must certainly amount to 12,000, as both in *Anas marila* and in *Dysporus bassanus* I have counted about 3000 contour-feathers.

and nearly pennaceous barbicels, and thus form a transition towards contour-feathers.[1] As regards their structure down-feathers have either a simple shaft, or combined with this an aftershaft, when the contour-feathers are likewise furnished with the latter, as, for example, in the diurnal rapacious birds, the Cranes, the Herons, and others; or they are umbelliform, in which case the shaft is entirely wanting, and the barbs are seated on the upper extremity of the tube, as, for example, in *Pelecanus*. I shall speak hereafter of the peculiar *powder-down-feathers*, which continually produce a dusty matter.

The downy covering of newly-hatched young birds consists, according to some authors, of down-feathers, and, according to others, of hairs; in most birds, however, it is formed neither of one nor the other, but solely of early-deciduous, down-like, or setiform processes, seated upon the apices of the first-formed barbs of contour-feathers, or even of down-feathers. It is only in the *Unguirostres* that the nest-clothing consists of true down-feathers furnished with a shaft and tube. But these down-feathers are stiffer, in all parts, than the subsequent ones, and their barbules are remarkably thin. They exhibit no knots, or very small ones, and these bent alternately in different directions.

3. The *semiplumes* hold, as it were, a middle place between the down- and contour-feathers, possessing the larger and more rigid stem of the latter, and the downy barbs and barbules of the former. They never stand, like the true down-feathers, between contour-feathers, but at the margins or extremities of the feather-tracts, where they complete the series of contour-feathers, or entirely take their place. They even form tracts without contour-feathers, when they stand closer together. They are, nevertheless, covered by contour-feathers, and withdrawn from the light. Frequently they have an aftershaft when this also occurs in the contour-feathers; they are then distinguished from the neighbouring contour-feathers only by the want of the pennaceous apex. Others are more like down-feathers. They are largest in some Storks, as, for example, in *C. argala* and *C. marabu*, in which they are seated beneath the lower tail-coverts, and are often employed as ornaments by our ladies; they also occur in the same situation in *Faleo albicilla*.

4. The *filoplumes* (Plate I, fig. 7) are very strikingly distinguished from the other three kinds of feathers by their peculiar position, their extraordinary slenderness, and by the entire deficiency or very small size of their vane. At the same time they are, as it were, associated with the contour-feathers, one, or even two, filoplumes standing quite close to every contour-feather of the head, neck, and trunk, apparently issuing almost out of the same pouch of the skin. More rarely, as in the Herons and *Unguirostres*, several filoplumes (sometimes as many as ten) stand near each contour-feather. In their structure they belong to the filamentous type, and no other occurs in them, except that sometimes, for example in some gallinaceous birds, they have downy barbs and barbules at the base.[2] The stem is usually so thin that it can scarcely be seen by the naked eye. In the Cassowaries alone it is much thicker, and, contrary to the general rule, greatly compressed. It is, however, always rigid, straight, long, and filiform, and has a very

[1] Perhaps these *surface down-feathers* (Licht-dunen) should be referred to the contour-feathers, under the assumption that the downy part, which in most contour-feathers occurs only at the inferior extremity, ascends in these to the extreme apex.

[2] A filoplume of this kind found in the common fowl (*Gallus Bankiva domestica*), is figured by Heusinger ('Histologie' I, tab. iii, figs. 1 and 2). Our figure (Pl. I, fig. 7) shows no downy barbs, and is taken from the feather of a Goose.

short tube, scarcely distinguishable from the pithless shaft. This stem either emits no barbs, just like hair, or gives origin to a few barbs (frequently only one or two), and these always at the extremity of the naked shaft. These filoplumes are probably common to all birds, at least I have never sought them in vain where I have taken the necessary trouble. Those standing very close to the contour-feathers are shorter, and entirely covered by them, but in most passerine birds, especially in *Fringilla*, *Sylvia*, and *Turdus*, some longer filoplumes occur at the nape, and these project and pass beyond the apices of the neighbouring contour-feathers. In the genus *Trichophorus* Temm.; they even project a long way and curve downwards, in the form of simple, barbless hairs. Filoplumes of a different and far more highly developed kind occur in the genus *Halieus*, Ill. (*Carbo*, Meyer), in which they almost acquire the character of contour-feathers, for I believe that the delicate, narrow, white, downy feathers which project on the neck from the otherwise metallic black plumage of this genus of birds must be regarded as filoplumes, as although they are furnished with perfect vanes, they agree both in position and in the slenderness of the stem and other parts with the feathers of this kind.

I think I have described the structure and kinds of feathers sufficiently for the necessities of this work, and now pass to their position as the true subject of my present communication, although I well know that the preceding furnishes but a very scanty indication of the infinite differences which may be detected by a careful study of the plumage of birds.

SECOND SECTION.

OF THE DISTRIBUTION OF THE PLUMAGE OF BIRDS IN DEFINITELY LIMITED TRACTS.

CHAPTER I.

Of the Arrangement of Feathers in General.

It is only in a very few birds that the contour-feathers are distributed, like the hairs of the Mammalia, uniformly, and in uninterrupted sequence over the whole body, in such a manner that only the horny covering of the beak, and the toes and tarsi are not covered by them; in most birds they are arranged in crossing rows. An uninterrupted covering of feathers occurs, for example, in the genus *Aptenodytes*, Linn., in which I have found it to be particularly complete; also in the Cassowaries, in which, besides the naked parts of the head and neck, only the pectoral callosity has no feathers; in *Palamedea cornuta*, in which the axillary region alone is destitute of feathers, and in *Palamedea chavaria*, which, however, also possesses the well-known featherless band on the neck. There are some other birds in which a similar character may be detected, although in a less degree of development. But most birds have an *incomplete* feathery covering, the contour-feathers on the head, trunk, and anterior limbs, forming more or less elongated, narrow bands, bounded by other bands which are either naked or only clothed with down. The latter are certainly covered, but by no means clothed, by the contour-feathers of the neighbouring feathered bands.

To these feathered bands I give the name of Feather-tracts or Contour-feather-tracts (*pterylæ*,[1] Federn-fluren), and to the naked bands, or those which are not beset with contour-feathers, that of featherless-spaces (*apteria*, Federnraine). Both kinds of bands may be readily distinguished and named according to the parts of the body on which they occur; I will, therefore, mention them at once, and propose the denominations which I shall employ to denote them in future.

I. I have particularly distinguished the following *Tracts*:—

1. The *dorsal tract* (*Pt. spinalis*, Rückgratflur).
2. The *humeral tracts* (*Pt. humerales*, Schulterfluren).

[1] Properly *feather-forest*, derived from πτερόν and ὕλη.

3. The *femoral* or *lumbar tracts*[1] (*Pt. femorales* seu *lumbales*, Oberschenkel- or Lendenfluren).
4. The (single or double) *inferior tract* (*Pt. gastræi*, Unterflur).

In a very few birds there are—

5. Lateral *neck-tracts* (*Pt. colli laterales*, Halsseitenfluren), which pass into the dorsal and inferior tracts.

The other parts covered with contour-feathers would furnish the following tracts, if, from their uniform feathering, they may be regarded as such.

6. The *head-tract* (*Pt. capitis*, Kopfflur).
7. The *alar tracts* (*Pt. alarum*, Flügelfluren).
8. The *crural tracts* (*Pt. crurales*, Unterschenkelfluren); and
9. The *caudal tract* (*Pt. caudæ*, Schwanzflur).

II. I distinguish as *spaces*:—

1. The lateral *neck spaces* (*Apt. colli lateralia*, Halsseitenraine).
2. The *lateral spaces* of the trunk (*Apt. trunci lateralia*, Rumpfseitenraine).
3. The *inferior space* (*Apt. mesogastræi*, Unterrain).

Besides these, the following occur more or less commonly:

4. The *spinal space* (*Apt. spinale*, Rückgratrain).
5. The *upper wing-spaces* (*Apt. alæ superiora*, Oberen flügelraine).
6. The *lower wing-spaces* (*Apt. alæ inferiora*, Unteren flügelraine).
7. The *crural spaces* (*Apt. cruralia*, Unterschenkelraine); and
8. The *head spaces* (*Apt. capitis*, Kopfraine).

I shall treat first of all these in general, and afterwards of each one by itself.

CHAPTER II.

Of the Causes of the Interrupted Plumage.

These must be sought on the one hand in the considerable weight of the feathers, and on the other, in the bending and movements of the limbs and neck. Thus, the contour-feathers of the neck and trunk, although they are usually much smaller than those of the wings and tail, are, when compared with the down-feathers or hair, evidently so large and especially so broad, that they cover the unevennesses and hollows of the surface of the body, fill up the differences of the external outlines, and confer upon the body that smooth and rounded form which is equally conducive to beauty, and to the power of flight. Nevertheless, the feathers, by their size alone, would certainly obstruct, if they did not prevent, the movement and free use of the limbs, especially the wings, whilst they could not render the outer surface any more uniform, if they

[1] The plural indicates that the tracts are in pairs or double.

closely covered the whole body in every part, and did not leave those naked spots, or at least spots destitute of contour-feathers, on which the limbs are more readily moved and in which they fit much better in repose, whilst on the other hand many excessive projections of the body are effaced and concealed by them. There is no question, that every featherless space has some such object, which, however, will be treated of hereafter. For, I believe, that the interrupted feather-clothing must be deduced, as a necessity, from the great size of the contour-feathers; as, on the one hand, such large structures could not be produced uniformly over the whole surface of the body without a great consumption of organic material and activity, whilst on the other hand, their size must be dependent on the extension and number of the feather-tracts, the latter diminishing in the same proportion as the former are extended and enlarged.

This view is confirmed by those birds which only possess narrow spaces, as, for example, the *Unguirostres*, the *Steganopodes* (Plate X), and the genera *Buceros* (Plate VI, figs. 1 and 2) and *Colius* (figs. 10 and 11), all which have very numerous, but small contour-feathers on the neck and trunk; whilst the birds provided with very broad spaces have the contour-feathers in their tracts very large, but few in number. Lastly, those birds which exhibit no spaces, have the wings rudimentary and useless for the purpose of flight, and their feathers are either very small, as in *Aptenodytes*, Linn., or, if not small, very narrow, as in the Cassowaries. In *Palamedea*, indeed, a different condition occurs, inasmuch, as the wings are available for flight; but, on the other hand, the plumage is not truly uninterrupted. (See the Second Part, Fam. *Alectorides*.)

CHAPTER III.

On the Methods of Investigating the Feather-tracts and Featherless Spaces.

In all those birds the young of which are nestlings, and at the same have tolerably naked spaces, the examination of the plumage for the tracts and spaces is very easy, so long as they are in the nest, and the contour-feathers are in course of formation so that they do not cover the spaces; but even then only in cases where there is no general downy coat. As, however, spaces of this kind do not always occur, and we have not always the opportunity of examining such young birds, some artificial contrivances are necessary to enable us to discover the feather-tracts.

To effect this three methods are especially applicable:—(1), we may carefully pluck the bird, and note the pouches, or pits, in which the contour-feathers were inserted; or (2), we may cut off the contour-feathers at the root, and then wet the body; or (3), we may strip off the skin, and after carefully cleaning it, examine it from the inside. In this last method, the contour-feathers reveal themselves at once by the projecting extremities of their tubes. The method to be adopted must depend upon circumstances, but it is always advisable to apply more than one to the same bird, because, according to the individual nature of the bird, sometimes one and sometimes another, furnishes the best results. But, after an external examination of the entire

plumage, which must never be omitted, an inspection of the inner surface of the skin is generally sufficient, and, indeed, this must always suffice when we can only obtain skins intended to be stuffed for collections. If I had not employed this third method, I should have found some difficulty in studying the arrangement of the feathers upon so many genera and species, some of them of great rarity.[1]

CHAPTER IV.

Of the Differences in the General Design of the Feather-tracts.

In the design of the feather-tracts I have noticed *two* chief differences, namely, *densely-feathered* tracts (*densipennæ*), as I may call them for the sake of brevity, or those in which the feathers stand close together, and *scantily-feathered* tracts (*raripennæ*), in which the feathers are more scattered and separated by greater intervals. Besides the contour-feathers, the tracts always contain filoplumes, and here and there also some semiplumes, especially at their margins. True down-feathers are wanting in the feather-tracts of all the groups characterised by me as *air-birds* and *ground-birds*, but in the *water-birds* they always occur between every four contour-feathers of the tracts; sometimes one, sometimes more (see *ante* p. 13). Other differences of the feather-tracts may be indicated by the following terms:—*strong*, when the contour-feathers have very thick tubes; *weak* or *stunted*, when the contour-feathers are small and insignificant. The tracts usually appear *very distinct* when they are circumscribed by a definite boundary, consist of strong feathers, and are margined by naked or merely downy spaces. Sometimes, however, they dwindle away towards the margin, and lose themselves as *weak* tracts in the neighbouring spaces, which then bear strong down-feathers or even semiplumes. By this arrangement, which I have met with in *Buceros* and *Colius*, the *interrupted* plumage passes into the *continuous* form.

The feather-tracts also vary greatly in their breadth; in some birds, such as *Galbula*, *Merops*, *Upupa*, and *Ardea* (see Plates IV and VIII), they are extraordinarily narrow,—in others, on the contrary, moderately broad, but with the spaces reduced in the same proportion. This kind of plumage, as it occurs, for example, in the *Steganopodes* and *Unguirostres* (Plate X),

[1] I have made observations as above described, not only in Halle, but also in the far richer museums at Berlin, Frankfurt-on-the-Maine, Leyden, Paris, and Geneva, the treasures of which were placed at my disposal by the great kindness of their chief authorities, MM. Lichtenstein, Cretschmar, Temminck, the two Cuviers, and the two Geoffroys. I was also greatly assisted by the distinguished artists, to whose talents and industry these collections are indebted for a great part of their lustre, namely, M. Rammelsberg, at Berlin; MM. Florence Prevost, Perrot and Bibron, at Paris; and M. Linder, at Geneva. All of these gentlemen have rendered me particular services in this department of my studies.

also resembles the continuous form in some degree, and might be regarded as continuous on a cursory examination.

The differences just indicated sometimes occur on the same bird, nay, even in the same tract. For there are tracts of which one part is densely, and another sparsely feathered; and others appear strong in one part, and weak in another. Some have a sharply marked margin on one side, whilst on the other they pass almost imperceptibly into the neighbouring space. And we also meet with tracts which are broad in one place, but very narrow in the rest of their extent.

In this way many different forms are produced. It is true, that nearly all tracts form bands longer than broad, following the direction of the length of the body, but although in many birds, they are continued without interruption, in others they are broken up by real or apparent gaps. A *real gap* is a spot in the tract, which bears no feathers at all; an *apparent*, or *false gap*, on the contrary, is one which is covered by weaker contour-feathers resembling down-feathers. A tract is also often merely divided longitudinally in some birds, and double in others; or another may be double which generally occurs in a simple form; then again, two tracts which are usually distinct may unite; and lastly, the tracts may extend or contract themselves, sometimes in one form, sometimes in another. In some birds, tracts may be wholly or partially wanting, which are generally present. I shall have to recur to these distinctions hereafter in the description of the different tracts, and therefore dwell no further upon them here, from a conviction that the indications already given will show the reader that there is a great variety in them.

Although the design of the tracts is sometimes very different in similar birds, or more accordant in others which have but little affinity, the attentive observer cannot fail to perceive that the tracts are partly in accordance, and partly different in the different families of birds, and that they by no means occupy the lowest place amongst those characters which are regarded as available for the establishment of families, or higher groups of birds. This is clear, from the simple fact, that there are some whole families and many genera of birds, which cannot be better distinguished from other similar forms by any external character than by the form and structure of their feather-tracts. As examples of this, I shall only mention the Nocturnal Rapacious birds, the *Passerinæ*, *Macrochires*, *Columbinæ*, *Gallinaceæ*, *Herodii*, and *Limicolæ;* and, as a few genera, among very many: *Rhynchodon* Nob. (including the Noble Falcons), *Pandion*, *Hybris* Nob. (*Strix flammea*, and its allies), *Cinclus*, *Ocypterus*, *Meròps*, *Galbula*, *Cuculus*, *Prodotes* (*Indicator* Cuv.), *Colius*, *Pavo*, *Otis*, and *Psophia*.

In certain families of birds, as for example, the *Cuculinæ*, *Lipoglossæ*, and *Amphibolæ*, the design of the feather-tracts is so discordant that it is scarcely available for the formation of a general character of the family; but then we find that the genera are all the better distinguished by the design of the tracts. But when a very definite family-type of the feather-tracts makes its appearance, as in the *Passerinæ*, *Limicolæ*, *Longipennes*, *Steganopodes*, and *Unguirostres*, the generic distinctions gradually disappear, although not entirely. Thus, among the *Passerinæ*, some genera have the dorsal tract divided on the back, while most of them have a simple one. This tract usually forms at this spot a dilatation, which in most genera is of a rhombic form, but in some is elliptical, laterally rounded, or almost circular. In other genera again, the anterior part of the tract in front of the dilatation is broader than the posterior part; or the reverse is the case. The inferior tracts in this family are somewhat enlarged upon the breast, or, in many genera,

they emit a larger or smaller branch at this spot. In *Oriolus*, and other genera, these tracts dwindle away at the inner margin, whilst in most they are very *strong* at that part. It is only in the genus *Cinclus*, in this family, that down-feathers occur between the contour-feathers, and also usually on the spaces.[1] Lastly, in *Ocypterus* (Plate III, fig. 4) alone, we find the singular *powder-down spots*, to which I shall refer hereafter. But I have now said enough about these differences.

The species of the same genus of birds usually agree with one another in the design of the feather-tracts when the genus has natural limits, and its species are sufficiently known. But if it has too wide a compass, and contains numerous dissimilar species, it cannot be surprising if differences are to be found with respect to the feather-tracts, corresponding to the groups of species. Thus I have found striking specific distinctions in the genera *Falco*, *Alcedo*, and *Bucco*, and their allies.

In the numerous individuals of one species no distinctions, except sexual ones, occur in the feather-tracts. When these occur it is not merely the structure of the feathers (as in *Paradisea*), but also their position, that appears to be changed, if I have been right in my observations. (See below, the genus *Paradisea* among the Passerine birds.) I have never met with accidental differences.

CHAPTER V.

Of the Different Feather-tracts.

Having already named the various feather-tracts observed by me, and explained their general properties and differences, I now pass to the detailed description of each tract.

I. The spinal tract (*Pteryla spinalis*).

This extends along the whole vertebral column, upon the middle of the whole of the back (in the sense of Illiger's *notæum*), from the nape of the neck to the tail, and is bounded by the lateral spaces of the neck and trunk. To the portion of it from the nape to between the shoulders I give the name of the *anterior* (*pars antica*), or *free* (*aprica*) part; to the rest, which is situated upon the back, that of the *posterior* (*postica*) or *covered* (*tecta*) part. The contour-feathers of the anterior part on the nape and between the shoulders always remain freely visible, whilst those of the posterior part are usually covered by the wings when folded up and drawn to the body.

In its form the spinal tract presents very great variations. In a very few birds only it

[1] Thus this genus agrees with the *water birds*, not only in its mode of life, but also in a remarkable detail of organization.

retains the same breadth throughout its entire course. Most frequently it is widened in one of two places, namely, either between the shoulders or behind them on the back, or in both spots, afterwards becoming narrow again. There are, however, some birds in which it is much broader on the whole of the back than on the neck. It is sometimes continuous, and sometimes has real or false gaps. These gaps likewise usually occur at two spots, near the above-mentioned widened portions, namely, either at the boundary of the free and covered portions, which is most frequently the case, or further down on the back. The spinal tract in such cases usually appears very broad, densely feathered, and strong, immediately before the gap; whilst behind it is weakened, and only gradually acquires stronger feathers. Moreover, the spinal tract is often divided, and then contains a spinal space, varying in length and breadth, at the point where otherwise the widening usually occurs. Sometimes, and this is very singular, a row of distant feathers accompanies the sides of the hindmost part of the tract, as I find to be the case in the Woodpeckers (Plate V, fig. 15).

The different forms which I have observed in the spinal tract are as follows:

1. Continuous throughout its course and strong, without any perceptible dilatation or division, as in *Prionites momota* and *Epimachus superbus;* this form is, however, distinguishable with difficulty from a similar tract interrupted by a false gap.

2. Continuous along the whole back, and scarcely perceptibly widened in the middle, but weak and somewhat stunted at the nape, as in some species of *Alcedo*, especially *A. ispida*.

3. Like the preceding, but strong at the nape, and interrupted between the shoulder-blades by a false or real gap, which is either broad or narrow. Examples of this form are furnished by *Alcedo rudis*, *A. maxima*, and *A. capensis*. In *Dacelo gigantea* the whole dorsal portion is weak, whilst the cervical portion is strong.

4. Continuous and strong, narrow almost throughout, but widened on the back into a shield or *saddle*, usually rhombic (rarely elliptical or roundish) in form, and then again narrow. This form of spinal tract occurs in nearly all those passerine birds which do not exhibit the fifth form; I have also seen it in one genus of *Cuculinæ*, namely *Trogon*. Sometimes the portion before the saddle is broader than that behind it, sometimes the reverse is the case. In *Oriolus* (Plate III, fig. 8) and *Pardalotus* the dilatation is more elliptical, as also in *Trogon viridis;* in *Trogon glocitans*, on the contrary, it is rhombic (Plate IV, fig. 19).

5. Exceedingly similar to the preceding form, but the partially-covered rhombic saddle encloses an insular lanceolate or rhombic space. I have met with a spinal tract of this kind in the passerine genera *Corvus*, *Ampelis*, *Coracina*, *Eurylaimus* (*E. nasutus*, Plate III, fig. 15), *Chasmorhynchus*, *Psaris*, *Ptilorhynchus*, *Cephalopterus* (Plate III, fig. 10), *Sericulus*, *Glaucopis* (*G. varians*), *Pipra*, *Orinus* Nob. (*Rupicola* Auctt.), *Phibalura*, *Alauda*, *Dicæum*, *Edolius*, *Oxyrhynchus*, *Tyrannus*, and *Arachnotheres;* and also in the Cuculine genus *Prodotes* (*Indicator* Auctt., Plate IV, fig. 17).

6. Agreeing with the fifth form, but the dilated portion, which is situated very far back, is interrupted once or twice, and thus becomes bilobed. A tract of this kind occurs in *Picus*, in which there are two gaps, one before the other at the posterior extremity of the bilobed saddle (Plate V, fig. 15), in *Yunx*, *Bucco* (*armillaris*, Plate V, fig. 2), *Pogonias* (*sulcirostris*), in which the arms of the furcate saddle are united to the posterior portion of the tract by a row of distant feathers (Plate V, fig. 7), and in *Micropogon* (*erythropygos*), in which the gap is exactly in the middle of the saddle (Plate V, fig. 5). Lastly, this form also occurs in the passerine genera *Hirundo* (Plate III, fig. 14) and *Dicæum*. It readily passes into the preceding form when the

commencement of the portion of the tract behind the gap is cleft, as I have found to be the case in several species of the genus *Bucco*, as circumscribed by Linné and Latham.

7. Continuous and strong, narrow on the neck, but widened from the shoulder-blades, and at the same time not divided longitudinally. I have seen this form of the spinal tract in *Phasianus*, *Gallus*, *Numida*, *Perdix* (*P. cinerea* and *P. coturnix*), *Crypturus* (Plate VII, fig. 12), and *Musophaga paulina* (Plate VI, fig. 9).

8. Like the preceding form, but the broader portion is cleft by a longitudinal space from the shoulders onwards. Examples of this tract are furnished by *Tetrao urogallus*, *Perdix javanica*, and *Hemipodius*. In the Pigeons the same structure occurs, but in them the feathers at the commencement of the widened part between the shoulders are much stronger, and represent a bilobed saddle (Plate VII, fig. 2). When the modification just indicated is destitute of the longitudinal space it passes into the eleventh form.

9. Continuous and strong throughout, elliptico-lanceolate on the back, and enclosing, in this widened part, a long and likewise lanceolate space. This form, which readily passes into the fifth, when the saddle is abbreviated, or into the tenth when the space reaches to the end of the tract, occurs in several families of birds, namely, among the *Macrochires*, in the genera *Trochilus* (Plate III, fig. 19), *Cypselus* (Plate III, fig. 17), and *Hemiprocne* Nob.; in the Cuculine genera *Galbula* (Plate IV, fig. 8), *Scythrops*, *Nyctornis* Nob. (*Nyctibius* Vieill., Plate IV, fig. 4), *Phœnicophanes*, *Centropus* (Plate IV, fig. 14), *Crotophaga* and *Cuculus* (Plate IV, fig. 12); also in *Upupa* (Plate VI, fig. 4) belonging to the family *Lipoglossæ*; in some *Fulicariæ*, such as *Fulica*, *Rallus* (Plate VIII, fig. 6), and *Gallinula*; and, lastly, in *Dicholophus*, which genus I associate with the *Alectorides*.

10. Continuous and narrow, furcately divided between the shoulder-blades, but not uniting again afterwards, giving origin to a right and a left dorsal tract, both of which are continued to the tail. I have found this very singular form only in *Rhamphastos* (Plate V, fig. 13) and *Pteroglossus*. Sometimes the tract is weakened exactly at the point of division, where it then appears to be interrupted.

11. *Interrupted* at the ends of the shoulder-blades in such a manner that the anterior free part is separated partly by a true and partly by a false gap of varying size from the posterior covered part. The anterior part is very strong, gradually becomes broader, and furcate; the posterior part is weaker, generally narrow, and neither partially dilated nor cleft. A spinal tract of this kind is possessed by most of the rapacious birds, and among the diurnal forms by the genera *Aëtos*, Nob. (including *Aquila* and *Buteo* of authors), *Circus*, *Milvus*, *Elanus*, *Pernis* (Plate II, fig. 4), *Astur*, *Polyborus*, *Morphnus*, and many others, all of which I unite in the single genus *Falco*, excluding from it, however, the genera *Rhynchodon* Nob. (*Falco* Auctt. *sensu stricto*, Plate II, fig. 6), and *Pandion*. It likewise occurs in *Gypogeranus*, *Gypaëtos* (Plate II, fig. 2), *Vultur*, *Neophron*, and *Cathartes*, although in the last three the commencement of the cervical portion is wanting. In the nocturnal raptores two bands formed of several series of feathers unite the fork with the posterior part of the tract (Plate II, figs. 9, 10), and precisely the same thing occurs in *Gypaëtos* and *Pernis*, except that in these each band consists only of one series of feathers, which is rarely met with in the Owls. A similar spinal tract is also presented by many species of the genus *Psittacus* (Plate V, fig. 17), and likewise in *Coracias* (Plate IV, fig. 6), *Opisthocomus* (Plate VI, fig. 13), *Eurypyga* (Plate VIII, fig. 15), *Diomedea* (Plate X, fig. 4), and *Thalassodroma*.

12. Interrupted like the preceding form, and furcate at the end of the anterior portion, but the entire posterior part *weak* and *very broad*. Examples of this form, which is not frequent, are furnished by *Falco cachinnans* and *F. brachypterus* (Plate II, fig. 5). The spinal tract of *Phœnicopterus* (Plate IX, fig. 7) is very similar. It is also closely approached by the genera *Crax*, *Penelope*, and *Pterocles* (Plate VII, fig. 4), although in these the posterior portion of the spinal tract is so much widened that it coalesces with the lumbar tracts, as is likewise the case in the *Nasutæ* (with the exception of *Diomedea*, Plate X), and in the *Unguirostres*. This form then approaches the fourteenth, in which, however, the broad posterior part has a central longitudinal space, and is, therefore, cleft.

13. Interrupted like the eleventh form, with a narrow and weaker posterior position; but the division of the anterior part *extends along the whole neck* up to the occiput. I have only met with this form once, namely, in *Scopus umbretta* (Plate IX, fig. 4).

14. Interrupted between the shoulder-blades, the anterior part cleft at the end and tolerably strong, the *posterior part cleft throughout nearly its whole length*, but more or less weakened at its commencement; the outer margins are also gradually stunted, the inner ones sharply marked, and the undivided extremity immediately before the tail is much narrower. This form passes into the ninth, from which it cannot always be exactly distinguished; it occurs frequently in various families of birds. Among the *diurnal rapacious birds* the genera *Rhynchodon* (Plate II, fig. 6) and *Pandion* possess it, and among the parrots *Psittacus pullarius;* it also occurs in all the genera of *Longipennes* (Plate IX), among the swimming birds; in several genera of wading birds, especially *Limicolæ*, for example, in *Œdicnemus*, *Charadrius* (Plate IX, fig. 9), *Strepsilas*, *Totanus*, *Triuga*, *Numenius*, *Ibis*, *Limosa*, *Recurvirostra*, *Dromas*, *Scolopax*, *Cursorius*, and *Glareola;* in some *Fulicariæ*, such as *Grus*, *Psophia* (Plate VIII, fig. 4), *Aramus* and *Podoa* (Plate VIII, fig. 9), and *Storks* (*Pelargi*), such as *Tantalus* and *Platalea*.

15. Exceedingly like the preceding form, but with the cervical portion of the anterior region of the tract so broad as to coalesce with the throat-tract to form a feather-coat covering the whole neck, *so that the lateral neck-spaces are wanting*. I have met with this form only in *Ciconia* (Plate IX, fig. 2) and *Colymbus* Ill. (*Podiceps* Lath., Plate X, fig. 11). The structure in *Phœnicopterus* (Plate IX, fig. 7) is similar; but I have already referred this genus to the twelfth form, on account of the undivided dorsal portion. It is also worthy of notice that the division of the cervical portion does not become visible only between the shoulders, but much farther forward upon the hinder surface of the neck. Hence the two long arms of the tract run parallel to each other, whilst the much shorter ones of the preceding form are very distinctly divergent.

16. Continuous and very broad, but weakened, and especially stunted at the margin of the covered part; longitudinally divided by a narrow space on the neck and between the shoulders. A spinal tract of this form occurs in *Buceros* (Plate VI, fig. 2), in the *Unguirostres* (Plate X), and in *Eudytes* (Plate X, fig. 12), *Alca* (Plate X, fig. 14), and *Uria* (*alle*); it is similar in *Procellaria glacialis* (Plate X, fig. 2), *P. capensis*, *Dysporus* (Plate X, fig. 9), and *Halieus*. In other genera of the *Steganopodes*, especially in *Phaëton*, *Plotus*, and *Pelecanus*, the spinal tract is much broader and coalesces with the humeral and inferior tracts, so that a nearly continuous feathery covering is produced,

17. Imperfect, the cervical portion being deficient; two fine spinal tracts running between the shoulder-blades issue from the lateral neck-tracts, which are here present, but soon terminate, even before reaching the extremities of the shoulder-blades. Corresponding with these are two

stunted dorsal bands, which are united only at the tail. This form occurs in *Ardea* (Plate VIII, fig. 11) and *Caneroma* (Plate VIII, fig. 14), and a similar structure in *Otis tetrax;* but *Otis tarda* differs from it in having the neck-tracts connected on the throat, and the dorsal portion of the spinal tract broader, with a narrower median space (Plate VIII, figs. 1 and 2).

II. The humeral tract (*Pteryla humeralis*).

This is one of the double tracts; a pair of such tracts occurring in all birds. In its design, it constitutes an extremely narrow band which springs from the middle of the shoulder, a little in front of the shoulder joint, immediately from the margin of the great wing-membrane, and is continued obliquely upon the humerus in a direction parallel to that of the shoulder blades. Anteriorly, it not unfrequently coalesces with the portion of the inferior tract which approaches most closely to the shoulder, or with the plumage of the great wing-membrane; elsewhere, it is completely circumscribed by spaces, being separated from the spinal tract by the lateral space of the trunk, and from the plumage of the fore-arm by the upper wing-space. It varies somewhat in position, however, being removed in some birds nearer to the shoulder-blade, whilst in others it runs nearly over the middle of the humerus. The latter is the case in the Passerine birds amongst others (Plate III); the former in the *Gallinæ* (Plate VII), and *Columbæ*. Scarcely any great differences occur, however, in the humeral tracts. They are usually the strongest of all the tracts, except those which bear the remiges and rectrices, and this is seen particularly at their posterior extremity, where the *axillary feathers*, which lie upon the wing in its folded position, and which are characterised by their thick tubes, are inserted into it. The few differences of form which I have been able to discover in the humeral tracts, are founded upon the number, size, and degree of approximation of these feathers. I find it strong and broad in the Rapacious birds, especially the Falcons (Plate II), in the Waders (Plate VIII), such as *Ardea leuce*, *A. egretta*, and *A. garzetta*, which possess peculiar, very large axillary feathers, and in the *Longipennes* (Plate IX); it is much weaker in the *Passerinæ* and *Cuculinæ* (Plates III—V); and generally very small, but also sometimes very large (as in *Colymbus*), in various *Pygopodes* (Plate X). The genus *Picus* (Plate V, fig. 15) is remarkable for its double humeral tract on each side, namely, a small inner one and a much larger outer one, both of which pass into the plumage of the great wing-membrane. In some birds, as, for instance, the *Steganopodes* (Plate X), and in *Buceros* and *Colius*, which possess a very broad spinal tract, the humeral tracts are united to the latter, but may nevertheless be recognised as distinct tracts by the stronger formation of their feathers.

III. The femoral or lumbar tract (*Pteryla femoralis seu lumbalis*).

Like the preceding always double, right and left, this tract forms a long, oblique band on the outer side of the thigh; its extension varies in both directions, and it is bounded by parts of the lateral space of the trunk. It varies in many ways.

1. Narrow, simple, straight, and oblique, that is to say, not parallel to the median line of the back, but rather tending to meet it if prolonged in imagination. In this form it may be:

a. Long, that is to say extending from the extreme end of the ischium to the knee. It presents itself in this state in the genera *Cypselus* (Plate III, fig. 17), *Trochilus* (Plate III, fig. 19), *Prionites*, *Musophaga* (s. *Corythaix*, Plate VI, fig. 9), *Alcedo* (Plate VI, fig. 6), *Upupa* (Plate VI, fig. 4), and *Psittacus* (Plate V, figs. 17 and 18).

b. Short, when it reaches neither the knee nor the pelvis. It has this form in some Owls, and in most of the Passerine birds (Plate III), and also in *Galbula* (Plate IV, fig. 8), *Todus* (Plate IV, fig. 10), *Trogon* (Plate IV, fig. 19), *Scythrops*, *Micropogon* (Plate V, figs. 4 and 5), *Bucco* (Plate V, fig. 2), and *Merops*, and in the genera *Sterna* and *Rhynchops* among the *Longipennes*.

2. Like the preceding form, but the posterior end coalescent with the spinal tract. Examples of this form are furnished by *Lestris* (*catarrhactes*, Plate IX, fig. 14), *Procellaria* (*glacialis*, Plate IX, fig. 2), and *Coracias* (*garrulus*, Plate IV, fig. 6).

3. Resembling the first form in direction, but so broad that it is connected with the spinal tract even at its anterior extremity. I have found this rare arrangement in *Cuculus* (Plate IV, fig. 12), and *Puffinus* (*obscurus*, Plate X, fig. 3), in which the tract is short, and in the *Columbæ* (Plate VII, fig. 2), in which it is of considerable length.

4. Long, straight, and united with the spinal tract both before and behind, so that an apparently peculiar space is formed between them. I have seen this form only in *Colius* (Plate VI, fig. 11).

5. Very broad and strong, so that it extends over almost the whole outside of the thigh, but remains completely separate from both the spinal tract and the crural tract. Most *Gallinæ* have a femoral tract of this kind (Plate VII), especially *Phasianus*, *Gallus*, *Pavo*, *Tetrao*, and *Perdix*.

6. Narrow but double, that is to say, divided into an outer and inner band, of which the former is much more oblique and extends to the knee. I have found it in this form, in *Strix brachyotus*, and the Toucans (Plate V, fig. 13). In the Woodpeckers, particularly *Picus viridis* (Plate V, fig. 15), the two very short bands meet together behind, and the inner one consists only of a single series of feathers. This is also the case with the Toucans.

7. Sparsely feathered, clothing the whole outside of the thigh, and completely united with the spinal tract. Examples are presented by the genera *Diomedea* (Plate X, fig. 4), *Plotus* and *Dysporus* (Plate X, fig. 9); by several genera of *Pygopodes*, e. g., *Colymbus* (Plate X, fig. 11), and by the genus *Phœnicopterus* (Plate IX, fig. 7).

8. I have found it to be entirely wanting in some rapacious birds (Plate II), such as *Gypaëtos* (fig. 2), *Falco brachypterus* (fig. 5), and *Strix bubo* (fig. 9), and in these cases the crural tract is very strong. In other rapacious birds, a short band composed of a single series of feathers occurs upon the hindmost part of the thigh, for instance, in *Falco apivorus* (fig. 4), and *Rhynchodon peregrinus* (fig. 6). The Veiled Owls (*Hybris*, such as *H. flammea*, fig. 10), alone possess a strong, very oblique femoral tract, consisting of several rows of feathers.

IV. The ventral tract (*Pteryla gastræi*).

This is usually simple at first, and only subsequently divides into a right and a left

portion. It alone constitutes the plumage over the whole inferior region of the body to which Illiger has given the technical name of *gastræum*, and it commences at a greater or less distance from the angle of the throat, except when it is connected with the uniform plumage of the head and nape by means of the throat-feathers. It is separated from the other tracts by the lateral spaces of the neck and trunk, and in proportion as the neck-space ascends towards the head, so does the ventral tract commence nearer to the head or throat. Usually, however, it commences at the chin, as in the nocturnal birds of prey (Plate II), or it, at least, originates at the angle of the throat, and is undivided through its first and shorter portion, but is soon divided, by the intrusion of the ventral space, into a right and a left band, which pass separately and uninterruptedly upon the breast,[1] after receiving the humeral tracts, or a lateral lobe of the plumage of the great wing-membrane; they are then continued along the belly and extend as far as the anus, or the tail. On the breast, each band generally emits an external lateral branch; and in very rare instances there is a second but earlier branch running inwards to the furcula, as in *Galbula* (Plate IV, fig. 7). We may, therefore, readily distinguish three parts in the ventral tract, namely—1, the *gular portion* (*Kehltheil*) which is situated on the neck; 2, the *truncal portion* (*Pteryla thoraco-gastrica*) which extends over the breast and belly; and 3, the *branch*, or external offshoot, which I sometimes call the *lateral tract* (*Pteryla lateralis*), and which is situated on the side of the breast, beside the truncal portion, and gives origin to those feathers, usually of large size, and often standing very close together, upon which the folded wings rest. Lastly, the *inner branch*, when it occurs, originates from the lower extremity of the gular portion, and is always quite short.

In different groups of birds the ventral tract presents differences as great and as deserving of notice as those of the spinal tract. These differences relate to the width, to the closeness of the plumage; and to the direction and form of the tract. The arrangement of the branches is particularly variable; sometimes they may be distinguished clearly enough, from their well-marked separation from the truncal portion; but sometimes they are united with the latter, and have only the extremities free. At the same time, they are sometimes long, sometimes short; sometimes broader than the truncal portion, sometimes equal to it in width, and sometimes narrower. In form, I have seen it lanceolate and pointed, and also truncated or rounded at the apex. In some birds, as, for example, the genera *Coracias*, *Ramphastus* (Plate V, fig. 12) and *Strix* (Plate II, fig. 8), and in the Falcons, it is of a hook-like form, emitting a linear band extending from the hepatic region to the humerus. This line seems to pass over upon the inner wing-membrane, into the *false wing* (*ala notha*) described by Möhring. In a few birds the branch returns posteriorly into the truncal portion again, thus forming an insular space, which is completely surrounded by the ventral tract (*e. g.*, in *Centropus*, Plate IV, fig. 13). The branch is, however, deficient in many birds, and when this is the case the truncal portion becomes dilated upon the breast; its outer margin may then remain quite straight without any indication of an angle or lateral projection; or, it may be suddenly narrowed at an obtuse angle at the region where the knee lies, to which I give the name of the *knee-covert* (*latibulum geniculi seu cruris*). Such a dilatation of the tract is to be regarded as essentially analogous to a branch which has not been separated, but is combined with the main tract throughout its whole length. The ventral tract is almost always continuous; I have rarely met with a false (*e. g.* in *Nyctornis grandis*,

[1] I give the name of the breast to the whole region of the body that lies over the sternum.

Plate IV, fig. 3), or true gap (*Ardea stellaris*, Plate VIII, fig. 10, *Scopus umbretta*, Plate IX, fig. 3), situated either at the end of the gular portion, or at the commencement of the branch (for example, in *Gypaëtos barbatus*, Plate II, fig. 1).

I have observed the following principal forms in the ventral tract:

1. Without an external branch, sparsely feathered, divided, even on the throat, by a narrow space into a right and left band, each of which, instead of emitting a branch, becomes greatly dilated upon the breast, is then suddenly narrowed at the region of the knee, and afterwards remains of the same width. A ventral tract of this kind occurs in some Diurnal Rapacious birds, such as *Gypaëtos* (Plate II, fig. 1), *Falco ecaudatus*, Daud., in which there is an inner or gular branch, and all the Vultures, in which, however, on account of the nakedness of the neck, the gular portion is wanting, except in *Neophron*, in which it is nearly complete; also the genera *Buceros* (Plate VI, fig. 1), *Pogonias* (*sulcirostris*, Plate V, fig. 6), *Ciconia*, and the other *Pelargi* (Plate IX), *Phœnicopterus* (Plate IX, fig. 6), and *Fulica* (Plate VIII, fig. 8). In *Gallinula chloropus* we meet with a similar structure, but the pectoral band is narrower, and exhibits a trace of a branch.

2. Like the preceding, broad or very broad; but the truncal portion gives off a short branch in the region in front of the knee-covert, and is not much narrower behind the latter. Examples of this peculiar form are presented by *Procellaria* (*glacialis*, Plate X, fig. 1, and *capensis*), *Puffinus* (*obscurus*), *Diomedea*, in which the band is very broad, and the emargination behind the branch deep; likewise by the *Unguirostres* (Plate X), in which this tract is widest, and scarcely divided, but the emargination is inconspicuous.

3. Without a branch, very broad throughout, scarcely separated at the neck, divided by a narrow ventral space only at the upper part of the breast. I find the ventral tract thus constituted in *Dysporus* (Plate X, fig. 8) and the other *Steganopodes*.

4. Without a branch; distinct and divided, even on the throat; broader on the breast, but without any sudden external dilatation; gradually narrowed posteriorly. It appears in this form in *Cypselus* and *Trochilus* (Plate III), and is similar in the true *Cuculinæ* and in *Pterocles*, although in these it is broader on the breast, and has the inner margin weakened.

5. Without a branch; first distinguishable on the breast (the plumage of the neck being uninterrupted), and then divided into a right and left band, both of which are very broad at the commencement, and gradually diminish backwards, without any indication of a branch or separated dilatation. I found it in this form in *Opisthocomus cristatus*.

6. Without a branch, and very anomalous, namely, combined on the neck and fore part of the breast to form an uninterrupted plumage, but divided, on the breast, into four bands, which run down to the tail, and enclose three spaces (one in the middle and one on each side near it). The outer bands are dilated externally on the breast as far as the knee-covert, and then narrowed; the inner bands, on the contrary, are linear throughout, and narrower than the outer ones. I have met with this truly singular arrangement in *Otis tarda* (Plate VIII, fig. 1) and similar species; in *Otis tetraæ*, on the other hand, the inner bands are much weakened, sparsely feathered, and imperfect, or divided again.

7. With an indistinct branch, narrow, and commencing on the throat, but divided by a median space, which is particularly broad on the breast and belly; the lateral branch projecting but little, if at all, and only at the end, where it is abruptly truncated. A ventral tract of this kind is presented by the *Passerinæ* (Plate III) and the genera *Phœnicophanes* (*viridirufus*),

Trogon (*viridis*, *glocitans*, Plate IV, fig. 18), *Prodotes* (Plate IV, fig. 16), *Prionites*, *Capito* (*melanotis*, *Tamatia*, Plate V, fig. 9), and *Monastes* (*fuscus*).

8. With an indistinct branch, and resembling the last form, but with a true gap at the end of the undivided gular portion; the latter contains very large feathers, and clothes a pendent, dewlap-like fold of the skin. This remarkable structure occurs in *Coracina cephaloptera* (*Cephalopterus ornatus*, Geoffr.), Plate III, fig. 9.

9. With a double branch; very narrow throughout, distinct on the throat, and already divided into a right and a left band, with a broad median space: the outer branch is very short, placed almost perpendicular to the main stem, and issues close to the knee-covert; the internal branch, which is longer, runs along the furcula, and starts from the lower extremity of the gular portion. This form is seen in the genus *Galbula* (Plate IV, fig. 7).

10. Very like the preceding form, but without the inner branch. This form occurs in *Merops* (*viridis*, *nubicus*); nearly the same arrangement is also met with in *Coracias* (from which *Colaris* cannot well be separated generically), Plate IV, fig. 5; but the external branch is somewhat longer, and nearly hooked, and the main stem is weakened from the breast downwards.

11. With one branch; narrow but strong, often distinctly separated, even on the throat, and soon afterwards cleft into a right and left band, which enclose the broad median space. The truncal portion linear, weakened; the branch distinct, long, densely feathered, standing off widely, truncated at the end, sometimes hooked. This form of the ventral tract occurs in many Rapacious birds (Plate II), especially the Falcons (in which a notch, resembling an internal branch, is observable at the lower part of the gular portion) and the Owls. It also occurs in the genera *Picus* (Plate V, fig. 14), *Yunx*, *Pogonias* (*senegalensis* and *unidentatus*, but not *sulcirostris*), *Micropogon* (*erythropygos*, *cayennensis*), and *Bucco* (*armillaris*, *roseicollis*, and *flavifrons*), Plate V, fig. 1.

12. With a branch, and similar to the preceding form, but sparsely feathered, and weakened throughout; the branch tolerably long, obtuse, and indistinctly limited on its inner margin. This form occurs in the Parrots, but with the following variations:—in some species, such as *Psitt. galeritus* and *pertinax*, the outer branch is very distinctly separated; whilst in others, such as *Psitt. hæmatodes*, *pullarius*, and *erithacus*, it is for the most part amalgamated with the main portion; a weak plumage having introduced itself between the branch and the main stem, which gives this form a great resemblance to the first one.

13. With a branch, like the eleventh form; but the branch long or moderately long, distinctly bounded, obtuse, densely feathered; the truncal portion appears weakened, dilated behind, and much approximated to its neighbour, especially on the breast, by which the ventral space is rendered narrow, although it extends nearly to the throat. I have seen a ventral tract of this kind in most of the *Limicolæ seu Scolopacinæ*—namely, in *Numenius*, *Charadrius*, *Tringa*, *Scolopax* (*rusticula*, in which, however, the division only commences at the lower part of the neck); also in the *Fulicariæ*, such as *Grus* (*cinerea*), *Psophia* (*crepitans*, which possesses the narrowest and most approximated pectoral bands, see Plate VIII, fig. 3), *Rallus* (Plate VIII, figs. 5—7), and *Crex*. The ventral tract is also similar in the *Longipennes*; but in some of the larger species, such as *Lestris catarrhactes* (Plate IX, fig. 13), the pectoral band is so broad, and the branch so short and narrow, that its formation agrees rather with that of the second form, such as we have found in *Diomedea*.

14. With a branch, broad, strong, and densely feathered throughout, divided by a narrow

space; the branch long, rounded at the end, separated by a narrow cleft from the pectoral band, to which it runs parallel. I have seen this kind of ventral tract in *Uria*.

15. With a branch; distinct, and divided into a right and left band, even on the neck; each of these bands, on reaching the breast, emits a very large, broad, acute, lanceolate branch; the pectoral band, on the contrary, is very narrow or much weakened, and separated by a true or false gap from the branch. This form occurs especially in the gallinaceous birds (Plate VII), but not in all of them.

16. With a branch, and narrow; the branch very distinctly separated, but curved and united again with the stem posteriorly, so as to enclose an insular space. I have found this remarkable form of the ventral tract in the Disk-Owls (*Hybris*, Plate II, fig. 11), in *Crotophaga*, *Coccygius* (*Guira*), and *Saurothera* (*Cuculus viaticus*, Licht). It is similar also in *Scythrops* (Plate IV, fig. 15); but the insular space is here clothed with isolated feathers, and thus weakened.

17. Irregular, inasmuch as the gular portion is wanting, its place being taken partly by the lateral neck-tracts, and partly by the cervical portion of the spinal tract. Thus the ventral tract consists entirely of a narrow pectoral band, with or without a branch, separated from its neighbour by a broad ventral space, and united anteriorly with the humeral and spinal tracts. I have found this very peculiar structure only in the Herons (*Erodii*). The pectoral bands are sometimes separated by a false gap from the lateral neck-tracts, as in *Ardeæ stellaris*, *minuta* and *scapularis*, and *Cancroma cochlearia;* and sometimes united with them, as in *Ardea cinerea*, *A. purpurea*, and other thin-necked Herons. A complete branch occurs only in *Cancroma;* in *Ardea* it is either entirely wanting or very imperfect (Plate VIII, figs. 10, 12, and 13).

V. The lateral neck-tract (*Pteryla colli lateralis*).

This occurs only in a few birds, namely, the above-mentioned Herons and the Little Bustard (*Otis tetrax*); it is always paired, left and right. Properly speaking, it does not constitute a distinct tract, but is produced by the union of the spinal and ventral tracts, when both of these are divided throughout their whole length by broad spaces, and the lateral neck-spaces are wanting. In the *thin-necked* Herons, therefore, these lateral neck-tracts pass without any interruption into both the spinal and ventral tracts of each side; in the *thick-necked* forms (*Butaurus*), on the contrary, at least in *Ardeæ stellaris*, *minuta*, and *scapularis*, they are separated from both by a false gap (Plate VIII). In *Ardea nycticoraæ* and *Cancroma* the arrangement occupies a middle place between the two forms; for in these the lateral neck-tracts are only continued into the spinal tract, and not into the pectoral bands of the ventral tract. In *Cancroma* they are also united in a peculiar manner at the end of the neck, so that they enclose a *median neck-space*.

The tracts which we have hitherto had under consideration are those which especially deserve the name, and I believe that their description would suffice for the representation of the different kinds of interrupted plumage; the other tracts, namely, those of the head, wings, and tail, usually consist of a scarcely interrupted or perfectly continuous plumage, and require no further detailed description. Nevertheless, any one with a predilection for uniformity of nomen-

clature may certainly give the name of *tracts* to these portions of the plumage also, and in this case the following must be added to those already mentioned.

VI. The head-tract (*Pteryla capitis*).

This usually clothes all the regions of the head, and passes over directly into the spinal and ventral tracts, so that these, as it were, originate from it; but if the lateral neck-space be only visible lower down on the neck, the head-tract may also be regarded as continued on the neck.

VII. The wing-tract (*Pteryla alaris*).

This is double, one for each wing; it comprises all the feathers inserted upon the wing, with the exception only of those which form the humeral tract. To this tract, therefore, belong—the wing-feathers (*remiges*) inserted into the hinder margin of the whole wing, from the finger-tips to the elbow; the *arm-feathers* (*pteromata*), which run down the inner surface of the lower arm in from one to three series; the *feathers of the wing-coverts* (*tectrices*), or the feathers of the upper side of the wing-membrane and of the upper surface of the arm; the *bastard wing* (*alula spuria*) inserted upon the thumb, and also the *upper* and *lower accessory wings* (*parapterum superius et inferius*, or, as I call them, the *parapterum* and *hypopterum*),[1] of which the one is usually inserted at the hinder margin of the upper arm, and the other on its inner surface. The wing-tract further includes the plumage of the great wing-membrane, especially the portion inserted on its margin, which is separated from the rest of the plumage by the upper and lower wing-spaces, and usually passes at the shoulder into the ventral and axillary tracts.

VIII. The crural tract (*Pteryla cruralis*).

This tract is also double, and occurs of the same form on both the right and left legs. It clothes the whole or the greater part of their surface, and extends, in some birds, also over the tarsus, and in a very few even to the toes. It is often weak throughout, or at least on the inside of the leg; on the outside, however, it is very strong in some birds, especially in all the diurnal birds of prey, and in the true Cuckoos (*Cuculus*). It will be more particularly described when the crural space comes under notice.

IX. The caudal tract (*Pteryla caudalis*).

This occurs on the true tail, or the last caudal vertebræ. From it originate the *rectrices*,

[1] Möhring named these accessory wings (which Illiger singularly confounded with the axillary feathers) *alæ nothæ*. The lower accessory wing is, however, composed of a series of flat feathers which runs along the inner side of the upper arm, not unfrequently as far as the breast, or even issues from the lateral branch of the ventral tract. It covers the lower wing-space, or, when longer, even a great part of the lateral space of the trunk.

and both the *upper* and *lower tail-coverts* (*tegmina caudæ superiora et inferiora*). It also includes the *oil-gland*, to which we shall refer more particularly hereafter. It likewise receives the posterior extremities of the spinal tract, the two truncal bands of the ventral tract, and the extreme portion of the lumbar tract.

Lastly, if we are to take into consideration certain very small specially-feathered spots, we might admit an *anal tract* (*Pteryla ani*) and an *oil-gland-tract* (*Pteryla glandulæ uropygii oleosæ*). The former surrounds the anal orifice in the form of a ring of contour-feathers, and occurs most distinctly in the *Passerinæ*, being particularly well shown in *Parus caudatus*. The latter clothes the apex of the above-mentioned gland in the circumference of its orifices, and consists not unfrequently of umbellated down-feathers, but usually of delicate little feathers, which occupy a middle place between contour-feathers and down, but are never exposed to the light.

CHAPTER VI.

Of the Spaces.

As the spaces and tracts mutually form each other, the form of the spaces has been already pretty well indicated during the description of the tracts; indeed, in describing the latter, some notice of the former could hardly be avoided. Hence I have only to indicate briefly here what was passed over in the description of the tracts, or could not well be mentioned.

We have already seen (p. 16) that the spaces are portions of the surface of the body which are not clothed with contour-feathers, but are covered by the contour-feathers or by the folded wings. I think it necessary to distinguish them from the truly *naked* portions of the skin, which are not even covered in this manner, but remain always freely visible, and have therefore selected this expression. They may be investigated at the same time as the tracts, and in the same manner; but for their accurate recognition an examination of the bird with the plumage uninjured should never be neglected, because the more perfect the tract the more distinctly does the space make its appearance.

With regard to their structure, the spaces are sometimes quite naked, and sometimes sparsely or densely clothed with down-feathers; the latter is especially the case in water birds. I have never hitherto found filoplumes upon them, but perhaps this may occur when the denser plumage has more resemblance to contour-feathers. To such spaces I give the name of *false spaces* (*apteria spuria*); and I may remark that they are usually less definitely bounded, and therefore add to the difficulty of distinguishing the tracts. Moreover, there are birds in which all the spaces are of the nature just described; whilst in others they are either naked or partially clothed with down. In no single bird, however, have I found the spaces perfectly naked; that is to say without any traces of down-feathers throughout their whole extent; but they are very bare, or almost naked, in a great number, as, for instance, the *Passerinæ*, *Macrochires*, Woodpeckers, Cuckoos, nocturnal Rapacious birds, and *Gallinaceæ*. More frequently the lateral neck-spaces and axillary spaces are perfectly naked, even when down-feathers

occur on the other spaces. Moreover, the character of many spaces changes at the breeding season. At this period portions of the spaces on the breast and belly of a great many birds usually lose all the down with which they are clothed at other times, notwithstanding that the skin is at the same time very full of blood; they thus acquire naked spaces, to which Faber's name of *brood-spots* may be applied. These occur in the females, and also frequently in the males, according as the incubation of the eggs is performed by the two sexes alternately or by the former alone.[1]

Let us now examine the different spaces above mentioned.

I. The lateral neck-space (*Apterium colli laterale*).

This is essentially only a continuation of the lateral space of the trunk, and is indicated by a distinct name merely for facility of description. Ascending on each side of the neck, between the cervical portion of the spinal tract and the gular portion of the inferior tract, it extends, in most birds, scarcely beyond the middle of the neck, but in some cases reaches the head, and in the *Owls* (Plate II, figs. 8 and 11) only terminates close to the chin. I find it shortest in the *Unguirostres* (Plate X, fig 7), *Steganopodes* (Plate X, figs. 8 and 9), and in some Waders, *e.g. Platalea*. It is entirely deficient in the *Herons* (Plate VIII) and *Storks* (Plate IX), where its place is occupied by the lateral neck-tract, whilst the rest of the surface of the neck is a *space*. In the birds with continuous neck-plumage, such as *Opisthocomus* (Plate VI, figs. 12 and 13), also, it does not occur.

In all long-necked birds, in which that part of the body is curved in the form of an *S*, so that the head rests between the high shoulders, the latter insert themselves in these lateral neck-spaces as in a covert, and this reception of the shoulders seems to be the chief purpose of the space.

[1] The brood-spots which I have had the opportunity of observing were generally situated in the median inferior space, or also in the branch-like processes of the lateral spaces. I have, however, ascertained that in some Owls even contour-feathers are destroyed in consequence of incubation, and thus gaps are produced in the inferior tracts. Faber and Brehm distinguish brood-spots according to their number and position, and even employ them to characterise birds; but their description of them is inaccurate and valueless, as they do not notice the regular distribution of the feathers, nor do they even state whether the brood-spots occur in the spaces or the tracts. Nor can this be deduced from Faber's distinction between *true* and *false* brood-spots ('Ueber das Leben der hochnördischen Vögel,' pp. 136, 138). He only states that the former occur solely on the bellies of some northern aquatic birds, and are produced by the birds themselves by tearing out the feathers (whether down- or contour-feathers is not mentioned); while the latter also appear on the breast, and are produced by simple wearing away during incubation. I have most certainly seen the two brood-spots ascribed by this writer to the species of *Phalaropus* between the lateral branch and the main stem of the inferior tract, and have convinced myself of the spontaneous shedding of the down-feathers at this spot. This may also be the case with the contour-feathers, when these are wanting at the period of incubation, as in the *Owls* (see that family). The birds may, however, in some cases pull out the feathers which have already become loose, and thus assist in the production of the brood-spots.

II. The lateral space of the trunk (*Apterium trunci laterale*).

This is of constant occurrence, and chiefly assists in producing the incontinuous plumage. Although it is the largest of all the spaces, and is only covered by the folded wings, it is not visible during flight, because the contour-feathers of the lateral branch of the inferior tract lie over it, or, if this is but small, the lower accessory wings assist in concealing it. It is smallest in *Palamedea*, the plumage of which has no vacant space except in the axillary region; usually, however, it is very large. Occupying the whole side of the trunk, it becomes broader as the spinal tract is narrower; it surrounds the greater part of the wing and thigh, and is continued from the shoulders between the spinal and inferior tracts, which bound it, to a greater or less distance backwards, often even as far as the tail. Its anterior and dorsal part, situated between the spinal and inferior tracts, passes into the lateral neck-space; the portion placed beneath the axilla, on the contrary, passes into the inferior wing-space. It also extends itself over the thigh, the spaces of which I am inclined to regard as parts of the lateral space of the trunk, because they stand off very little from the trunk. Thus, this space includes the femoral space. When the external lateral branch of the inferior tract occurs this space surrounds it, as the sea flows round a peninsula, and in fact separates it from the main stem of the inferior space. The purpose of this space seems not to be only the facilitation of the movements of the wing, but likewise to serve for the reception of the folded wing, in such a manner that it may be supported upon the feathers of the branch of the ventral tract. Hence, whenever the wings do not fit themselves very closely to the body in repose, or do not rest upon the feathers of this branch, the lateral space is very small in proportion to the size of the wings. The opening between the outer branch and the main body of the inferior tract appears, however, to favour the movement of the leg, and also, as we have already seen, to assist in incubation.

III. The inferior space (*Apt. mesogastræi*).

This runs as a simple median space in the middle line of the ventral surface, between the two stems of the inferior tract, and commences at various points in the gular region. In a few birds only, *e.g.* the *Herons* (Plate VIII), it originates near the chin; in general it makes its first appearance upon the anterior half of the neck, and runs along the breast and belly to the anus. Hence, it may be divided into three parts. The *gular* portion is wanting almost entirely in most *Palmipedes* and in *Alcedo ispida*, as, indeed, generally in all birds with a continuous neck-plumage. The *pectoral* portion, like the *ventral*, differs chiefly in breadth, and in this respect stands in an inverse ratio to the inferior tract—the broader the latter the narrower the inferior space, and *vice versâ*. I find it broadest in many aerial birds, such as the *Accipitrinæ* (Plate II), *Passerinæ* (Plate III), and *Macrochires* (Plate III); in most *Cuculinæ* (Plate IV), the *Picinæ* (Plate V), and in *Upupa* (Plate VI, fig. 3). It is particularly narrow in the *Gallinæ* (Plate VII) and many aquatic birds, as, for example, the *Fulicariæ* (Plate VIII), *Limicolæ* (Plate IX), *Longipennes* (Plate IX), and *Nasutæ* (Plate X); but in all these the ventral part gradually becomes broader. I found it to be narrowest in the *Steganopodes*, *Unguirostres*, and *Pygopodes* (Plate X). Of its peculiar form in *Otis* (Plate VIII, fig, 1), in which there is neither

cervical nor pectoral portion, and the ventral portion consists of three narrow, parallel, insular bands, I have already spoken in describing the ventral tract of that bird (see p. 28).

The purpose of this space must apparently be sought for in the fact that the neck, when it is retracted, and, in consequence, forms a large projection at its lower extremity, meeting the equally prominent ridge of the breast, would disproportionately increase the amount of the feathery covering if it were present on this spot, and thus, of course, deform the body of the bird, instead of making this projecting part as inconspicuous as possible, by concealing it under the neighbouring plumage. But for this purpose the region of the body in which the above-mentioned projections occur must itself be destitute of feathers. The inferior space may, likewise, perform an important part during incubation, as I have already indicated.

IV. The spinal space (*Apt. spinale*).

This is produced by a longitudinal division of the spinal tract, which it renders double at those places where it occurs. This space is very often wanting, and when it is present it is short and even insular. It is usually seen only on the back, at those spots where the spinal tract is dilated. Only in *Ardea* and *Cancroma* (Plate VIII) it makes its appearance in the place of the otherwise simple cervical portion of the spinal tract, and is bounded by the lateral neck-tracts, which are continued as spinal tracts upon the back. In *Rhamphastus* (Plate V, fig. 13), on the other hand, it occurs only on the trunk, and not upon the neck and nape. The other variations of this space may be easily ascertained from the differences of the spinal tract which have already been described.

V. The upper wing-space (*Apt. alæ superius*).

This space extends over a larger or smaller portion of the upper arm and the great wing-membrane, separates the axillary tract from the other feathered parts, and is covered by the axillary feathers which form the tract just mentioned. It is probably never wanting, except in some birds with continuous plumage; but is sometimes very small and almost abortive, as in many water-birds. It is large in the aerial birds, especially in the *Passerinæ* (Plate III) and *Picinæ* (Plate V).

VI. The lower wing-space (*Apt. alæ inferius*).

This is generally much larger than the preceding space, and extends over the lower part of the upper arm, the great wing-membrane, the axillary wing-membrane, and even the forearm, but is covered anteriorly by the contour-feathers inserted in this margin of the great wing-membrane, which are broadened and lengthened for this very purpose. It is usually a continuation of the lateral space of the trunk, and is directly connected therewith, when not restricted to the great wing-membrane alone. In some birds, as, for example, the *Accipitrinæ* (Plate II, fig. 1), and the water-birds, it contains in the middle of its surface a row of contour-feathers, and is more or less concealed by them; but it also disappears when the plumage of the anterior margin of the great wing-mem-

brane is disseminated over the surface of the latter. In many other birds, on the contrary, this space is either entirely naked or sparsely or densely clothed with down. I find it to be broadest in the *Passerinæ* (Plate III), in many of the *Cuculinæ* (Plate IV), in *Upupa* (Plate VI, fig. 3), *Alcedo* (Plate VI, fig. 5), the *Picinæ* (Plate V), *Fulicariæ* (Plate VIII), *Erodii* (Plate VIII), and some other birds. The accessory wing of the forearm, however, when it occurs together with this space, is attached to it and partly covers it.

Both the upper and lower wing-spaces are necessary for facilitating the movements, and especially the folding, of the wing.

VII. The crural space (*Apt. crurale*).

This usually separates the femoral tract from the rest of the plumage of the leg, and appears as a naked ring at the upper end of the tibial region, on the inner surface of which it spreads out, and generally covers it. It is sometimes entirely or nearly naked, sometimes densely clothed with down-feathers. In the water birds it is generally very indistinct, and by no means definitely bounded; indeed, it is always of subordinate importance in the pterylographic characters of birds. Its purpose is, doubtless, to assist the free movement of the leg, and especially to allow of its being bent backward.

VIII. The head-spaces (*Apteria capitis*).

Besides the perfectly naked spots which may be detected upon the heads of many birds, there are in this region several truly featherless spaces, which, however, are concealed by the neighbouring plumage. A featherless space of this kind occurs, for example, in the Woodpeckers in the middle of the vertex, following its longitudinal direction (Plate V, fig. 15), and a second smaller circular one is seen on each side close to this. Beneath the former lie the cornua of the hyoid bone, which are rolled up when in repose. In *Upupa epops* (Plate VI, figs. 3 and 4) I have likewise met with both these spaces; and in the Cockatoos a large round vertical space is present behind the transverse crest. In *Coracias*, *Oriolus*, and most, but not all, of the *Passerinæ* (Plate III, figs. 2, 3, 7, 9, and 13), I have also remarked a small naked spot near the eye, which might be named the *temporal space* (*apterium temporale*); but in these the median space is wanting. A proportionately larger space appears at the nape in *Trochilus moschitus* (Plate III, fig. 19), and may be indicated as the *nuchal space* (*apt. nuchale*). I have also met with this, although in a less perfect form, in *Colius capensis* (Plate VI, fig. 11).

To the general considerations which properly close with the description of these various spaces, I shall add a few words upon the remarkable *powder-down-tracts* and upon the *oil-gland* of the rump, as I cannot find any better place in which to give a general account of them. Indeed, the former, as *tracts*, belong more properly to the end of the fifth chapter; but as these tracts do not consist of contour-feathers, but of down, and, moreover, do not occur in all or many birds, I thought it better to exclude them from the description of the feather-tracts. Still less does the description of the anal gland or oil-gland of the rump appear to belong

here. Nevertheless, as this gland is sometimes naked and sometimes clothed with a circlet of feathers, at least at its outlets, it may be regarded either as the bearer of a particular tract when the latter is the case, or when the circlet of feathers is wanting as endowed with a peculiar space, and thus its consideration may be combined with that of the plumage of birds. These considerations determined me to give a general description of both these objects at the close of the section on General Pterylography.

CHAPTER VII.

Of the Powder-down-Feathers and their Tracts.

In certain birds belonging to very different groups, there are down-feathers of very remarkable structure, the shafts of which are never completed at their lower extremities, but continue growing out of the persistent follicle, whilst the upper ends of the barbs are broken off. To these feathers I give the name of *Powder-* or *Dust-down-feathers* (*Puder-* or *Staubdunen*), because they are constantly pouring out a white or bluish dust from the upper open extremity of the follicle which surrounds the shaft, no doubt the dry residue of the fluid from which this feather is formed.[1]

Such down-feathers, which might, in some degree, be regarded as secretory organs, occur particularly in the lumbar region and on the sides of the back, but likewise in other places. In some birds they are scattered all over the body and not collected into tracts, as in *Gypaëtos barbatus*, in which they produce a yellow dust;[2] likewise in *Rhynchodon subbuteo* and some Parrots, such as *Psittaci galeritus, sulphureus, dufresnii, ochrocephalus, alexandri*, and *pondicerianus*. On the other hand, in other birds they form very dense tracts, and always on certain spots, which are not usually covered with contour-feathers.

I have found these definitely limited *powder-down-tracts* of very different forms, numbers, and positions, in certain Hawks of the sub-genera *Elanus* and *Circus*, and also in *Ocypterus, Crypturus, Eurypyga*, all the *Ardeæ*, and *Cancroma*.

In *Elanus furcatus* there is a simple, large, continuous powder-down-tract on the hinder surface of the back and the lumbar region, accompanying the portion of the spinal tract which is situated over the sacral vertebræ and distinctly separated from the scapular portion, and extending forwards far beyond it.

In *Elanus melanopterus* and *Cymindis uncinata*, on the contrary, the powder-down-feathers form two symmetrical tracts on the sides of the pelvis, and the posterior portion of the spinal

[1] May not this dust be produced by the crumbling of the membrane which intervenes between the feather and the matrix, and which is dried and thrown off in proportion as the latter becomes enlarged? See my observations on the Genesis of Feathers, p. 9 (B.).

[2] In this bird I could not find any true powder-down-feathers; consequently, if it possesses them, they are probably transitory.

tract runs through between them. I find them similarly arranged in *Circi æruginosus, pygargus,* and *cinerarius,* except that each tract tapers off anteriorly into a narrow band.

In *Ocypterus leucorrhynchus* (Plate III, fig. 4) I have found on each side four powder-down-tracts, which form continuations or borders of contour-feather-tracts, in a very peculiar manner, such as I have met with in no other bird. One of them lies close to the rhombic saddle of the spinal tract, the second and third accompanying the two sides of the femoral tract; the fourth is a nearly square appendage to the extremity of the lateral branch of the inferior tract.

In *Crypturus variegatus* the powder-down-feathers are intruded among the lateral feathers of the great saddle of the spinal tract, and form, with them, a mixed tract, the portions of the spinal tract before and behind this spot being much narrower (Plate VII, fig. 12).

In the *Herons* (Plate VIII), the only birds in which these powder-down-feathers were previously known, although their nature was not understood, there are always two large tracts on the hinder part of the hips, and two smaller ones near the furcula; a third pair, composed of narrow bands, in the inguinal region, is not always present. I have found all three pairs in *Ardeæ cinerea, purpurea, nycticorax,* and *ralloides;* the third pair was wanting in *Ardeæ stellaris* and *minuta,* and probably does not occur in any of the Bitterns.

Cancroma cochlearia agrees with the true Herons in the form and position of its powder-down-tracts (Plate VIII, figs. 13 and 14). In *Eurypyga helias* (fig. 15), which I was enabled to examine in Paris by Cuvier's kindness, I found only the two large dorsal tracts, like those of the Kites.[1]

CHAPTER VIII.

On the Anal Oil-gland.

The remarkable gland surrounded by the caudal tract, which is generally known by the name of the *oil-gland,* and which occurs in most birds, has hitherto been but superficially treated by authors, and by no one carefully examined in many birds; so that, with the exception of what I have myself stated in my contributions to Naumann's 'Naturgeschichte der Vögel Deutschlands' and in some other places, scarcely anything special has been published about it.[2]

It is situated above the last vertebræ of the tail, between the tubes of the rectrices; it is usually covered only by the skin, but sometimes by a tendon, from which the elevator muscles of the tail originate, and it secretes the oleaginous fluid with which birds lubricate their feathers.

Essentially it consists of two glandular bodies, more or less united together, but always at their posterior extremity; and as each lobe is broader and rounded anteriorly, and narrow and pointed behind, where they have a common issue, they together present the general form of a heart.

[1] For some additional remarks on the powder-down-tracts in various birds, see Appendix, note 1.—P.L.S.

[2] Something will be found about it in Tiedemann's 'Zoologie,' ii, p. 135; in Cuvier's 'Leçons sur l'Anatomie Comparée,' v, p. 260; and also in Blainville, 'De l'Organization des Animaux,' i, p. 104.

Internally the gland consists of parallel, filiform, closely packed, secretory tubules, which commence in cæcal extremities, and gradually unite into several stems or sacs, which open either into a common cavity of very variable size or directly at the end of the elongated posterior process.[1]

The oil-gland is largest in the *water-birds* and in those aerial birds which go into the water; in the others it is smaller. I find it of the largest proportional size in *Pandion*, *Dysporus*, *Sterna*, and *Procellaria*; the comparatively smallest that I have seen is in *Caprimulgus europæus*.

It appears to me to be very remarkable that this gland is regularly deficient in certain birds.[2] Thus, I have been unable to find it in any specimen of the Common Bustard (*Otis tarda*) examined by me, and also in two of the Little Bustard (*Otis tetrax*) which were killed near Halle. In the same way it is wanting in *Casuarius novæ hollandiæ*, of which I was enabled by Cuvier to examine two specimens in Paris, and have since obtained a third for the Academic Collection at Halle; likewise in the same number of individuals of *Casuarius indicus* which lately died in Halle, and the skins of which are now set up in the Zoological Museum of the University. The other cursorial birds, to which I have given the name of *Platysternæ*, such as *Struthio camelus* and *Rhea americana*, are also destitute of the oil-gland. In *Aptenodytes*, on the contrary, to which I formerly denied the gland, it is really present, but is concealed beneath very stiff feathers. It is wanting, however, in many of the American Parrots, of which I have repeatedly examined fresh specimens, as, for instance, in *Psittaci rufirostris*, Illig., *dominicensis*, *leucocephalus*, *ochrocephalus*, *dufresnii*, *menstruus*, and *purpureus*, and this is the more remarkable as most of the other species, among which are some very nearly allied to those just mentioned, possess very perfect oil-glands. However, other similar apparent anomalies occur, and I may mention, among those with which I am acquainted, the deficiency of the gland in *Columba coronata* and *C. militaris*, and also in *Argus giganteus*, although the nearest relatives of these birds are well provided with it.

But even leaving these exceptions out of the question, there are many remarkable differences in this organ. I regard it as a difference of great importance whether the elongated issue of the gland is furnished with a circlet of feathers at the end or destitute of it. This circumstance always furnishes a definite group-character—it is either an indication of family, or at least a generic character. Thus, I find the circlet of feathers above mentioned in all the *Diurnal Birds of Prey* (with the exception of *Cathartes*), in the *Picinæ*, *Amphibolæ*, *Psittacinæ*, *Lipoglossæ*, *Gallinaceæ*, and all the *Aquatic Birds*; on the other hand, it is deficient in the *Nocturnal Birds of Prey*, *Passerinæ*, *Macrochires*, *Cuculinæ* (except *Prodotes* s. *Indicator*), and the *Columbinæ*.

The plumage of the skin over the gland itself stands in near relation to the absence or presence of this circlet of feathers. Thus, it is always wanting in those birds in which the circlet of feathers at the orifice is deficient, but in the opposite case it is usually present; but even then it presents differences, the feathers sometimes standing close together, sometimes at greater distances

[1] The internal structure of the oil-gland of the Swan has recently been accurately described by Joh. Müller, in his admirable work on the glands, 'De Glandularum Secernentium Structura Penitiori,' Lipsiæ, 1830, fol., p. 41, tab. ii, figs. 1 *a*, *b*.

[2] I say regularly, and by no means as a deformity, as in the case of the tailless Domestic Fowls, in which alone, so far as I am aware, this deficiency of the oil-gland has hitherto been noticed. See Réaumur, 'Art de Faire Eclore des Oiseaux Domestiques,' 1752, ii, p. 332; and Tiedemann's 'Zoologie,' *loc. cit. supra*.

apart, and being either down-feathers or, at least in part, stiffer contour-feathers. I have found such contour-feathers, mixed with downy plumes, largest and most abundant upon the oil-gland of *Diomedea exulans*.

In the general form of the gland I find the following chief differences:

Nearly triangular in *Vultur leucocephalus*, *Falco milvus*, *Lanius minor*, and most of the *Passerinæ*.

Truly cordate, and consequently not longer than broad, in most of the *Diurnal Rapacious Birds*, in *Strix nyctea* and *S. flammea*, *Cypselus apus*, *Picus viridis*, *Yunx torquilla*, *Musophaga paulina*, *Alcedo ispida*, *Œdicnemus crepitans*, and many others.

Elongato-cordate in some Owls, such as *Strix aluco* and *S. otus*; also in the Common Pigeon, and in *Scolopax rusticula*.

Obtusely cordate, that is to say, bilobed anteriorly and truncate behind, in *Ciconia*, *Larus*, *Sterna*, and *Halieus*.

Deeply bilobed, the two halves being widely separated, and only united at the extremity, in *Cuculus*, *Coccygius*, *Picus martius*, *Psittacus aracanga* and *ararauna*, and in the Ducks and some of the Mergansers.

Transversely reniform in *Sturnus*, and very similar to this in many other *Passerinæ*.

Very broad, transversely elliptical, in *Tetrao tetrix*.

Cordato-elliptical, longer than broad, in *Perdix coturnix*, *Dysporus bassanus*, and *Pelecanus crispus*.

There are, however, some forms which occupy a middle place between those just described, and even variations among different individuals of the same species, apparently dependent on differences of age, sex, or individual conformation.

It is usually *thick* and *convex* in the Aquatic Birds, although even in many of these it is *flat*; it is flattest in *Dysporus*.

In *Strix flammea* and *Caprimulgus europæus* I find it nearly erect, so that only the hinder part lies upon the tail.

In many instances the efferent duct is not distinctly separated from the gland, but passes gradually into it, by becoming thickened anteriorly; in other cases it is very thin from its commencement, and readily distinguishable from the body of the gland. I find this latter form in all the *Passerinæ*, and in *Upupa*, in which the efferent duct forms a hollow, nearly pyriform body, in some of the *Gallinaceæ* and *Ducks*, and in *Scolopax rusticula*; the former structure is the usual one in all other birds. Thus, the duct is usually produced by the gradual posterior elongation of the two halves of the gland, but it also issues from the posterior surface of the gland, and then the body of the gland at the base of the duct is more or less elevated, as I have seen it in the *Passerinæ*, and in *Tetrao*, *Perdix*, and *Colymbus*.

In *Dysporus* and *Pelecanus* this process is entirely wanting, and in these I find in each of the flat halves of the gland, which are truncated behind, a peculiar orifice, situated before the apical margin; this is simple in *Dysporus*, but consists of several small apertures in *Pelecanus*. Moreover, even when the above-mentioned process is not deficient the external orifice is double, each half of the gland having its own aperture. The two apertures may generally be distinguished with ease; but in the *Passerinæ*, the *Owls*, and perhaps generally in all birds of which the outlet has no circlet of feathers, they are so small and placed so close together that their recognition is difficult. In *Upupa epops*, in which, as I have already mentioned, the efferent

duct is pyriform, this has really only a simple orifice, but at the base of its rather wide cavity[1] each half of the gland pours out its secretion through a distinct orifice. Whether there are any other cases of the same kind I do not know, but they are certainly very rare; for in many birds in which I have at first thought that I could detect only a simple orifice, I have afterwards, on a more careful examination, found two apertures, which were certainly small, but nevertheless perfectly distinguishable.

I have already mentioned, with regard to *Pelecanus*, that several external orifices may occur on each half of the gland. In fact, this is the ordinary case in the Water-birds, which possess a short, thick issue, crowned with feathers, such as the *Pelargi*, *Longipennes*, *Diomedea*, *Uria*, and *Alca*. In *Ciconia alba*, *C. nigra*, and *Diomedea exulans*, there are on each half of the gland five orifices, arranged in a curved line; in *Grus cinerea*, *Sterna hirundo*, *Lestris catarrhactes*, and *Uria troile*, I find only three, which in the two last-mentioned species are situated in a pit. In *Tantalus ibis* numerous orifices on each half of the gland form a complete circle; and in the very large gland of *Pelecanus crispus*, the two sets, each of six openings, lie in two parallel longitudinal lines upon its back.[2] In all cases where the oil-gland has several apical apertures, there are the same number of main stems or sacs, in which the gland-ducts open. But if there be only two apertures, one for each half of the gland, each of the latter has also a simple cavity, which contains the secretion poured out by the gland-ducts. This cavity, however, presents many differences. It is sometimes narrow and short, and passes so short a distance into the mass of the gland, that it almost appears to be only a cavity of the efferent nipple; in other cases, on the contrary, it is much wider and longer. I found it to be largest in the great oil-gland of the Osprey (*Pandion haliaëtos*), in which it has a very thick peculiar wall, perforated by the orifices of the numerous secretory canals.

Lastly, the matter secreted by the gland is always of an oleaginous nature, but differs in density, colour, and odour. In most cases it has the consistence of a salve, rarely that of a fluid oil; its colour is usually whitish, but sometimes brownish; in Water-birds it is commonly yellow—I even remember to have seen it of a saffron colour. As a general rule it is inodorous, but not unfrequently has a peculiar but variable odour; that of *Anas moschata*, as already

[1] In this cavity, which is kept extended by the tubes of the feathers of the circlet situated in its wall, the secretion of the gland, which is at first yellow, but afterwards becomes blackish, collects in the female (but only in this sex, and not in the male, who does not take part in incubation, although he does assist in feeding the young), and is the cause of the powerful odour which the Hoopoe diffuses about this period. This odour is given off only by the females and the young; by the former as long as they are sitting and feeding their young, by the latter as long as they remain in the nest. Is this odour intended to protect the females and young from the pursuit of predaceous animals?

[2] Joh. Müller (*loc. cit.*) describes in the gland of the Swan two large apertures, surrounded by numerous smaller ones. The latter, however, are by no means glandular orifices, but the holes in which the feathers of the circlet are inserted. As the gland examined had been preserved in alcohol, these, as usual in such cases when the fluid is not strong enough, had become loose, and fallen out, in consequence of incipient putrefaction. The swan (*Cygnus*), like all the *Unguirostres*, has only one rather wide aperture in each half of the gland.

remarked by Tiedemann, has an odour like musk. But that many temporary differences may occur in this respect, may be learnt from the example of *Upupa epops*, already mentioned.

From these statements with regard to the oil-gland, it is easily seen that it is very well adapted for the determination of natural groups of Birds, and that sometimes whole families, such as the *Diurnal Raptores*, the *Passerinæ*, and the *Columbinæ*, and sometimes many individual genera (*e.g.*, *Cathartes*, *Pandion*, *Cinclus*, *Upupa*, *Caprimulgus*, *Dysporus*, and *Pelecanus*), may be best and most certainly distinguished from their allies by its structure.

SECOND PART.

SPECIAL PTERYLOGRAPHY.

CHAPTER I.

Rapacious Birds—Accipitrinæ.

The sole general and characteristic condition of the tract-formation in this group, is the *furcate division* and *degradation* of the portion of the spinal tract situated between the shoulder-blades, by which it may be distinguished with certainty at least from the *Passerinæ*. To this may be added some less characteristic peculiarities, especially the wide separation of the two stems of the inferior tract, and also the emission, by each of them, of an external branch, which is usually connected with the main stem only in front. The lumbar tract is but little marked throughout, or is entirely deficient; the crural tract, on the other hand, is just as strongly developed. There are always *ten* primaries; and in the spurious wing I have always found *four* feathers. The number of tail-feathers amounts in most Accipitrinæ to *twelve*, and is never less; some Vultures have *fourteen*.

I. Diurnal Rapacious Birds—*Accipitrinæ Diurnæ*.

The most important pterylographic characters of these consist in the presence of an aftershaft on the contour-feathers, which is wanting only in *Cathartes* and *Pandion;* in the occurrence of down-feathers among the contour-feathers in the tracts; and in the presence of a circlet of feathers at the apex of the oil-gland, which, however, singularly enough, does not occur in the Vultures of the New World (*Sarcorhamphus* and *Cathartes*). Both in this character, and in the form of the pectoral portion of the inferior tract, these Vultures approach the Owls, especially *Hybris flammea;* and the same statement applies to *Pandion*, which also approaches the Owls in its reversible toe. Between the Vultures of the Old World, those of America, and the Falcons, there are, however, other pterylographic differences of considerable significance.

a. Vultures of the Old World.

The chief pterylographic character of these is, the enormous dilatation of each half of the inferior tract upon the great pectoral muscles into an external branch, which, however, remains

united with the main stem throughout its whole course. To this may be added the separation of the gular portion of the inferior tract from the pectoral portion by a space, which is found only in these Vultures, and runs round the neck close in front of the furcula. This may be called the *jugular space* (*apt. jugulare*).

1. Gypaëtos *barbatus* (Plate II, figs. 1 and 2).

Of this bird I have repeatedly examined skins, and finally two perfectly fresh specimens (an old female and a young male), sent to me from Coire by the chamois-hunter George Gutscher, the skins and skeletons of which now form beautiful preparations in the zoological collection of the University of Halle. I find the following pterylosis :—

In the feathers of the trunk and head the aftershaft is pretty distinct, even in the bristles of the beak and beard, which are true contour-feathers, and are rendered particularly remarkable by the fact that the barbs are almost entirely deficient on the main shaft, whilst the aftershaft, which is very little shorter, bears distinct barbs on its basal half. All the spaces were densely clothed with large down-feathers of a white or yellowish colour, with the exception of the inferior space in the female, in which the down-feathers were wanting on the breast and belly, forming a brood-spot. The contour-feather tracts also have down-feathers among their feathers; but in the continuous plumage of the head and neck they were almost, if not entirely, deficient. As these down-feathers are discoloured by a yellow dust, which is also perceived as a hoary (*hauchartiges*) coating upon the contour-feathers of the head and neck, I was led to regard them as powder-down feathers, which, however, they do not appear to be. They certainly do not form true powder-down tracts.

From the uniform plumage of the head, which extends downwards for about one third of the length of the neck, three processes originate, one of which runs down the back of the neck, as a spinal tract, as far as the shoulders, where it divides into a broad fork. The other two pass, gradually diverging, along the anterior surface of the neck, and embrace its base by the approximation of their pointed extremities ; a circumstance which is characteristic of *Gypaëtos*. The inferior tract consists of two symmetrical widely separated halves, which are very greatly dilated upon the pectoral muscles. Posteriorly, towards the extremity of the sternum, they are again narrowed, and are continued over the belly as mere narrow bands, which converge from the extremity of the pelvis and terminate *near the anus*. The lower portion of the spinal tract is united to the above-mentioned fork between the shoulders by two converging rows of single feathers, and is then continued uninterruptedly as a narrow band along the dorsal vertebræ, to terminate at the oil-gland. We may also see very distinctly a broad *axillary tract* separated from the rest of the plumage of the upper arm, but the *femoral tract* is entirely deficient. On the upper surface the wings have a homogeneous plumage, uniformly distributed over the great wing-membrane; beneath they exhibit two rows of successively larger feathers on the anterior margin of the great wing-membrane, and the rest is a true *inferior wing-space*, clothed, however, like all the spaces, with a soft down, and concealed by the contour-feathers of the anterior margin. In this space is situated the *musculus extensor metacarpi radialis;* the other part of the upper arm bears the feathers of the *inferior wing-coverts* (*pteromata*), arranged in three rows, which increase considerably in length towards the elbow. The *parapterum inferius* (Möhring's *ala notha*) is of considerable size, and

consists of *ten* feathers in a row running down the inside of the upper arm: of these, the fourth from the elbow is 8 inches in length. The *parapterum superius* is small, and consists of five feathers (indicated on the left side of fig. 1), in the axilla, which certainly stand exactly in the direction of the axillary tract, but are separated from it by the superior wing-space (*apterium alare superius*). The number of remiges is 31, of which 10 are inserted upon the hand, as in all the Diurnal Birds of Prey; the first and fifth are of equal length, as are also the three intervening, much longer ones. All the five are distinguished from the following feathers by a dilatation of the inner half of the vane, which is very long and large on the first, and gradually becomes shorter. From the sixth to the tenth these feathers rapidly decrease in length, but those inserted on the forearm are all of equal length; the twenty-eighth is the elbow-feather, and the thirty-first is very short. The crural tract is of considerable strength, especially on the outside; it extends over the greater part of the tarsus, which, however, is truly naked at its lower extremity, although it is covered by the feathers inserted higher up. The long tail projects considerably beyond the contracted wings, and contains *twelve* graduated rectrices. The oil-gland is clothed with downy feathers, not only at its apex, but also upon its anterior surface.

2. Vultur.

Differs from *Gypaëtos* in having the head and upper part of the neck sometimes quite naked, sometimes clothed with down, but is allied to it in having the two pectoral bands of the inferior tract separated by a gap from the plumage of the lower surface of the neck or gular portion of the inferior tract. This gular portion, however, is undivided, and not, as in *Gypaëtos*, furcate, and forms a peculiar, large shield, composed of densely packed, down-less contour-feathers beneath the throat.

Savigny's beautiful investigations ('Descr. de l'Egypte,' tome xxii, p. 231) first showed that the Vultures form two clearly distinguishable families. These two sections differ from each other pterylographically.

a. Gyps, *Savigny*.

(Small-headed Vultures.)

With a small head, naked above; nearly vertical, narrow, fissure-like nostrils; a tongue with spinose margins; and *fourteen* tail-feathers.

Of this group I have examined *Vultur fulvus*, one of which I kept alive for five months, and *V. indicus* and *V. galericulatus*, both in skins from Lamare-Picquot's collection. The most important common pterylographic character, besides the above-mentioned number of rectrices, is probably the presence of a distinct *lumbar tract*, composed of *one* or *two* rows of feathers, and separated by a true space from both the crural and the spinal tracts. To this may be added, the dilatation of the posterior portion of the spinal tract, which is very considerable upon the pelvis, but becomes pointed anteriorly, and projects with its apex between the arms of the anterior part.

1. *V. indicus*, Temm., *Pl. Col.* 26 (the adult Bird).—Head and upper part of the neck perfectly naked, without any feathers. Contour-feathers of the trunk with a few single downy barbs, instead of the accessory shaft. The down-feathers are extremely soft, with very long, fine, soft barbs, and scattered transverse barbules. Nevertheless, they are not umbellated down-feathers, but are distinctly divided into two shafts, which are of equal length, but must be regarded as main and accessory shafts. Their colour is snow-white. They clothe all the spaces, and also occur among the contour-feathers.

Neck-ruff but slightly developed, consisting of short, somewhat decomposed (*zerschlissenen*) feathers. The only other matters that deserve notice are, that the inferior tracts, which are very broad upon the pectoral muscles, do not nearly extend to the anus; that the lumbar tract forms only *one* row of 6 or 7 feathers, above which a single feather stands; and that the posterior half of the spinal tract is composed of six rows of feathers, which are at first white and afterwards brown.

In the wings I found the feathers arranged as follows:—Remiges *thirty-six*, of which ten are on the hand. In folding, all the remiges of the hand pass beneath those of the arm, which increase in length posteriorly, and reach as far as the longest of those of the hand. The first primary is as long as the seventh; the second and fifth are of equal length; the third and fourth the longest of all. Feathers of the lower wing-coverts in three rows; the hinder ones, towards the elbow, perceptibly longer, equal in length to the rectrices of the same part. *Parapterum* (*superius*) formed of few (about 5 or 6) large feathers, which appear to be separated from the axillary tract; *hypopterum* large, composed of about ten flat principal feathers, which are protected at the base by the same number of flat inferior covert-feathers, standing in a row before them. The crural tracts form externally true breeches, as they may be termed, but internally consist only of whitish down; the tarsi with rounded scales, which also extend over the bases of the toes; beyond this there are scutes. Middle toe remarkably long, united with its neighbours by a curved membranous fold. All the claws strong and crooked.

Tail-feathers stiff, somewhat worn away, but still reaching beyond the folded wings; all of nearly equal length.

2. *V. galericulatus*.—Head and upper part of the neck clothed with bristly feathers, the lower part to the ruff stronger. Neck-ruff distinct, white, as are also the dorsal half of the spinal tract, the lower wing-coverts, the lesser wing-coverts, the inside of the thighs, and all the down-feathers. Contour-feathers brown, with a whitish streak along the shaft; in general stiff, with but little down, and scarcely perceptible aftershaft. The *inferior tracts* commence only at the shoulders, and are very broad upon the pectoral muscles, where they consist of scattered feathers; they are afterwards narrow, composed of three rows of feathers, and do not reach to the anus. *Cervical tract* strongly furcate, broad. The *spinal tract* commences between the arms of the fork, and soon becomes broader, but consists only of short and rather isolated feathers. *Lumbar tract* very distinct, composed of *two* rows of rather large feathers.

Remiges thirty-six, ten of which are on the hand; the first five with a very distinct emargination of the inner vane, and narrowed from this to the apex; the first as long as the seventh; the second and sixth, and the third and fifth, also equal; the fourth somewhat larger and the longest of all.

Tail-feathers probably fourteen, but in this specimen I could only detect twelve. Oil-gland, as usual in the Vultures, with a short circlet of feathers at its apex.

3. *V. fulvus.*—The pterylosis agrees exactly with that of *V. galericulatus*, even in the light plumage of the head and upper neck, formed of bristly feathers, and afterwards becoming downy. The true tracts of the neck only commence in the ruff, and those of the breast are separated from them by a narrow space. In no part can I find anything peculiar; even the lumbar tract is present. The number of remiges is thirty-six; the first five have an emargination of both the outer and inner vanes, extending very far down, which becomes gradually less marked from the first primary, and is precisely similar to that in *V. indicus*. In length the first is equal to the seventh, the second to the fifth, and the third is somewhat shorter than the fourth, which is the longest. In this species, also, the primaries and the entire hand lay themselves beneath the arm-feathers, and are concealed by these during repose, so that, as the last remiges of the arm are very long, only about an inch of the apex of the primaries continues visible. *Tail-feathers* very distinctly *fourteen*. Oil-gland covered with down, and consequently scarcely perceptible externally; its apex short and broad, with the ordinary circlet of feathers. Two distinct orifices at its extremity.

b. Ægypius, *Savigny.*

(Large-headed Vultures.)

With a larger head, usually clothed above with bristly feathers; circular, open nostrils; a wide auditory aperture; a smooth, fleshy tongue, thicker and raised at the margin; and *twelve* tail-feathers.

Of the members of this section I have examined *V. cinereus* (*s. arrianus*, Temm.), *V. pondicerianus*, and *V. angolensis*, Lath.; of the two latter only the skin, and this in the stuffed condition. The complete absence of the lumbar tract seems to be common to all of them, and to constitute their chief pterylographic character. Not less characteristic is the narrower form of the dorsal portion of the spinal tract, which moreover does not extend forward between the arms of the furcate scapular portion, but is united to the extremities of the branches of the fork by two divergent rows of single feathers. In these two particulars these Vultures agree exactly with *Gypaëtos*.

1. *V. cinereus.*—Head with peculiar, scattered contour-feathers, running out at the extremities of the barbs in the form of capillary, setiform points. On the occiput these feathers are longer, and the main shaft with its barbs is curved upward, producing an appearance as if each feather were reversed, and the aftershaft, which is scarcely one third of the size of the main shaft, inserted on the outer surface. Auditory aperture surrounded by a ring of feathers, and above it a naked streak, which is directed towards the equally naked nape. Sides of the head also perfectly naked. The throat, or space between the rami of the lower jaw, is clothed with long, narrow, bristle-like contour-feathers, which extend anteriorly as far as the jugular tract, and form with this a connected whole. The latter runs down the fore part of the neck, gradually becoming broader, and forms, beneath, the shield peculiar to all Vultures, which is here separated from the two inferior tracts by a space, but is less strongly marked than in *Gyps*. The *spinal tract* commences *higher up*, very little behind the naked nape, and is equally broad from the first. Where it passes on to the trunk, it divides into two less divergent branches, which, as has

already been mentioned, are connected by two rows of single feathers with the narrow dorsal portion, which is three feathers in breadth. On each side of the latter, at some little distance, there is another row of distant contour-feathers. Inferior tracts exactly as in the other Vultures, and somewhat separated from the anus behind. Lumbar tract wanting. The crural tracts form breeches, but the feathers in them are not very large. *Humeral tracts* greatly developed, becoming broader and densely feathered behind, intimately united with the inferior tract in front. When this union occurs, there stand, on the top of the axilla, several longer feathers curved somewhat forwards and upwards, which are correctly represented in the figures of this bird. The wing-feathers present no peculiarities: remiges *thirty-five*, of which ten are on the hand; the first five with a gradually diminishing emargination on the inner margin. First primary as long as the seventh; second longer than the fifth, but shorter than the fourth; the third the longest of all. Tail much rounded, with *twelve* feathers. Oil-gland feathered, and with a circlet of feathers at the end of the scarcely distinct apex.

All the *spaces* clothed with long, bushy down-feathers, particularly large in the lateral neck-spaces, which are very distinct, continued between the throat and the inferior tract, and connected with the inferior space.

Contour-feathers with an accessory shaft, which is especially firm and rigid on the long, narrow feathers of the lower surface of the neck.

2. *V. pondicerianus*, Temm., *Pl. Col.* 2.—Head and upper part of the neck naked, the former with scattered setiform feathers, the latter on each side with a projecting naked fold of skin, which extends down upon the lateral neck space, even in the feathered part of the neck. In other respects exactly like *V. cinereus*, but the contour-feather plumage weaker in all parts, probably weaker than in any other predaceous bird. The jugular shield is longer and narrower, and its feathers less dense or less depressed than in the other Vultures. The inside of the shank is merely clothed with down, perhaps even perfectly naked in the middle. Humeral tract united anteriorly with the inferior tract; feathers of the latter strongest and longest on the inner margin, where they are usually narrowest. The down of the contour-feathers more abundant, and, with that of the down-feathers, very soft, white, and easily moved. Both these characters also occur in the Cinereous Vulture, but not in the Small-headed group. Wings and tail with no peculiar characters.

3. *V. angolensis*, Lath.—This rare bird, of which I have seen two stuffed specimens in the Imperial Cabinet of Natural History at Vienna, is of about the size of *Neophron percnopterus*, which it also resembles in its slender beak, but at the same time is distinguished from it by its small, vertical, elliptical nostrils. The two specimens were of different sexes; the male has a thinner beak, with a much longer and more strongly hooked tip. It is the original of the figure in the 'Museum Leverianum,' and was obtained from the Leverian collection. The specimen figured in Brown's 'Illustrations of Zoology' is likewise this bird. The female, which is somewhat larger than a Raven, has the beak nearly of the same form as in *V. cinereus*, but the nostril is more elliptical. In both sexes the upper part of the head, the region of the ear, and the neck are covered with bristle-like contour-feathers; the rest of the contour-feathers have a large downy aftershaft. The pterylosis, so far as I could examine it, was exactly as in the Vultures, with the pectoral part of the inferior tracts broad. Tail in both individuals with *twelve* feathers; but on the wings I found not more than twenty-five remiges, amongst which, however, there were evidently some gaps; the first two graduated: the third, fourth, and fifth longest; all five with a

diminution of the inner vane, which, although slight, extended far down. The apices of the wings reach to the end of the tail. Complete breeches on the shanks. Presence or absence of the femoral tract uncertain.[1]

3. Neophron.

Judging from an examination of *N. percnopterus* and *N. monachus*, this genus has all the pterylographic characters of the true large-headed Vultures, especially the narrow dorsal portion of the spinal tract, which does not reach up between the branches of the cervical portion, but is united therewith by rows of single feathers. The lumbar tract also is entirely wanting. Of course the inferior tract is much dilated upon the breast, and the gular portion is separated from it by a space, and united to the axillary tracts. All the spaces are likewise clothed with soft down-feathers, and these are not wanting among the contour-feathers. In the structure of the wings *Neophron* seems to be distinguished by a smaller number of remiges (*twenty-eight* in *N. monachus*, of which ten are on the hand); in other respects these are as in *Vultur*, namely, the first five with a diminution of the inner vane, and graduated so that the first is equal to the sixth, the second to the fourth, and the third the longest. It is remarkable, however, that *N. percnopterus* constantly has *fourteen* tail-feathers, and *N. monachus* only *twelve*. The complete absence of a jugular tract in *N. monachus*, in which the neck, as is well known, is perfectly naked, whilst in *N. percnopterus* there is a furcate jugular tract, starting even from beneath the jaws, and also a simple cervical tract commencing at the occiput, appears to indicate the distinctness of the two forms. This furcation of the jugular tract, however, furnishes the chief pterylographic distinction between *Neophron* and *Vultur*. In *N. percnopterus* the long narrow tongue is not toothed at the margin; that of *N. monachus* I have not been able to examine. Structure of the foot as in *Vultur*, all the naked parts being covered with small round scales, with only three or four scutes immediately above the claws; a moderate web between the outer and middle toes. Claws strong, pointed, and curved not much less than in the Buzzard (*Falco buteo*); those of the hinder and inner toes, as usual, most strongly curved.

[1] In the above-mentioned collection this bird stood under the genus *Falco*, to which it certainly does not belong. Nor do I think it is a *Vultur*, but rather a *Neophron*. The supraciliary bone, which occurs in the Vultures, is evidently deficient, as in *Neophron* and *Cathartes*; but the beak is less elongated than in the former, and the position of the nostrils is quite different. The plumage in the male is white, in the female clay-yellow; the tail black, white at the extremity; spurious wings and remiges of the arms black, as are also the coverts; but the primaries are white, with black tips in the female. Axillary feathers large, black, whitish at the tips. Tarsi thick, moderately long, covered throughout with coarse scales; those in the middle of the fore part rather larger. Toes also scaled, but with 3—4 scutes at the extremity. Claws tolerably curved and acute; tips of the toes beneath furnished with just such sharp papillæ as in *Pandion*; a membrane between the middle and outer toes.

B. Vultures of the New World.

The chief pterylographic character of these, as of the Old World Vultures, is to be found in the formation of the pectoral portion of the inferior tract. This is not separated by a space from the jugular portion, but the two sections of the tract are perfectly continuous. Just as the inferior tract, gradually enlarging, has arrived over the pectoral muscles, it receives the axillary tract, and thus acquires a very remarkable breadth. It then divides into two branches, which, however, are generally weak, and are rendered indistinct by the circumstance that the feathers of the tract are more scattered. The two branches are at first of equal width, and run parallel; towards the extremity of the great pectoral muscles they curve in towards each other; and whilst the inner one is continued unchanged as the ventral portion, the outer one is narrowed, and returns by a narrow process, running along the margin of the *musculus pectoralis major*, to the ventral part again. In this way the two branches enclose a pretty large insular space, the whole tract thus presenting a very close resemblance to that of *Centropus* (Plate IV, fig. 13). This, however, does not conclude the list of the pterylographic peculiarities of the American Vultures; but we must add:—1. The amalgamation of the jugular part of the inferior tract with the cervical portion of the spinal tract, which would convert the plumage of the lower part of the neck into a continuous one, *if the inferior space did not entirely or partially penetrate it.* 2. The remarkable narrowing of the dorsal portion of the spinal tract, which frequently consists only of two rows of feathers, gradually diverging anteriorly, and connected with the branches of the fork of the cervical part. 3. The presence of a large lumbar tract. 4. The constant and invariable presence of *twelve* feathers in the tail. 5. The absence of a circlet of feathers at the apex of the oil-gland. The broad, obtuse form of this organ seems to stand in relation to this. At its extremity there are two distinct orifices. 6. The covering of the feet may also be cited as a characteristic element; it consists of small scales upon the tarsus, but of scutes upon the whole of the toes: moreover, besides the outer and middle toes, the middle and inner toes are united by a membrane.

The elongated nostrils, paralled to the longitudinal axis of the beak, certainly remind one of *Neophron;* but the absence of a bony septum between them is one of the most characteristic external distinctions of the American Vultures: the tongue, moreover, has a series of teeth on its margin, at least in *C. papa* and *C. aura.*

I have examined *C. gryphus, papa, aura* and *urubu* (*fœtens* Illig.), and found in all some little differences in the form of the tracts, but no characters from which I could justify their division into the genera *Sarcorrhamphus* and *Cathartes.*

4. Cathartes.

Down-feathers everywhere upon the spaces and between the contour-feathers; the latter with a few soft barbs in place of the deficient aftershaft. Head entirely or nearly naked, as also the upper part of the neck; the latter probably always. The pterylosis only commences at the ruff of feathers, and is continuous, being only interrupted beneath by the inferior space; the latter

is at first quite naked. Wings with a very variable number of remiges, at the utmost thirty-six, at the lowest twenty-three, of which ten are on the hand; the first three rapidly graduated, the third probably always the longest, the first equal to the seventh; all as far as the sixth emarginated on the inner vane; spurious wing with four feathers. *Parapterum* not well marked, composed of eight feathers not easily distinguishable from the rest; *hypopterum* more distinct, consisting of twelve long, flat feathers running down upon the upper arm.

1. *C. gryphus*.—Short, hair-like feathers on the head and upper part of the neck; neck-ruff formed only of down-feathers. Lateral neck-space short, reaching from the shoulder to the base of the neck. Spinal tract very broad (6—10 feathers) from its commencement, and strong; but the short lobes of the furcate portion soon taper off, so that they terminate with a single feather. Dorsal portion consisting, for the first half, of two distant rows of feathers; afterwards of four rows, but becoming no wider. Humeral tract large and broad, apparently with air-cells among its quills; the space between it and the upper plumage of the wing very narrow. Inferior tract very sparsely feathered, the insular space not very large, and therefore not particularly perceptible; the ventral portion extends to the anus. Lumbar tract of two rows, with twelve feathers in each, distinctly separated from the spinal tract, but coalescent with the crural tract. Down-feathers behind the oil-gland, partly standing beneath it, and not to be regarded as apical feathers. Altogether *thirty-six* remiges, of which the thirty-third is at the elbow; on the hand, as usual, ten.

2. *C. papa*.—Neck quite bare, except at the nape, where there is a band composed of hair-like feathers, which also extends over the vertex; lower part of the neck feathered all over above, but with the plumage unequal, thicker anteriorly, where it forms the ruff, and similarly thickened on a small band in the direction of the spinal tract; lateral regions sparsely feathered, interrupted beneath by the perfectly naked inferior space. Lateral neck-space limited to the shoulder. Scapular portion of the spinal tract distinct, with a deep bifurcation; the branches slender, obtuse at the end. Axillary tracts strong and large, situated close to the shoulder-blades, whence the space separating them from the plumage of the arm becomes *broader*. Posterior half of the spinal tract entirely formed of two rows of feathers, which at first diverge and have the feathers distant, but are subsequently parallel and denser; somewhat widened in the pelvic region. Lumbar tract short, separated from the crural tract, biserial. Inferior tract rather more densely feathered than in *C. gryphus;* but the insular space much larger, and quite naked. Inferior space at first narrow, in consequence of the inward bending of the inner branch of the inferior tract; somewhat broader on the belly; perfectly naked in front. Wing plumage as in *C. gryphus*, but only *thirty-two* remiges, of which the last but one stands at the elbow.

3. *C. aura*, Vieill. The head and fore part of the neck are quite naked. The plumage of the neck goes further towards the head, but is weakened towards the trunk and abridged on the sides, when the lateral neck-space is perceptible in front of the shoulder. Spinal tract exactly as in *C. papa*, except that the feathers in the middle of the dorsal part are somewhat softer and almost downy. Lumbar tract separated from the crural tract. Inferior tract similar in arrangement to that of *C. papa*, but with the feathers more sparse, so that this is rendered small and indistinct. All the rest as in *C. papa*, but only *twenty-seven* remiges; the ten primaries in the same proportions as in *C. gryphus* and *C. papa*; the twenty-fifth at the elbow, and the longest of the arm-feathers.

4. *C. urubu* (*fœtens* Illig.; *atratus* Temm.; Buff. *Pl. Enl.*, 187).—Head and fore part of the neck warty, with very scattered, hair-like feathers. Neck plumage uninterrupted, commencing

with an ascending point near the occiput, forming no ruff, and apparently divided anteriorly beneath only by a continuation of the inferior space;[1] feathers generally sparse; cervical and scapular portions of the spinal tract exactly as in *C. papa*, as also the somewhat broader dorsal portion, which is *triserial posteriorly*. Lateral neck-space short, but perceptible. The femoral tracts pass into the crural tracts. Inferior tract very broad, but sparsely feathered, with a small insular space on the pectoral muscles; outer branch anteriorly very broad, broader than usual. Remiges only *twenty-three*, or at the outside twenty-five in number; but ten of these are still on the hand. Tail not rounded as in the other species, but abruptly truncated; the middle feathers are, consequently, somewhat abbreviated. Oil-gland quite naked.

All these four species are described from skins in the collection at Halle; the second was also examined in a fresh state.

C. Falcons.

Falco, *Linn.*

This group, which includes so many species, and is so readily and certainly characterised by the structure of the beak and feet, has no single, equally general and exclusive pterylographic character; for although in most Falcons the inferior tract possesses a freely diverging external lateral branch, which, if it were only universal, would clearly distinguish them from the Vultures both of the Old World and of America, there are, according to my observations, two exceptions to this rule, as both in *Falco haliaëtus* (Plate II, fig. 7) and in *F. ecaudatus* Daud. we find a simple, generally enlarged pectoral tract, in which respect these two Falcons agree perfectly with the Old-World Vultures. Still, notwithstanding this great similarity, a pterylographic difference between them and the Vultures may be demonstrated; namely, that in the latter the jugular portion of the inferior tract is completely separated by a space from the pectoral portion, whilst in the Falcons referred to the two parts are connected and pass into each other. This union of the two tracts is, indeed, proper to all the Falcons, but is not always so distinct and perfect. The jugular portion of the inferior tract forms an inner branch at its lower extremity just before the furcula, which passes down along the furcula to its lowest part, and there terminates; this is wanting only in *Pandion* and *Rhynchodon*. This branch is frequently very short, but is, notwithstanding, recognisable from the fact that the inferior tract itself is diminished immediately behind the branch, and then consists only of a single row of feathers, which is continued over the furcula, and effects the union of the jugular with the pectoral portion. If it were altogether wanting (which, however, I have never found to be the case), there would be a complete approximation to *Gypaëtos*, if at the same time the outer branch of the pectoral portion were coalescent with the main stem; but, as far as I know, this case never occurs, and the above-mentioned mode of union, together with the undivided condition of the pectoral band of the inferior tract, always constitutes a characteristic distinction of the Falcons. As, moreover, the jugular portion of the

[1] As the skin of the only specimen examined by me had been cut longitudinally beneath, it did not allow the extent of the inferior space to be determined accurately.

inferior tract is always divided, and thus double, in one half of its extent in these birds, they cannot for this reason be confounded with the true Vultures, and it would really be only to *Gypaëtos* and *Neophron* that the two anomalous Falcons above referred to would nearly approach in the formation of the inferior tract. From the Vultures of the New World, on the other hand, the Falcons are quite sufficiently distinguished by the absence of the insular space in the pectoral tract, and the complete division of the inferior tract on the neck.

However, the pectoral portion of the inferior tract is always very variable throughout the Falcons; and besides the complete coalescence of the branch with the main stem, and its perfect separation therefrom, there occurs a complete series of intermediate steps, which show how the one form gradually passes into the other. Thus the branch is often free only at the end (*F. bidentatus* Temm. *Pl. Col.*, 38), in other cases as far as the middle (*F. lophotes* Temm., *Pl. Col.*, 10), or to within one third from the base (*Gypogeranus serpentarius*), or, lastly, quite free, as I have figured it in *Falco fulvus* (Pl. II, fig. 3). The latter case is the most frequent.

Not less variable, and consequently equally inapplicable as a characteristic element, is the posterior part of the spinal tract. In the Vultures it presented us with a character for the pterylographic distinction of *Gyps* and *Ægypius*, in its two different forms; and its form in the Falcons is still more liable to change. The narrow, band-like form, such as occurs in *Gypaëtos* and *Ægypius*, appears to be most generally diffused; but it is by no means a constant character, even in those species in which it occurs, as the posterior part is sometimes remarkably short, as in *Falco buteo*, and sometimes long and reaching to the fork of the anterior part, as in *F. milvus;* but even then it usually exhibits that division into the divergent rows of feathers (Plate II, fig. 4) which also occurs in the above-mentioned Vultures. Another more constant, and therefore more characteristic form, consists in the complete division and dilatation of the two limbs of the tract as far as the caudal pit, which characterises the genera *Rhynchodon* (Plate II, fig. 6) and *Pandion*. More rarely I have met with a third primary form, which occurs as a generally dilated tract, sparsely feathered at the sides (Pl. II, fig. 5). Intermediate between this form and the first-mentioned are two American Falcons (*F. melanops* Temm. *Pl. Col.*, 105, and *F. anthracinus* Licht., from Mexico), inasmuch as in these there is a narrow dorsal band of uniform breadth, but inside it some sparsely scattered contour-feathers.

In the enumeration of such differences I must not omit to mention that the lumbar tract also falls into the category of variable pterylographic structures, being sometimes entirely wanting and sometimes present, but never, apparently, attaining any considerable extension or strength. The occurrence of powder-down tracts in its vicinity has already (p. 37) been mentioned generally, and will occupy us again hereafter.

I shall say nothing at present of the variability of structure of the wings and tail, as this is well known, and has already been generally employed by ornithologists for characterising their numerous subgenera. I need only repeat here that all the Falcons possess ten primaries and twelve tail-feathers.

If we now take into consideration the differences of the pterylosis just indicated, in order to arrange the Falcons in accordance with them, it is a matter of course that this classification cannot be a natural one, being only drawn from a single character. We must, therefore, not expect this from it, but rather rest satisfied with the result here given, namely, finding the pterylographic multifariousness summarily represented in it. This, indeed, was our problem.

1. Falcons with the pectoral stem of the inferior tract *undivided.*

a. With the posterior portion of the spinal tract of uniform breadth and furcate anteriorly.

The representative of this remarkable combination, which is so extremely similar to the Vulturine type, is the *Falco ecaudatus* Daud. (*Le Bateleur*, Le Vaill. *Ois. d'Afrique*, I, pl. 7 and 8), of which Lesson has formed the subgenus *Theratopius*. I have also to mention, with regard to the pterylography of this very singular bird, that the inner branch at the extremity of the jugular portion of the inferior tract is very distinct, that the union of the jugular with the pectoral portion consists of a single row of feathers, and that the lumbar tract appears to be deficient. The two arms of the scapular part of the spinal tract are remarkably long, as they project beyond the apices of the scapulæ. The dorsal portion reaches nearly to these arms, and divides only into two very short, diverging rows of feathers, which unite themselves to the arms of the fork. The number of remiges is *thirty-three*, a perfectly enormous number for a Falcon: the first is, perhaps, the longest, but I must leave this uncertain, as it was in process of growth, otherwise certainly the second: the third is a little shorter, and the remainder to the tenth rapidly diminish. The first five have an emargination on both halves of the vane; this is but slight on the outer one, but on the inner it forms a very acute angle, and commences near the middle of the length of the feather. By this means the second half is rendered very narrow and acute. Tail very short, scarcely one fourth the length of the portion of the folded wings which projects over it.

In other particulars of its structure this bird approaches the Buzzards; but it has the feet entirely covered with scales, and with only one or two scutes upon the backs of the toes immediately above the base of the claws; likewise a remarkable analogy with the Vulturine type.

b. With the posterior part of the spinal tract deeply divided, and dilated externally on each arm.

Falco (Pandion) *haliaëtos*. (Plate II, fig. 7.)

This Hawk, which is so remarkable in many respects, does not present only the two peculiar characters already indicated, but it differs pterylographically in many other points from the rest of its associates. These differences are as follows:

1. The contour-feathers *have no aftershaft*, and are generally very small and short; indeed, smaller than in any other Falcon. Hence the legs present no appearance of breeches, and the trunk seems very small in comparison with the wings and legs. The feathers of the inferior tract are the smallest of all.[1]

2. The inferior tract divides close to the throat, and its two arms separate considerably. In the vicinity of the furcula they become dilated, but form no interior branch; they pass uninterruptedly and constantly becoming broader upon the pectoral muscles, of which they occupy the whole of the middle surface, continue backwards at an equal distance from the crest of the

[1] The absence of the aftershaft causes this Falcon to approach the Owls as much pterylographically as it does zoologically in the reversible toe, and anatomically in the non-pneumatic femora and the completely closed osseous canal on the *os metatarsi* for the passage of the sinew of the *extensor digitorum communis*.

sternum and the outer margin of the *pectoralis major*, and occur broader than usual upon the ventral surface, upon which, however, they terminate before reaching the pelvis and the anus.

3. The *hypopterum*, which is generally confined to the inner surface of the upper arm, is continued upon the breast, and forms a row of large contour-feathers close to the outer margin of the pectoral tract.

4. The spinal tract, as far as the shoulder, is without any distinguishing marks; but its dorsal part consists, at first, of two rows of single feathers, which issue, parallel to each other, from the points of the fork, become broader in proportion as they increase in length, and only coalesce immediately in front of the oil-gland, to form a short, broad, main stem, which has contour-feathers sprinkled beside it.

5. The lumbar tracts are probably entirely wanting.

6. The oil-gland is remarkably large, probably larger in proportion than in any other bird; it is cordate, with a short apical part with two orifices; each half of the gland has a large, deeply penetrating, wide cavity, of which the wall consists of a very thick membrane.

7. In the wings I find *twenty-nine* remiges, which is also a comparatively large number. Of these the first is somewhat longer than the fifth, and the second and third exceed all the others in length. The first three have an angular emargination on the inner half of the vane, and are diminished in size from this point; the fourth exhibits a trace of this. The *ala spuria* has a thin, straight claw, and, at least sometimes, *five* feathers.

8. Rectrices short, reaching only to the tips of the folded wings.

2. Falcons of which the pectoral tract emits a completely or partially free exterior branch.

a. With the dorsal portion of the spinal tract deeply divided, and each limb dilated exteriorly.

Here belong all the *Noble Falcons*, which, as they differ more than any other group from the other Hawks, I regard as forming a distinct genus, for which I propose the name of *Rhynchodon*. Judging from an examination of *Rh. islandicus*, *peregrinus*, *æsalon*, *subbuteo*, *tinnunculus*, *tinnunculoides*, *rufipes*, *concolor*, Temm., and *cærulescens* Lath., they present a very great and complete agreement in the pterylosis, the chief peculiarity of which is expressed in the above-mentioned form of the dorsal portion of the spinal tract and the jugular portion of the inferior tract (see Pl. II, fig. 6). The following points appear to me worthy of notice:

The *down-feathers* are white or gray, remarkably soft, mould-like, and clinging together when pressed; they all have a short main shaft and an aftershaft of equal length. They are sometimes entirely wanting in some spaces, as, for example, on the lateral neck-spaces; they are everywhere sparse.

Contour-feathers with a considerable, but, as usual, merely downy aftershaft; main shaft rigid; barbs for the most part pennaceous.

Head uniformly feathered, but with the region of the eyes naked, and the lores clothed with setiform feathers arranged in a whorl.

Spinal tract with robust feathers throughout; it starts nearly from the occiput, and divides in a long fork between the shoulders. The dorsal portion commences with two parallel rows of simple feathers between the fork, and becomes perceptibly broader by the addition of new rows on the outside of each of the original rows, but at the same time more sparsely feathered. The

two rows unite only at the caudal pit, and then pass in the form of a broad band to the oil-gland. We found just this tract also in *Pandion*, and its form is peculiar to these two groups.

Humeral tracts not very broad, with few, but very large and strongly tubular feathers.

Lumbar tracts always small, each consisting at the utmost of twenty feathers, sometimes almost abortive, intermixed with powder-down-feathers, and very closely approximated to the spinal tract.

Crural tracts formed of contour-feathers only on the outside, forming breeches; internally downy.

Inferior tract simple as far as the middle of the neck, narrow, separated from the spinal tract by the lateral neck-spaces. Its two limbs likewise narrow, strongly divergent, and in consequence united with the axillary tract at the shoulder, but *destitute of the interior branch* which occurs in most Falcons, and descends from the furcula into the bend of the neck (fig. 3). On the other hand, the exterior branch, *equal in breadth to the main stem*, is present on the pectoral muscles. The interspace between them is considerable, and greater than usual; the exterior hook at its apex, which occurs in many Falcons, and leads to the *hypopterum*, is also wanting. The main stem closely approaches the crest of the sternum anteriorly, and diverges behind, so that the inferior space is much broader on the ventral part; the two main stems curve towards the anus, and terminate close to it.

Remiges twenty-three, sometimes twenty-four or twenty-five, rarely only twenty-one; primaries alway ten. The first more or less abbreviated, *the second always the longest;* both, or only the former, with an angular emargination situated very close to the apex. The third sometimes longer, sometimes shorter, than the first.

Rectrices very rigid, usually somewhat longer than the apices of the folded wings; the outer ones with their tips bent inwards, and at this point completely concealed beneath the intermediate ones; hence the tail appears narrow posteriorly.

The species examined differ only in the number and form of the remiges, and I therefore describe these; the latter might be appropriately employed as a specific character.

R. islandicus.—Twenty-five remiges. The first two with an angular emargination; the third longer than the first, but the fourth shorter.

R. peregrinus.—Twenty-three remiges. The first two with an angular emargination, which, however, is imperfect on the second; the third shorter than the first.

R. æsalon.—Twenty-four remiges. The first two with a complete angular emargination, which is also perceptible on the third; the first as long as the fourth, or a little shorter.

R. subbuteo.—Twenty-three remiges. The second the longest; the first but little shorter, longer than the third.

R. tinnunculus.—Twenty-three remiges. First and second with a slight angular emargination; first nearly as long as the fourth.

R. tinnunculoides seu *cenchris.*—Twenty-three remiges. The second the longest; first as long as the third, or a little shorter.

R. rufipes.—Number of remiges uncertain; only the first with an angular emargination, and somewhat shorter than the third.

R. concolor Temm. *Pl. Col.*, 330.—Twenty-three remiges. Primaries very narrow and pointed; the first only with a perceptible angular emargination, and longer than the third; the fourth reaches to the emargination in the first; the twentieth is at the elbow, and is the longest

of the remiges of the arm. Tips of the wings at least as long as the tail, if they do not exceed it.

R. cærulescens.—Twenty-one remiges: the first and second with a slight angular emargination, which extends very far down; first considerably longer than the third. I was particularly struck by the absence of the circlet of feathers at the apex of the oil-gland, which occurred in at least two of the specimens examined by me. I do not venture to decide whether this is the rule.

b. With the dorsal stem of the spinal tract enlarged on all sides, undivided and sparsely feathered (Plate II, fig. 5).

Of this group I am acquainted with two Falcons, which are also very similar in their external appearance, but nevertheless sufficiently distinct.

1. *Falco cachinnans* Linn. *Herpetotheres cachinnans,* Vieill. *Galerie,* I, Pl. 19.—Eyelids with distinct lashes. Plumage of the head uninterrupted, giving origin above to the spinal tract, below to the inferior tract. The former without anything characteristic as far as the scapular portion; but the dorsal portion sparsely feathered to the caudal pit, thence diminished and continued as a narrow band along the caudal vertebræ to the oil-gland. It is consequently formed generally as in *Rhynchodon,* but without the median longitudinal division, and is therefore more sparsely feathered. Lumbar tracts distinctly present, but short and separated from the crural tracts. Inferior tract narrow in all parts; inner branch at the end of the gular portion indistinct; outer branch completely separated from the pectoral stem, somewhat broader than the narrow main stem itself, and far removed from it; the ventral portion of the main stem removed far outwards, running along the margin, and terminating laterally in front of the anus. Remiges imperfect, so that their number is uncertain: the first very much abbreviated, scarcely measuring two thirds of the second; the latter as long as the fifth; the third and fourth very little longer, but the longest of all; the sixth somewhat longer than the first, but much shorter than the fifth; the following ones diminishing still more. The first three with a distinct emargination situated about the middle of the vane, and a corresponding narrowing of the inner half of the vane; this narrowing is also slightly indicated on the fourth. Tail moderately long, somewhat longer than the folded wings, rounded. Tarsi as long as in *F. buteo,* powerful, scaled throughout; toes likewise scaled, but with three scutes above the claws. Beak large, particularly thick and high, curved from the very base, most like that of the Buzzards. Nostrils round, with a central cartilage perceptible at the bottom.[1]

2. *Falco brachypterus* Temm. *Pl. Col.* 116 young, 141 adult.—Notwithstanding a great external similarity to the preceding species, this is not merely superficially distinct from it, but belongs to a totally different group. Pterylographically the cervical and scapular portions of the spinal tract, and the entire inferior tract, agree perfectly with those of the preceding bird; the only thing to be remarked being, that the two stems of the latter are much more approximated to each other, and run along the middle of the belly. But the case is very different with the dorsal part of the spinal tract, inasmuch as this resembles an elongated ellipse (Plate II, fig. 5),

[1] This Falcon is most remarkably distinguished from the Buzzards by the want of the supraciliary bone, in which respect it approaches *Rhynchodon,* although the beak is quite differently formed; the feet are less powerful, and the structure of the wings is different. It holds an intermediate position between the two forms.

only contracted into a band immediately in front of the oil-gland, but even there still broad; and it consists exclusively of scattered feathers, which become stronger posteriorly. To these differences we may add the complete absence of the lumbar tract, and of the large eyelashes on the eyelids. The wings are also very different. The number of remiges was not ascertainable. The first five gradually become longer, although the increase of each feather is less than that of the preceding one; the fifth is the longest; the sixth is somewhat longer than the third; the remainder are very gradually abbreviated. Tail remarkably long, covered by the folded wings only at the base; its feathers broad and rounded. Beak nearly as in the Buzzards, but stouter and more powerful; nostril round; apex of the mandible emarginate, bidentate. Tarsi very long, entirely covered with scales, as are also the toes, except that over each joint, and at the extremity above the claws, there are two plates.

c. With the dorsal stem of the spinal tract narrow, composed of two or three rows of feathers, but strong, either completely separated from the scapular portion, or connected with it only by two rows of single feathers.

α. With sparsely scattered contour-feathers by the sides of the band-like dorsal stem of the spinal tract.

Of this group I am acquainted with two species, namely—

1. *Falco melanops* Temm. *Pl. Col.*, 105.—The cervical portion of the inferior tract has at its extremity a distinct but short branch, and is diminished, behind this, to a single row of feathers. The exterior branch of the pectoral stem is perfectly free, but *much narrower* than the pectoral stem itself; it is dilated at the extremity into a hook, which passes to the *hypopterum*. In the spinal tract I find nothing remarkable as far as the shoulder: the dorsal portion is separated by a perfect gap from the scapular portion; its feathers are pretty stiff, and it has three or four series of sparse contour-feathers beside it. The lumbar tracts are wanting. In the wings are *twenty-three* remiges: the first much abbreviated; the second and third less, but still perceptibly so; the fourth nearly equal to the fifth, which is the longest; the remainder rapidly becoming shorter. The first three have a remarkable emargination in the middle of the inner half of the vane, and exhibit a diminution on this side; hence the second half of the remiges is very acute. Tail moderate, rounded, projecting more than one half beyond the folded wings.[1] The tarsi with broad scutes behind; those of the front smaller and more scale-like. Beak and nostrils quite different from those of *F. cachinnans*, and more like those of the Buzzards; the eyelashes are also wanting, which are possessed by *F. cachinnans*.[2]

2. *Falco anthracinus* Licht., from Mexico.—Pterylosis exactly as in the preceding bird, but all the tracts rather broader and stronger, especially the scapular part of the spinal tract. The dorsal portion with its main stem somewhat shorter, and the sparse contour-feathers surrounding it distributed over the whole back and the loins, but without forming a true tract upon the latter.

[1] In Temminck's figure the wings are represented too short and too blunt, and in my specimen the caudal band is much broader and nearer to the apex: both these characters are perhaps due to difference of age.

[2] Hence it does not appear to be possible to unite this Falcon with the genus *Herpetotheres* Vieill., as Lesson has done, especially as it possesses the supraciliary bone which is wanting in the latter (see note, p. 57). Temminck describes it as an *Astur*, but I regard it rather as a *Buteo*.

Twenty-four or twenty-five remiges in the wings: the first five graduated, the difference between them being nearly equal, or very gradually becoming less; the fifth the longest; the first scarcely so long as the eleventh, or first of the secondaries; all up to the fifth with a diminution of the inner half of the vane, which descends very low down, and is scarcely recognisable on the last of them. Tail moderately long, rounded. Tarsus with scutes both before and behind.[1]

β. No scattered contour-feathers beside the band-like dorsal portion of the spinal tract, but either mere down-feathers, or two very sparse rows of single contour-feathers, one on each side.

The pterylographic differences presented by the numerous species of this group are generally small, and relate merely to the greater or less separation of the external branch of the inferior tract from its main stem, or to the comparative lengths of the remiges; but we may also employ the absence or presence of a lumbar tract, and the occurrence of powder-down-tracts, for characterising a few species in which they occur. I have observed the latter in the Harriers (*Circus*) examined by me, as also in *Falcones plumbeus*, *bidentatus*, *melanopterus*, *lophotes*, and *uncinatus*, and in all in the form of two elliptical fields situated on the sides of the spinal tract, not far from the tail. Externally the narrow lumbar tract runs close to these powder-down-patches; I have found it at least in the Harriers, and in *F. bidentatus*, *plumbeus*, and *lophotes*. I have also met with a very distinct lumbar tract in *Gypogeranus serpentarius*, the Eagles and the Buzzards; it is less distinct and weaker in the Hawks and Honey Buzzards, and in the subgenera allied to them, in which, indeed, it is sometimes wanting. The separation of the external branch of the inferior tract is most complete in the groups *Circus*, *Gypogeranus*, *Milvus*, *Astur*, and *Morphnus;* it is less complete, the interval between it and the main stem being neither so deep nor so broad, in *Aquila*, *Buteo*, *Polyborus*, and *Cymindis;* and I have found it to be quite incomplete, so that only the apical half, or even the last third, appears to be separated, in *F. lophotes*, *plumbeus*, and especially *F. bidentatus*. In all these cases, however, the external branch is very distinctly marked out by the different direction of its rows of strong feathers. As I have already repeatedly remarked, a hook-like branch, which passes into the *hypopterum*, very often originates from its apex, especially in *Circus*, *Gypogeranus*, *Astur*, *Polyborus*, and *Pernis*. Hence the character which must chiefly occupy us is the number and relative size of the remiges.

1. Aquila.

a. With feathered tarsi.

1. *F. fulvus*.—The form of the inferior tract of this bird, which may serve as the type for most of the other Falcons, may be seen at a glance in Plate II, fig. 3. The only peculiarity of the Eagles

[1] Although this bird, which has not yet been figured, or perhaps even described, closely approaches the Buzzards in its structure, it agrees best in the length of the tarsus with *Falco urubitinga* (Temm., *Pl. Col.*, 55). It is entirely blackish-brown, except that the first four remiges are white at the base, and the rest marked with lighter and darker bands. The tail has a median white band. The cere and the feet are yellow. [This species is now usually called *Urubitinga anthracina* (Nitzsch)—the present description of it being the earliest published.—P. L. S.]

is the greater breadth of the exterior branch, which also contains stronger feathers. With regard to the dorsal portion of the spinal tract, it is to be remarked that between it and the fork of the scapular portion some scattered contour-feathers are to be perceived, which are more numerous, and consequently placed closer together, in the Sea Eagles. This arrangement forms, as it were a transition from that occurring in *F. melanops* and *F. anthracinus*, to that of the ordinary Falcons with two divergent rows of feathers. The upper surface of *F. apivorus* is represented in Plate II, fig. 4. There are twenty-seven remiges; the first five with the usual angular emarginations, of which a trace is still visible on the sixth. The first primary perceptibly abbreviated, as long as the eighth; the second somewhat shorter than the sixth; the third nearly equal to the fourth and fifth, but the fourth really a little longer than either of the other two.

2. *F. chrysaëtos* seu *imperialis*.—In all respects like the preceding, except that the first primary is longer than the eighth, and but little shorter than the seventh.

3. *F. nævius*.—The first six remiges with an angular emargination, which is but slight on the sixth; first primary longer than the eighth.

4. *F. ducalis* Licht. (*F. Bonellii* Temm., *Pl. Col.*, 288).—First primary of the same length as the eighth, fourth longest; first five with a strong emargination of the inner half of the vane, placed far down the feather.

5. *F. pennatus* Temm., *Pl. Col.*, 33.—First five primaries with a considerable emargination: first as long as the eighth; second as long as the sixth; third equal to the fifth; fourth but little longer than the latter.

b. With naked tarsi.

In the Eagles of this section the whole plumage is closer; the external branch of the pectoral portion of the inferior tract is *only half free*, and is united at its apex by a hook to the *hypopterum*. The dorsal part of the spinal tract is also longer, and scarcely separated from the scapular portion.

1. *F. leucocephalus* Buffon, *Pl. Enlum.*, 411.—Remiges somewhat imperfect, but the first as long as the seventh, the third equal to the fifth, and the fourth a little longer than the latter.

2. *F. albicilla*.—In all *twenty-seven* remiges: first five with an emargination situated far down, of which a trace is perceptible also on the sixth; first primary as long as the eighth; second longer than the seventh; the fifth the longest, but the third, fourth, and sixth only a little shorter.

3. *F. brachydactylus*.—Likewise with *twenty-seven* remiges: first five with a very strong angular emargination on the inner vane, situated low down on the first, but gradually ascending on the following feathers. First primary scarcely so long as the seventh, second longer than the sixth, and the third (in two of the specimens examined by me) the longest.

4. *F. macei* Temm., *Pl. Col.*, 8 & 223.—*Twenty-seven* remiges: the first five with an emargination situated very low down. First primary scarcely so long as the eighth, second longer than the seventh, third and fifth of equal length, fourth as much longer as the sixth is shorter than the fifth.

2. Buteo.

a. With feathered tarsi.

F. lagopus.—Twenty-four remiges : the first four with an emargination ; the fourth longest. External branch of the pectoral portion of the inferior tract quite free. Lumbar tract very indistinct.

b. With naked tarsi.

1. *F. buteo.—Twenty-five* remiges : first four with an emargination of the inner vane ; first as long as the eighth, second longer than the sixth, third and fourth the longest. Dorsal part of the spinal tract rather far removed from the scapular part. Internal branch of the jugular part of the inferior tract distinct, but short ; its union with the pectoral stem very narrow. Pectoral stem united in front with the humeral tract ; its external branch quite free, with a very distinct hook at the end.

2. *F. baccha* (*Hæmatornis* Gould). Le Vaill., *Ois. d'Afr.*, Pl. 15.—*Twenty-five* remiges ; the first as long as the tenth, the second as long as the seventh, the third equal to the sixth, the fourth and fifth of equal length and the longest ; first five with a slight diminution of the inner vane. Pterylosis exactly as in *F. buteo*. Outer branch of the inferior tract quite free, with a hook at the end. Tarsi and bases of the toes scaled ; only the second half of the toes with scutes. Tarsi long ; toes short. The separation of this bird from the *Buteones* appears to be necessary on account of the shortness of the wings, which reach only to about the base of the tail. It somewhat approaches the *Harpyiæ*.

3. *F. busarellus*, Shaw. *Le Buseray*, Le Vaill., *Ois. d'Afr.*, I, Pl. 20.—*Twenty-five remiges ;* the first five graduated ; but the third, fourth, and fifth differing but little in length, although the fifth is the longest. The narrowing of the inner vane very gradual, forming no emargination. Pterylosis resembling that of *F. buteo ;* but the external branch of the pectoral stem of the inferior tract only half free, as in the Sea-Eagles.

3. Morphnus.

a. With naked tarsi.

F. urubitinga Temm., *Pl. Col.*, 55. Both eyelids with weak eyelashes.—The remiges of the specimen examined were being moulted, but were probably twenty-five in number ; the first very short ; the second, third, and fourth uniformly graduated, the latter the longest, but the fifth only a little shorter, and the sixth as long as the third. The first four with a deeply seated but slight angular emargination. Secondaries long ; the longest of them equal to the second primary. Pterylosis somewhat peculiar, especially on account of the very small breadth of all the tracts. Jugular portion of the inferior tract with a very narrow inner branch, and united to the pectoral

stem by a single row of feathers. Outer branch quite free, but narrow, with a hook of a single row of feathers at its extremity; main stem somewhat dilated near the branch. Lumbar tract perceptible, but weak.

b. With feathered tarsi.

F. tyrannus Temm., *Pl. Col.*, 73.—Both eyelids with weak eylashes. *Twenty-five* remiges: the first five graduated, the differences being uniform and small; the first remarkably short, the fifth the longest, the sixth shorter than the fourth, the seventh longer than the third. Pterylosis as in the preceding species, but with all the tracts rather broader, and both the inner and outer branches of the inferior tract shorter. Dorsal portion of the spinal tract very weak.

4. Cymindis.

The two species of this group examined by me, namely, *F. hamatus* Temm., *Pl. Col.*, 61, and *F. uncinatus* Temm., *Pl. Col.*, 103, 104, and 115, differ but little in their pterylosis from *Buteo;* indeed, only in the fact that the outer branch of the pectoral inferior tract is placed very close to the stem, and is somewhat more connected with it at the base. All the tracts are narrow, but otherwise without anything remarkable about them. The wings, which extend nearly to the end of the tail, consist in *F. hamatus* of *twenty-five*, and in *F. uncinatus* only of *twenty-three* remiges, of which the first is as long as the seventh, the second is nearly equal to the sixth, but still a little shorter—indeed, just as much as the third is shorter than the fifth, and the fourth is the longest. The first has a very strong and deeply seated angular emargination, of which a slight indication appears on the two following primaries. This group is, however, best distinguished from the *Buteones* by the want of the connecting membrane between the toes, and the notching of the sharp inner margin of the middle claw.

5. Polyborus (*Caracara*, Cuv.).

The nearly-naked face and the strongly-developed eyelashes distinguish this group from the preceding, and show its near relationship to the following one, which approaches very closely both to *Polyborus* and to *Morphnus*.

1. *F. aterrimus*, Temm., *Pl. Col.*, 37 and 342.—*Twenty-two* remiges: the first somewhat shorter than the seventh, the second somewhat longer than the sixth, the third having the same proportion to the fifth, the fourth a little longer than either of them; the primaries generally very long, and the remiges of the arm very short; first four primaries with a diminution of the inner vane.

Pterylosis with no peculiarities; all the tracts narrow, but the outer branch of the inferior tract broader and quite free, with a strong hook at the end. Dorsal portion of the spinal tract

short, half sparsely feathered, posteriorly densely feathered. Eyelids with small lashes. Nostril with a central process, as in the Noble Falcons.

2. *F. degener* Illig.—Beak with the nostrils and cheeks exactly as in the preceding species, but the pterylosis somewhat stronger in all parts, and the spinal tract different, having a remarkably short fork, with its limbs broad and strongly divergent. The posterior portion reaches this fork with its most anterior sparse feathers. Remiges of the specimen examined not present in their full number; first four graduated, the first as long as the seventh, the second longer than the sixth; the third and fourth equal in length, and the longest; the fifth but little shorter; the first three with a slight emargination of the inner vane.

3. *F. cheriway* seu *brasiliensis* (Vieill., *Gal.*, I, Pl. 7).—This species is distinguished by the remarkable depth of its beak and the oblique position of its elongated nostrils. The pterylosis also, although closely agreeing with that of *F. degener*, differs in having the dorsal portion of the spinal tract elliptically dilated upon the caudal pit, where it encloses a narrow, lanceolate, insular space—a structure which I have never met with elsewhere among the Falcons. Remiges of the specimen examined imperfect; the first five with a diminution of the inner vane, the third and fourth the longest.

6. Gypogeranus.

The remarkable bird known as the Secretary (*F. serpentarius* Gmel.), which constitutes the sole representative of this group, appears to me, from its general structure, to approach most closely to the subgenera *Morphnus* and *Polyborus*, and to be essentially only an exaggerated form of the long-legged type which is proper to most of the members of these groups. Moreover, the entirely shielded tarsus is by no means a character peculiar to it, as it is already indicated in *F. anthracinus* Licht., which, except as regards the differences in the pterylosis, is very nearly allied to *F. urubitinga*. *Gypogeranus* is, however, pterylographically peculiar in many respects, especially in the connection of the two gular stems of the inferior tract as far as the point where the inner branch issues from them. This is present, but very narrow. The outer branch, on the contrary, is much broader, perhaps twice as broad as the main stem; it is, at the same time, quite free, and far removed from the stem. The latter descends very close to the crest of the sternum, and only turns a little more outward upon the ventral region, where it terminates at a considerable distance from the anus. The cervical portion of the spinal tract, in which the two rows of large nape-feathers are situated, is broad and densely feathered; its branches between the shoulders are short, but broad. The dorsal portion commences at the fork, with two parallel rows of single feathers, and proceeds in the same form to the caudal pit, where it becomes broader, but is imperfectly defined and sparsely feathered at the sides. The lumbar tracts are present, and biserial, but not long. In the wings I counted twenty-eight remarkably acute remiges, of which the first is equal to the seventh and the second to the sixth; the third, fourth, and fifth are the longest, and nearly equal; the fourth slightly exceeding the other two. The first five show a diminution of the inner vane, which extends very far downwards; in repose they reach about to the middle of the tail. The rectrices are graduated and acute, with the two middle ones obtuse, and suddenly becoming much longer. The naked lores, cheeks, and eyelids are certainly not

peculiar to this group, but are not so perfectly marked in any other. The large and very strong eyelashes, of which I have counted thirty in the upper and half that number in the lower eyelid, appear to stand in relation to this, for I find them always much developed in naked-cheeked Falcons, and, on the contrary, small in those in which these parts are feathered. Beak without any denticulation or angle on the margin of the upper mandible, exactly as in *Morphnus*, *Polyborus* and *Buteo*, and also of the same comparative size; much more powerful than in *Pernis*, *Astur*, *Milvus*, and *Circus*, in which genera a more or less perceptible angular emargination of the margin of the upper mandible usually occurs.

7. Pernis.

F. apivorus (Plate II, fig. 4).—Lores and region of the eyes densely feathered, even to the eyelids, which are quite destitute of lashes. The pterylosis exactly as in *Buteo;* the outer branch of the pectoral tract quite free, with a notable terminal hook; the inner branch at the end of the gular portion more distinct and longer. Dorsal portion of the spinal tract with two divergent rows of feathers, which reach to the scapular fork; elsewhere narrow. Remiges *twenty-four*, sometimes one less; the first scarcely so long as the seventh, the second longer than the sixth, the third but little shorter than the fourth, which is the longest; only the first three exhibit a diminution of the inner vane, commencing low down towards the base.

8. Astur.

Of this group I have examined *F. palumbarius*, *F. nisus*, *F. gabar* (Temm. *Pl. Col.*, 122), and *F. nitidus* Lath. (*F. striolatus* Temm., *Pl. Col.*, 87). In the pterylosis I found everything as in *Pernis*, except that the outer branch of the pectoral stem appears to be somewhat shorter, but at the same time more closely approximated at the base to the equally broad stem: on the other hand, the terminal hook and the inner branch are equally distinct. The lumbar tracts are either entirely wanting, or consist, as in *Pernis*, only of a single row of a few feathers. The wings reach to the commencement of the tail, and contain from twenty-three to twenty-six remiges; the first is often scarcely equal to the tenth, the second to the seventh or eighth, the third to the sixth, and the fourth to the fifth: the fourth is, however, usually a little longer, and is then the longest of all. The first five or six present a gradually decreasing narrowing of the inner half of the vane.

9. Milvus.

Pterylosis not peculiar; inner branch on the jugular part distinct, but short; outer branch entirely free, with a perceptible terminal hook. Dorsal portion of the spinal tract usually long. Remiges remarkably long, very acute, the third and fourth the longest, the first as long as the seventh or eighth; from three to five of the first with a strong, deeply-seated angular emargination, followed by a diminution of the inner half of the vane.

a. Tail forked.

Of this group I have examined *F. milvus*, *F. ater*, and *F. furcatus*. The type of the group is perfectly represented in them all; they also possess lumbar tracts, although these are narrow. In *F. milvus* and *F. ater* the fourth, and in *F. furcatus* the third, primary is the longest.

b. Tail truncated.

To this position I refer *F. pondicerianus*, which agrees perfectly with *F. milvus* in the rest of its organization, and differs from it even in its pterylosis only in the absence of the lumbar tracts. *F. plumbeus* (*Ictinia* Vieill. Temm., *Pl. Col.*, 180 young), cannot be so decidedly placed here; yet it differs pterylographically only in having the outer branch of the inferior tract more closely approximated to the main stem. Its wings are exactly as in *F. milvus;* the fourth primary is but little longer than the third, which, like the two preceding ones, has a slight emargination. In all, there are *twenty-three* remiges, and the lumbar tract is present. The tooth in the beak, which characterises this species, is also indicated in *F. pondicerianus* and the True Kites.

10. Elanus.

Judging from an examination of *F. melanopterus* (Temm., *Pl. Col.*, 85 adult, 319 young), the pterylosis fully justifies the separation of this group from the preceding.

The gular portion of the inferior tract is very narrow, and its inner branch remarkably long. The outer branch of the pectoral stem is connected for three fourths of its length with the main stem, and then separates very perceptibly from it. The dorsal portion of the spinal tract does not reach the fork of the scapular portion, but two rows of single feathers, which run parallel to it, attain the fork. Immediately on the outside of these rows of feathers the two large, elliptical powder-down-tracts, which are pointed behind, commence; these reach to the lumbar tracts, which consist of only one row of small feathers. The wings contain *twenty-five* remiges, of which only the first has a true angular emargination, and is a little shorter than the second, which is the longest. The well-known, remarkably soft, silky nature of the plumage conduces not a little to the pterylographic difference between this group and the preceding one.

11.

I regard as the representative of a distinct group the remarkable *F. lophotes* (Temm., *Pl. Col.*, 10), referred by Cuvier to the True Falcons, with which it has certainly nothing to do[1]. Pterylographically, it closely approaches the preceding Falcons, especially in the outer branch of the inferior tract being separated only at the extremity, and in the similarly situated distinct powder-down-tracts. But the wings are short, and contain *twenty-four* remiges, of which the first are

[1] This genus is now usually termed *Baza*, having been so named by Hodgson in 1836.—P. L. S.

graduated. Their proportions cannot be accurately stated, as they were in moult in the specimen examined, but the third is probably the longest. This and the two preceding have a deeply seated, imperfect emargination.

12. Diplodon.

Under this name I separate as a distinct group two species referred by Cuvier and Temminck to the True Falcons ;[1] they no more belong to the True Falcons than does the preceding. Unfortunately, I have been able to examine carefully only one species, *F. bidentatus* Lath. (Temm., *Pl. Col.*, 38) ; and I refer the second, *F. diodon* Temm., *Pl. Col.*, 198, to this position solely from its external similarity. Pterylographically, however, *F. bidentatus* agrees perfectly with *F. lophotes*, but the outer branch of the inferior tract is still further united to the stem than in that species. The dorsal portion of the spinal tract remains far from the scapular part, and has no rows of feathers beside it. The powder-down-tracts extend forwards in the shape of narrow bands to the shoulders. Of remiges I counted *twenty-three ;* the first was as long as the ninth ; the second and third were in process of growth ; the fourth considerably longer than the fifth, so that it or the third is the longest. The emargination of the first primary is so slight that it may almost be said not to exist.

13. Circus.

The species of this group examined by me, namely, *F. pygargus*, *F. æruginosus*, and *F. cinerarius*, agree in all the characters of their pterylosis with *Milvus*, *Pernis*, and *Astur*, especially in the narrow form of the tracts, the condition of the dorsal portion of the spinal tract, the smallness of the lumbar tract, and the shortness of the inner branch of the inferior tract ; and differ from them chiefly in the oblique position of the outer branch of the inferior tract, which does not run parallel to the main stem, and is therefore rather more connected with it anteriorly than in the above-mentioned Falcons. This difference is increased by a distinct oval space in front of the ear and beneath the eye, which I met with at least in *F. pygargus ;* but the Harriers may be with most certainty distinguished as a form differing at least from all other European Falcons by the powder-down-tracts which ascend on each side of the dorsal portion of the spinal tract as far as the shoulders. In the acute and narrow wings I found twenty-four and twenty-five remiges, of which the first is equal to the sixth or seventh, the second not quite equal to the fifth, and the third is either of the same length as the fourth or does not quite equal it. The four last mentioned have a very imperfect angular emargination, and a corresponding diminution of the inner vane.

In conclusion, I may notice the nest-plumage of the Diurnal Rapacious Birds, which I have carefully investigated, especially in *Falco æruginosus* and *F. palumbarius*. It consists, as usual (see p. 14), of downy barbs, which are attached to the first perfect barbs of *all the contour-feathers*, even the remiges and rectrices, and disappear as the bird becomes fledged. More-

[1] The group had been previously named *Harpagus* by Vigors in 1824.—P. L. S.

over, the whole body, with the exception of the axillary cavity and the lateral neck-spaces, is covered with true permanent down-feathers, which bear no evanescent tips. In these birds I found no setiform tips on these nest-down-feathers, such as occur elsewhere, for example, in the Cursorial Birds (see below, Chapter VI).

II. Nocturnal Rapacious Birds (*Accipitrinæ nocturnæ*).

There are two points which essentially distinguish this group pterylographically from the preceding, namely, the *constant absence of the aftershaft* and the *want of the circlet of feathers at the apex of the oil-gland.* Besides this we may indicate, as a general character of the Owls, the remarkable size of all the contour-feathers, and the consequent narrowness of the tracts. In many places, especially on the two gular portions of the inferior tract, these consist only of two rows of feathers, but usually, as on the dorsal part of the spinal tract, of three rows, the feathers of which are placed alternately, so that every two feathers of the outer rows form a quincunx with one of the middle ones. A larger number of rows usually occurs only on the cervical band and the pectoral bands, in which there are generally *five*. Between these feathers of the tracts the down-feathers are probably entirely wanting; at least I always miss them when I particularly look for them. In their form the tracts agree in general with those of the Falcons, although they present noticeable differences. Among these the chief is that in the Owls the region of the throat between the rami of the lower mandible is never continuously feathered (see Plate II, figs. 8 and 11), but the inferior tract issues from the angle of the gonys, in the form of a narrow band, and divides on the middle of the neck, or close to the front of the furcula, but never emits an *inner branch.* The truncal stems of the inferior tract, as in *Circus*, are placed very close to the crest of the sternum, then bent, separating more from each other towards the ventral surface, and only meeting at the anus. The spinal tract also, although arranged in accordance with the principal type of the Falcons, presents this difference—the two arms of the dorsal portion which run to the fork of the scapular portion consist, probably always, of *two* rows of feathers.

The differences of the species among themselves are shown in the following arrangement:

I. *Owls with the outer branch of the inferior tract free posteriorly.*

This form of the inferior tract, which is shown in Plate II, fig. 8, agrees perfectly with the principal type of the Falcons; even the hook springing from the extremity of the outer branch, and running to the *hypopterum*, is usually present. The species belonging to this section are again divisible into two groups, according to the arrangement of the scapular portion of the spinal tract.

A. *With the scapular portion of the spinal tract forming a deeply divided fork.*

In this case the furcation reaches to the end of the neck, the true nape, and is always connected by two slightly divergent, biserial bands of contour-feathers with the dorsal portion, which is simple from the caudal pit. The dorsal portion is not merely continued to the oil-gland, but surrounds this with its feathers.

a. With ear-tufts.

1. Bubo, *Cuvier.*

α. Tarsi and toes feathered.

1. *Strix bubo.*—The tracts, which are represented in Plate II, figs. 8 and 9, have all the characters of this group completely developed, and may, therefore, very well be regarded as primary representations of the true Owl-structure. A true lumbar tract is wanting; on the other hand, two rows of stronger contour-feathers are observed, forming a sort of breeches on the upper part of the shank. The wings have *twenty-nine* remiges, the last two small; the first three with an angular emargination of the inner vane, the first extending far down, the second only at the apex, with the margin of the outer vane toothed; the first somewhat shorter than the fifth; the third the longest, but very little longer than the second and fourth.

2. *Str. mexicana.*—Tracts exactly as in *Str. bubo;* twenty-five (?) remiges, the first three with the inner vane emarginate close to the apex; the first as long as the fifth, or even a little longer; the second longest; the third but little, and the fourth considerably shorter.

3. *Str. virginiana,* Wils., *Amer. Orn.,* ii, 257, *pl.* 30, *fig.* 1.—Tracts exactly as in *Str. bubo; twenty-seven* remiges, the first three with the inner vane emarginate near the apex; the first as long as the fifth; the third the longest, but little longer than the second and fourth.

4. *Str. lactea,* Temm., *Pl. Col.,* 4.—Exactly as in *Str. bubo.*

β. Tarsi and toes naked, covered with a uniformly warty skin, in which two or three half rings are formed only immediately above the claws. The plumage leaves the heels free behind, but in front runs down upon the tarsi a little way in the form of a pointed band.

5. *Str. ceylanensis* Lath. (*Str. ketupa* Temm., *Pl. Col.,* 74).—All as in *Str. bubo,* only the main stem of the inferior tract was completely rubbed off on the breast, undoubtedly because the skin had belonged to a female which was engaged in incubation, for the contour-feathers of this part are lost during the breeding season, as I have observed in our indigenous species, especially *Str. aluco* and *Str. flammea. Twenty-four* remiges, the first three with a slight, deeply seated emargination; the first equal to the ninth; the fifth the longest, but little longer than the fourth and sixth; second and third considerably abbreviated.

6. *Str. leschenaultii* Temm., *Pl. Col.,* 20.—*Twenty-four* remiges; the first four with a considerable emargination, which is especially noticeable on the first and second; first a little longer than the eighth; second equal to the fifth; third and fourth of equal length, but little longer than their neighbours.

2. Otus, *Cuvier.*

Pterylosis nearly as in *Bubo,* but the larger contour-feathers of the shank are placed higher, about the knee, and are continued upon the thigh, where they form a tolerably strong femoral

tract. Two biserial bands of delicate contour-feathers are also observable at the sides of the dorsal portion of the spinal tract, parallel to but at a considerable distance from it, running down from the scapula to the hip-joint. The fork of the scapular portion of the spinal tract sparser, and the limbs of the dorsal portion shorter than in *Bubo;* the simple main stem is consequently longer.

1. *Str. otus.*—*Twenty-four* remiges; the second and third the longest, both with a slightly noticeable emargination of the inner vane near the apex.

2. *Str. brachyotus.*—*Twenty-four* remiges; the second the longest; the first somewhat shorter than the third, with an emargination near the end of the inner vane.

3. Scops, *Cuvier.*

In the pterylosis I can find no difference from *Bubo,* except that the tracts, and especially the dorsal portion of the spinal tract, are softer.

1. *Str. asio* Temm., *Pl. Col.*, 80.—*Twenty-two* remiges, the first four with a slight, deeply seated emargination of the inner vane, and graduated; the fourth the longest; the third equal to the sixth, the second to the seventh, the first scarcely equal to the ninth.

2. *Str. scops.*—*Twenty-three* remiges, the first three with a strong angular emargination of the inner half of the vane near the apex; the first as long as the fifth; the second and third nearly of equal length, but the third the longest. No ear-valve. Toes naked.

b. Without ear-tufts.

1. *Str. aluco.*—Pterylosis exactly as in *Bubo,* except that the dorsal portion of the spinal tract appears at first to be separated from the scapular portion, and the convergent rows of feathers which unite them appear to be wanting. Lumbar tracts present and of considerable size. *Twenty-three* remiges; first five with an emargination; the fourth and fifth the longest. I have already mentioned that in incubating females the contour feathers of the main stem of the inferior tract are deficient, and thus brood-spots are produced; the outer branch is not in the least implicated in this.

2. *Str. uralensis* Temm., *Pl. Col.*, 27.—I could neither examine the pterylosis nor exactly determine the number of remiges in the specimens observed; I shall therefore only mention that the first primary is equal to the tenth, and that the fourth and fifth are the longest. The first three or four have an emargination.

3. *Str. lapponica.*—Of this species, which is very nearly allied to the two preceding, and has exactly the appearance of a young bird, I have only been able to examine stuffed specimens at Paris and Berlin. The number of remiges was not accurately determinable; the first was only as long as the tenth; the second was equal to the seventh, the third to the sixth, and the fourth and fifth were the longest; the first four had a right-angled emargination of the inner vane, situated very near to the apex.

4. *Str. nyctea.*—Pterylosis exactly as in *S. aluco;* the spinal tract interrupted behind the fork, but the interval shorter. *Twenty-nine* remiges; the first nearly as long as the fifth, and

the second as the fourth; the third not much longer, but the longest. The twenty-sixth is placed at the elbow. The pollex has no nail.

B. *With the scapular portion of the spinal tract briefly cleft.*

The division of this part is, indeed, usually perceptible, but is constantly shorter than half the distance of the extremities of the fork from the end of the neck. Frequently there is some trouble in detecting any furcation at all. The dorsal portion is always united with the fork by two convergent rows of *single* feathers. In the other characters the pterylosis differs in no respect from that described for *S. bubo* and *S. aluco;* even the lumbar tract is present.

a. With a tolerably distinct fork.

1. *Str. nisoria.—Twenty-four* remiges; the first as long as the sixth; the second intermediate between the fourth and fifth; the third somewhat longer than the fourth; the first three with an emargination situated near the apex.

2. *Str. cunicularia* Temm., *Pl. Col.*, 146.—In all respects like the preceding species, except that the first primary is equal to the fifth, and is the only one that has an emargination.

3. *Str. pygmæa* Bechst.—Exactly like the two preceding species. The remiges, like the whole plumage, were in course of moulting in the specimen examined; their proportions were consequently not determinable.

b. With a scarcely perceptible fork.

4. *Str. passerina* Bechst.—*Twenty-four* or *twenty-five* remiges; the first as long as the fifth or sixth; the third and fourth the longest, especially the latter; the first four with a distinct emargination, and the second to the fourth with a corresponding diminution of the outer vane.

5. *Str. dasypus* Bechst.—Pterylosis remarkably delicate; that is to say, the tracts are very narrow in all parts. Scapular portion almost undivided. *Twenty-three* remiges; the first two with a strong emargination near the apex; the first equal to the eighth, the second to the fifth, and the third the longest.

6. *Str. pumila* Temm., *Pl. Col.*, 39.—Tracts exactly as in the preceding species. *Twenty-five* remiges; the first two with a slight, deeply seated emargination; the first shortest of all the primaries; the second equal to the seventh, the third to the fifth, and the fourth very little longer than either of the latter.

II. *Owls in which the outer branch of the inferior tract returns into the stem posteriorly.*

The Disk-owls (*Str. flammea* Linn., *Str. perlata* Licht., *Str. furcata* Temm., and *Str. badia* Temm.) belonging to this group are in every respect so peculiarly organized and so different from the other Owls that I must attribute to them the rank of a distinct genus, for which I

propose the name of *Hybris*. We shall dwell here, however, solely upon the pterylographic differences. These are chiefly limited to the peculiar form of the outer branch of the inferior tract, described above and clearly shown in Plate II, fig. 11; this agrees precisely with that of *Cathartes*, only differing in that in *Hybris* the contour-feathers are more numerous and stand closer together. Here also I have had occasion to remark the formation of brood-spots by the disappearance of the contour-feathers on that part of the main stem which lies opposite to the outer branch. In the males which I examined at the same season of the year I did not find the brood-spots. Twenty-four remiges, none of them with an emargination; the first three nearly of equal length, but the second really the longest. Oil-gland briefly cordate, very broad in front, with a large, deeply penetrating cavity, and two minute feathers at the apex over the orifices, which cannot be accidental, as I found them constantly.

The facial *disk*, from which this genus receives its name, and which is most perfect in them, consists in all the Owls of several rows of small, but strong and very much curved contour-feathers, which originate anteriorly above the eyes at the base of the beak, are continued on the sides of the forehead and vertex, descend in a curve behind the orifice of the ear, and continue beneath this and the eye on the margin of the lower jaw until they meet again in a curve on the throat in front, between the rami of the lower jaw. The whole region of the skin in which these feathers stand is elevated in the form of a fold, especially at the spot behind the orifice of the ear, and in this fold are inserted the very stiff tubes of the feathers described. Usually, these small feathers are not seen at all, because the long, sparsely barbed, and partly setiform feathers of the lores, the region of the eyes, and the chaps lie over them, and it is then these that form the true disk, that is to say, the circle of feathers around the eye. In the region between the eye and the ear these feathers are very numerous, and stand upon a second high fold of skin which here rises suddenly from the integuments of the head; this lies over the great orifice of the ear and closes it (see Plate II, where in fig. 11 the fold is represented turned back). As the disk increases in size, so does this fold, which may be appropriately named the *ear-operculum*; it is, therefore, exceptionally large in *Str. flammea*, but also tolerably strong in *Str. otus* and *brachyotus*, and in *Str. aluco*, *uralensis*, and *lapponica*. I found it to be small, indeed almost wanting, in *Str. nyctea*, *Str. nisoria*, and the Little Owls. With this is connected the slight development of the disk. The disk-feathers of *Str. otus* are particularly remarkable; they consist of a large tube, perfectly open above, upon which a very small, sparsely barbed shaft is seated. By this structure they furnish a very definite proof in favour of the interpretation of the shaft, as a one-sided prolongation of the outermost, most divergent point of the upper edge of the tube. In proportion as the disk becomes less perfect the fold of skin upon which the small, strong contour-feathers are seated also becomes weaker, and those parts of the fold which are situated upon the face in front of the eye are then probably always wanting. In such cases two separate small folds of skin occur at the ear—an anterior one forming the operculum, and a posterior one which may be compared to the conch of the ear.

CHAPTER II.

Singing-birds (*Passerinæ*).

The pterylographic variation in this large group, which includes two fifths of all the known birds, is less than in either the preceding or the following groups, so that this portion of their organization confirms the observation deduced by me from all the characters of the Singing-birds, that, when taken in their correct and most natural limits, they form the most constant and uniform group to be found among birds, and that we must, therefore, proceed most cautiously in employing the few differences which they present for the purpose of grouping the species in natural genera, subgenera, and families.[1] The following pterylographic characters are general and deserving of notice.

The contour-feathers usually have a very weak and downy aftershaft,[2] but they have no down-feathers among them, except in one genus (*Cinclus*). Down-feathers are also in most cases entirely deficient on the spaces, or they are very much scattered upon them. The number of contour-feathers is very small, although, perhaps, not the least that occurs among birds. They form, without exception, limited narrow tracts, and leave the greater part of the trunk uncovered. The number of these tracts is as usual, but the proportions of the spinal and inferior tracts are alone characteristic. The head is usually clothed with an uninterrupted plumage, in which, however, there is immediately behind the eye a small, naked, roundish spot, concealed by the contour-feathers, to which I give the name of the *temporal space* (see *anteà*, p. 36, and Plate III). This space is, however, often wanting—for example, in *Tanagra*, *Pardalotus*, and others. Two main tracts issue from the head—one on the nape, as the commencement of the spinal tract; the other from the densely feathered throat, as the commencement of the inferior tract. The *spinal tract* always forms a linear or band-like stripe, is never interrupted between the shoulders, and is dilated only upon the back behind the scapulæ into a rhomboidal or elliptical saddle, which, in many cases, incloses an oval or fissure-like space, the *ephippial space* (*apterium sellæ*). Behind the saddle the *rump-band* commences, frequently, when a space is present, with two convergent single or double rows of contour-feathers (see Plate III, fig. 15), but becoming again a simple, although rather broader stem at the caudal pit and ceasing at the oil-gland. The two rows of feathers behind the saddle appear to be very rarely wanting, as, for example, in *Hirundo* (Plate III, fig. 14). The *inferior tract* is divided before the middle of the neck into two symmetrical halves, each of which is continued along the middle of the breast, and terminates in front of the anus. The two halves are widely separated from each other; they emit no true lateral branch upon the breast, but are much dilated throughout this entire region; and it is only at the end of this dilated

[1] Upon the general organization of this group see the article "Passerinæ," in 'Ersch und Gruber's Encyklopädie,' iii sect., Bd. xiii, p. 139, which was worked up from an Essay by Nitzsch.—B.

[2] I have not always been able to detect it, and must therefore suppose that it is sometimes wanting, *e. g.* in *Ocypterus* and *Eurylaimus*.

portion that the outer angle is somewhat separated from the main stem. In a few genera, *e. g.*, *Menura* (Plate III, fig. 11), and *Grallina*, this separation reaches to the middle of the wider portion, and in these cases we may regard it as a *half-free lateral branch;* usually the apex alone is separated (Plate III, fig. 9), but in many cases even this does not occur (Plate III, figs. 7 and 13). Lastly, the ventral portion never reaches the anus, or the caudal tract behind it. These characters of the two tracts occur, besides the *Passerinæ*, only in *Trogon* and *Pogonias*, in which, however, other peculiarities of the pterylosis make their appearance and justify their separation from the *Passerinæ*. The *humeral tracts* of the *Passerinæ* are small, or at least narrow; they lie far downwards, transversely across the humerus, are separated from the plumage of the wing by a very large upper wing-space, and are almost always immediately, although slightly, connected in front with the gular portion of the inferior tract. The *lumbar tracts* are also small, and neither unite with the caudal tract, nor reach the knee; but apparently are never entirely wanting. The *hypopterum* (or *pectoral arm-wing*, as it might be called) is entirely deficient, and its region, like the inferior wing-space, is concealed by the feathers which are inserted upon the margin of the great wing-membrane. At the utmost, some semiplumes are found in its place. The *parapterum*, or the plumage on the hinder margin of the upper arm (*upper arm-wing*), consists only of a few short feathers (Plate III, figs. 2, 8, 9, and 10). The number of remiges is most commonly *eighteen* or *nineteen* among the Passerinæ. When the former number is present, there are only *nine* on the hand; and the first primary, which is always somewhat reduced in size, is in this case entirely deficient. This arrangement occurs in *Procnias*, *Tanagra*, *Pardalotus*, *Euphone*, *Fringilla*, *Loxia*, *Emberiza*, *Anthus*, *Motacilla*, and some other genera. If, on the contrary, there are nineteen or more remiges, *ten* of them are always inserted on the hand, as in the other genera. Both cases, however, sometimes occur in the same genus, as in *Alauda*. I have rarely found more than nineteen remiges; for example, *twenty* in *Coracina* and *Chasmarhynchus*. I have only once met with a still larger number, namely, twenty-three, or even twenty-four, in *Ptilorhynchus holosericeus* (Temm., *Pl. Col.* 395 and 396). This variation must, however, be regarded as very small in so large a group, especially when we consider how much greater it is in other families, as, for example, the Rapacious Birds. The rectrices are almost invariably *twelve;* the male of *Menura superba* has *sixteen;* and *Phrenotrix* and *Edolius* sometimes, and perhaps always, have only *ten*. Finally, the oil-gland is widened, and furnished with a very short, narrow, distinct, nearly cylindrical tip, which is rounded off at the extremity, and is destitute of the circlet of feathers round the orifices; indeed, this gland is quite naked throughout the *Passerinæ*, except in the genus *Cinclus*, in which it bears small down-feathers upon its surface. No other birds have this organ of precisely the same structure: in most of them it is furnished with a circlet of feathers at the apex, or, where this is wanting, the tip is gradually united to the body of the gland, so that the latter exhibits a conical form.

The covering of the feet, which are almost invariably[1] naked from the heel downwards, also presents much that is characteristic, although it by no means furnishes so constant and characteristic a peculiarity for this group as has recently been asserted.[2] On the front of the tarsus and the upper surface of the toes it always consists of horny half-rings. The number of these on the tarsus varies from two to nine, but is more constant on the toes, inasmuch as here a small half-

[1] Only a few of the Swallows have feathered feet.

[2] In Wiegmann's 'Archiv,' 1839, i, p. 332.

ring is situated upon each joint, and between these one or two larger ones. On the posterior surface a soft warty skin is always observed at the upper part on the heel, and at the lower part near the toes; but between these two points there are usually scutes. Most commonly there are two long, narrow, linear plates, placed upon the hinder surface of the tarsus in such a manner that they meet at an acute angle, and are covered in front by the margins of the anterior scutes. Superiorly they are in contact with the heel joint; below they do not quite reach to the hinder toe, and here one or two smaller scutes are frequently superadded to them. This structure may be regarded as that of the true Passerine type, as it occurs in most of the genera, probably always in *Corvus*, *Glaucopis*, *Paradisea*, *Epimachus*, *Bombycilla*, *Tanagra*, *Euphone*, *Fringilla*, *Loxia*, *Emberiza*, *Ploceus*, *Cassicus*, *Icterus*, *Sturnus*, *Pastor*, *Buphaga*, *Oriolus*, *Lanius*, *Thamnophilus*, *Bethylus*, *Ceblepyris*, *Muscicapa*, *Edolius*, *Lamprotornis*, *Turdus*, *Ixos*, *Accentor*, *Malurus*, *Grallina*, *Motacilla*, *Anthus*, *Saxicola*, *Sylvia*, *Regulus*, *Parus*, *Troglodytes*, *Cinclus*, *Pitta*, *Myiothera*, *Anabates*, *Sitta*, *Dendrocolaptes*, *Certhia*, *Philedon*, *Nectarinia*, *Cœreba*, and *Hirundo*. Nevertheless, a considerable number of genera do not possess this structure. In the first place, when this foot becomes thicker and plumper, as in *Promerops* Cuv., *Gracula* (*Eulabes* Cuv.), and many species of *Sturnus* and *Lanius*, the posterior sharp edge in which the two hinder plates usually meet disappears, and there is found in this place a series of exactly the same elliptical scales or warts which occur above and below at the heel and the point of articulation of the toes. Still more remarkable than this is the structure of *Alauda*, *Pteroptochus*, and *Menura*, in which two rows of scutes make their appearance instead of the two long plates. Of these the inner row, especially below, consists of very narrow elliptical scutes. In a third modification this inner row of scutes entirely disappears, and the outer one leaves only a trace of its existence, in the form of six or seven large oval scales, whilst the whole of the remainder of the posterior surface is covered with small, elliptical, umbilicate scales. I find this structure in *Psaris* (*Lan. cayanus*, *validus*), *Muscicapa plumbea*, *animosa*, and *ferox*, and some others. A fourth and last modification is shown in the complete absence of all large scales among the small, elliptical, umbilicate ones which cover the whole hinder part of the tarse. This structure is the predominant type among the *Ampelidæ*, especially in *Coracina*, *Cephalopterus*, *Gymnocephalus*, *Chasmarhynchus*, *Ampelis*, *Eurylaimus*, *Calyptomene*, *Rupicola*, and *Phibalura*. *Eurylaimus corydon*, however, presents an exception, as this species, on account of its very thick tarsi, possesses a series of parallelogrammatic scutes between the scales, exactly upon the hinder edge, which are wanting in the other species. The genera above mentioned are in general distinguished by thick tarsi, and therefore the posterior scaly clothing is very broad. When the tarsus becomes more slender the scaly covering becomes narrower, and then consists only of two or three rows. I find it in this form in *Philedon auricularis* and *Synallaxis setaria*. The latter is the only species of its genus that I have been able to examine.[1]

Finally, I have to remark, with regard to the nest-plumage of the Passerinæ, that, as is well known, it does not consist of down-feathers, but of long, hair-like structures, which are seated upon the apices of the uppermost barbs of the very young contour-feathers. They appear as a very light, yellowish, hairy or bristly clothing, first of all on the two sides of the head, on the humeral tracts, and on the saddle of the spinal tract, and make their appearance somewhat later

[1] This description of the tarsus of the Passerine birds is founded upon my own investigations on the specimens in the collection of the University of Halle.—B.

on the other parts of the spinal tract, the lumbar tracts, the apices of the arm-remiges, and perhaps also those of the rectrices: I have, however, been unable to find them anywhere on the inferior tract of very young nestlings.

On examining the pterylographic differences, to the description of which I now pass, it will be soon seen that they cannot here, any more than among the Rapacious Birds, be used in the formation of a natural classification, as the most nearly allied genera vary in the form of the saddle and of the pectoral tract, the only parts of the pterylosis which furnish differential characters, although this is not frequently the case in the species of the same genus. Here, therefore, I follow that arrangement of the genera which I regard as the most natural, and describe under each those peculiarities and variations which appear to me to be deserving of notice.

1. Corvinæ.

All the members of this family examined by me have the saddle of the spinal tract broad and laterally acute-angled, enclosing an elongated, fissure-like space. I find nineteen, and in rare instances twenty remiges, of which ten are on the hand; of these the first three are abbreviated, and the fourth and fifth usually the longest. In *Corvus fuliginosus* and *C. azureus*, however, which possess twenty remiges, the fifth and sixth, and probably also the seventh, are longer than any of the rest, and the first four are graduated. Moreover, the dilatation of the pectoral band is separated from the main stem for a considerable distance at the end, and the space is removed somewhat nearer to the posterior shorter part of the saddle, but enclosed only by the biserial arms of the rump-tract, which is at first four, subsequently five, and at last six feathers in breadth. The rectrices are usually of equal length, but are graduated in *Corvi pica, vagabundus, fuliginosus*, and *azureus*.

I find precisely the same structure of the tracts as in *Corvus* in *Glaucopis leucoptera* and *G. cinerea*, which agree most closely in the form of the wings with *C. fuliginosus*.

In *Glaucopis varians* Temm. (*Phrenotrix temia* Horsf.) I have not only found *eighteen* remiges, of which only *nine* are on the hand, and the fifth and sixth the longest, but, what is much more remarkable, only *ten* very much graduated rectrices, of which the two middle ones are dilated at the apex. The most careful examination showed no gaps in the tail. Moreover, the different feathering of the nasal grooves not only indicates that this species should be separated from *Glaucopis*, but even that it should be united with the following group.

2. Paradisidæ.

A. *Without an ephippial space.*

1. *Paradisea apoda* (Pl. III, fig. 13).—Saddle widely rhombic, acute-angled; inferior tract with no separation of the dilated portion, but remarkable in the male from the approximated large shafts of the ornamental feathers, which are rooted only in this part of the inferior tract, but are surrounded by no softer feathers. Twenty remiges, ten on the hand; the first five graduated, the sixth the longest.

2. *Epimachus.*—This genus, which is usually placed in the neighbourhood of *Upupa*, is undoubtedly a member of the Passerine group, and stands in the same relation to *Paradisea* as *Corvus graculus* to the true Ravens and Crows. The two species examined by me, *E. superbus* and *E. regius*, differ somewhat in their pterylosis: the former approaches *Paradisea* more closely in so far that the dilatation of the pectoral tract is not separated at the end; but the dorsal tract has a very narrow, scarcely perceptible saddle. In *E. regius* the dilatation of the pectoral tract is very distinctly separated at the end, and the saddle is perfectly cordate and bilobate behind. Between the two lobes, in the emargination, the rump-band originates with two rows of feathers, which separate a little, and increase on the caudal pit to three, and further on to four rows. Both species have twenty remiges, of which ten are on the hand; the first graduated; the third to the fifth the longest in *E. regius*, remarkably broad and emarginate at the apex in the male.

3. *Gracula religiosa* (*Eulabes* Cuv.).—Saddle as in *Paradisea;* dilatation of the pectoral tract separated at the end. Nineteen remiges, the fourth the longest.

4. *Kitta thalassina* (Plate III, fig. 6).—Saddle rhombic, obtuse-angled, emitting, by the side of the rump-band, two rows of single contour-feathers. Remiges incomplete in the specimen examined.

B. *With a large ephippial space.*

5. *Ptilorhynchus holosericeus* Temm., *Pl. Col.*, 395.—All the tracts narrow; the dilatation of the pectoral tract separated at the end. Saddle rhombic, elongated, with an equally elongated, lanceolate space. Twenty-three, or even twenty-four, remiges; the fifth and sixth the longest.

3. Ampelidæ.

a. With a large central space in the saddle of the spinal tract.

(All the members of this group are destitute of the posterior laminæ of the tarsi, instead of which elliptical warts make their appearance; these, however, are wanting in most of the large species of *Pipra*, leaving the tarsi quite naked behind.—Burm.)

1. *Coracina.*—Twenty or twenty-one remiges; the first six graduated. Saddle acute-angled on the sides. *C. calva*, *C. scutata*, and *C. rubricollis.*

2. *Cephalopterus.*—Number of remiges not exactly ascertained; tracts as shown in the figures (Plate III, figs. 9 and 10). The chief distinction consists in the elongated, laterally obtuse form of the saddle. The separation of the inferior tract of the neck from the pectoral tract behind the gular sac is also remarkable. The male alone has the beautiful gular tuft of feathers; and the female has a short, erect frontal hood, instead of the larger structure of the other sex.

3. *Chasmarhynchus nudicollis.*—Twenty or twenty-one remiges; the third and fourth longest. Saddle acute-angled at the sides and broad, as in *Coracina.*

4. *Eurylaimus.*—Eighteen or nineteen remiges; the third, or, with the latter number, the fourth, the longest. This occurs only in *E. corydon*, which also has a more elongated and laterally obtuse saddle. I find a shorter saddle, more acutely angled at the sides, and eighteen remiges, of which

nine are inserted on the hand, and the third is the longest, in *E. horsfieldii*, *nasutus*, and *cucullatus*. The rectrices are graduated in all.

5. *Calyptomene viridis*, Raffles (*Rupicola viridis* Temm.).—Pterylosis exactly as in the second group of *Eurylaimus*, but with nineteen remiges, of which ten are on the hand, and the third is the longest.

6. *Pipra*.—Following the example of Wagler (*Isis*, 1830, p. 928), I unite under this name the genera *Pipra*, *Rupicola*, and *Phibalura*; and the more readily, as none of the species examined by me exhibited any differences in the pterylosis. They possess a rhombic saddle, the elongated space of which is enclosed posteriorly only by two converging rows of contour-feathers standing singly or two together, which unite at the caudal pit to form the narrow rump-band. The pectoral band in all is furnished with a branch slightly separated at the end. They have also nineteen or twenty remiges, of which ten are on the hand, and amongst these often some of singularly abnormal structure, with remarkably diminished vanes.

In *P.* (*Ampelis*) *carnifex*, in which the first three are the longest, the fourth and fifth are thus peculiarly formed; in *P. rupicola* the first and the fourth, here the longest. This species has perhaps only eighteen remiges, and nine on the hand. I have examined also *P. peruviana*, *P. filicauda*, *P. caudata*, and *P.* (*Phibalura*) *flavirostris*, in which no such remiges occur.[1] The last-mentioned species has a forked tail and acute wings, in which the second primary is the longest; the two preceding species have graduated tails, and the fifth primary is the longest. Moreover, in *Phibalura* the outer toes are not united at the base, which renders its generic separation more admissible.

b. With a simple saddle in the spinal tract.

(In the covering of the tarsus the members of this section agree exactly with the typical Passerinæ; the posterior laminæ, consequently, are not wanting.—Burm.)

7. *Procnias ventralis* Temm., *Pl. Col.*, 5.—The saddle is not rhombic, but parallel-sided, although pointed at both ends, and thus carried over into the anterior and posterior parts of the spinal tract. The outer branch of the pectoral tract is but very slightly free at the end. Eighteen remiges, *nine* on the hand; first three equal and longest.

8. *Hypothymis* Licht.—The saddle in *H. chrysorrhœa* is elongated, rounded on the sides; in *H. cæsia* shorter and broader, with acute lateral angles. The pectoral branch is slightly separated at the end. There are nineteen remiges, of which ten are on the hand: the first small, the second and third abbreviated, pointed; the fourth, fifth, and sixth equal, longest, and rounded at the end. The tail is twice as long as in *Procnias*.

9. *Bombycilla*.—Pterylosis exactly that of the second species of *Hypothymis*, that is to say, a rhombic, acute-angled saddle, and a straight pectoral branch, scarcely separated at the end. Nineteen remiges, of which ten are on the hand: the first remarkably small; the second and third longest. Tail short, but somewhat longer than in *Procnias*. The horny laminæ at the ends of the secondaries and rectrices are singular, but well known. *B. garrula*, *B. americana*.

[1] The Piprine genus *Machæropterus* also presents a very abnormal structure in the primaries, for a description of which see P. Z. S., 1860, p. 90, and Ibis, 1862, p. 175—P. L. S.

4. Tanagridæ.

All the members of this group that I have been able to examine agree precisely in their pterylosis. They have eighteen remiges, of which *nine* are on the hand. The saddle is an acute-angled rhombus, and the outer branch of the pectoral tract stands off a little at the end. The temporal space appears to be wanting in them.

1. *Pardalotus punctatus.*—First three remiges equal and longest.

2. *Euphone rufiventris.*—First primary somewhat shorter; second, third, and fourth the longest. *E. diadematа* Temm., *Pl. Col.*, 243: first primary much abbreviated; the second moderate; the third, fourth, and fifth the longest.

3. *Tanagra.*—Second, third, and fourth primaries usually the longest; sometimes the third, fourth, and fifth. I have examined *T. missisippensis*, *T. cyanisterna* Less., *T. vittata*, *T. coryphæa*, *T. leveriana* (*Bethylus* Cuv.), *T. archiepiscopus*, and others.

5. Fringillidæ *seu* Conirostres, *Cuv.*

This group approaches the preceding very closely in its pterylosis, having a simple rhombic saddle, a pectoral branch scarcely separated at its extremity, and *eighteen* remiges, of which *nine* are on the hand. Only the Larks (*Alaudæ*) sometimes possess nineteen or even twenty remiges, and an ephippial space, which, however, is not possessed by *A. bifasciata* Temm., *Pl. Col.*, 393, and this bird is otherwise very peculiar in several respects. I find in it a simple elongated saddle, perfectly different from the acute-angled primary type of the other Larks. I have examined the following species of this family :

1. *Alaudæ arvensis, cristata, arborea,* and *alpestris,* have a large ephippial space, and, except the last, ten primaries; *A. alpestris* has only nine. The ephippial space is very small in *A. frontalis* and *A. melanocephala,* each of which distinctly possesses ten primaries. Lastly, *A. bifasciata* has no ephippial space, but ten primaries.

2. *Emberizæ lapponica, nivalis, miliaria, citrinella, schœniclus, hortulana,* and *cia,* present nothing remarkable or peculiar.

3. *Fringilla.*—I have examined all the indigenous species, including the *Pyrrhulæ,* and found nothing peculiar in them; I have even distinctly seen the temporal space in several species, as for instance, *Pyrrh. enucleator.* Among the exotic species *F. erythrophthalma* (*Emberiza* Wils., *Pipilo* Vieill.) has attracted my notice by its unusually abbreviated first primary; as has also *F. malacca* (*Loxia* Lath.), by the presence of *nineteen* remiges, of which the first is extremely small. In all the second, third, or fourth primary is usually the longest, although but little exceeding the neighbouring ones, and even the first.

4. *Phytotoma.*—I have only been able to examine stuffed specimens of this genus, and therefore do not know its pterylosis. In the wings I found eighteen remiges, of which the first is very perceptibly abbreviated, and about equal to the eighth; but the second is a little shorter than the third, which is the longest. The tarsi have the usual half-bands in front, but behind they are covered with small scales.

5. *Loxia.*—The Crossbills precisely agree in their pterylosis, as also in the structure of the wings, with the true Finches.

6. *Ploceus.*—The three species of this genus that I have examined, namely, *Loxia philippina*, *Ploceus personatus* (*Textor alecto* Temm., *Pl. Col.*, 446), and *Fringilla ignicolor* Vieill. (*Oryx ignicolor* Less.), have in the main the pterylosis of the Finches, and also a very distinct temporal space; but they have *nineteen* remiges, of which *ten* on the hand, the first exceedingly small, the second somewhat abbreviated, and the third or fourth usually the longest. In *P. philippinus* the saddle is nearly triangular, that is to say, abruptly truncated behind; in *P. personatus* it appears to enclose a small space immediately in front of the commencement of the rump-tract.

6. Sturnidæ.

To this group I refer the genera *Psarocolius* Wagl. (*Icterus et Cassicus* Auctorum), *Oxyrhynchus*, *Sturnus*, *Pastor*, Temm. (*Gracula* Licht.), *Buphaga*, *Oriolus*, and *Sericulus*. Of these *Oxyrhynchus* and *Psarocolius* have only *eighteen* remiges, and *nine* on the hand, although I have actually found ten in *Ps. icterus* Wagl., but the first was so small that I doubted whether it was to be reckoned among the remiges. The other genera have *nineteen* remiges, of which *ten* are on the hand. In these also the first primary is frequently of remarkably small size, especially in *Sturnus militaris* (*Agelaius* Vieill.), *S. capensis* Linn., *Pastor tristis* Wagl., *P. roseus*, *Buphaga africana*, and probably in all the species of *Sturnus* and *Pastor*. In *Oriolus* alone, which has twenty remiges, it is half the size of the second. In other respects the pterylosis displays all the characters of the Finches, namely, a dilatation of the pectoral tract somewhat separated at the end, and a rhombic saddle in the spinal tract. In *Buphaga* the latter encloses a very small space in front of the commencement of the rump-band: this was also observed in some species of *Sturnus* and *Pastor;* for example, in *P. tristis* and *S. capensis*. A very large space, occupying the whole length of the saddle, occurs, however, in *Oxyrhynchus cristatus* and *Sericulus regens*. In the true *Orioli* the space is not present, but at the same time the saddle is much narrower and lanceolate (Plate III, figs. 7 and 8). In *O. galbula*, also, I found no divergent portion at the end of the dilatation of the very strong pectoral tract, although it occurs in *O. viridis* and *O. melanocephalus*, especially the latter.

7. Dentirostres, *Cuv.*

(*Laniadæ et Muscicapidæ*, Auctorum).

In this group, which contains a great number of species, I have met with the following pterylographic differences.

A. *With twelve rectrices.*

a. Saddle without a space.

1. *Barita.*—Twenty remiges; first four graduated, fourth and fifth the longest. Dilatation of the pectoral tract somewhat separated at the extremity; saddle short, broadly rhombic, acute-angled. *B. strepera, B. destructor, B. varia.*

2. *Thamnophilus* seu *Vanga.*—I have examined only the large and beautiful typical species, which has been repeatedly described, *T. striatus* Quoy et Gaimard ('Voy. de Freycinet,' Pl. 18 and 19; *T. vigorsii* Sucii, 'Zool. Journ.,' iv, 554; *Lanius undulatus* Mikan, 'Delect. Flor. et Faun. Brasil.;' *Lanius procerus*, Mus. Berol.) It has *twenty* remiges, which are all very broad and obtuse, graduated as far as the fifth, which is of the same length as the sixth and seventh. The dilatation of the pectoral band is somewhat separated, and the saddle is heart-shaped reversed, emitting a single row of feathers from its middle as the commencement of the rump-band.

3. *Lanius.*—Besides the indigenous species, all of which have a broadly rhombic, posteriorly abbreviated saddle, and nineteen remiges, I have examined *L. phœnicurus* (E. Indies), *L. plumatus* Shaw, *L. brubu* Licht., *L. guianensis* Licht., *L. scapulatus* Licht., and *La Cravatte blanche* Le Vaill., Pl. 115. In all, the first primary is very small, and the second also perceptibly abbreviated. In the last-mentioned three species, the first three are graduated, and the fourth, fifth, and sixth are the longest; in the others, on the contrary, the third is the longest, and the two following ones approach it most nearly. Our indigenous species agree with this second condition, but in *L. excubitor* the first primary is much larger than in the other three species.

4. *Ceblepyris* (*Graucalus et Campephaga*).—Dilatation of the pectoral tract somewhat separated at the end; saddle much elongated, rhombic, narrow; rump-band remarkably broad: nineteen remiges; the first very short, the fourth the longest. *C. novæ-guineæ, C. viridis* (*Graucalus*, Quoy et Gaimard, *Sphecothera*, Vieill.). *C. fimbriata* has a somewhat broader saddle.

5. *Ocypterus leucorrhynchus* Cuv.—Pterylosis of the preceding; saddle narrow, but widened by the two powder-down tracts situated beside it; another similar tract is placed near the lumbar band, and at the extremity of the dilatation of the pectoral tract (Plate III, fig. 4). Twenty remiges: the first quite minute; the second, third, and fourth the longest, and comparatively very long. Contour-feathers without an aftershaft.

6. *Trichophorus barbatus* Temm., *Pl. Col.*, 88.—Pterylosis of the *Lanii*, especially the broad saddle, obtuse behind, from the middle of which issues a rump-band which is at first very weak. Nineteen remiges: the first rather short; the following, as far as the fourth, graduated; and the fourth and fifth the longest. The remarkable, bristle-like feathers of the nape and vertex, which also occur in *Edolius crinitus*, are very long filoplumes. (See p. 15.)

7. *Muscicapa.*—Besides the indigenous species *M. luctuosa* and *M. grisola*, I have examined *M. ruticilla* and *M. cærulea*, as also *M. malabarica* and *M. bambusæ*, with long, graduated tails (*Acis* Less.), and some similar species which could not be exactly determined. All have a simple saddle, and this is frequently narrow and lanceolate, as in *M. cærulea* and *M. malabarica*. It is broad, and obtuse behind, as in the *Lanii* in *M. bambusæ* and *ruticilla;* uniformly rhombic, with acute lateral angles in *M. luctuosa* and *grisola*. In the latter, as also in *M. cærulea, bambusæ*,

malabarica and others, the number of remiges is *nineteen*, so that the first primary is present, although small, and the second is also abbreviated. According to the length of the other primaries, the species forms two groups. In *M. malabarica* and a second undetermined species with a very strongly graduated tail the *third* and *fourth* are the longest; in the others sometimes the *fourth* and *fifth*, as in *M. luctuosa*, *grisola*, and *cærulea*; sometimes the *fifth* and *sixth*, as in *M. bambusæ*, and another species, which is distinguished by a much longer and broader bill, has no graduated tail-feathers, and rather appears to be a *Platyrhynchus*. I found only eighteen remiges, of which the *third* and *fourth* are the longest, in *M. ruticilla* and an allied species from Mexico.

b. With a space in the saddle of the spinal tract.

a. The large space occupies the whole saddle.

(All the members of this section with which I am acquainted are distinguished, not only by the form of the saddle, but also by the covering of the tarsus, which consists of half-bands only in front, and behind of small elliptical scales, with a row of larger ones along the outer side close to the half-bands. It is remarkable that this tarsal covering occurs in the *Ampelidæ*, which are likewise furnished with a large ephippial space.—Burm.).

1. *Psaris* Temm.—Saddle and its space of quite enormous size, but rhombic and acute-angled. Temporal space not present. First primary but little shorter than the second; third longest in *P. cayana* and *P. leucospilon*; in *P. valida* (*Le Distingué noir* of Azara) the second primary is remarkably small, with the inner vane diminished and pointed (another structure which reminds us of the *Ampelidæ*—Burm.).[1]

2. *Tyrannus* Cuv.—Saddle more elongated, the space narrower, but still fully as long as the acute-angled saddle. First primary but little shorter than the second, both these and also the following ones remarkably acute in many cases. Margins of the mandibles of the large broad bill covered with fine velvety denticulations, at least in many species, such as *Lanius tyrannus*, *L. pitangua*, and *Musc. cayennensis*. I have found pointed first primaries in *L. tyrannus* and *L. despotes*. I have also examined *Musc. audax* Lath., and *M. legatus* Licht.

3. *Platyrhynchus*.—I have carefully examined only one species of this group, namely, *P. hirundinaceus* Spix (*P. rupestris* Neu Wied). It has precisely the pterylosis of the preceding genus, but the saddle is weaker, especially at its hinder part, which encloses the space only with two rows of single contour-feathers.

β. The space minute, visible only at the end of the saddle in front of the origin of the rump-band.

Drymophila carinata Temm., *Pl. Col.*, 418.—This beautiful bird is distinguished pterylo-

[1] The small second primary is found in the adult males of all the species of *Psaris*, or *Tityra*, as it is more correctly termed. (See remarks in P. Z. S., 1857, p. 67.) There can be no question of the intimate connection between this group and the *Cotingidæ* (*Ampelidæ* of Burmeister), and they are placed together by all the best modern authorities.—P. L. S.

graphically by its very narrow main tracts, from which the dilated portion of the pectoral tract is separated at the end for a considerable distance. The saddle is of an elongated rhombic form, rather more obtuse behind, where it encloses the small elliptical space. *Nineteen* remiges, the first scarcely half as long as the second, which is also notably abbreviated; the third as long as the fifth, and the fourth a little longer than either of them. The lateral neck-space reaches almost to the head, and is covered with down-feathers.

B. *With ten rectrices.*

Edolius.—Pterylosis as in the *Lanii;* that is to say, the pectoral band broad, scarcely separated at the end, and the saddle distinctly rhombic, but still somewhat different, inasmuch as this saddle has no space in *E. puella* (*Irene* Horsf.), whilst there is a space in *E. crinitus* and *bilobus*. In the latter it is of very small size, and resembles the structure in *Drymophila;* in the former, on the contrary, it occupies the whole length of the saddle. All have nineteen remiges, of which the first is about half as long as the second, which is equal to the eighth, whilst the third is but little shorter than the fourth, which, either alone (*E. puella*) or with the fifth (*E. bilobus, crinitus, malabaricus*), is the longest. I found in all of these the above-mentioned number of rectrices; but this has already been remarked by Lesson ('Manuel d'Ornithol.,' i, p. 148). The peculiar, long, bristle-like frontal feathers, furnished, however, with weak barbs, which occur in *E. crinitus* Temm., are particularly remarkable, and appear, as in *Trichophorus*, to be filoplumes.

8. Subulirostres *seu* Canoræ.

This group, probably the most numerous in species of all the sections of Passerinæ, exhibits very little difference in the form of its pterylosis, as I have found in nearly all the species examined by me an undivided rhombic saddle and a dilatation of the pectoral tract furnished with an outer branch, which is usually more or less separated at the end, rarely truncated; *half free* only in *Grallina* and *Menura* (Plate III, fig. 11), the only examples of this structure among the Passerinæ. *Sylvia turdoïdes* exhibits a longitudinal space in the saddle, which, however, is set with two rows of sparse contour-feathers, and probably occurs also in the other Reed Warblers. All of them have *twelve* rectrices, except the male *Menura*, which has *sixteen*. Most of them possess nineteen remiges; but three groups, viz., *Anthus, Motacilla*, and *Hylophilus* Temm., have constantly only *eighteen*, the first primary, which is always much abbreviated, being here entirely wanting. On the other hand, *Menura* possesses *twenty-one* remiges, the largest number occurring in this group. The most natural grouping of the numerous genera appears to be in accordance with the structure of the wings. Thus I find either—

1. *Long acute wings, of which the second, third, fourth, and fifth remiges are the longest;* and then—

a. Nineteen remiges, in the genera—

Lamprornis (usually written incorrectly *Lamprotornis*), *Turdus*, *Phyllornis*, *Accentor*, *Grallina*, *Henicurus*, *Sylvia*, *Parus*, and *Regulus*; or—

b. *Eighteen remiges*, the first being deficient, in—

Anthus, *Motacilla* (Plate III, figs. 1 and 2), and *Hylophilus* Temm. (*Sylv. pœcilotis* Temm., *Pl. Col.* 173, 2; *S. amaurocephala* Licht.), *Sylvia chrysoptera*, Wils., *Turdus aurocapillus*, Wils., and others.

2. *Short rounded wings, of which the first four, five, or six remiges are graduated, and the following primaries are nearly of the same length as the secondaries and tertials. In this case the first primary seems never to be deficient.* Here the genera—

Troglodytes, *Pteroptochus*, *Menura* (Plate III, figs. 11 and 12), *Pitta*, *Myophonus*, *Myiothera*, *Cinclus* (distinguished as remarkably in the structure of the wings by the agreement in length of the second and third remiges with the two following, these four being the longest, as by the dense downy clothing which covers, not only all the spaces, but also the intervals between the contour-feathers, and even the oil-gland), *Ixus* (*T. ochrocephlus* Lath., *T. atricapillus* Temm., *T. leucocephalus* Mus. Frank.), *Copsychus* Wagl. (*T. macrurus* Lath., *T. mindanensis*), *Cinclosoma*, *Timalia*, *Pomatorhinus*, *Malurus* (*marginalis*) *Synallaxis* (*setaria*), *Opetiorhynchus* (*turdineus* Neu Wied, *Turd. scolopaceus* Licht., to which I refer *Campylorhynchus scolopaceus* Spix, *Picolaptes zonatus* Less., and *Pic. brunnicapillus* Guér., *Mag.* v, i, 47, and also *Opet. rufus* Mus. Frank. [*Turdus figulus* Licht.], *Op. rupestris* Kittl., of which the wings are rather more acute, and *Ochetorhynchus ruficaudus* Meyen. The first three species, of which I have examined the skins, have the dilatation of the pectoral tract strongly divergent at the extremity, a structure intermediate between the ordinary one and that of *Menura* and *Grallina*. *Anabates* also, in my opinion, is best placed here, and forms the transition to the Certhiaceæ, which the preceding genera likewise approach very closely.

9. Certhiaceæ.

This group, although inferior to the preceding in extent, is, nevertheless, much more variable pterylographically. In respect of the form of the saddle, it presents the two sections already repeatedly mentioned.

A. *With a simple saddle in the spinal tract.*

1. *Sitta*.—Saddle rhombic, elongated, almost lanceolate; dilatation of the pectoral tract perceptibly separated at the end. Nineteen remiges, ten on the hand, the first very short, the third, fourth, and fifth the longest. Tarsus behind, with simple, *undivided* laminæ. *S. europæa*, *carolinensis*, *canadensis*.

2. *Dendrocolaptes.*—Pterylosis exactly as in *Sitta;* remiges of the same number, but the first larger; third, fourth, and fifth longest. Tarsus behind, with a series of scutes instead of the simple plates.

3. *Certhia.*—Dilatation of the pectoral tract distinctly separated for some distance; saddle broader, more acute-angled, posteriorly more obtuse (Plate III, fig. 3). Nineteen remiges, the first very small, the third to the sixth the longest.

4. *Philedon.*—Much as the species of this group differ in the form of the bill, they present little variation in the pterylosis, which is exactly as in *Sitta.* The number of remiges is also the same, but the first is usually half the length of the second, and the fourth alone, or the fourth and fifth, usually exceed all the others in length, although but little. I find the saddle broad and rather acute-angled in *P. cuculligerus* Licht. and *P. Novæ Hollandiæ* Lath.; it is very narrow and lanceolate in *P. phrygius* (*Merops phrygius* Lath.).

5. *Campylops hamatus* Licht.—Pterylosis as in *Certhia,* but the divergent portion of the pectoral tract is short. Wings imperfect in the specimen examined.

6. *Nectarinia.*—Pterylosis exactly as in the preceding genus. *Nineteen* remiges, of which the first is small, and the third, fourth, and fifth are the longest, occur in *N. scarlatina, N. aurifrons,* and their allies. *N. flaveola* and its allies, on the contrary, have only *eighteen,* the first small one being deficient. In the latter the saddle also is narrower and lanceolate.

B. *With a space in the saddle of the spinal tract.*

7. *Promerops caffer* Cuv.—Saddle very broad and acute-angled, completely occupied by the space, so that the rump-band commences with only two converging rows of single feathers; pectoral band somewhat divergent at the apex. Nineteen remiges, the first primaries graduated, with an emargination of the inner half of the vane, which is remarkably large on the fifth. Tarsus behind with small elliptical scales, the two posterior laminæ not being in contact. Tail long, forked.

8. *Arachnotheres chrysogenys* Temm., *Pl. Col.,* 388, 1.—Pterylosis exactly as above, except that the saddle is more elongated anteriorly, and therefore the space is also larger. Nineteen remiges, of which the first is very small, and the fourth the longest. Margins of the upper mandible finely denticulated at the apex.

9. *Dicæum pectorale.*—Pterylosis exactly as in the Swallows, namely, the saddle broad and deeply bilobate, and the rump-band completely separated from it (Plate III, fig. 14). Eighteen remiges, of which the first, second, and third are nearly of equal length and the longest.

10. Hirundineæ.

The single genus *Hirundo,* which constitutes this group, differs more than any other in its habitus from the general type of the Singing-birds, and in this respect approaches very closely to some *Cuculinæ,* namely, the *Cypseli.* For this reason I usually place it at the end of the Passerinæ, in the vicinity of the anomalous cuculine form just mentioned, which stands in the same relation to the true Cuckoos as the Swallows to the ordinary Song-birds. However, pterylo-

graphically *Hirundo* does not differ from the rest, but rather harmonises completely with *Dicæum* (see Plate III, fig. 14), in that the rows of single contour-feathers uniting the saddle with the rump-band are either entirely deficient (*H. rustica, urbica*), or indicated only by two rows of very sparse contour-feathers (*H. rupestris*). The dilatation of the pectoral part of the inferior tract is somewhat divergent at the end. The number of remiges is eighteen, of which nine are on the hand, and of these the first is the longest; the first six secondaries are remarkable on account of their broad, emarginate extremities. Tail forked, but the outer feathers are remarkably elongated only in *H. urbica*.

CHAPTER III.

Piciform Birds (*Picariæ*).

The group of Piciform Birds is the most various of all, both as regards the general structure of the body and the pterylosis, and in regard to the latter I know of no single character which is peculiar to it. It usually agrees with the Passerinæ in the want of down-feathers upon most of the spaces and all the tracts; but in *Alcedo* both parts are downy, as in *Cinclus*. The presence of the aftershaft is here not even a character of the subordinate families, but merely a generic character. I have found it in *Cypselus*, *Trochilus*, *Caprimulgus*, *Coracias*, *Prionites*, *Leptosomus*, *Prodotes*, *Trogon*, *Micropogon*, *Pogonias*, *Jynx*, *Picus* (in which, however, it is very small), *Psittacus* (in which it is of considerable size, not exceeded by that of the Gallinaceæ), *Musophaga*, and *Colius*, whilst it is decidedly wanting in all the other genera of this family examined by me. A similar difference is exhibited in the feathering of the apex of the oil-gland, which is so constantly deficient in the Passerinæ. I have found it in most of the genera, although sometimes very imperfect, but I decidedly have not seen it in *Caprimulgus*, *Coracias*, *Prionites*, *Merops*, *Galbula*, any of the *Cuculinæ*, *Capito*, and *Monastes*. The total absence of this gland in many Parrots (see p. 39) considerably increases this want of uniformity in the character of the group.

When primary differences of structure are to be found in such small parts and organs, we shall not be surprised to find still greater variations in the arrangement of the tracts, and to see in them scarcely anything more than generic characters. It is therefore impossible to give a pterylographic description of the families, and I have only been struck by the general sparsely feathered structure of the tracts, which becomes more considerable and strongly marked in proportion as the genera consist of constant inhabitants of the tropical zones. It is also impossible to cite differences of numbers in particular definitely feathered parts as group-peculiarities, as these are not less multifarious than the other structures; nevertheless, I may remark that the *Humming-birds* possess only sixteen remiges, the smallest number of all, whilst twenty-seven or twenty-eight occur in *Buceros*, and that this number is exceeded in no genus of Piciform Birds, and, indeed, is rarely attained, from twenty to twenty-three being the usual number. The

number of rectrices is less variable; it is certainly more uniformly divided between ten and twelve than in the Passerinæ. I find *twelve* in *Coracias*, *Prionites*, *Merops*, *Galbula*, *Todus*, *Leptosomus*, *Prodotes*, *Trogon*, *Capito*, *Monastes*, *Picus*, *Yunx*, *Psittacus*, and *Alcedo*; and *ten* in *Cypselus*, *Trochilus*, *Caprimulgus*, *Cuculus*, *Centropus*, *Phœnicophanes*, *Scythrops*, *Crotophaga*, *Bucco*, *Micropogon*, *Pogonias*, *Rhamphastus*, *Buceros*, *Upupa*, *Colius*, *Musophaga*, and *Opisthocomus*.

1. MACROCHIRES.

In this family I place the two genera *Cypselus* and *Trochilus*, which, indeed, present but little external similarity, but are very nearly allied in the structure of their wings. The form of the feather-tracts also justifies this union, although there are some pterylographic differences. Both have a distinct, downy aftershaft, which is larger in *Cypselus* than in *Trochilus*. In neither of them are there down-feathers among the contour-feathers; but *Cypselus* has distinct dark gray down on the spaces of the trunk, which does not occur in *Trochilus*. Moreover, the broad bands of the inferior tract, uniformly narrowed from before backwards without any trace of an outer branch, and commencing as two narrow, widely separated bands even from the chin, furnish a good family character, as does also the large, elongated, elliptical or lanceolate ephippial space, which reaches to the caudal pit (*Cypselus*), or even to the oil-gland (*Trochilus*). By both these characters they are definitely distinguished from the Passerinæ, whilst they, to a certain extent, approach the *Caprimulgidæ*, especially the genus *Nyctornis*, in which, however, the inferior tract has an interior gular branch, and the spinal tract is at once weakened and dilated in its posterior part, characters which do not occur in the *Macrochires*. Both genera of this family have, moreover, *ten* rectrices, and usually only *sixteen* remiges, of which *ten* are seated on the hand. The latter are characterised by their enormous length, their very strong shafts, and their very narrow, but thick outer vane. The first is almost always of equal length with the second, and these are the longest; very rarely I have found the first shorter than the second. The naked oil-gland has no circlet of feathers at the apex.

1. *Cypselus*.—The presence of down-feathers on the spaces, the very large aftershaft on the contour-feathers, and the narrow form of the bands of the spinal tract, constitute the characters of this group.

a. In *Hemiprocne* Nob., to which *Acanthylis* or *Chætura* may also be referred, I find remarkably long, strong, and densely feathered lumbar tracts, and the spinal tract diminished in its posterior portion from the shoulder-blades. In *H. collaris* (Temm., *Pl. Col.*, 195; *Cypselus torquatus*, Licht.) the stems of this tract are rather broad, and contain several rows of feathers; in *H. acuta* (*Cypselus acutus* Pr. Max. v. Neu Wied, 'Beitr.' iii, 1, 351) the anterior part consists of two rows of feathers, and is apparently interrupted at the nape, whilst the hinder part is uniserial on each side, and divided as far as the oil-gland. The latter is very small. The stiff tail-feathers in both species terminate in horny, acute points. In the second I found *sixteen* remiges.

b. The true *Cypseli*, of which I have carefully examined only *C. apus* (Plate III, figs. 16 and 17), have a naked annular spot around both the eye and the orifice of the ear; a uniform, strong spinal tract, three feathers in breadth in each branch near the space, and weaker, although very

long, lumbar tracts. The axillary tracts also appeared to me to be somewhat longer than in *Hemiprocne*. This species possesses *eighteen* remiges. In its contour-feathers I was struck by the circumstance that all the barbs of the main shaft, even to the very lowest, possess a pennaceous structure at the base, and only become downy towards the end. This remains the same up to two thirds of the entire feather, but the downy part gradually increases in length. The oil-gland is here proportionately still smaller than in *Trochilus*, and is also much narrower and more acute.

2. *Trochilus* (Plate III, figs. 18 and 19).—The group-character of the Humming Birds, as regards their pterylosis, is therefore the smaller aftershaft on the contour-feathers, which I have recognised distinctly only on the large feathers of the rump, and also the absence of down-feathers on the spaces; further, the broad rhombic form of the spinal tract, the very long and rather broad spinal space, extending from the scapulæ to the oil-gland, and the slight, scarcely perceptible development of the lumbar tracts. Whether the nape-space (see Pl. III, fig. 19) beneath which the long cornua of the hyoid bone are situated, found by me in *T. moschitus*, occurs in all the species, I cannot decide, from a deficiency of investigations. In several specimens preserved in spirits, which I could not determine with precision, it was still larger than in the above-mentioned species. Moreover, the cordate oil-gland, furnished with a short tip, is remarkably broad and large for so small a bird.

2. CAPRIMULGINÆ.

(*Cuculinæ nocturnæ* Nitzsch.)

This family very closely approaches *Cypselus* pterylographically, but the contour-feathers have a weaker aftershaft, and the wings contain from *twenty-one* to *twenty-two* remiges, *ten* of which are seated on the hand. The oil-gland is remarkably small, probably the smallest in proportion that occurs in the whole class of birds; it is of an elongated oval form, without a circlet of feathers at the tip. The forms of the tracts, singularly enough, have a remarkable resemblance to the type of several Rapacious Birds, but differs in the various genera. Among these analogies I reckon the forking and interruption of the spinal tract between the shoulder-blades in *Caprimulgus*, the emission of an interior branch from the end of the gular portion of the inferior tract in *Nyctornis*, and the division of the dorsal and rump portions of the spinal tract in the same genus. We may, therefore, regard as the chief peculiarity of the family the densely feathered vertical band, which is readily distinguished from the sparse plumage of the head, and passes behind into the cervical portion of the spinal tract; this has not occurred to me elsewhere, and it is the more remarkable in this group, as none of its members possess a large and striking feather-crest.

1. *Caprimulgus* (Plate IV, figs. 1 and 2).—Two rows of sparse contour-feathers run on each side of the densely feathered vertical band (at least in *C. europæus*). Spinal tract at first broad, forked between the shoulder-blades, each branch united to the broad rump-band by a single row of contour-feathers. Lumbar and humeral tracts very broad. Inferior tract divided from the commencement of the throat, without an interior branch at the base of the neck, but with a

dilatation of equal breadth upon the breast, not separated, but truncated at the end, and connected by a uniserial hook with the hypopterum. The stiff bristles of the gape are true stems, which bear a row of short fine barbs at the base immediately above the quills. Index finger, as well as the pollex, with a claw, which, however, is often extremely minute. Tarsi with scutes in front, warty behind, touching the ground, at least during repose. The genus appears to be plantigrade throughout. Claw of the middle toe denticulated within; the *outer toe only four-jointed.* The species examined were *C. europæus, C. longipennis* (remarkable for its peculiarly formed, elongated ninth primary), *C. forcipatus,* and *C. psalurus* Temm., *Pl. Col.*, 157, 158, both with furcate tails, but the last clearly and specifically distinguishable from the preceding very similar species by the elongation of the two middle tail-feathers.

Ægotheles novæ hollandiæ Vigors ('Linn. Trans.' xv, 1, 179), which I have examined only in a mounted state, and therefore can say nothing about its pterylosis, agrees very closely in the structure of its feet with the *Podargi,* and has also a five-jointed outer toe, no comb on the claw of the middle toe, and the toes longer than the tarsus.

Podargus gigas.—Pterylosis exactly as in *Caprimulgus,* but with the rump-band shorter, and the two diverging limbs running from it to the scapular portion longer, and composed of two rows of feathers. Twenty-one remiges, the first as long as the eighth, the second as the sixth, and the third, fourth, and fifth the longest.

Nyctornis æthereus, Neu Wied (Plate IV, figs. 3 and 4).—Spinal tract like that of *Cypselus,* uninterrupted, with a large lanceolate spinal space, but weaker from the ends of the shoulder-blades, and therefore apparently interrupted at this point. The posterior weaker portion, extending from the ends of the shoulder-blades to the oil-gland, is dilated and sparsely feathered from the commencement on the outside, and consists internally of three rows of strong feathers which enclose the long spinal space reaching as far as the oil-gland. Inferior tract divided from the throat, emitting a narrow, curved, inner branch, which extends upon the breast, at the lower extremity of the neck. Behind this branch it is so diminished that it becomes nearly interrupted, as in *Gypaëtos,* to the inferior tract of which it has a great resemblance; it then suddenly becomes very broad upon the breast, more densely feathered externally, sparsely feathered and gradually dying out internally, but still passing upon the belly as a broad band, which, however, at last becomes narrow, and is composed of only two rows of feathers. In this bird, also, a hook originates from the end of the pectoral band, and runs to the hypopterum. Apparently twenty remiges, the first shorter than the fifth, the third the longest. Tarsi remarkably short, shorter even than in *Caprimulgus;* outer toe with *five* joints; middle claw not pectinated, but dilated on the inner margin.

3. TODIDÆ.

(*Cuculinæ calopteræ* Nitzsch.)

Contour-feathers with a slight aftershaft, at least in *Coracias* and *Prionites; twelve* rectrices, a naked oil-gland, often conical at the apex, and *ten* primaries. In other respects, the pterylosis is variable, and often peculiar.

A. *Without an inner branch at the lower extremity of the cervical portion of the inferior tract.*

α. *The spinal tract contains a space.*

1. *Coracias.*—The representation of the pterylosis of *Coracias galbula* (Plate IV, figs. 5 and 6) agrees perfectly with that of *Coracias bengalensis* and *Colaris gularis*. All have a slightly separated but densely feathered outer branch on the pectoral portion of the inferior tract, from which a hook issues, running to the hypopterum; the whole inner part of the inferior tract is sparsely feathered, as is also the upper pectoral region externally near the base of the lateral branch. The spinal tract, which is furcate and strong between the shoulders, commences at the rump-band with two long converging limbs which only unite at the caudal pit; by the side of it there are scattered contour-feathers, as far as the strong biserial lumbar tract. The oil-gland is of an elongated oval form, without a conical tip. In all these species there are twenty-three remiges, of which the first is abbreviated; and the second, third and fourth are the longest.

2. *Merops.*—In its pterylosis this genus is intermediate between *Coracias* and *Galbula*. With the latter it agrees in the narrow form of the tracts, and with the former in the want of the inner branch at the lower part of the neck. The pectoral band of the inferior tract is somewhat dilated and separated at the end; in the middle of its outer side there are also some contour-feathers which lead to the hypopterum. The spinal tract is narrow and nearly interrupted at the nape, but tolerably broad on the rest of the neck; it is simple between the shoulders, or only divided at the end of the shoulder-blades, and united by two rows of single feathers with the rump-band, which is divided by the spinal space as far as the caudal pit. Twenty-two or twenty-three remiges, of which the first is very short, the second the longest, and the third and fourth very perceptibly abbreviated. Oil-gland with a conical tip. The species examined were—*M. nubicus*, *M. philippinus*, and *M. viridis*.

β. *Spinal tract without a space.*

3. *Prionites.*—The tracts narrow, as in *Galbula* and *Merops;* but the outer branch of the pectoral stem of the inferior tract is *completely separated*, and united to the hypopterum not merely by a uniserial hook composed of semiplumes, but by a second row of feathers originating from its base. The inferior tract is also connected with the humeral tract immediately in front of the base of the outer branch. The spinal tract runs from the occiput to the oil-gland in the form of a simple band which becomes a little broader between the shoulders; the oil-gland is of an elongated oval form. Twenty-one remiges; first four graduated; fourth, fifth, and sixth the longest. Rectrices graduated; the two middle ones in *P. momota* with elliptical apical laminæ to the vanes.

4. *Todus.*—Pterylosis exceedingly peculiar (Plate IV, figs. 9 and 10), especially the inferior tract, which, as in the preceding, is furcate on the throat, and passes on to the breast as a simple band on each side. This, however, then immediately divides into two broad, strongly feathered branches, of which the outer and shorter one runs to the humerus, whilst the inner and broader one descends along the margin of the furcula and crest of the sternum, to divide again a little behind the middle of the breast. The broad outer branch thus produced stands off to a con-

siderable extent from the narrow main stem, which consists from the first of two rows of smaller feathers, and takes a more outward direction upon the ventral surface, where it runs along the margin and terminates in the vicinity of the anus. The simple spinal tract is less remarkable; this precisely resembles that of *Prionites*, but is somewhat dilated behind the scapulæ. The humeral and lumbar tracts are distinct, but narrow, especially the latter. Nineteen remiges; ten on the hand, the first to the fifth graduated, the fifth the longest, but only slightly exceeding the fourth and sixth. Oil-gland with a conical tip. *T. viridis*.

B. *With an inner branch at the end of the gular portion of the inferior tract.*

5. *Galbula*.—Tracts remarkably narrow, not composed of more than two rows of feathers on any part of the body, otherwise very similar to those of *Merops*, differing, indeed, chiefly in the above-mentioned inner branch (Plate IV, fig. 7). Pectoral band not dilated, but with a short outer branch at the end of the breast, and a row of feathers issuing from the axilla and running to the hypopterum. Spinal tract simple as far as to between the shoulders (Pl. IV, fig. 8), then dividing and enclosing a broad, lanceolate space, which reaches to the caudal pit, but showing no difference in the plumage between the scapular and rump portions. Lumbar tracts weak; humeral tracts more distinct. Twenty (*G. grandis*) or twenty-two (*G. viridis*) remiges, of which ten are on the hand; the first very short; the second and third graduated; the fourth to the sixth the longest, but the last primary but one nearly of the same length. Oil-gland with a conical tip. Tail-feathers sometimes graduated (*G. grandis*).

4. Cuculinæ.

(*Cuculinæ veræ*, Nitzsch.)

This group, to which I refer the genera *Cuculus*, *Coccygius*,[1] *Saurothera*, *Crotophaga*, *Scythrops*, *Phœnicophanes*, *Leptosomus*, *Prodotes* (*Indicator*, Auctt.), and *Trogon*, has no definite pterylographic character; the only character that appears to occur in all of them is the nakedness of the tip of the oil-gland, which is not furnished with a circlet of feathers. Perhaps, however, the want of down among the contour-feathers (although all the spaces are clothed with semiplumes), observed in *Cuculus canorus*, may be a general charcter of the group. Most of them, indeed, are destitute of the accessory plume on the contour-feathers; but this is present in *Prodotes* and *Trogon*. These genera and *Leptosomus*, again, have twelve rectrices, and the rest only ten. The genera differ still more in the form of the tracts; and only the chief typical members of the family, such as *Coccygius*, *Saurothera*, *Centropus*, *Scythrops*, and *Crotophaga*, agree so closely in all their tracts, that they might be regarded as forming one pterylographic group. Accordingly the following arrangement may be established:

[1] Thus written by Nitzsch; Vieillot writes the name *Coccyzus*—(Burm.).

A. *With ten rectrices: contour-feathers always without an after-shaft.*

a. *The pectoral portion of the inferior tract is dilated, uniformly sparsely feathered, and extended over the whole breast.*

Cuculus (Plate IV, figs. 11 and 12). This genus is further distinguished by the circumstance that the inferior tract is divided from the throat itself; that its ventral part is very broad, and far from reaching the anus; and that the spinal tract, which encloses a large, lanceolate space, extending from the commencement of the shoulder to the caudal pit, is dilated over the whole hinder part of the back, coalesces with the lumbar tracts, and is very sparsely feathered. The very long caudal process, densely clothed with large feathers, is also one of the generic peculiarities, as also the extremely weak plumage of the tibial region. The oil-gland is exceedingly slender in both halves, but is completely immersed up to the tip, and, therefore, appears triradiate; in front of it there stands on each side a single rigid feather. Rectrices very large, with the cavity of the tube extending for a remarkable distance into the shaft. Nineteen remiges; the first very short; the second considerably shorter than the third, which with the fourth and fifth are the longest. The species examined were—*C. canorus, serratus, glandarius, lugubris,* Horsf., and *orientalis;* in the latter the portion of the spinal tract between the shoulders is rather stronger, whilst the portion behind this spot is very weak at its commencement.

b. *The pectoral portion of the inferior tract is not quite so broad, but more densely feathered, and encloses posteriorly a narrow insular space.*

The genera *Bubutus, Saurothera, Coccygius, Centropus, Scythrops,* and *Crotophaga,* which belong to this division, are so similar in their pterylosis, that a merely general description may serve for them. In these (see Plate IV, figs. 13—15) the inferior tract divides rather later, nearly in the middle of the neck, into two limbs, and passes upon the breast with a breadth of four rows of feathers. Here it soon increases to six or seven rows, and then runs with its margins nearly parallel as far as the middle of the breast, where each band divides again into two limbs. The inner limb is continued as the main stem nearly parallel to the crest of the sternum, and passes at the same distance upon the belly, over the lateral surface of which it runs nearly to the anus, before which it terminates. The outer limb departs rather more from the main stem, and turns towards the outer margin of the breast, where it emits a hook, which passes into the hypopterum. Immediately afterwards it again turns inwards, and approaches the main stem, which it rejoins in the form of a small band, usually exactly on the margin of the sternum, thus enclosing an insular space. This course is most distinctly seen in *Centropus* (*philippensis,* fig. 13, and *rufipennis*), but nearly as well in *Crotophaga ani. Saurothera marginata,* Kaup (*Cuc. viaticus* Licht.) differs in having both the main stem and the branch narrow, the former biserial, the latter triserial; and the connecting band consists only of a single row of feathers. In *Scythrops novæ hollandiæ* (fig. 15), on the contrary, in which both parts are equally distant from each other, they are of equal breadth and triserial, but the connecting band consists of only one row of strong feathers, the greater part of the space being covered with small, sparse contour-feathers. *Bubutus isidori,* Less. ('Traité,' p. 145) approaches this form, inasmuch as the space is remarkably small, and enclosed

exteriorly only by a single row of feathers. *Coccygius* (*cajanus, chrysogaster, americanus, galeritus,* and *guira*), on the contrary, diverges more in having a branch much turned outwards, narrower than the main stem, and which only recurs to it by a single row of feathers. The space thus formed is very small in the first-mentioned three species, but very large and resembling the form in *Saurothera* in the other two. In the rest of the pterylosis these six genera do not differ from *Cuculus;* but in them the feathers are more closely approximated on all the tracts, and the rump-tract on the tail is weaker; the scapular part of the spinal tract is also usually more densely feathered, and more clearly distinguished from the limbs of the rump-tract by the sparse plumage of the latter. The number of remiges amounts to nineteen or twenty; *Scythrops* alone has twenty-three. In it and in *Coccygius americanus* (*Cuc. americanus*, Auctt.) the third primary is the longest, in the other genera the fifth, sixth, and seventh, and the preceding ones are always strongly and equally graduated, so that the first is of very small size. The long tail also usually contains graduated feathers. We have also to notice the stiff lashes on the upper eyelids occurring in all these genera except *Bubutus*, which alone has perfectly naked cheeks and temples.

c. *The dilated pectoral part of the inferior tract is narrow, and of uniform breadth, and encloses no space.*

Phœnicophanes viridirufus.—Sides of the head in the region of the eyes naked and warty, the head otherwise uniformly feathered. Spinal tract narrow, simple as far as the shoulders, then divided and continued in the form of two similar, narrow limbs as far as the caudal pit, enclosing a long space. From this point it is simple, but narrow, with sparse feathers beside it, which are well distinguished from the strong, biserial lumbar tracts, although they reach to them. Inferior tract simple to the middle of the neck, then divided into two narrow branches. Each branch twice as broad upon the breast, but densely feathered and parallel-sided, the dilatation truncated and somewhat separated at the end; thence again narrow, and not reaching the anus. Nineteen remiges, the first graduated, the fourth to the sixth the longest.

B. *With twelve rectrices, and an after-shaft on the contour-feathers.*

Leptosomus afer (*Cuculus afer* Auctt.), of which I have only been able to examine stuffed specimens, belongs to this group from the number of the tail-feathers.[1]

Prodotes Nob. (*Indicator* Auctt.)—Pterylosis exceedingly peculiar, there being on the breast a perfectly free outer branch of the inferior tract (Pl. IV, fig. 16), which is not divided until low down upon the neck, whilst the dorsal tract, which remains simple as far as the pelvis, exhibits a rhombic saddle (fig. 17) enclosing a lanceolate space. Twenty remiges, of which the first and second are the longest. Oil-gland with a small circlet of feathers at the tip, the quills of which extend the walls of the apex. The species examined were, *P. albirostris*, Temm.; *Pl. Col.* 367; *P. proditor*, Licht; and a third very small species.

[1] In two examples seen by me, the outer toe appeared to contain only four joints, a remarkable peculiarity if it should be confirmed by more accurate investigation. Not less singular is the absence of the nasal septum,—the *nares* being truly *perviæ*. [Nitzsch is in error here. The outer toe of *Leptosomus* has the normal number of phalanges, as I have lately shown. See Appendix, note 2.—P.L.S.]

Trogon. The pterylosis of this genus, of which I have examined four species (*T. duvaucelii*, *ardens*, *glocitans*, and *viridis*), is exactly that of a Passerine bird, the only difference consisting in the very long after-shafts. The dorsal tract (Pl. IV, fig. 19) runs in the form of a narrow band as far as the sacrum, where it becomes dilated into a short, rhombic, acute-angled saddle; or in *T. viridis* into an elongated, rhombic one (fig. 20), and then again becoming narrow passes to the oil-gland, which has no circlet of feathers at the tip. The lumbar tracts are distinctly present, but short and small. The inferior tract is as in *Prodotes*, except that the outer branch does not diverge, but is entirely adjacent to the main stem, forming a densely feathered dilatation of uniform width, obliquely truncated at the extremity. The ventral portion, which commences at this point, is uncommonly wide. In general the plumage is remarkable for the large size of all the contour-feathers, and the entire absence of down. In the wings I found from eighteen to twenty remiges, but always ten on the hand; the fifth is the longest, and the first very short but broad. The outer tail-feathers are graduated. It is further remarkable that, of the four toes, the first and second are turned backwards, and not, as usual in Scansorial Birds, the first and fourth.

6. Picinæ, *Nitzschii*.

This group also has no general pterylographic character, at least none belonging to itself alone. For the connection of the humeral tracts with the inferior tract, which occurs in all the *Picinæ*, is by no means unfrequent, and occurs in exactly the same manner in *Alcedo*. Thus not only does the gular portion emit one or two rows of contour-feathers from near its extremity to the humeral tract, but the outer branch also sends forth a second row from its base at the point where it diverges from the main stem of the inferior tract. This outer branch is usually free throughout its course, but in *Pogonias sulcirostris* we find in its place a mere dilatation. This genus, with its allies *Bucco* and *Micropogon*, has its dorsal tract two-limbed on the back; a similar dorsal tract occurs also in *Picus* and *Jynx*, in which, however, it is interrupted before the division, whilst in the former genera the interruption usually occurs behind the arms of the fork. On the other hand *Capito*, *Pteroglossus*, and *Rhamphastus*, have a dorsal tract which is simple as far as the shoulders, but the rump-band is entirely or partially cleft. The number of rectrices varies between twelve and ten, and the feathering of the apex of the oil-gland is no less variable; whilst all the Picinæ appear to possess ten primaries and scansorial feet. The after-shaft occurs in *Micropogon*, *Pogonias*, *Jynx*, and *Picus*; it is deficient in all the other genera. But down-feathers are wanting in all, both between the contour-feathers and on the spaces.

a. Bucconidæ.

a. With ten rectrices, and the apex of the oil-gland feathered.

The members of this group have likewise a distinct after-shaft on the contour-feathers.

1. *Bucco*.—Inferior tract simple nearly as far as the end of the neck, then two-limbed, with each limb dilated, and thus united with the humeral tract, so that the above-mentioned two series of feathers are not perceptible. Outer branch free throughout its course, its plumage

rigid, with a hook at the end leading to the hypopterum. Dorsal tract simple to the end of the shoulder-blades, and here divided. Each arm is much dilated in *B. armillaris* (Plate V, figs. 1, 2), but of uniform width in *B. cyanops;* in both completely separated from the rump-band. On the other hand, in *B. roseicollis* (fig. 3), *philippinensis* and *flavifrons*, the two narrow limbs are united to the simple rump-band by two still narrower converging double series of feathers. Femoral tracts present, either simple and short, as in *B. armillaris* and *roseicollis*, or angular, a branch issuing from the end of the femoral band, and running parallel to the rump-band, as in *B. cyanops* and *philippinensis*. In all there are twenty-one remiges, the first very short, the second distinctly shorter than the following three, which are the longest, the longest of all being sometimes the third and sometimes the fourth.

2. *Micropogon*.—Pterylosis exactly as in *Bucco*, but all the tracts narrower, and the lines of union with the humeral tract at the extremity of the gular portion of the inferior tract distinct, although only uniserial. The chief difference between the genera lies in the rump-band, which, in *Micropogon*, is cleft, either throughout (fig. 4, *M. cayennensis*, and *viridiaurantius*), or only in front (fig. 5, *M. erythropygos*, Licht., and *margaritaceus* Temm., *Pl. Col.*, 490). The femoral tract is simple in *M. cayennensis* and *M. erythropygos*, or angular, just as in *Bucco*, in *M. viridiaurantius*, but with a gap at the apex of the angle. In the last-named species, also, the two rows of the rump-band are at first only uniserial, and are somewhat curved throughout their course. All three species have twenty or twenty-one remiges, of which the first is very short, the second and third are graduated, and the fourth, fifth, and sixth, are the longest.

In *M. erythropygos* I found on the heel-joint (Pl. V, fig. 5) a peculiar circlet of acute tubercles, such as I have also detected in young Wrynecks.

3. *Pogonias*.—This genus, in the form of the dorsal tract (Plate V, fig. 7), in most species approaches the second group of the *Buccones*, and in *P. unidentatus* alone agrees exactly with *Micropogon erythropygos* as regards the division and divergence of the rump-band. All the species possess two-limbed, angular femoral tracts, which, however, as in *M. viridiaurantius*, have a gap at the vertex, so that the two limbs apparently run parallel. Here, also, the pectoral tract very distinctly follows two types—for in *P. niger*, *unidentatus*, and *senegalensis*, it is narrow, and the outer branch is separated to the middle from the main stem (Pl. V, fig. 8); whilst in *P. sulcirostris* (fig. 6) this tract is of considerable width, and the strongly feathered outer branch is adjacent throughout its course to the weakly feathered main stem. All the four species agree, however, in having a temporal space close to the naked circle of the eye, which is also perceptible in *Bucco armillaris*. They also possess twenty to twenty-one remiges, of which, in *P. sulcirostris*, the third is pretty nearly equal in length with the fourth, fifth, and sixth, whilst in the other three species it is perceptibly shorter.

b. With twelve rectrices, the apex of the small acute oil-gland naked, and no after-shaft on the contour-feathers.

1. *Capito*.[1]—Tracts narrow, but the feathers inserted in them on the trunk very large and

[1] [There is no doubt that the genus here denominated *Capito* (*Bucco* of Linnæus) and its allies form a family very distinct from the preceding group, and most nearly allied to the Galbulidæ and

closely placed. Dorsal tract simple to between the shoulders; then a broad gap, behind which commences the rump-band, which is divided *half-way* (in *C. tamatia*, Plate V, figs. 9, 10), or *all the way* (*C. collaris*, *C. melanotis*) to the oil-gland. In *C. tamatia* and *collaris* the rump-band emits from the commencement of the two limbs two lateral series of feathers, which run backwards, but in *C. melanotis* it is gradually dilated towards the middle. This species also has the outer branch of the pectoral portion of the inferior tract completely adjacent, whilst in the two other species it diverges for half its length. The strong femoral tract is simple, but in *C. collaris* it has a row of feathers above it just as in *Pogonias sulcirostris*. Remiges twenty-one, the first uniformly graduated, the fourth and fifth longest.

2. *Monastes*.[1]—Pterylosis in all parts exactly as in *Capito tamatia*, except that the tracts are a little wider. The outer branch of the inferior tract is separated only at the end, but strongly, and the two limbs of the rump-band are pointed in front (Plate V, fig. 11); the two rows of feathers issuing from them are also wanting. I carefully examined only *M. fuscus*, in which I found twenty remiges, of which the fourth and fifth are the longest, and the first three are very strongly graduated. The oil-gland has a few fine hairs at the apex.

B. Rhamphastidæ.

Contour-feathers with no after-shaft; oil-gland *with* a circlet of feathers at the apex; *ten* tail-feathers.

The form of the tracts, which may be seen from Plate V, figs. 12 and 13, is perfectly concordant in essential points in all the species of this family examined by me, namely, *Pteroglossus viridis*, *Rhamphastus erythrorhynchus*, *R. discolorus* Wagl., *R. tucai*, and a fourth undetermined species, and approaches most nearly to that of *Capito*. I found in all an inferior tract, which is simple to the middle of the neck, but is remarkably broad only in *R. erythrorhynchus*. The two narrow limbs of this, commencing at this point, send a branch to the humeral tract, form a strong and perfectly free outer branch with a very distinct hook at its extremity on the breast, and then run as narrow biserial bands along the trunk to the anus. The dorsal tract is still more singular. Running simply as far as between the shoulders, it has at this point generally a gap,[2] behind which the rump-band commences with two separated limbs, which run thus divided to the tail itself, enclosing the oil-gland between them. The two portions of the rump-band are at first approximated, but soon diverge, become broader externally, and then continue nearly parallel. Beside them, in the region of the sacrum, there is on each side a row of strong contour-feathers, which may be regarded as the inner limb of the angular femoral tract; the other, or outer limb, runs transversely over the upper part of the tibia and the whole femur, and finally joins the rump-band, at least in *R. erythrorhynchus*. Another remarkable

Trogonidæ.—See Sclater's 'Synopsis of the Fissirostral Family Bucconidæ,' 8vo, London, 1854, and Burmeister's 'Syst. Uebersicht d. Th. Brasiliens,' vol. ii.—P.L.S.]

[1] As Vieillot's name *Monasa* is founded upon a false etymology, and must properly be written *Monastes*, Wagler's alteration of it to *Lypornis* appears to me to be superfluous.

[2] In the species of which the name is unknown to me this gap was wanting, and the simple part was united to the strongly convergent halves of the rump-band.

character is the length of the true tail, which bears on its lower surface a peculiar tract, consisting of an elliptical ring of feathers, in which the tail-coverts are inserted. This length of the tail explains the peculiarity of the Toucans, so well represented by Gould, namely, the erection of the tail against the back during sleep. In *R. tucai*, however, the fleshy tail was much shorter than in the other species. All have twenty-two remiges, of which the first three or four are much graduated, but the following three are the longest: the hypopterum is entirely wanting, and the parapterum can hardly be said to exist. Several recent observers have called attention to the horny plates in which the feathers of the head terminate in some species of *Pteroglossus* (Froriep's 'Notizen,' 1831, Dec., No. 692; and 1833, No. 816, p. 24). I have seen the Peruvian species described by Pöppig, *P. lepidocephalus* (*P. poeppigii* Wagl., *Isis*, 1832, 1230), in the museums at Dresden and Vienna.

c. Picinæ veræ.

Contour-feathers with a weak after-shaft like that of the Passerinæ; *twelve* tail-feathers, but the two outer ones small and bent in between the two preceding ones. Oil-gland with a strongly feathered tip, and very broad and strong throughout.

1. *Picus.*—The pterylosis of this large genus, of which I have been able to examine only a few species, presents even in these considerable differences. These, however, consist in the form of the dorsal tract, and the whole of the other tracts agree so nearly in structure that this may very well be described in general terms. On the head (Plate V, fig. 15) the vertical space is especially remarkable, a band destitute of contour-feathers extending from the base of the beak, over the forehead to the occiput, which I find in all Woodpeckers; the temporal space is also present. The rest of the surface of the head is densely feathered. The inferior tract starts from the throat as a narrow band, and very soon divides into two limbs, which afterwards send off branches of union with the humeral tracts, form on the breast a perfectly free outer branch which has a hook at its extremity, and continue in a slight curve to the anus, close to which they terminate.

A peculiarity of the Woodpeckers, and one which occurs almost universally among them, is the presence of a small, inner humeral tract (Pl. V, fig. 15), running along upon the most elevated points of the shoulder parallel to the very broad main tract, which runs lower down transversely over the humerus; this is apparently a continuation of the feather-band uniting the inferior tract to the shoulder (Plate V, fig. 14). This small humeral tract was wanting only in an umber-brown Sumatran species, to which I shall give the name of *P. luridus*,[1] as it appears to be still

[1] *P. luridus* Nitzsch. Somewhat smaller than *P. medius*, umber-brown, with fine, pale ochreous yellow transverse lines on the back, wings, throat, sides of breast, and belly, these are wanting on the vertex, the nape and the middle of the breast; on each side of the neck there is an elongated ochreous-yellow stripe, and between these the whole front of the neck is deep blackish-brown. In the male there is also on each side of the throat, besides the close undulated marking, an elongated blood-red spot. The bill is elongate-conical, slightly curved, very acute and almost without angles, only the upper middle one being indicated. The upper mandible is black; the lower one and the feet yellowish-gray (after death). Nineteen remiges, of which ten primaries, the first three strongly graduated; the

undescribed. The lumbar tract, on the contrary, presents the same characters as in *Rhamphastus* and consists only of two short limbs, which are, therefore, generally biserial, and touch each other at the apex. The wings bear from nineteen to twenty-one remiges, but always ten on the pinion, of which the first is rather short, the second is likewise shorter than the following ones, but the third is sometimes equal to the fourth and fifth and with them the longest, and sometimes exceeded by the fourth, fifth, and sixth, which are then of equal length. The peculiar formation of the tail-feathers proper to all Woodpeckers is too well known to need description, but the character of the outer feathers above mentioned must have escaped the notice of many observers, as several authors (even Wagler in his *Systema Avium*) sometimes limit the number of rectrices to *ten*, which is wrong according to my observations.

The discrepancy of the dorsal tract appears in several points. The tract certainly starts from the nape in all Woodpeckers as a simple narrow band, and continues of the same form as far as the shoulders, but its further course is different.

1. In *P. luridus*, NOB. and *P. concretus*, TEMM. (*Pl. Col.*, 50), the dorsal tract divides even between the shoulders into two limbs, which diverge a little, at the same time increasing in breadth, then again become narrower and run parallel to each other to the oil-gland, which they enclose between them, just as in *Rhamphastus*. In *P. concretus* both stems are very strong, and therefore the space between them is but narrow; in *P. luridus*, on the contrary, the stems are very weakly feathered, and the space is broad, especially in front in the region of the sacrum.

2. In *Picus tridactylus* and *P. carolinus* the dorsal tract continues simple as far as the end of the shoulder-blades, and here divides into two limbs, which widen perceptibly, but terminate in a truncated extremity. From these issue two converging rows of single feathers, which meet on the sacrum, and then form the simple, narrow rump-band, which terminates at the oil-gland, but has a row of contour-feathers close to it on each side which enclose the gland. This form pretty closely approaches that of *Pogonias* (Plate V, fig. 7) and *Bucco* (Plate V, fig. 2). *Picus martius* has the same structure, but the two rows of feathers which unite the arms of the scapular part with the rump-band are wanting in that species, although the entire tract is stronger.

3. In the other species the dorsal tract is interrupted by a distinct but short gap, at the end of the simple portion which extends low down between the shoulders, and immediately behind the gap there are two triangular divergent spots of feathers which represents the widening limbs of the preceding form.

a. In *P. bengalensis* and *auratus* these spots are united with the simple rump-band by two single converging rows of feathers; but

b. In *P. macei* and the rest of our indigenous species these lines are wanting, and the rump-band is completely separated from the above-mentioned spots. In both cases the rows of feathers beside the rump-band, enclosing the oil-gland, are usually present (Plate V, fig. 15); these, however, are sometimes wanting, as in *P. medius*, or they consist merely of down-feathers. The latter are continued upon the fleshy tail, which is very broad in the Woodpeckers in contrast to the Toucans, and form the upper tail-coverts behind the oil-gland, whilst the lower tail-coverts are

fourth, fifth, and sixth equal and longest. Twelve rigid tail-feathers, but the two outermost remarkably small, and like the next two on each side, much softer than the rest. *P. concretus*, TEMM., *Pl. Col.*, 90, and *P. pœcilolophus*, TEMM., *Pl. Col.*, 197, 1, are somewhat related to this species, but both of them possess a coloured crest, which is wanting in my species.

inserted in a circlet of feathers which may be observed upon the tail itself behind the anus. An interesting peculiarity of the Woodpeckers, which occurs elsewhere, so far as I know, only in *Alcedo*, is the absence of a nestling down-plumage in the young, which are perfectly naked until the permanent feathers make their appearance.

4. *Picumnus minutus*.—Pterylosis exactly as in our indigenous Woodpeckers; that is to say, the dorsal tract is twice interrupted, and the simple rump-band is very weak. In this species, also, I found twelve tail-feathers and ten primaries, of which the fourth and fifth are the longest.

5. *Yunx torquilla*.—Pterylosis, also, as in most of the Woodpeckers, especially the indigenous species; but the femoral tract is still more distinct, biserial, and complete even to the apex of the thigh. Twenty-one remiges; the *first scarcely perceptible*, the *second and third the longest*. Twelve rectrices; the outermost, as in the Woodpeckers, concealed between the two preceding. In young birds I observed the same circlet of warts on the outside of the heel-joint which I have above described (p. 94) in *Micropogon erythropygos*.

7. Psittacinæ.

Contour-feathers with a large and distinct after-shaft, very sparsely distributed, probably present in smaller comparative number than in any other Birds; and hence there are down-feathers not unfrequently between them, especially on the head and neck, and also on the spaces, and sometimes imperfect powder-down tracts on the pelvis. Oil-gland, when present, with a circlet of feathers on the long, thin, cylindrical tip. There are from *twenty* to *twenty-four* remiges in the wing, but always *four* feathers on the thumb and *twelve* tail-feathers. The form of the tracts varies; they are sometimes remarkably broad, sometimes narrow.

Out of 208 species of this family cited by Wagler in his Monograph,[1] I have been able to examine only about thirty, and I therefore do not venture to speak in general terms of the differences of the pterylosis, which appear, from my observations, to be not inconsiderable. I shall cite those species which I have investigated in Wagler's genera, and describe the position of their feathers in detail so far as it is necessary.

1. *Sittace* Wagl.—Of the large, long-tailed Macaws (*Macrocercus* Vieill.), I have carefully examined *Psittacus macao* Auctt. I found the head uniformly but sparsely feathered, with the exception of its perfectly naked spots, and from it *two* tracts issue. One of these commences at the throat, close behind the margin of the very large lower mandible, immediately behind which, probably in all Parrots, there is a semicircular naked space; this tract is broader than the second, which starts from the nape, where the plumage of the head itself is narrowed. The first tract, the commencement of the inferior tract, consists of five or six rows of feathers, and remains simple for fully half the length of the neck, but then forks and passes, with very little divergence of the two limbs, each three feathers in width, as far as the furcula, over which it runs and then passes, four feathers in width, upon the surface of the breast. From this point each half becomes visibly broader, extending both towards the arm and towards the crest of the sternum, so much that almost the entire surface of the pectoral muscles is covered by them. Nevertheless, each band, even at its widest part, consists only of six, or at the utmost

[1] 'Monographia Psittacorum,' Monach., 1835, 4to.

seven rows of feathers, which are as wide apart as in *Buceros* (Plate VI, figs. 1, 2), except that in the region of the outer branch the two outer longitudinal rows, for a space of four transverse rows, are more closely approximated, and bear stronger feathers. Towards the end of the sternum each band again becomes narrower, being at first four and afterwards only three rows in width, by which means a broader, elliptical inferior space, reaching to the anus, is produced between the two bands on the ventral surface. The inferior tracts also terminate at the anus, after their coalescence with the equally sparse and nearly uniform plumage of the thigh. The dorsal band issuing from the occiput presents very different characters. It is from the first narrow, three feathers broad, and densely feathered. As far as the shoulders it retains its linear form, and divides at this point into two narrow limbs, only two feathers in width, but rather strong, which extend somewhat beyond the middle of the shoulder-blades. Immediately between the extremities of these commences the second or covered portion of the dorsal tract, in the form of two much more sparse, weaker, parallel bands of feathers, containing only a single contour-feather in the first transverse row, two in the second, three in the third, and so forth, until they have become so broad that their outermost very weak and always sparser rows coalesce with the uniformly sparse plumage both of the thighs and crura. In this way the two bands are continued to the caudal pit, after approaching and coming in contact with each other from the middle of the pelvis. From this point a biserial band of stronger and more closely approximated feathers runs through the homogeneous plumage of the rump to terminate at the oil-gland, which is present in all the large Macaws. Besides these tracts we observe only a *simple*, narrow, biserial humeral tract, which runs pretty exactly behind the axillary cavity, and is connected anteriorly with the inferior tract. Powder-down feathers are entirely deficient. In the wing I found twenty-three remiges, of which the third and fourth are the longest.

I believe I found precisely the same pterylosis in *P. aracanga*, *ararauna*, *severus*, *militaris*, *macavuanna*, and *carolinensis*, Wils.; indeed, it seems to occur in all true Macaws. *P. carolinensis* alone differs from the larger South American species in having the cere covered with a dense, satin-like plumage, *twenty-one* very long acute remiges, of which the second and third are the longest, and in the *complete absence of the oil-gland;* but it has exactly the sparse plumage of *P. macao;* indeed, the ventral portion of the inferior space was still narrower, and scarcely wider than the naked band on the sharp edge of the *crista sterni*.

On the other hand, the small South American Parrots with wedge-shaped tails, which Wagler refers to *Sittace*, differ in several points from the Macaws. Of these I have most carefully examined *P. pertinax*, the pterylosis of which is represented in Plate V, figs. 16—18. It will be seen from the figures that the inferior tract divides higher up on the neck, that the two pectoral bands leave a considerable portion of the surface bare as spaces, both in the middle towards the sternal crest and externally on the trunk, and that the central or inferior space is as wide on the breast as on the belly. To these characters may be added the considerable strengthening of the portion of the inferior tract representing the outer branch, which consists at first of two and subsequently even of three rows of stronger feathers, and is somewhat divergent at the end. The dorsal tract exhibits the following differences: it is separated, at least anteriorly, from the long, biserial femoral tracts, and behind the caudal pit it consists merely of an undilated, more densely feathered band. The most important circumstance, however, is the presence of

a double humeral tract, such as has already been described in *Picus*, and which occurs here still more distinctly. Moreover, the large inferior humeral tract is much stronger and broader than in the true Macaws. In *P. pertinax* I found *twenty-one* remiges, of which the first was very little shorter than the second and third, and these are of the same length as the *fourth*, *which is distinguished by a remarkable and almost abrupt narrowing and acumination of the extremity of its vane*, whilst the fifth is perceptibly shorter even than the first. I found precisely the same structure in *P. auricapillus*, Hahn (*Sittace jendaya* Wagl.) and *P. solstitialis*, two species which closely resemble *P. pertinax* in their pterylosis, and, like it, are provided with a small, deeply bilobed oil-gland, beset at the tip with *six* umbellate down-feathers. On the other hand, this is wanting in *P. viridissimus*, Kuhl (*P. rufirostris*, Illig., Licht.; *Sitt. tirica*, Wagl.), which certainly also belongs to this group, and in which I could not detect the above-mentioned acumination of the fourth primary. These species are entirely destitute of powder-down feathers.

Domicella Wagl.[1] The pterylosis of the two species of this genus examined by me, namely, *P. domicella* Auctt. (*D. atricapilla* Wagl.), and *P. garrulus*, agrees almost exactly with that of *P. pertinax;* but the inferior tract was more sparsely feathered, and its branch by no means so distinctly differentiated from the main stem by a stronger formation of the feathers. The inferior space, separating its two halves, terminated at the bottom of the throat, so that the plumage of the lower surface of the neck was uninterrupted. On the other hand, the lumbar tract consisted of three rows of feathers, and coalesced anteriorly with the crural tract (which, as in the Raptorial Birds, formed breeches), and posteriorly with the dorsal tract. Both the humeral tracts were present, but the smaller one only indicated as an angle, the larger one consisting of two rows of feathers. Twenty-one remiges; the first ones rather acute; the first as long as the third, the second the longest. Oil-gland present in both, rather broad, its halves thick, closely approximated, the tip cylindrical, rather long. No powder-down feathers.

3. *Trichoglossus* Wagl.—Of this group I have examined only *T. hæmatodes*, and have ascertained that it is distinguished by comparatively narrow tracts. The inferior tract has a very distinct outer branch upon the breast, between which and the weaker main tract there are, however, a few contour-feathers. The hinder part of the dorsal tract was very briefly forked, so that the simple stem of the fork is equal in length to the two branches. I found twenty-one remiges and a distinct oil-gland, but no powder-down feathers.

4. *Psittacus* Wagl.—From my investigation of *P. erithacus*, *dominicensis*, *ochrocephalus*, *leucocephalus* and *dufresnianus*, the species of this genus appear to belong to two pterylographic groups, for *P. erithacus* exhibited no trace of an outer branch on the inferior tract, and presented precisely the same characters as *P. domicella* and *P. pertinax;* whilst in *P. dominicensis* and the other American species, the biserial strongly and densely feathered outer branch is distinctly separated from the sparsely feathered main tract. The dorsal tract is of the usual formation as far as the fork, but in *P. dominicensis* the posterior or covered portion forms a general, sparse plumage coalescing with the femoral and crural tracts, in which a furcate division can only be recognised in front, but no densely feathered fork-stem is to be observed posteriorly; whilst in

[1] Wagler says in the character of this genus, "*lingua simplex glabra;*" but I find in both species that the tongue is as strongly spinose as in *Trichoglossus hæmatodes*, with which, therefore, these species should be united. [This fact has been subsequently noted by Dr. Weinland, 'Journ. f. Orn.,' No. xii, p. lxix, and Mr. Wallace, 'Ann. N. H.,' 1859, Feb., p. 147.—P.L.S.]

P. erithacus such a densely feathered stem is visible at the end of the fork. To this may be added, that *P. erithacus* alone possesses an oil-gland, while the above-mentioned American species certainly have not this organ, but are furnished with scattered powder-down feathers in the posterior portion of the dorsal tract, these being especially distinct in *P. ochrocephalus* and *dufresnianus*.[1] The number of remiges in these is twenty-three, and the second, third, and fourth are the longest; *P. erithacus* has twenty-four. The inner small humeral tract is certainly present, at least in the American species, but much smaller than in *P. pertinax*.

5. *Pionus* Wagl.—Of *P. menstruus* and *purpureus*, the only species of this group that I have examined, I can only mention that the oil-gland was *entirely* deficient, without any powder-down feathers being present. In the wing I found twenty-two obtuse remiges, of which the third is the longest. Unfortunately I did not at the time notice the forms of the tracts in these birds, which I only once had the opportunity of examining.

6. *Psittacula* Wagl.—*P. pullarius* possesses in its general arrangement precisely the pterylosis of *P. pertinax*, but the tracts are much narrower and almost linear throughout. In the inferior tract the biserial outer branch was certainly not divergent from the narrow main stem, but indicated by stronger and closer feathers. The posterior portion of the dorsal tract forms a weakly feathered fork, which, however, is not dilated externally, and its stem reaches from the caudal pit to the *distinctly existent* oil-gland. There are no powder-down feathers. The wing bears twenty remiges, of which the second is the longest.

7. *Platycercus*. Besides *P. erythropterus*, which I carefully examined, I have seen of this genus *P. novæ seelandiæ*, *P. pennantii*, and some other species not accurately determined. The first-named species exhibits a very remarkable narrowness of all the tracts, which were only two feathers broad, but in other respects presents the forms proper to the Parrots, namely, the double humeral tract, the furcate form of the hinder part of the dorsal tract, which is cleft as far as the caudal pit, and the arms of which pass in between the stronger limbs of the anterior part, the long lumbar tract, and the inferior tract divided before the middle of the neck. The chief peculiarity of the *Platycerci* is also presented by this tract, namely, *a complete and perfectly* (*indeed, widely*) *divergent and rather stronger outer branch*. The long, acute wings consist of twenty-two remiges, of which the second is the longest; the oil-gland is present, but there are no powder-down feathers. *P. novæ seelandiæ* presents the same characters; but the more obliquely placed outer branch forms a hook at the end, and the fork of the posterior part of the dorsal tract is somewhat dilated. Moreover, I only counted twenty remiges in the wings.[2]

8. *Palæornis*, Wagl.—In this group also I overlooked the form of the tracts, and only noticed that the two species investigated (*P. alexandri* and *torquatus*, Briss.) possessed an oil-gland, but no powder-down feathers. The number of remiges was from twenty-one to twenty-three, and the second was the longest; this, as also the first and third, has the inner half of the vane narrowed towards the apex, and furnished with a slight angular emargination.

[1] It is remarkable that powder-down feathers occur only in those Parrots which are destitute of the oil-gland, but not in all of these.

[2] The almost total absence of a furcula, which has already been referred to as a peculiarity of many Parrots (*P. mitratus*, *eximius*, and *galgulus*) in Taylor's 'Phil. Mag.,' 1831, No. 51, p. 232, occurs as a general character of the *Platycerci* examined by me, and also in *P. pullarius*. This bone is weak in all the Parrots.

9. *Calyptorhynchus* Vig., Wagl.—According to my examination of *P. leachii* and *funereus* the pterylosis has exactly the form of that of the *Platycerci*, and consists of narrow tracts two feathers in width, with a distinctly separated narrow outer branch on the inferior tract, a remarkably broad inferior space, and, what is most singular, a narrow, *simple* humeral tract. By the side of the furcate rump-tract there are powder-down feathers, although the oil-gland is distinctly present. Like the following group, this has also *a large circular vertical space* commencing immediately behind the feathers of the crest, which stand in *two* transverse rows on the forehead, and extending to the occiput. In the wings I found twenty-two remiges, of which the first are very acute and have the inner web narrowed for more than half its length; the third is the longest.

10. *Plyctolophus* Vig. (*Cacatua* Wagl.) The true Cockatoos, of which I have examined *P. cristatus*, *sulphureus*, and *galeritus*, possess the vertical space described in the preceding genus, but have not exactly the same pterylosis in other respects. I certainly noticed a divergent branch on the inferior tract of *P. galeritus;* but the tracts themselves were broader and more sparsely feathered, although all of them contained only two rows of feathers, with the exception of the nape-portion of the dorsal tract and the outer branches of the inferior tract, which consisted of three rows. This species possessed powder-down feathers on the region of the pelvis and a very distinct oil-gland; the latter I also detected in *P. sulphureus*, but in *P. cristatus* it is reduced to a small membranous mamilla beset with feathers. In this last-mentioned species the inferior space passed over the whole lower surface of the neck to the throat and the naked space behind the lower mandible, so as completely to divide the inferior space into two halves. At the same time, the outer branch did not appear to me to be distinctly separated from the main stem, and each half of the inferior tract seemed to form a simple, very sparsely feathered quadriserial band. The wings also presented very peculiar characters, the remiges, twenty-two or twenty-three in number, being obtusely rounded at the end, the third equal in length to the fourth, fifth, and sixth: the hindmost secondaries were but little shorter than these four longest primaries. Moreover, the first four or five presented a distinct emargination of the inner web, which reached far down upon them. This, at least, is the form of the wing in *P. cristatus*.

8. Lipoglossæ.

The three genera which I refer to this family, namely, *Buceros*, *Upupa*, and *Alcedo*, with the subordinate divisions of recent writers, agree pterylographically in the absence of an after-shaft on the contour-feathers and in the feathered tip of the oil-gland, but differ greatly in other respects both in the form of the tracts and in the general character of the plumage. For, whilst in *Buceros* the feathers are very sparsely distributed and form an almost uninterrupted plumage, *Upupa* has narrow, linear tracts; and although these also occur in *Alcedo*, this genus is remarkably distinguished by a dense, general downy covering, which is wanting both in *Upupa* and *Buceros*. The latter two genera have *ten* rectrices, whilst *Alcedo* possesses *twelve*.

1. *Buceros*.—According to my examination of *B. abyssinicus*, *biarcuatus*, *plicatus*, *coronatus*, and *nasutus*, the larger species tend towards a nearly uninterrupted plumage, whilst in the smaller ones the spaces are broader and appear more distinctly. All of them have the feathers very sparsely inserted, and no down-feathers on the trunk: there are only a few on the inferior wing-

space, which is also the largest of all the spaces. (Plate VI, fig. 1.) I likewise observed a narrow central inferior space, starting only from the lower extremity of the neck; a short lateral space on the trunk; an indistinct, narrow superior wing-space beside the humeral tract (fig. 2); and a narrow lanceolate spinal space between the shoulder-blades. This latter appeared to be wanting in *B. biarcuatus* and *coronatus*, but was distinctly visible in *B. nasutus*. This species also had a somewhat longer and broader inferior space, and a very distinct broad lateral space, which was observable both superiorly near the dorsal tract, and inferiorly beside the bands of the inferior tract. In the posterior part of this, on the thigh, two rows of feathers appear distinctly as a *lumbar tract*. The pterylosis of this species is, however, just as sparse and weak, as in the species figured and the rest of the group; the axillary tracts alone, which are three or four rows in breadth, are distinguished, especially towards their posterior extremity, by stronger and more closely approximated feathers. On the rest of the body, with the exception of the neck, the contour-feathers are very lax, for the most part with downy barbs, and with their barbules not well linked together. In *B. abyssinicus* I counted twenty-seven remiges, in *B. plicatus* twenty-six, in *B. biarcuatus* twenty-four, and in *B. coronatus* and *B. nasutus* only twenty-one; of these the first three are very strongly graduated, and the fourth, fifth, and sixth are the longest and of exactly equal length; *B. biarcuatus* alone is distinguished by having the seventh the longest and all the preceding ones graduated. None of the remiges present any degradation or diminution of the inner web, but they are on the whole narrow and pointed. The thumb always bears *four* feathers.

The oil-gland, which I have carefully examined only in *B. abyssinicus*, appears as a large, rounded bulb, covered all over with woolly feathers; I could not detect on it any mamilla or orifice, but the shafts of the above-mentioned feathers penetrated the bulb throughout to the base. In *B. biarcuatus* and *B. plicatus*, the external aspect of this organ was exactly the same; but in *B. nasutus* the gland has a very elongated cylindrical appearance; it lay precisely upon the middle feathers of the tail, and bore at its obtuse extremity a circlet of very short oil-feathers.

I have yet to notice that the margins of the eyelids, especially the upper ones, are furnished with very strong lashes, and that these are larger in proportion as the naked space surrounding the eye is extended. In most cases, also, there is a naked space under the throat, as in the Parrots.

2. *Upupa* (Plate VI, figs. 3 and 4).—The tracts of this genus are remarkably narrow, and in this respect, as also in their form, resemble those of the analogous genus *Galbula*. The head is sparsely feathered, with a narrow longitudinal space in the middle of the crest, and a large temporal space behind each eye. The neck is for the most part naked, as down-feathers are almost entirely wanting here not only on the tracts, but also on the spaces. I have detected a few, partly rather strong down-feathers, only at the inner margin of the inferior space, at the outer margin of the truncal portion of the dorsal tract, on the lower wing space, on the femoral tracts, where they pass imperceptibly into the contour-feathers, and in the vicinity of the axilla between it and the branch of the inferior tract. The dorsal tract is uninterrupted; commences as a narrow, but still quadriserial band at the nape; continues of the same structure to the shoulders, and divides here into two limbs, which are each four feathers broad, run along at the inner margin of the shoulder-blades, and, enclosing the entire spinal column between them, meet again at the caudal pit, from which they run as a simple stem, retaining the same breadth, to the oil-gland, immediately in front of which they terminate. The inferior tract is still narrower and weaker; it commences as a simple band at the throat, but divides immediately into two

biserial limbs, which, at the bottom of the neck, give off a row of feathers to the axillary tract, and pass upon the pectoral muscles under considerable divergence. Here each stem gives off a triserial outer branch, which runs parallel to the mainstem, and terminates in an obtuse extremity. The mainstem itself, two feathers in width, at first somewhat approaches the crest of the sternum, then passes more outwards, describes a moderate curve upon the belly, and terminates near the anus. The weak axillary tract is simple and three feathers broad; the long lumbar tract consists of two rows of weak feathers, but the tibia is clothed with a homogeneous sparse plumage. In the wings I found twenty remiges, of which the first is very small, whilst the second is equal to the seventh, and the third, fourth, and fifth are the longest. The upper accessory wings (*parapterum superius*) consist of seven feathers; the lower accessory wings (*parapterum inferius*) are merely formed of semiplumes, which are continued on the breast as far as the outer branch of the inferior tract, forming a hook with it. The whole of the great wing-membrane beneath is a large space, which is covered by the feathers of its anterior margin; above it is half covered with feathers, and the rest, as far as the axillary tract, is a space. The singular structure of the oil-gland in this bird has already been mentioned (p. 41); I will now describe it in more detail. It consists of two almost completely separated, widely distant halves, the posterior ends of which are apparently united only by cellular tissue; these are seated upon a large pyriform membranous cavity, the acute hinder end of which is stretched and held open by the tubes of the circlet of feathers which are inserted in it. The vanes of these feathers are bent outwards posteriorly, and form the wide, trumpet-like entrance to the cavity, in the base of which, opposite to the orifice, two small pits may be observed, in which the numerous secretory tubes of each half of the gland open. The gland exhibits no other cavity, but presents a radiating texture in its interior, from the course taken by the canals of the gland. In the latter I found at all times a yellowish, inodorous oil; but the cavity behind the gland contained, not in the males, but in the females at the breeding season, and in the young nestlings, a thicker blackish fluid which diffused the most insupportable odour, and is the cause of the ill name of the Hoopoe in this respect. This is merited, however, only at the breeding season, and even then not by the male, but only by the female and young. The latter, which I have repeatedly seen, possess a lax nest-clothing, the downy barbules of which are seated upon the first barbs of the future contour-feathers, as I have ascertained most decidedly by a very careful examination. These barbules, however, are wanting in all parts of the inferior tract and on the wings, but they occur on all other parts which bear contour-feathers, issuing from the apices of the latter. I was also struck by the very remarkably broad and snow-white skin of the angle of the mouth in these young birds.[1]

Upupa africana and *U. erythrorhyncha*, which I likewise examined, agree exactly in all their pterylographic characters with the European species, as does the second also in the form of the oil-gland and the shape of the wings; nevertheless, *U. erythrorhyncha* has only *nineteen* remiges, and the fourth, fifth, and sixth are the longest. There can consequently be no doubt that this species, which is referred by Temminck to *Epimachus*, and by Lichtenstein to *Nectarinia*, belongs to the present genus.[2] The skeleton also, which I examined in the Museum at Frankfort, shows it to be a *Upupa*.

[1] In this respect the Hoopoe much more resembles the Passerinæ than the other Picariæ, the young of which, especially those of *Alcedo* and *Picus*, usually possess a very slight dilatation of the skin of the rictus.

[2] [Confer also Strickland's remarks 'Ann. Nat. Hist.' xii, p. 238 (1843), upon the affinities of *Upupa* and *Irrisor*.—P.L.S.]

3. *Alcedo* (Plate VI, figs. 5—7).—In the form of the tracts this group agrees pretty closely with *Upupa;* but the main bands are broader, especially those of the ventral surface of the trunk; and the spinal space is wanting, although nearly at the same spot the dorsal tract is dilated into an elongated lanceolate saddle. But the Kingfishers are chiefly distinguished from *Upupa* and the other Picariæ by the presence of a tolerably distinct downy coat on the spaces, which is also continued between the contour-feathers of the tracts, and is deficient, or at all events very weak, only on the dorsal tract. On the lateral neck-spaces the down-feathers are very small, but rather large on the lateral spaces of the trunk; they everywhere present a simple main shaft, but no after-shaft. The feathers of the rather large, cordate, feathered oil-gland presented no umbellate form, but rather a short, flat shaft, furcate at the end, having five or six barbs on each side, and emitting three or four barbs from each end of the fork. It struck me as particularly remarkable that the young birds have no nestling-down, but are at first perfectly naked, and soon afterwards, when the contour-feathers sprout forth and still remain in the closed follicles, present somewhat the aspect of a young Hedgehog. How does this agree with the dense downy covering of the old birds? The presence of the latter is evidently to be accounted for by the residence of the Kingfishers on the shores and banks of inland waters, and appears, as in the case of *Cinclus*, to indicate a certain faculty of diving. At the breeding season this downy coat is interrupted, presenting *five* large brood-spots, namely, one on each side between the outer branch and the main stem of the inferior tract, a third in the inferior space exactly upon the crest of the sternum, and two others on the belly close to the inner margin of the main stems of the inferior tract. On all these spots the down-feathers are deficient, and the skin presents a great turgescence of the subjacent blood-vessels; a trace of weakening may even be observed on the neighbouring bands of contour-feathers. The specimen that I examined was a male, which had been taken on the nest sitting on four eggs; among the Kingfishers, therefore, both sexes incubate.

The characters of the tracts presented but slight differences in the species examined. In all of them the inferior tract, which is very narrow at its commencement at the angle of the chin, was simple as far as the lower extremity of the neck, and became divided only immediately in front of the furcula; at the same spot as in *Cuculus*, *Picus*, *Rhamphastus*, and others, it gave off a row of feathers to the axillary tract, and then passing on the breast, formed an outer branch stronger than the main stem, but parallel to it and of the same width. From its outer surface originates a somewhat sparse plumage running to the hypopterum. The main stem is continued nearly parallel to the crest of the sternum, curves somewhat outwardly on the belly, and then passes on in a strong curve to the anus, near which it terminates. The dorsal tract appears to be less uniform. In *A. ispida*, and the very similar *A. bengalensis*, a more densely feathered vertical tract could be distinguished among the uniformly sparse plumage of the head, originating at the bill and embracing its base; but this ceased at the nape, where the dorsal tract commenced at first very weakly (Pl. VI, fig. 6), continuing of the same width of four feathers as far as behind the shoulder-blades, but with its feathers very strong from the middle of the neck. From immediately behind the shoulders to the caudal pit it widened into a lanceolate saddle, which gradually passed into the narrow triserial rump-band, terminating at the oil-gland. In all the other species examined by me,—namely, *A. omnicolor* Temm. (*Pl. Col.*, 135), *A. coromanda* (*Dacelo* Less.), *A. senegalensis* (*Pl. Enl.*, 594), *A. maxima*, *A. smyrnensis*, *A. capensis*, *A. rudis*, and *A. collaris*,—the dorsal tract was of uniform strength as far as the commencement of the shoulder-blades, but

was here interrupted by a true or (in *Dacelo gigantea*, Pl. VI, fig. 7) false gap, behind which it again commenced as a sparsely feathered hinder part enlarged in all directions, and continued in the same form to the caudal pit, at which it was contracted into a stronger rump-band two or three feathers in width. By the side of this in *A. coromanda*, *smyrnensis*, *capensis*, and *omnicolor*, I find scattered contour-feathers which extend to the lumbar tract and render this indistinct. In *A. collaris* the very long rump-band which reaches to the commencement of the pelvis is accompanied by two rows of contour-feathers at a moderate distance apart; and the lumbar tract is very distinct, and indeed strong: in *A. rudis*, *maxima*, and *senegalensis*, on the contrary, the rump-band is somewhat broader, stronger, and definitely limited. All these species, like *D. gigantea* (Pl. VI, fig. 7), have a rather strong and broad lumbar tract. In the smaller Kingfishers the number of remiges is twenty-two, in the larger ones twenty-four or twenty-five, of which the third is always the longest, whilst the first and second remain perceptibly shorter, the former being not longer than the tenth. In *A. collaris* alone (which is further strikingly distinguished by having the outer branch of the inferior tract very near the main stem), the first primary is as long as the second, third, fourth, and fifth, which exceed all the rest in length. The number of rectrices was twelve in all the species.

9. Amphibolæ.

The presence of an after-shaft on the contour-feathers is a pterylographic character common to all the members of this family; as also the occurrence of a circlet of feathers on the tip of the oil-gland, and the number of rectrices, which is always ten. With these characters, however, we seem to have exhausted the points of agreement of the genera belonging to the group, and their essential differences necessitate the following arrangement:

A. *With the bands of the inferior tract narrow, and the outer branch distinct and freely divergent.*

This group includes the genera *Corythaix* and *Musophaga*, of which the latter is pterylographically represented on Plate VI, figs. 8 and 9. Besides the species figured (*M. paulina*), I have examined *M. violacea* and *M. variegata* (*Phasianus africanus* Lath.), as also the well-known *Corythaix persa*. All agree perfectly with the figure here given, possessing a general covering of feathers on the head (except when naked rings are present round the eyes), from which two main tracts originate, one on the nape, the other on the throat. The former, the commencement of the dorsal tract, passes as a simple narrow band to the anterior end of the trunk, where it becomes a little dilated and then breaks off. Beyond a large gap situated between the shoulder-blades, which, however, is less distinct in *Corythaix persa* and which undoubtedly constitutes the chief pterylographic character of the Musophagidæ, commences, at the extremity of the interscapulium, the gradually widening hinder part of the dorsal tract, which gradually extends into a sparsely feathered saddle, consisting, however, of rows of feathers running obliquely from before backwards, in which the true main stem is still indicated by two closer central rows. It is only in *M. paulina* that the femoral tracts remain distinctly separated from this large saddle, and the portion situated on the tail is here only distinguishable as a narrow triserial band; in all the

other species the sparse plumage completely covers the whole hinder part of the back, passing not only over the thighs, but even upon the tibiæ. I found no such differences in the inferior tract. Simple as far as the middle of the neck, and separated from the dorsal tract by a broad lateral neck-space which reaches to the head, it divides at the middle of the neck into two limbs, which pass on the breast in a converging direction, and here, after sending off a single row of feathers to the axillary tract, form a parallel-sided, strong, and perfectly free outer branch, from the extremity of which a hook is emitted only in *M. variegata*, and even this is not continued upon the arm, the hypopterum consisting only of semiplumes. The main stem, which is at first narrowed, runs onward close beside the sternal keel, passes slightly divergently upon the belly, and terminates somewhat laterally near to and in front of the anus. Besides these the axillary tracts alone are noticeable as strong feather-bands. The wings are covered above by a dense plumage, which reaches pretty nearly to the axillary tract, but is almost wanting beneath as far as the rows of feathers on the anterior margin of the wing-membrane and those of the fore-arm. On this inferior wing-space, as also at the upper end of the central inferior space, I found down-feathers; but these were wanting on all the other spaces, as well as between the contour-feathers. The number of remiges is twenty-two or twenty-three, of which ten are inserted on the pinion. The first three are graduated, and the fourth, fifth, and sixth are the longest. The long tail always consists of ten feathers.

B. *With the stems of the inferior tract dilated, and no divergent outer branch.*

a. Dorsal tract dilated on all sides, and sparsely feathered.

The genus *Colius*, which was first declared to be allied to *Corythaix* by Burchell ('Travels in Southern Africa,' vol. i, p. 214 [1822])—an opinion long since entertained by me, and recently strengthened by anatomical investigation—has a very remarkable arrangement of the feathers, and can only be compared in this respect with *Buceros*. This relation may be recognised from the representation of the pterylosis of *Colius capensis* given on Plate VI, figs. 10 and 11. In this species and in *C. striatus* I found a general sparse plumage, the contour-feathers of which are distinguished by their remarkably soft and thin tubes, and therefore do not everywhere project equally distinctly through the skin. It is only in the region of the outer branch of the inferior tract, the occipital portion of the dorsal tract, and the hinder part of the latter, that we find stronger feathers; and those on the last-mentioned part form anteriorly two recognisable limbs, between which the weaker plumage of the interscapulium penetrates. Hence there remain on the body only the following small downless spaces:—1, a right and left lateral neck-space reaching to the shoulder; 2, a likewise double but very narrow rump-space; 3, a tolerably large, double axillary space; and, 4, a simple inferior space, in which the anal opening is situated, and which is entirely confined to the hindmost portion of the ventral surface. To these may be added—5, a scarcely perceptible, simple occipital space at the extremity of the occiput, resembling that of *Trochilus* but much smaller. The species examined had nineteen remiges, of which ten were inserted on the pinion. The first four are graduated, and the fifth is the longest. The number of rectrices, which are strong and stiff, is ten; but the two outermost are so small, and stand so far above, almost over the two following, that they may easily be overlooked.

b. Dorsal tract much contracted, especially its hinder part, which forms a very narrow, biserial band.

Here I place the genus *Opisthocomus,* which is anomalous in many respects. The figure of its pterylosis (Plate VI, figs. 12 and 13) shows that the continuous plumage of the head, which is very sparse, but denser on the vertex, is continued upon the neck, and does not allow the formation of lateral neck-spaces. From the lower extremity of this neck-plumage the inferior tract commences as two broad bands, which run down close to the keel of the sternum, and become somewhat stronger at the outer margin where the branch would be situated. At the end of the sternum these are narrowed, and pass on, gradually becoming weaker, to the anus, at which they terminate with a breadth of only two feathers. Both on the tract itself and on the spaces between its bands, true down-feathers are placed, although not very closely. The same sparse condition is exhibited also by the lumbar tracts and the plumage of the crura and wings; but the narrow axillary tracts and the dorsal tract contain more closely approximated, although smaller feathers. The latter starts as a strong, triserial band from the midst of the plumage of the lower part of the neck, and divides between the shoulders into two limbs, with which the originally divergent feather-rows of the biserial hinder part are united at the end: from the caudal pit onwards it becomes somewhat broader, and encloses the oil-gland, which is larger, and has a circlet of feathers at the tip, stronger than in the preceding genera. In the wings there are nineteen remiges, of which ten are on the pinion; the first four are graduated, and the fifth and sixth the longest. The tail has ten large rectrices.

CHAPTER IV.

Pigeons—*Columbinæ.*

But few, and these not very important, peculiarities can be indicated as the pterylographic characters of the Pigeons, with which I unite the Sand-grouse (*Pterocles* and *Syrrhaptes*): indeed, it appears to me that except the very broad form of the tracts which closely cover more than half the surface of the body, the small, non-mamelliferous and perfectly naked oil-gland alone furnishes a good group-character. Both the Pigeons and Sand-grouse, indeed, are entirely destitute of down; but the after-shaft, which occurs in the latter, is wanting in the former. On the other hand, the two forms agree in the furcate form of the anterior part of the spinal tract, and the remarkable weakening of its hinder part, which commences between the branches of the fork; but a very similar structure is possessed by certain Gallinaceæ, such as *Numida* and *Penelope.* The number of remiges varies from twenty-one to twenty-eight, and that of the rectrices from twelve to sixteen.

1. Columba.

For the sake of more easy comprehension, I retain this great genus in its old extent, although I fully believe that it may be broken up into several genera with the same justice as *Psittacus*, *Falco*, and others of similar extent, for this opinion is supported by the great differences in the pterylosis even of the few species that I have examined. The general characters were only as follows:

The contour-feathers throughout have no after-shaft, and they stand close together, forming strong tracts. No down-feathers are observed amongst them, and these are also wanting on most of the spaces; I have detected a few only on the inferior wing-space, and the lateral spaces of the trunk. Even the young birds while still in the nest have no down-feathers, but simple yellow tufts of bristles appended to the tips of the contour-feathers. In this respect they precisely agree with the Passerinæ (see p. 74). The form of the tracts on the dorsal surface is the same in all the species, always presenting a strong, furcate anterior part of the spinal tract, and a posterior part, weakened at its commencement and margins, and divided by a narrow longitudinal space, from which, however, the broad femoral tracts are pretty distinctly separated. The anterior part is very clearly separated from the inferior tract by the lateral neck-spaces, which ascend nearly to the head. The inferior tract is broad at its commencement on the throat, and divides at the lower part of the neck; its pectoral tract is usually widened throughout, seldom narrow, and furnished with a distinct outer branch. The oil-gland, when it occurs, is obtusely cordate and perfectly naked. Its two halves have very thin walls, and possess a very wide cavity, extending through the whole gland. The remiges, which are usually long and pointed, amount at the utmost to twenty-five, of which the second is the longest.

In accordance with the number of rectrices, we may establish the following two groups:

I. Pigeons with Twelve Rectrices.

The species belonging to this group, which includes the whole of our indigenous Pigeons, exhibit in their pterylosis the form already described, and figured (Plate VII, figs. 1 and 2) as that of *Columba livia;* they all have a very broad and strong inferior tract, occupying the whole lower surface of the neck, dividing only immediately in front of the furcula, then becoming broader on the breast, where, however, it forms no outer branch, but is continued, widened throughout, as far as the hinder margin of the *musculus pectoralis major*, and becomes narrowed into the ventral portion as it runs along upon this margin. The ventral portion is short, half the width of the pectoral portion, and terminates at the anus. The region of the outer branch in the pectoral portion is very strong, and emits a few rows of feathers in front, running to the hypopterum. Above we find beside the dorsal tract a strong broad scapular tract, which is pointed behind.

In *C. livia* the division of the hinder part of the dorsal tract, which reaches to the caudal pit, is remarkably narrow, and the broad femoral tracts are connected by a few feathers with this hinder portion; in *C. tigrina* I found a much broader spinal space, and the lumbar tract was free all round. The other species of this section, such as *C. œnas*, *palumbus*, *turtur*, and *risoria*, agree more especially with the domestic Pigeon. *C. talpacoti* presents a remarkable peculiarity in its short, obtuse wings, the third, fourth, and fifth feathers of which are furnished with an angular emargination, gradually becoming weaker, towards the apex of the outer half of the vane, whilst the fourth alone possesses a very acute projecting angle at the base of the inner vane. The second primary is the longest, but the first and third are but little shorter.

II. Pigeons with Sixteen Rectrices.

The two species of this group known to me, namely, *C. militaris* and *C. coronata*, are further very remarkably distinguished from the other Pigeons *by the complete absence of the oil-gland.* The former, however, agrees perfectly in its pterylosis with *C. livia*, but nevertheless differs from it in the form of the first three remiges, which are remarkably pointed, and of which the third possesses a very singular emargination at the base of the inner vane. *C. coronata* differs very materially even in the structure of the tracts from all other Pigeons known to me, in this respect rather approaching the Gallinaceous Birds. Thus it has on the neck an almost uninterrupted plumage, the lateral neck-spaces being remarkably short, and the division of the inferior tract only commencing immediately in front of the furcula. Each limb passes on the breast in a very broad form, and sparsely feathered, and for some distance increases in width. Then it divides into *three* branches, the innermost of which, nearly approaching the crest of the sternum, is the true main stem, and consists of the greatest number (three to four) of rows of feathers; it is continued uninterruptedly on to the belly, when it turns a little outwards, and then returns in a curve to the anus. The second or middle branch is more sparsely feathered, but narrower; it runs parallel to the main stem, and terminates at the margin of the *musculus pectoralis major*. This is the true outer branch of the inferior tract. The third branch, the outermost in its position, originates nearly in the region of the axillary joint, and is strongly but very sparsely feathered; it turns more towards the inside of the upper arm, and runs down upon this as the hypopterum. The rest of the pterylosis has nothing peculiar. The dorsal tract is strong in the anterior, furcate portion; in the posterior portion, cleft longitudinally, sparsely feathered, and dilated externally, but not connected with the rather strong lumbar tracts. A weak plumage is presented by the tibiæ. The wings bear twenty-five remiges, the shafts of which are quadrangular, and have *three* furrows on the flat lower surface, one in the middle and one on each side; their form is not so narrow and acute as in other Pigeons, and the whole wing is more rounded.[1]

2. Pterocles.

In this genus, of which I have examined three species, namely, *P. coronatus*, *exustus*, and *setarius*, the pterylosis on the ventral surface (Plate VII, fig. 3) agrees pretty closely with that of *Columba livia;* but the uniform breadth and parallel-sided form of the bands of the inferior tract, which has not the least indication of an outer branch on the breast, may furnish a good distinctive, character. Above, at the shoulder-joint, it has beside it a few weaker feathers, which unite it with the axillary tract; the hypopterum, however, is not connected with it, but runs down beside it on the margin of the *musculus pectoralis major*. The dorsal surface (Plate VII, fig. 4) presents several distinctions, especially—1, the shortness of the lateral neck-space, which reaches only to the

[1] In its internal structure *Columba coronata* less strikingly resembles the Gallinaceæ, especially in having no traces of cæca, rudiments of which are always present in the other Pigeons. The gall-bladder is also entirely deficient.

beginning of the neck; 2, the absence of the superior wing-space; 3, the coalescence of the lumbar tracts with the hinder part of the dorsal tract; and, 4, the union of the latter tract with the plumage of the tibia. On the other hand, the form and structure of the anterior part of the dorsal tract is exactly as in the Pigeons, whilst the hinder part certainly has the same general constitution, but is much more dilated, and extends far more deeply between the arms of the scapular fork. To this may be added, that in *P. coronatus* and *P. exustus* the narrow spinal space is entirely wanting, but is distinctly present in *P. setarius*. In all these I found from *twenty-seven* to *twenty-eight* remiges, of which the ten belonging to the pinion are all strikingly graduated, so that the first is the longest; the secondaries again increase somewhat in length, but the longest of them is still scarcely half so long as the first primary. The tail always contains *sixteen* rectrices. Lastly, the Sand Grouse are distinguished from the Pigeons by the presence on the contour-feathers of an after-shaft (which, however, is but small); from the Gallinaceous Birds by the oil-gland being perfectly naked, even at the tip; and from both these groups by the perceptible, although weak, downy coating of the spaces.

CHAPTER V.

Gallinaceous Birds—*Gallinaceæ*.

Few families of equal extent have so concordant a pterylosis as that to the consideration of which we now turn, and, with the exception of the still more uniform Passerinæ, scarcely any group of birds of this rank can vie with it in the definiteness of its general type. Hence a general and accurate representation of it may be given with peculiar facility and completeness.

The contour-feathers have a considerable but only downy after-shaft, which is attached to the end of the very short and delicate quill, and is but weak in comparison to the very strong stem of the main shaft. The latter also bears far more downy than pennaceous barbs, and is characterised in the dorsal feathers of many genera (for example, *Polyplectron, Argus, Cryptonyx, Penelope, Crax, Crypturus*) by the enormous width of that portion of its extent on which the downy barbs are seated (see Plate I, fig. 1). True down-feathers are rare, and are entirely wanting among the contour-feathers; they stand singly here and there upon the spaces, most abundantly on the lateral spaces of the trunk, and become converted into semiplumes in proportion as they approach the contour-feather tracts. I have also observed down-feathers in the space between the outer branch and the main band of the inferior tract, as also on the inferior space in the jugular region immediately over the furcula; on the contrary, the lateral neck-space, which extends nearly to the head, is always naked. I have found powder-down feathers only in one genus, namely *Crypturus*. Here they form the border of the greatly elongated saddle of the dorsal tract, and partially penetrate between its outermost contour-feathers.

The tracts themselves are always very definitely bounded, but by no means very broad,

although pretty strong and densely feathered; they are never so close, however, even in the outer branch of the inferior tract, as in the Passerinæ. The *dorsal tract* always starts simply from the nape, and either remains simple to the oil-gland, or divides in the scapular region into two limbs, which afterwards coalesce again and circumscribe a lanceolate spinal space. The dorsal tract is also *either of uniform strength* in all parts, which is the most usual case, or *it has a gap* between the shoulder-blades, situated at the commencement of the furcation, and is further remarkable from the fact that the feathers of the anterior part are stronger than those of the hinder part. I have met with this condition only in *Numida;* a similar one as regards the feather-structure, although without a true gap, occurs in *Penelope*. Both forms, but especially the former, strikingly approach the type of the Pigeons. The *axillary tracts* are always broad but short; the *lumbar tracts* are uncommonly large and strong, but generally quite free, separated from the rump-portion of the dorsal tract, and composed of long, strong, but chiefly downy feathers, the length of which appears very remarkable when the legs are drawn backwards. The *inferior tract* is sometimes simple (*Gallus, Pavo*), sometimes divided at its commencement on the throat (*Crypturus*), but in the former case always divides, before reaching the middle of the neck, into two limbs, which gradually diverge and at the same time become broader. From the very commencement of the pectoral surface, therefore, they cover the latter completely, with the exception of a narrow space close to the crest of the sternum, and are also united externally with the axillary tracts. After a short course this breadth ceases, and we may at once distinguish a strong and always *wedge-shaped* outer branch, the strongly feathered outer margin of which runs parallel to the inner margin of the pectoral band, whilst the inner margin forms an acute angle with the main stem. The branch usually terminates at the hinder margin of the *musculus pectoralis major;* it rarely passes beyond this (as in *Crypturus*, Plate VII, fig. 11), and becomes united posteriorly to the lumbar tract. The characters of the main stem are exactly the reverse of those of the branch—it is therefore very narrow and weakened, and runs down close to the crest of the sternum. On reaching the ventral surface, the two bands do not separate from each other, but frequently *coalesce to form a single stem,* which is directed straight to the anus, and terminates there. This *very peculiar* form of the inferior tract is the true and genuine Gallinaceous type, which becomes indistinct in proportion as the general characteristic Gallinaceous structure is effaced—hence it is deficient in *Crypturus* (Plate VII, fig. 11), and gives place to a Columbine structure.

In striking harmony with this form of the inferior tract is the short, rounded form of the wings, which is an equally genuine Gallinaceous structure. When carefully examined, the wings of the Gallinaceæ present from twenty-two to twenty-nine remiges, of which ten or eleven are inserted upon the pinion, and the fourth, fifth, and sixth are usually the longest; whilst the preceding and following feathers are uniformly shortened and graduated, and the *eleventh* is the smallest of all. This very small feather is sometimes the last on the pinion (*Phasianus*), sometimes the first on the ulna (*Tetrao*), and appears to be frequently deficient (for example, in *Numida, Polyplectron, Lophophorus, Crax, Penelope,* and *Crypturus*). The next is again as long as the tenth; thence onwards to the elbow-feather (the eighteenth, nineteenth, or twentieth) each feather increases a little in length, the remainder (from the elbow) being rapidly diminished graduatedly. By this means the extended wing acquires its peculiar bilobed appearance. On the thumb, also, I have always found four feathers, but in the tail all the numbers that occur in the whole class, namely, ten, twelve, fourteen, sixteen, eighteen, and twenty are met with.

With regard to the oil-gland, I have still to state that it has usually a flat, cordate form, but is perfectly elliptical in *Crypturus* and entirely wanting in *Argus*. In the first case it possesses a very distinct mamilla, the extremity of which is surrounded by a circlet of six or seven large umbellate plumes; in the second case the mamilla is wanting, and the scarcely perceptible orifices are situated on the upper surface of the gland, surrounded by four umbellate plumes. The two halves are always distinctly separated, although placed close together, and each of them contains a very wide cavity, extending deeply into the interior.

This great and almost complete agreement renders it impossible to group the genera of Gallinaceæ pterylographically. I prefer, therefore, employing the groups that I have established upon other generally anatomical characters, describing the species observed in each group, and indicating such deviations as I have been able to detect. In the first place, as has already been remarked under the Pigeons, I separate the Sand-grouse (*Syrrhaptidæ*) from the Gallinaceæ. I then divide the latter into two main groups, one of which includes only the genera *Hemipodius*, *Crypturus*, and *Megapodius;* the other all the rest of the Gallinaceæ. The latter, again, may be divided into *Tetraonidæ*, *Phasianidæ*, and *Penelopidæ*.[1]

1. Tetraonidæ.

1. *Tetrao*.—Judging from the examination of *T. lagopus*, *cupido*, *umbellus*, *hybridus*, *tetrix* and *urogallus*, the characters of the pterylosis are nearly as in *Meleagris* (Plate VII, figs. 9 and 10), but it appears to me that a rather strong formation of the fork of the scapular portion of the dorsal tract is characteristic of the *Tetraones;* the lanceolate spinal space also may be a little longer. The main stems of the inferior tract are united from the extremity of the sternum onwards, and this common part is here rather long. In the wings of *T. umbellus* I counted twenty-five, in *T. cupido* twenty-eight, in *T. hybridus* twenty-six, in *T. tetrix* twenty-five, and in *T. urogallus* twenty-nine remiges, of which the third or fourth is the longest, and the eleventh strikingly abbreviated. The tail in all these species contains eighteen feathers.

2. *Perdix*.—Of this genus I have examined *P. cinerea*, *petrosa*, *saxatilis*, *javanica*, *dentata*, Temm. (*guianensis* Lath., Licht.), *marylandica*, and *coturnix*. In two, namely *P. petrosa* and *javanica*, I found a narrow spinal space in the same position as in *Tetrao* and *Meleagris*, and also exactly the same form of dorsal tract; in the others I did not observe this space, although the dorsal tract has precisely the same form. In all of them, the pectoral band is remarkably weak and almost gap-like anteriorly close to the outer branch, and the ventral portion of the two bands is united into one. The lumbar tracts are free. *P. coturnix*, *dentata*, *marylandica* and *javanica* have twelve tail-feathers and from twenty-two to twenty-three remiges; in *P. petrosa* and *saxatilis* I found fourteen rectrices and twenty-four remiges; *P. cinerea* has eighteen feathers in the tail and twenty-three in the wing. In the Quails, as is well known, the first primary is the longest; in the true Partridges, on the contrary, the third, fourth, or fifth; the first three

[1] On the anatomical peculiarities of these groups consult my observations in Naumann's 'Naturgeschichte der Vögel Deutschlands,' vol. vi, pp. 270 and 429.

are sometimes (as in *P. dentata* and *marylandica*) curved inwards in the form of a sickle, sometimes (as in *P. cinerea* and *petrosa*) notched and narrowed on the inner vane.

2. Phasianidæ.

a. The main stems of the inferior tract remain completely separated to the anus.

1. *Meleagris.*—Besides the above-noted variation of the inferior tract, which is probably caused by the shortness of the sternum and the corresponding greater extension of the ventral surface, the pterylosis of the Turkey (*M. gallopavo*, Plate VII, figs. 9 and 10) presents no peculiarities except in the greater breadth of the two main stems of the inferior tract. The dorsal tract is rather sparsely feathered in the middle, and encloses a lanceolate space between the shoulder-blades, which also extends into the widened portion. The lumbar tracts are entirely free, and the axillary tracts on the whole not so strong as usual. The naked caruneulated portions of the head and anterior part of the neck cause the two bands of the inferior tract to commence only on the middle of the latter, where they are separated from each other; but the dorsal tract reaches nearly to the occiput. In the wings I counted twenty-eight remiges, of which the eleventh is very small; the tail contains eighteen rectrices. The after-shaft of the contour-feathers is minute, but is of considerable size on the down-feathers which form the borders of the tracts. The commencement of each band of the inferior tract near the branch also consists only of such down-feathers. The oil-gland has seven large umbellate plumes on its mamilla. On the jugular portion of the inferior space in the male, immediately in front of the furcula, there is, as is well known, a long beard-like tuft, which consists of several stiff bristles, perfectly destitute of barbs, but hollow.

2. *Numida.*—This genus approaches very closely to the preceding in its pterylosis, but is distinguished by the following points, as appears from an examination of *N. meleagris* and *N. mitrata* Lath. The dorsal tract is interrupted at the extremity of the strong scapular fork, and the rather narrow posterior portion, which, however, as in *Meleagris*, is broader in front, has no longitudinal space. The axillary tracts are much narrower, but the lumbar tracts are so broad, at least anteriorly, that they come in contact with the dorsal tract. The main stem of the inferior tract commences in front near the branch with only one row of feathers, and appears to be separated from its neighbour posteriorly as far as the anus. The contour-feathers have a still smaller after-shaft. On the wings there are twenty-four remiges, but the eleventh is not so remarkably reduced in size; the tail consists of *sixteen* feathers.

b. The main stems of the inferior tract coalesce into a single band from the extremity of the sternum.

1. *Cryptonyx.*—The species investigated by me, *C. coronata*, has the dorsal tract of *Meleagris*, and the broad lumbar tracts, coalescent with the dorsal, of *Numida;* but is distinguished from both by the remarkably narrow, acute, outer branch of the inferior tract and its very narrow

main bands, with regard to which I could not ascertain with certainty whether they coalesce behind, although they seem to do so. The wings bear twenty-two remiges, of which the eleventh is very small; in the tail I counted fourteen rectrices. The contour-feathers have a rather large after-shaft, and, singularly enough, a fine longitudinal furrow on the upper surface of the lower and thicker part of the shaft. The long feathers of the nape are entirely destitute of barbules on the distant barbs of the part exposed to the light; lower down they become downy, and bear a very small after-shaft.

2. *Polyplectron chinquis*, Temm., *Pl. Col.*, 539.—Pterylosis as in *Cryptonyx*, but the broad, hinder part of the spinal tract is somewhat narrower in front, the longitudinal space in it is perfectly cuneate, and the union of the lumbar tracts with the dorsal tract is not so broad. Inferior tract narrow, but the branch rather broader. Contour-feathers with a large after-shaft, and the lower part of the shaft very broad, on which even the inner side *has no longitudinal furrow*. Remiges probably twenty-three; the first three strongly graduated and falciform. The small eleventh feather was not observed; in the tail twenty feathers, and above these about ten tail-coverts of half their length.

3. *Lophophorus refulgens*, Temm., *Pl. Col.*, 507 ♂ and 513 ♀.—The tracts throughout exhibit no difference from the forms observed in *Polyplectron* and *Cryptonyx*, except that the dilated portion of the dorsal tract, the longitudinal space in it, and the outer branch of the inferior tract are broader; the lumbar tracts also appear to be completely separated from the rump part of the dorsal tract. The wings bear twenty-six remiges, and the eleventh is not diminutive; the first three are falciform, but not so short as in *Polyplectron*. The tail contains eighteen feathers.

4. *Gallus*.—The figures of the tracts in the Common Fowl, given in Plate VII, figs. 5 and 6, show, as its chief peculiarity, the want of the insular space in the less dilated dorsal part of the dorsal tract; in all other respects it agrees with the preceding genera, although the lumbar tracts are imperfectly separated from the dorsal tract. A second species examined by me, *Gallus furcatus*, Temm., *Pl. Col.*, 483, had a very distinct insular space in the dorsal tract, which was also broader on the anterior part of the back, but otherwise presented no differences. Both had fourteen rectrices; but *G. bankiva* possesses twenty-four and *G. furcatus* only twenty-two remiges, of which the eleventh is the smallest in both.

5. *Phasianus*.—Judging from an examination of *P. pictus, nycthemerus, sieboldi, diardi, veneratus* and *colchicus*, this genus is distinguished from *Gallus bankiva* by nothing except the number of the tail-feathers, which is eighteen. The number of remiges is twenty-six, and the eleventh is of very inconsiderable size. Two small, conical fleshy lobes, placed superiorly at the extremity of the naked cheeks near the occiput, support the feathers which many Pheasants, *e.g. P. colchicus*, are able to erect like ear-tufts—they are evidently analogous structures to the horns of *Tragopan satyrus*.

6. *Argus*.—This genus also does not differ at all in the type of its tracts from the common Fowl and the Pheasants, but is strikingly distinguished from all other Gallinaceæ by the *total absence of the oil-gland* in both sexes. I counted twenty-six remiges, of which the eleventh was very remarkably small; but only twelve rectrices. The enormous length of the secondaries, which occurs in both sexes, but in the female in a less degree, is an important generic character; of the primaries the first five are graduated, and the other five *all of equal length*.

7. *Pavo*.—Whilst the rest of the tracts (Plate VII, figs. 7 and 8) are of exactly the same form

as in *Gallus*, *Phasianus*, and *Argus*, the dorsal tract of the Peacock differs very essentially from the Gallinaceous type. It is linear and of equal breadth to behind the shoulder-blades (Plate VII, fig. 8), but begins to widen in the pelvic region. Anteriorly, immediately behind the shoulder-blades, there are beside it a few scattered contour-feathers. Consisting of three rows of feathers up to this point, it receives the addition of a fourth row at the extremity of the shoulders, and then increases by one feather in each transverse row upon the pelvis, thus forming a great saddle, which covers the whole region of the rump to the tail. This saddle consists of from fifteen to twenty transverse rows, of which the last seven are each sixteen feathers broad, the four preceding ones twelve, and the six preceding these ten; these are followed by some rows with nine, eight, seven, six, and five feathers, which quite gradually effect the transition of the narrow spinal tract into its wide hinder portion. It is only in the latter that the beautiful feathers of the male are seated, and therefore this part in the female is much smaller, shorter, and weaker, although similar in its arrangement. In the wing I counted from twenty-eight to thirty remiges; the ten primaries are graduated on both sides, so that the sixth is the longest; the eleventh is very small. In the male the tail contained twenty, or exceptionally nineteen feathers; in the female regularly only eighteen. The oil-gland is present, but concealed in the flesh up to the mamilla. The contour-feathers exhibit no remarkable and sudden thickening at the lower extremity of the shaft, and have a very small after-shaft; in both these respects they resemble those of the Turkey.

3. Penelopidæ.

1. *Crax*.—This genus has most resemblance to the Peacock in its pterylosis, and is distinguished from it only by the circumstance that the dorsal tract is dilated even at the commencement of the shoulder-blades, and then gradually becomes so broad that it is completely coalescent with the lumbar tracts. The whole of this dilated portion is, however, sparsely feathered. In the inferior tract the two main bands are separated as far as the anus, and the outer branch is narrower and weaker. The contour-feathers are moderately thickened at the lower extremity of the shaft, and have a very small after-shaft. The wings consist of twenty-four remiges, of which the *seventh* is the longest, and the eleventh is not diminished. In the tail I counted *twelve* graduated rectrices; the oil-gland bears only a few small feathers on the mamilla. I examined *Crax alector* and *C. blumenbachii*, which agreed in all respects.

2. *Penelope*.—I have only been able to examine two species, namely, *P. jacutinga* and *P. superciliaris*. The latter agrees exactly with *Crax*; in the former, however, there is a narrow space in front, between the shoulder-blades, in the generally diffused dorsal tract, which covers the whole of the back; this is enclosed by the tolerably strong limbs of the scapular fork, and reaches but a short distance into the hinder part. In the inferior tract I could find no difference from *Crax* in either species, and hence it would appear that the complete separation of the two main stems as far as the anus is common to all the *Penelopidæ*. Nevertheless, in *P. jacutinga* they were united to each other by a transverse band immediately in front of the anus. In this species a few very widely scattered contour-feathers stand near the main bands on the outside; and I was particularly struck by the enormous thickening of the lower part of the main stem of its contour-feathers, which occupies two thirds of the whole length of the shaft. This part is

obtusely triangular, slightly convex anteriorly, posteriorly with a rounded edge, and without a median furrow. The after-shaft is at the same time remarkably small. In the wing I counted twenty-six remiges in *P. jacutinga*, and twenty-three in *P. superciliaris*; in the former the seventh, in the latter the sixth, was the longest, and the preceding ones were distinguished by a narrow, strongly curved, nearly falciform form. The tail in both species consisted of *twelve* feathers. The oil-gland as in *Craæ*.

4. Crypturidæ.

Although this group decidedly differs in many of its characters from the rest of the Gallinaceæ, it is nevertheless destitute of any exclusive pterylographic character; on the contrary, the type of its plumage is quite analogous to that of the other Gallinaceæ. I have, however, never observed any great thickening of the lower half of the shaft of its contour-feathers, and have always found the bands of the inferior tract completely separate down to the anus.

1. *Crypturus*.—This genus has two remarkable peculiarities. One of these occurs in the dorsal tract, and consists in the presence of powder-down-feathers, which enclose the dilatation of the hinder part, and separate it both from the spaces and from the lumbar tracts (Pl. VII, fig. 12). These powder-down-feathers therefore form no true tracts, but are intruded into the gaps of the contour-feathers, so that in *Crypturus* we find true down in these places among the contour-feathers, a peculiarity which occurs in no other Gallinaceous bird. However, the dilated portion of the tract starts thus suddenly from the narrow rump-band only in *C. tataupa* and *C. variegatus*; in *C. tao* it narrows gradually, and thus approaches more to the form of *Phasianus*, *Argus*, &c. The second peculiarity consists in the structure of the inferior tract, which is divided very high up, almost at the throat, and has a very remarkable form after it passes on to the breast. At this point, indeed, we soon recognise the difference between the strong outer branch and the weak main stem; but the former, in complete opposition to the true Gallinacean type, is narrower than the latter. To this must be added, that the outer branch does not terminate as usual on the breast, but is continued beyond the pectoral boundary, passes through the lateral space of the trunk, and unites with the anterior extremity of the lumbar tract of the same side. Nowhere else have I observed a similar union of the two tracts. The lumbar tract itself is large, as in all the Gallinaceæ, and separate from the dorsal tract (Plate VII, fig. 12). I have already mentioned that the *Crypturi* possess a very small elliptical oil-gland, the orifices of which are situated upon its upper surface. Below this I found in *C. tao* ten rather large rectrices, but in *C. tataupa* and *C. rufescens* they are certainly wanting. The first-mentioned species also differs in the absence of the after-shaft upon the contour-feathers, which is very distinctly possessed by the other two species. In the wings of all four species I found from twenty-three to twenty-six remiges, among which there was no diminutive eleventh; the third (*C. rufescens*) or the fifth (*C. variegatus* and *C. tao*) was the longest, and the preceding ones are narrower, and falciform, at least in *C. tao*.

2. *Hemipodius*, *s. Ortygis*.—This genus also has many remarkable peculiarities. The most important is evidently in the dorsal tract, which widens from the end of the shoulder-blades, and only contracts again at the caudal pit, forming a lanceolate elliptical saddle, which is occupied throughout its whole length by a spinal space, also of lanceolate form. The contour-feathers at the margin of the space are strong, but they become weaker as they are situated more exteriorly

In the other tracts I have noticed only their narrow form, especially that of the outer branch of the inferior tract, which is obtuse at the end, and sends a hook to the hypopterum. The main bands remain separate as far as the anus. The lumbar tract is as long as in the true Gallinaceæ, but not so strong. In the wing I counted *twenty-five* remarkably short remiges; the first is the longest, but is nearly equalled by the second, third and fourth; the following rapidly become shorter, but the eleventh is not smaller than the others; the hinder secondaries, again, are rather long. I could not precisely ascertain the number of tail-feathers—according to Temminck ('Hist. Nat. des Gallinacés,' iii, 609) the genus has ten—in *H. pugnax* I found only six, but some were wanting. I have likewise examined *H. tachydromus*. The oil-gland is present, and circlet of feathers on its mamilla.

3. *Megapodius*.—Of this rare and aberrant form I have only been able to examine a stuffed specimen of *M. rubripes* in Temminck's collection, and by this means ascertained that it possesses the general characters of the Gallinaceæ. The remiges were short and curved on to the body, but unfortunately they were being moulted; the first, however, were decidedly graduated. In the tail I found only eight feathers, probably for the same reason. The contour-feathers had a distinct after-shaft, and the oil-gland bore a circlet of feathers at the apex.

CHAPTER VI.

Cursorial Birds (*Currentes* Auctt.).

Platysternæ Nitzsch.[1]

The four known members of this remarkable and abnormal family are distinguished pterylographically from all other birds especially by the circumstance that certain conditions of plumage occur in them as a general rule, which are met with elsewhere only as occasional exceptions. The first and most important is undoubtedly the complete absence of interruptions in the plumage, inasmuch as the whole body, with the exception of the constantly naked parts of the head and neck, the naked band on the breast along the crest of the sternum, the tarsi, and in the African Ostrich the legs and the sides of the trunk, is covered, after the fashion of Mammals, with a homogeneous feathery coat, which consists entirely of contour-feathers. In the true Cassowaries these contour-feathers have an after-shaft equal to the main shaft; in the Ostriches the after-shaft is entirely wanting; but in all the peculiar hooked structures on the barbules are absent, and the contour-feathers consequently never present coherent surfaces, but merely regularly branched tufts. Hence the feathers of the Cursorial Birds truly occupy a middle place between down- and contour-feathers, being strongly and powerfully formed like the latter, but, like the former, not united into continuous surfaces. The second marked character is

[1] Although, in his 'Memoir on the Carotid Artery of Birds,' Nitzsch placed this group at the end of his system, he afterwards became convinced that it must be intercalated here, between the Gallinaceous and Wading Birds.—(Burm.)

unquestionably the total absence of the oil-gland. Along with the power of flight both remiges and rectrices are wanting; in the Indian Cassowary alone the rigid shafts of the former are still indicated in the form of thick, long, powerful spines.

This is all that I have to say upon the pterylosis of the Cursorial Birds, all the species of which I have repeatedly examined, even in a fresh state. But the first coat of the young birds presents material for some further remarks. This consists, as in all cases, of truly downy barbs, which are seated upon the apices of the future contour-feathers. I have ascertained the mode in which this union is effected in *Dromæus novæ hollandiæ*, of which, as also of *Rhea americana*, I have been able to examine very young examples, only two or three weeks old. I found that the down is at first a true perfect feather, which is inserted into the same follicle from which the contour-feather subsequently grows. Each of these down-feathers in *Dromæus* has two shafts of the same structure, and analogous in their ramification to those of the future contour-feathers, but the number of barbs is much less, at the utmost six or eight. The two uppermost barbs, in which, as in a sort of fork, both the main and after-shafts terminate, are for the most part not at all feather-like, but are simple linear lanceolate bristles, finer towards the end, round, flat beneath, and so long as not unfrequently to exceed the whole down-feather in length. The next two or three barbs also bear similar but much smaller bristles. Hence arises the apparent hairy covering possessed by the young Cassowary, which is usually well expressed in representations of it. At the base each down-feather has a small tube, with the inferior open and cleft extremity of which the extreme tips of the following contour-feathers (both shafts and barbs) are amalgamated, so that, as soon as the contour-feathers sprout forth, the down-feathers are suspended upon them, and are cast off, or fall of themselves, only at a later period. The structure in *Rhea* is exactly the same; but as this genus has only a single shaft in each feather, the down is also only provided with one shaft.[1]

[1] I have had the opportunity of examining the downy covering of an African Ostrich at the utmost a few weeks old. It presented precisely the above-described structure of feathers; and although, on account of the youth of the specimen, no trace of the future contour-feathers could be detected, and therefore the down-feathers themselves were still inserted in the skin, I have no doubt that in this genus also they are elevated and thrown off by the contour-feathers. The uppermost four or six barbs of these down-feathers ran out into long, linear-lanceolate, horny, perfectly naked processes, destitute of barbules, which were bent down on the body, and lightly covered the true downy coat, at least upon the trunk. Both the down-feathers and these appendages of theirs were partly yellowish-gray and partly black; that is to say, some of the feathers were entirely of one colour, others of the other, and they stood intermixed with each other. Even on the head and neck this young Ostrich had a general setiform covering, which presented a very definite coloration and pattern. The vertex and forehead were yellowish-brown, the throat and fore part of the neck reddish-white, the hinder part of the neck more grayish, and rows of elongate black spots ran down the sides of the neck. On the body black and white feathers stood intermixed, but the former predominated above and the latter on the sides. The sides of the trunk in the vicinity of the thighs were naked, but both the thigh and the tibia were covered by the fine setigerous downy coat.—Burmeister.

CHAPTER VII.

Wading Birds (*Grallæ*).

In this group of birds, which includes many species, there prevails a considerable difference of pterylosis, as, indeed, would appear probable from the differences in the external forms of its members. Hence we can hardly indicate any exclusive pterylographic characters. With the following equivalent group, that of the Swimming Birds, it agrees in the presence of down-feathers not only on the spaces, but also among the contour-feathers. This general law for all aquatic birds appears to be subject only to a single exception (in *Otis*), although many differences are met with as regards the size and closeness of the down-feathers, especially on the spaces. I found the down most scanty on the spaces of *Dicholophus*, and densest in *Fulica*. With this the constant presence of the after-shaft on the contour-feathers appears to be in harmony, and its universal occurrence (except in *Palamedea cornuta* and *Podoa*) seems especially to furnish a pretty certain distinction of the Wading Birds from the Natatores, in which it is wanting in whole families (*e. g.* the *Unguirostres*). Although in some members of the present family it may be sometimes very small and delicate, as, for example, in *Palamedea*, *Grus*, and *Fulica*, it is probably deficient only in the two birds above mentioned, in which I could not detect it at all; in many cases, as in *Otis*, it is very large, and but little inferior to that of the Gallinaceæ. I always find it to be largest on the feathers of the inferior tract, especially in the region of the breast; it is smaller on the feathers of the anterior part of the dorsal tract, and smallest on the hinder part of the latter. Moreover, the down-feathers also possess an after-shaft, when there is an after-shaft on the contour-feathers. With regard to the form of the tracts, no general statement can well be made; I remark only that the lumbar tract is never deficient, and that the dorsal always encloses a space, at least on certain parts of its extent, but is not always interrupted or furnished with a gap. The inferior tract is very variable. Usually its bands are narrow, and in one genus (*Ardea*) probably the narrowest in the class of Birds; nevertheless, a great breadth, especially of the pectoral portion, also occurs, and in one instance (in *Palamedea*) even an almost uninterrupted plumage. The oil-gland is in general large, with a short mamilla, and furnished with a circlet of feathers. This is wanting only in the genus *Dicholophus;* but the entire gland is regularly missing in *Otis*. Sometimes several orifices are visible in each half of the mamilla, for example, in *Grus*, *Ciconia*, and *Anastomus*. The number of remiges varies between twenty and thirty-six; on the pinion there are usually *ten*, sometimes (as in the Storks and Flamingoes) *eleven*. The tail contains very various numbers of rectrices; at least *ten* (in *Parra*, *Cancroma*, and some of the Bitterns, but in the latter also *eleven* or *twelve*), usually *twelve*, rarely *fourteen* (*Phœnicopterus*, *Fulica*), or *eighteen* (*Podoa*), in *Otis* always *twenty*, and in a species of Snipe (*Scolopax stenoptera*) as many as *twenty-six*—the greatest number that occurs in any bird.

1. Alectorides.

To this group I refer the genera *Palamedea*, *Otis*, *Dicholophus*, *Psophia* and *Grus*, but I cannot give any special pterylographic character for them, although several of them present very definite and, indeed, quite peculiar conditions.

A. *With broad tract-bands or with uninterrupted plumage.*

1. *Palamedea.*—This genus constitutes a very good pterylographic transition from the Cursorial to the Wading Birds, inasmuch as in certain characters its pterylosis approximates to each of these groups. It presents the following characters:—In *P. chavaria* the contour-feathers have a very weak, scarcely perceptible, after-shaft, which is rather more distinct only on the feathers of the nape, and is entirely wanting in *P. cornuta*. The latter species also wants the ordinary longitudinal furrow on the lower surface of the shaft, which is flat on both sides; this furrow occurs in *P. chavaria*. The plumage is, moreover, nearly uninterrupted and pretty uniformly sparse, and consists of down- and contour-feathers intermixed. In the region of the axillary tracts I remarked a closer approximation and stronger structure of the contour-feathers, and a similar character occurs at the margin of the breast, where we should expect to find the outer branch of the inferior tract. Between the two more densely feathered spots, and therefore exactly in the axillary cavity, there is also the only merely downy space that I could discover. It is, however, produced somewhat downwards on the sides of the trunk, and terminates in the femoral region. Besides this space there is also in *P. chavaria* the perfectly naked and featherless neck-ring; but this is wanting in *P. cornuta*. I found *twenty-seven* remiges, of which the first is equal to the ninth, and the second to the sixth, and the three between the latter gradually become somewhat longer, so that the fifth is certainly the longest, but only exceeds the fourth by a little. The tail contains *twelve* feathers, and the feathered oil-gland has a circlet of feathers on the mamilla.[1] In the skin itself I was struck by its emphysematic nature in several places, for example, on the ventral surface.

2. *Otis* (Plate VIII, figs. 1 and 2).—No down-feathers among the contour-feathers, but somewhat scattered ones on the spaces, most distinctly on the lateral space of the trunk and the

[1] Of this extremely peculiar genus of Birds I have been able to examine only the bones of the limbs which I found in the Museum at Munich (there were no anatomical preparations of *Palamedea* in the Museums of Berlin, Leyden, Paris, and Vienna, at the time of my visits to those places). By this examination I ascertained at least that these bones are pneumatic *to their very extremities*, a peculiarity which, as far as I know, occurs elsewhere only in *Buceros* (see Naumann's 'Naturgesch. der Vogel Deutschl.,' Bd. ix, p. 225). The two wing-spurs cover two conical tubercles, of which the larger originates at the base and the smaller at the apex of the *os metacarpi digiti medii seu maximi*. At the apex of the second joint of the same finger there is also the trace of a similar tubercle. As to the true affinities of this genus of Birds, I am, however, still in doubt, and place it here only provisionally; it appears to belong to the *Fulicariæ*.

inferior wing-space, but also pretty clearly on the cervical portion of the dorsal space. These down-feathers, as also the lowest downy barbs of the contour-feathers, are remarkable for their very intense rosy red colour, in which they differ greatly from the grey or white down of all other birds. When exposed to the light they lose their colour, and are therefore paler in proportion as they are high up on the feather. The tracts are remarkable in many respects. The dorsal tract is divided high up on the back of the neck, and continues, uniformly becoming stronger, as far as the extremity of the shoulder-blades. Here, immediately on the inner margin of each limb, commences the much weaker hinder part, which then encloses a much narrower space and widens exteriorly. Hence the strong lumbar tracts, which extend to the knee, nearly come in contact with the dorsal tract. From the caudal pit onwards the dorsal tract is simple, and, combining with the lumbar tracts, clothes the hinder pelvic region and the tail in the form of an uninterrupted plumage, in which the oil-gland would be situated if it were present; *it is, however, entirely wanting.* The inferior tract is undivided, at least to the middle of the neck (in *O. tetrax*), or even to its extremity (in *O. tarda*), and is connected laterally with the dorsal tract, so that the lateral neck-space is absent with the exception of a small rudiment at the base, immediately in front of the shoulder. In *O. tetrax* each limb becomes somewhat broader as it passes on the breast, and emits at this point a branch equal to the main stem and parallel and closely approximating to it, which terminates before reaching the end of the *musculus pectoralis major*, whilst the main stem of the tract passes on to the belly, where it is greatly bent outwards, and runs on to the anus, towards which it turns in a curve. The remarkably broad inferior space formed by this course of the inferior tract is neither naked nor clothed only with down, but bears six rows of contour-feathers distributed at equal distances upon the surface of the space; these, however, are shorter than the tract-bands, and terminate at the middle of the belly, but reach anteriorly to the end of the division of the two bands. The inferior tract in *O. tarda* is differently formed (Plate VIII, fig. 1). In this species it only divides behind the furcula, and emits no outer branch, but is strongly dilated on the fore part of the breast, although the outer branch is indicated by a sudden narrowing at the end of the *pectoralis major*, and by the greater strength of the feathers at this part. Instead of the six rows of contour-feathers there are, in the still broader inferior space, two inner tract-bands, which are at first four, soon afterwards three, and from the end of the sternum only two feathers in width, continuing thus in a straight line to the anus, where they coalesce with the outer main bands. The axillary tracts are broad and strong, scarcely separated by a narrow space from the homogeneous plumage of the wings; beneath there is, instead of them, a general space on the wing, in which, on the humerus, the feathers of the hypopterum proceeding from the breast are situated. The number of remiges is thirty-two in *O. tarda*, thirty in *O. tetrax*, of which ten are seated on the pinion; the first of these is remarkably and the second slightly abbreviated; the third and fourth are the longest. In the tail I counted twenty feathers in both species. With the exception of *O. tarda* and *O. tetrax*, I have not been able to examine any species pterylographically.[1]

[1] The exact determination of the natural affinities, and consequently of the systematic position, of the Bustards, is a very difficult task. In the structure of the skeleton, especially in the form of the sternum and furcula, *Otis* agrees perfectly with the Snipes, especially with *Numenius*; in the structure of the skull it most closely approaches *Œdicnemus*, but diverges very distinctly from the type of the *Limicolæ* in some respects, for example, in the position of the small nasal glands in the orbit.

B. *With narrow, much contracted tract-bands.*

2. *Dicholophus.*—The pterylosis of this remarkable bird has much that is peculiar about it, but it most closely approaches that of *Psophia* and *Grus*. The head and the greater part of the neck are clothed by an uninterrupted plumage; but in the former the region of the eye is naked, and behind the orifice of the ear there is a rather large circular space. On the naked spot above the upper eyelids I counted about twenty very large cilia. Among the contour-feathers there are some sparse down-feathers, which also occur on the spaces, but are here almost still more scattered. On the neck the lateral space is entirely wanting. The inferior space, on the contrary, commences about the middle of the neck; it does not, however, widen posteriorly, but even becomes somewhat narrower, whilst, exactly as in *Gypaëtos* (Plate II, fig. 1), a strong inner branch issues from the lower extremity of the neck-plumage, and runs down on the edge of the furcula nearly to its lowest part. With this inner branch the pectoral band is connected only by a few feathers, another peculiarity which reminds us of the structure in the Hawks. The pectoral band itself consists, remarkably enough, at first merely of a moderately broad, rather densely feathered outer branch, curved into the form of an S; but the main band is completely separated from this, and only commences upon the upper part of the breast, close to the crest of the furcula; on reaching the belly it turns somewhat more outwards, and terminates close to the hindmost part of the pelvis, at some distance from the anus. Coexistent with these great peculiarities in the pterylosis there is a dorsal tract formed exactly as in *Psophia* and *Grus*. This originates as a tolerably strong fork directly from the extremity of the neck-plumage, and terminates before the end of the shoulder-blades. The hinder part soon afterwards commences with two rows of feathers, which gradually widen externally, and approach each other until they coalesce at the middle of the pelvis to form a somewhat sparsely feathered rump-band. At some distance from this are observed the narrow but strong lumbar tracts. The axillary tracts have nothing characteristic about them; they are separated by a narrow space from the upper plumage of the wing. Beneath, the entire wing, with the exception of the feathers standing on the anterior margin of the great wing-membrane, is a uniform space; even the hypopterum is *entirely wanting*. Of remiges I found about *twenty-five;* the first are graduated, especially the four outermost, for the seventh is the longest; five feathers are inserted on the thumb, and I counted *twelve* rectrices in the tail. The distinctly visible oil-gland is of a conical pyriform shape, and entirely naked, even on the mamilla.

3. *Psophia* (Plate VIII, figs. 3 and 4).—The pterylosis of *Psophia* differs from that of *Dicholophus* in the following points. The homogeneous plumage of the head, in which I do not

Hence, after more mature examination, I would not extend my formerly expressed opinion (in Naumann's 'Naturgesch. der Vögel Deutschl.,' Bd. vii, p. 7) that *Otis* is very nearly allied to the latter family, so far as to unite it therewith; but I now prefer to combine it with *Dicholophus, Psophia,* and *Grus,* as all these genera agree in many points, although they also differ from each other. *Grus* and *Psophia* approach the *Fulicariæ* just as much as *Otis* does the *Limicolæ,* and *Dicholophus* occupies a middle place between them.

notice any space behind the ear, extends only to the beginning of the neck, and at this point emits two tract-bands. The superior, or cervical band, becomes stronger as it descends, and divides between the shoulder-blades into two very strong arms, seven or eight feathers in breadth, *which become gradually narrower*, and terminate in a single feather. From these the hinder part of the dorsal tract originates with two convergent rows of *single contour-feathers*, which lose themselves at the commencement of the pelvis in a weak but broad and sparsely feathered rump-band. The latter terminates at the tail in front of the naked oil-gland, *which is furnished with a circlet of feathers at the tip*. The inferior tract divides before the middle of the neck, and consists of two narrow weak bands, which become tolerably strong when passing on the breast, and here form a strong, *incurved*, outer branch of four or five feathers broad, with which the very weak main band running down close to the crest of the sternum is at first united only *by a single row of feathers*. Towards the middle of the breast, at the point where in *Dicholophus* the main stem first commences, this, in *Psophia*, becomes biserial, and continues so as far as the anus, in front of which it terminates, curving outwards in an arched form upon the belly. The other tracts are not peculiar; the lumbar tract is present, but narrow, and completely separated from the rump-band. The wing has on its upper surface a homogeneous plumage, which advances pretty close upon the axillary tract; beneath, it is occupied by the great wing-space, in which the hypopterum is not deficient (Plate VIII, fig. 3). Of remiges I counted *twenty-four*, of which *ten* on the hand, the third or fourth being the longest; on the thumb there are four feathers, and the tail contains *twelve*. I have yet to remark that the peculiar texture of the neck-plumage is caused by an upward curvature of the shaft, with which is combined a very soft and almost downy structure of the barbs and barbules. True down-feathers are very sparingly distributed over the spaces, but are also present, at least among the contour-feathers of the outer branch.

4. *Grus.*—According to my examination of *G. cinerea*, the pterylosis agrees perfectly in its general arrangement with that of *Psophia*, differing only in the following characters. The contour-feathers have a weaker after-shaft, most nearly resembling that in *Palamedea chavaria;* in the down-feathers, on the contrary, both shafts are of equal size. The homogeneous head-plumage, which, however, is interrupted on the occiput by the well-known nearly naked spot, extends as far as the middle of the long neck. On the above-mentioned occipital spot there are setiform feathers, on the capillary shaft of which I can, however, detect a few barbs, and even a small downy accessory plume. The anterior part of the dorsal tract is cleft further, and the space occurring between the branches of the fork reach up the point where the *ptilosis continua* of the neck ceases. The hinder part of the dorsal tract, which is formed exactly as in *Psophia*, is connected by its dilatation with the extremities of the strong lumbar tracts. The inferior tract is rather broad anteriorly, at the point where it passes on to the breast, and its main stem continues longer united with the outer branch. The main stem itself is of equal breadth and strength from beginning to end; but the outer branch is connected at its extremity with the hypopterum, which, therefore, is not deficient. The oil-gland has not only a circlet consisting of about twenty umbellate plumes on the mamilla, but also some large down-feathers on its surface; each half encloses *three cavities*, and has the same number of orifices. In the wing I counted thirty-three remiges, of which the first is equal to the fourth, and the second and third are the longest; they are all broader at the base, and emarginated, especially on the inner vane, for the apical two thirds of their length. The tail contains *twelve* feathers.

2. Fulicariæ.

This family cannot be separated pterylographically from the preceding unless I were to unite with it the last two genera of the latter. Nevertheless it presents in itself rather remarkable differences, which I prefer putting forward tabularly.

I. *With narrow tract-bands and a distinctly divergent outer branch on the inferior tract.*

A. *The dorsal tract has a true gap at the end of the shoulder-blades.*

The genus *Aramus*, Vieill. (*Notherodius*, Temm.), which belongs here, differs in no respect from the type described for *Psophia* and *Grus*, and might properly be placed with them in the family of the *Alectorides* if in the form of its bill and its long toes it did not so distinctly resemble *Rallus*. From this last-mentioned accordance it would appear to be pretty certain that Lichtenstein's notion, according to which this bird is a *Rallus* (he calls it *Rallus gigas*) comes nearest to the truth, and that this genus can be referred neither to the *Erodii* nor to the Storks, although, as Temminck thinks, it is certainly nearly allied to *Grus*, at least in its pterylosis. For its more definite characterisation, I may observe that the *ptilosis continua* extends beyond the middle of the neck, and that the space causing the bifurcation of the anterior part of the dorsal tract reaches up to it. The posterior part of this tract is very weak, divided as far as the caudal pit, dilated behind, and coalescent with the femoral tracts. The inferior tract is not so broad on the anterior part of the breast as in *Grus*, and its main stem here, as in *Psophia*, appears to be weakened, but becomes stronger and broader at the end of the breast. The two stems meet before reaching the anus. The form of the wings and the texture of the plumage are, however, exactly as in *Rallus;* in the wing I counted twenty-six remiges, of which the first is equal to the tenth, the second to the seventh, and the third, fourth, fifth, and sixth are the longest. They all terminate in an obtusely rounded and rather broad extremity, not acute, as in *Grus;* and the first has an emargination both at the base of the inner and at the apex of the outer vane, from which it acquires a very remarkable and peculiar form. In the tail there are *twelve* feathers.

B. *The dorsal tract is neither interrupted nor strikingly weakened at the end of the shoulder-blades.*

This form of the dorsal tract, which is shown in Fig. 6 of Plate VIII, constitutes the true Fulicarian type, and occurs in all these birds which at the same time possess weakened and soft tail-feathers. The outer branch, moreover, in this second group, differs essentially from the type of the *Alectorides* in its remarkably broad and posteriorly pointed form and its strong structure. Here also there is no *ptilosis continua*, except upon the head, for the lateral neck-space almost

touches the point of the lower jaw (Plate VIII, fig. 7), and the inferior space reaches considerably beyond the middle of the neck. But the spinal space is shorter, and only occupies the lower end of the neck. The main stem of the inferior tract reminds one rather of the structure in *Psophia*, *Aramus*, and *Dicholophus*, as it issues at first from the branch as a single weak row of feathers, and only becomes broader towards the middle or extremity of the breast (fig. 5). The dorsal tract is certainly not strong, but consists of rather small feathers, and is never more than three rows broad. From the end of the neck to the caudal pit it forms an elongated ellipse, which completely encloses a similar, or more properly a lanceolate, space. The very short and simple rump-band terminates in front of the oil-gland, which is small, but yet bears a circlet of feathers. Near the rump-band run the lumbar tracts, which are remarkably long, and dilated externally in the middle; these even pass somewhat beyond the knee, and appear to extend as far as the inguinal region. Such large and strong lumbar tracts probably occur nowhere else; nevertheless they are, in general, not united either to the dorsal or crural tracts. The rest of the pterylosis presents nothing peculiar. The axillary tracts are short and not very broad, but strong; the homogeneous sparse plumage of the wings almost coalesces with them. Beneath the greater part of the wing is a space, down which, on the upper arm, the hypopterum runs. The remiges are short, but broad, and the form of the wing is rather rounded, although the second or third feather is the longest. The rectrices are, however, still more peculiar from their small size and remarkable softness; they exceed the dorsal feathers but little, if at all, in stiffness. Such peculiar lax rectrices I have seen only in the true *Fulicariæ*.

To the present group belong the genera *Rallus*, *Crex*, *Porphyrio*, and *Parra*. The first three have *twelve* tail-feathers and exactly the same pterylosis as that figured (Plate VIII) as occurring in *R. aquaticus*. In *Parra*, of which I have examined all the four principal species (*P. sinensis*, *africana*, *ænea*, and *jassana*), I found only *ten* tail-feathers, and a remarkable narrowing of the bands of the dorsal tract close behind the shoulder-blades; whilst, on the other hand, the hindmost, or pelvic portion of it, was dilated. This genus also has weaker lumbar tracts, and these are united with the uropygial portion of the dorsal tract by sparse contour-feathers. Of the three other genera, I have examined the following species:—1, *Porphyrio hyacinthinus*; 2, *Creces pratensis*, *porzana*, *pusilla*, *phœnicurus*, and *lateralis*; 3, *Rallus aquaticus*. In all these the number of remiges varied, according to the size of the bird, between twenty-one and twenty-four, of which ten were always seated on the pinion. The first is rather abbreviated, as is also the second in the species of *Crex*, but not in *Rallus* nor *Porphyrio*. The Crakes also have the broadest and most rounded remiges, for in *Porphyrio* these are much more pointed.

II. *With broad tract-bands, and no separated branch on the inferior tract.*

To this group belong the genera *Gallinula*, *Fulica*, and *Podoa*. With the same form of inferior tract, distinguished by a general dilatation on the breast, in which the outer branch is indicated by the sudden narrowing of the tract at the margin of the *m. pectoralis major*, the dorsal tract presents differences corresponding to those with which we have become acquainted in the preceding group.

A. The type of *Rallus*, *Crex*, *Porphyrio*, and *Parra*, makes its appearance here in the genera

Gallinula and *Fulica*, and, indeed, exactly as represented in *Rallus*, therefore in its most perfect form. At the same time the former genus, of which, however, I have examined only a single species (*G. chloropus*), approaches the type of the *Rallinæ* still more closely in the possession of a faint short notch at the end of the dilated portion of the inferior tract, by which this is still more distinctly indicated as a branch, and, indeed, is somewhat separated. All the rest is as in *Fulica*, in which the above-mentioned notch is entirely wanting. The lateral space, like the inferior space, does not extend to the middle of the neck in *Gallinula*, and the lanceolate spinal space does not touch the neck at all; in *Fulica* the two first-mentioned spaces reach higher up on the neck, and a portion of the spinal space is visible upon it. The lumbar tracts are very long, and have sparse contour-feathers beside them on the dorsal side, at least in *Gallinula*. The tail bears the same small soft rectrices as in the *Rallinæ;* their number in *Gallinula* appears to vary between ten and twelve, but is certainly fourteen in *Fulica*. I found twenty-three remiges in *Gallinula*, and twenty-five in *Fulica;* in the latter the second, in the former the third, was the longest.

B. In *Podoa* (Pl. VIII, fig. 9) the type of *Aramus*, *Grus*, *Psophia*, and *Dicholophus* is reproduced, the dorsal tract being discontinuous at the end of the shoulder-blades, and having its anterior forked portion much stronger than the hinder part, which is divided as far as the oil-gland. The hinder portion commences with single rows of feathers from the extremities of the fork, becomes gradually broader, and attains its greatest extension only immediately in front of the caudal pit, where it again becomes simple. The scapular and lumbar tracts are also remarkably weak, only biserial, and the latter especially are much shorter than in the other *Fulicariæ*. It also surprised me to find a *ptilosis continua* reaching almost to the end of the neck, and therefore even exceeding that of *Aramus;* for both the lateral neck-spaces and the inferior space scarcely pass above the level of the shoulders, whilst the spinal space does not even reach that level. The wing differs greatly from that of the species of *Fulica* in its elongated pointed form, although the relative proportions of the remiges are the same; the number of remiges is probably twenty-one, that of the rectrices certainly eighteen. The latter are of a firmer texture than those of *Fulica*, *Gallinula*, and the *Rallinæ*. I have already mentioned the total absence of the after-shaft on the contour-feathers (p. 120).

3. Erodii.

The peculiar powder-down-tracts which occur only in members of this family among the Wading Birds certainly form their best pterylographic character, for there are important and extremely remarkable differences in the form of the other tracts in the genera belonging to it. In general, the exceedingly narrow, often only biserial, structure of the tracts may be cited as a character of the group, although in one genus (*Eurypyga*) an uninterrupted plumage is to be found on the whole of the neck down to the trunk. The absence of lateral neck-spaces thus caused is, however, a family character, inasmuch as in *Ardea* and *Cancroma* a tract occurs exactly where this space ought to run. With this all the general characters of the *Erodii* are exhausted, for the down-feathers on the spaces and the after-shaft on both down- and contour-feathers are characters which occur in almost all the Waders. This applies also to the circlet of feathers on the short mamilla of the oil-gland, which in other respects presents no peculiarity of formation.

The above-mentioned powder-down-tracts, however, present many peculiarities in this

family, and differ both in number and position. When only two are present, as in *Eurypyga*, they are situated on the back near the hinder part of the dorsal tract, and reach from the rump nearly to the shoulder-blades, each resembling half an ellipse (Plate VIII, fig. 15). But if there are four tracts, as in the Bitterns (figs. 10 and 11), one pair is situated in the same place, but is much smaller, and limited only to the posterior pelvic region. Each tract is elliptical, and so broad that the entire hinder part of the thigh is covered by it. The other pair occurs on the ventral surface, and consists of two elongated elliptical bands, which exactly follow the course of the furcula, and separate the cervical from the pectoral portion of the inferior tract. Lastly, when six powder-down-tracts occur, as in all other *Erodii*, there are, besides the two pairs just described, a third pair, consisting of two small and very narrow bands, which are placed on the ventral surface in the inguinal region, near the outer margin of the stem of the inferior tract.[1]

1. *Ardea* (Plate VIII, figs. 10—12).—The pterylosis of the head is uninterrupted, but in the circumference of the ear there is a circular space, which is very distinct in the Bittern. Immediately at the occiput commences a broad space, which runs down on the back of the whole of the neck, and accompanies the spinal column to the oil-gland. On the lower surface the head-plumage extends a little beyond the angle of the jaw, and then divides into two narrow limbs, which turn outwards, and run down exactly on the sides of the neck. I therefore call them *lateral neck-tracts*. Having a breadth of three or four rows of feathers as far as the point just mentioned, they there suddenly become narrow, and extend as uni- or biserial bands more towards the dorsal surface of the neck, pass in the same condition on to the fore part of the trunk, and then, gradually becoming broader and stronger, run on between the shoulder-blades, but terminate before attaining the extremities of the latter.

These two tract-bands may be regarded as the scapular part of the dorsal tract, and we may suppose that the spinal space, which usually reaches only to the shoulder-blades, or at the utmost passes on to the commencement of the neck, has here been prolonged up to the head. This circumstance would then be the most remarkable peculiarity in the pterylosis of the Herons. From the extremity of the tract just described commences the hinder part of the dorsal tract, which is deeply cleft as far as the oil-gland: it is usually separated by a small gap from the anterior part, and at first consists only of one or two rows of feathers. Immediately in front of the oil-gland it becomes simpler and very broad, nay, even dilated, so as to cover the whole basal portion of the tail. The above-described lateral neck-tracts are, however, equally the commencement of the inferior tract, and result essentially from the union of the limbs both of the dorsal and inferior tracts, which are divided up to the head. Hence the truncal portion of the inferior tract also issues from the extremity of the lateral neck-tracts, runs on to the breast as a narrow band of three or four feathers in width, is even more or less diminished at the end of the *musculus pectoralis major* (*A. nycticorax*), and becomes both weaker and narrower on the belly. In the Bittern the pectoral portion is anteriorly united only with the axillary tract, and through this with the anterior part of the divided dorsal tract before the latter passes into the lateral neck-tract, which is distinctly set off from it, so that, when seen from below (Plate VIII, fig. 10), it appears as if the inferior tract were entirely separated from the lateral neck-tract, which, however, is not the case. The lateral neck-tract rather forms at its extremity a short inner branch turning

[1] For some additional remarks on the powder-down-tracts in this group and its allies see Appendix I, note 2.—P.L.S.

towards the furcula, which, in the true Herons, especially *A. russata* Wagl., is much longer, and in *Cancroma* (Plate VIII, fig. 13) even meets in the middle with its fellow of the opposite side. These are the most important and peculiar characters of the pterylosis in *Ardea;* I therefore merely mention that all the Herons possess short but strong femoral tracts, which come in contact posteriorly with the powder-down-tracts, and that the upper surface of their wings presents a continuous plumage separated by a narrow space from the axillary tract which contains very strong feathers. Beneath the greater part of the wing is a space in which, on the humerus, stand the strong feathers of the hypopterum. These pass on to the breast and meet the inferior tract (Plate VIII, figs. 10 and 12). The parapterum (fig. 11) is not less strong. On the margin of the wing I counted from twenty-five to twenty-nine remiges according to the size of the species; of these ten stand on the pinion. The third is usually the longest, although but little longer than the preceding and following ones; the others from the fifth onwards become more rapidly abbreviated; the first two or three usually possess an angular emargination at the apex of the inner half of the vane. The tail generally contains *twelve* feathers, but in several species (*e.g.*, *A. stellaris*, in which, however, eleven or twelve are sometimes present, *scapularis* and *tigrina*) only *ten*, or even *nine* (*A. sibilatrix*).

According to the number of powder-down-tracts, the position of which has already been described, two groups of Herons may be distinguished, and these also present other differences:—

A. *Four* such tracts, or two pairs, occur in *A. minuta* and *stellaris*.

B. *Six* powder-down-tracts are possessed by *A. scapularis, ralloides, tigrina, virescens, nycticorax, sibilatrix, russata,* Wagl., *leuce, egretta, speciosa,* Wagl. (*malaccensis,* Alior.), *cinerea,* and *purpurea*.

2. *Cancroma* (Plate VIII, figs. 13 and 14). The pterylosis agrees in its general arrangement with the type of the true Herons, and only differs in the circumstance that the lateral neck-tracts are somewhat broader, and the inner branch issuing from its lower extremity runs down the furcula until it meets the opposite one at an acute angle. Another distinction is to be found in the form of the pectoral part of the inferior tract, which possesses a very distinct free outer branch, four feathers in breadth, with which a slightly everted tip of the hypopterum is united. The main stem itself is biserial, and much weaker than the branch; it passes along nearer to the crest of the sternum than in the true Herons, and turns more inwards upon the belly, so as to leave more room for the somewhat larger inguinal powder-down-tracts. The dorsal tract is as in the Herons, but the hinder part has its simple uropygial band somewhat longer. By these means also more room is left for the powder-down-tracts situated beside it, and this they entirely fill. The lumbar tracts are proportionately shorter and weaker. In the wing I counted twenty-two remiges, and ten on the pinion; the first are somewhat falciform, and attenuated at the end of the inner vane; the third, fourth, and fifth are the longest. In the tail I found only *ten* feathers; and I also missed the down-feathers among the contour-feathers.

3. *Eurypyga* (Plate VIII, fig. 15).—The uninterrupted plumage not only of the head, but also of the entire neck, is indisputably the chief distinction of this genus from *Ardea*. From the extremity of this *ptilosis continua* the dorsal tract starts in the form of two parallel biserial bands, which extend as far as in *Ardea*. From each band there springs a row of weak feathers, which very soon unite to form the weak, biserial, uropygial band. This commences as far up as the middle of the back, and only terminates at the oil-gland, near which the remarkably long but narrow lumbar tracts unite with it. Exactly in the space thus formed by each lumbar tract and the uropygial band there is a powder-down-tract, which fills it completely, at least behind.

The inferior tract, which springs from the neck-plumage in two diverging limbs a little in front of the furcula, has exactly the same formation as in *Cancroma*, so that any further description of it is superfluous. But the powder-down-tracts in its vicinity are wanting in *Eurypyga*. Unfortunately, I was unable to ascertain exactly the number of remiges, the specimen examined by me being engaged in moulting: on the pinion, however, there are certainly ten, of which the third is the longest. In the tail I counted only nine feathers; but between the middle ones there were distinct gaps, so that the true number would probably be twelve.

4. Pelargi.

The family of the *Storks*, to which I refer the genera *Scopus*, *Ciconia*, *Anastomus*, and *Tantalus*, stands, in many respects, in remarkable contrast to the *Erodii*, and as regards its pterylosis has only the most general characters of the Waders in common with them. The most important character of the group is to be found in the remarkable enlargement of the two bands of the inferior tract upon the breast, as these cover the whole surface of the *musculus pectoralis major*, and are obliquely truncated posteriorly at its margin, thus passing into the ventral portion, which is scarcely half so wide, runs on to the anus, and terminates close to this. Of an outer branch, such as is possessed by some of the Herons, there is consequently no trace; nay, there is not even a stronger plumage in its place, but each stem of the inferior tract rather diminishes in strength quite gradually from without inwards, and disappears only close to the crest of the sternum. This form of the inferior tract is, however, the only common pterylographic character of the four genera, although the slight development of the lumbar tracts which are abbreviated anteriorly, and the remarkably large, pluriserial inferior and superior paraptera, both of which run down the long humerus of the Storks, may also be regarded as a peculiarity of the group of *Pelargi*.

1. *Scopus* (Plate IX, figs. 3—5).—This genus has a very singular neck-plumage, which, however, only differs from the form of the tracts described in the Herons, in that a lateral neck-space is present. In this way there are produced upon the neck four tracts and four spaces. The two upper tracts (fig. 4), which contain the broad upper neck-space between them, are the halves of the anterior part of the dorsal tract, divided up to the head; they are at first only two feathers in breadth, but increase to three feathers from the end of the neck, and terminate pretty strongly before the extremities of the shoulder-blades. The two inferior tracts (fig. 3) represent the divided cervical portion of the inferior tract; they are somewhat broader than the upper ones, and terminate in an obtusely rounded extremity near the shoulder. Separated from them, but united with the neighbouring axillary tract (fig. 3), the broad pectoral band commences at the level of the shoulder, and in its further course perfectly agrees with the type of the family. The hinder part of the dorsal tract, however, presents peculiar characters (fig. 4), forming a *single*, triserial, and rather weak band, which commences quite separate from the anterior portion behind the arms of the latter, and terminates at the oil-gland. In the wing I counted twenty-six remiges, of which ten are on the pinion; the first were graduated, and the first equal to the seventh. The tail bears twelve rectrices.

2. *Ciconia*.—The Storks with feathered necks, of which I have examined *C. alba* (Plate IX, figs. 1 and 2), *nigra*, and *leucocephala* (*umbellata*, Wagl.), have a continuous plumage as far as

the middle of the neck. From this point the plumage is divided above by the spinal space, and beneath by the inferior space; the lateral neck-space is only visible at the base in front of the shoulder, in the form of a short lobe. The dorsal tract passes between the shoulder-blades in two narrow parallel stems, and terminates a little before them with tolerably strong plumage. The hinder part does not reach the extremities of the anterior portion; it is very weak throughout, especially externally, and has a longitudinal space reaching to the caudal pit. The inferior tract is united with the axillary tracts in front on the shoulder, but otherwise presents no peculiarities. The other tracts also present nothing remarkable. On the other hand, it struck me as singular that in *C. leucocephala* I could find no after-shaft on the contour-feathers; this is not deficient in the indigenous species, although it is small and weak. An organ of remarkable peculiarity in the Storks is, however, the thick short oil-gland, furnished with a strong circlet of feathers, inasmuch as it appears to possess a very variable number of orifices and internal cavities. In *C. alba* there are *two* on each side; in *C. nigra, five*. All the three species above mentioned have *eleven* primaries, of which those from the first to the fourth or fifth are graduated; in *C. leucocephala* I found in all thirty remiges, in *C. nigra* thirty-two, and in *C. alba* thirty-four. The number of rectrices is *twelve*. In *C. leucocephala* these form a strongly forked tail, beyond which the long lower tail-coverts project far in the middle. By this means the tail acquires a very remarkable three-lobed form.[1]

The Storks with naked necks, such as *C. mycteria* and *C. argala*, do not differ much from the preceding in the arrangement of the tracts. The plumage usually commences close to the base of the neck, and is then completely interrupted beneath by the inferior space, and above by the spinal space. The lateral neck-space is wanting. In the dorsal tract the hinder part is remarkable equally for its sparse plumage and for the want of the spinal space. I only saw a trace of this space in the middle in *C. argala*. The commencement of the hinder part in both species also extends far in between the limbs of the anterior part. The inferior tract presents no peculiarity, but its plumage is more sparse. The lumbar tract consists only of a single row of tolerably strong feathers, and reaches to the knee. The number of remiges is thirty-six, of which eleven are placed on the hand in *C. mycteria*, and ten in *C. argala;* in the former the third, in the latter the second, is the longest. Both species have twelve rectrices; but the former species has *six* and the latter only *five* feathers on the thumb. The same number occurs in *C. alba* and *C. nigra*, but *C. leucocephala* only possesses *four*. These are probably the greatest numbers of feathers which occur on the thumb-joint of any Birds. In the oil-gland of *C. argala* I found *six* separate orifices and cavities in each half; these were so environed by short oil-feathers, that each half has a distinct circlet. In *C. argala* I did not examine the gland so particularly; on the other hand, I found no after-shaft on the contour-feathers in this species. The last point worthy of notice is the enormous size and thickness of the quills of the remiges in these Storks; as far as I know, they are the thickest that occur in any Birds.

3. *Anastomus*.—The pterylosis of *A. coromandelicus* agrees precisely with that of *Ciconia alba*, and I therefore need not describe it further. In the wing I counted twenty-eight remiges, of which eleven were inserted on the pinion; the third was the longest. The hypopterum was as large as in the Common Stork. In the oil-gland at least *three* orifices are visible in each half, but I could not detect more in the dry specimen. The tail contains twelve feathers.

[1] This structure of the tail likewise occurs in the South American *Ciconia maguari*.—P. L. S.

4. *Tantalus.*—From an examination of *T. ibis*, *leucocephalus*, and *lacteus* (Temm., *Pl. Col.*, 352), this genus appears to reproduce the two forms of the naked-necked and feathered-necked Storks, although there is always a dense feathery coat on the neck from the end of the naked face, and this is interrupted by the spinal and inferior spaces only behind the middle. Thus in *T. ibis* I found precisely the same arrangement of the feathers as in the Common Stork, especially the long space in the hinder part of the dorsal tract, and the short femoral tracts, confined to the posterior extremity of the thigh. On the contrary, the other two species presented a spinal tract of which the anterior part had quite remarkably widely separated limbs, between which the sparsely feathered, continuous hinder part projected a little. The lateral neck-space was wanting in all three species, as in the Storks and all the *Pelargi*. The number of remiges was from thirty-one to thirty-three, and of these in *T. lacteus* eleven are distinctly inserted on the pinion; the third is the longest, and, like the first, second, and fourth, has the inner vane remarkably emarginated a little way from its base, and then tapered to a point. The hypopterum in *T. leucocephalus* is very large, and appears to consist of several rows of feathers. The length of the humerus, a character common to all the *Erodii* and *Pelargi*, is particularly favorable to its development. With this, also, the remarkable size of the hinder secondaries, which is found both in the Herons and the Storks, may likewise be connected. On the oil-gland, which is uncommonly thick, with a broad and truncated extremity, I detected several orifices in each half, and these in *T. ibis* were arranged in a circle; but the exact number of these apertures escaped me. In the tail I always found *twelve* rectrices. A peculiarity which I have detected in many Water-Birds, and mention here in the first place of *T. leucocephalus* and *lacteus*, is the pneumatic texture of their skin. Air gets under the skin through the axillary cavity from the anterior lateral cells of the trunk, and not only diffuses itself here to a great or less extent, but actually penetrates into small sacs of the skin itself, which occur between the quills of each four contour-feathers, and are filled from the main reservoir of air by an orifice, which is generally rather narrow. In these *Tantali* I found such sacs in the two strong-plumaged limbs of the anterior part of the dorsal tract, but nowhere else. They are largest in *Dysporus* and *Pelecanus*, in speaking of which I shall refer to them in more detail.

5. Odontoglossæ.

Under this name I place the peculiar genus *Phœnicopterus*, the European species of which (*P. antiquorum*) I have carefully examined, as forming a distinct and abundantly well-characterised family. Its pterylosis (Plate IX, figs. 6 and 7) is perfectly Stork-like, and occupies, as it were, a middle place between the two groups distinguished under *Ciconia* and *Tantalus*. The neck is clothed with a continuous and very dense plumage, in which the lateral neck-spaces are entirely deficient; the inferior space first makes its appearance below, whilst the spinal space extends but little beyond the anterior limit of the trunk. The two limbs of the inferior tract are therefore united as far as the shoulder with those of the dorsal tract; here they separate, and the former (the inferior tract-bands) soon afterwards receive the broad, remarkably densely feathered, and posteriorly rounded axillary tracts. From this point the inferior tract is perfectly Stork-like, but more densely feathered, and especially stronger on the outside, particularly in the region of the outer branch. The two limbs of the anterior part of the dorsal tract are but narrow, and are

also weaker, more approximated to each other, and shorter than in the Storks, for they only just reach the middle of the shoulder-blades. Immediately behind them commences the hinder part, which is at first very weakly feathered, and afterwards becomes somewhat stronger, and so gradually increases until, at the caudal pit, it does not yield in strength to the bands of the inferior tract. The spinal space is entirely deficient, exactly as in the naked-necked Storks, although in the Flamingo the neck is densely feathered. The lumbar tracts, which consist of a single series of strong feathers, are also very remarkable; they commence rather far forward upon the knee, and run alongside of the plumage of the rump nearly to the tail. The feathering of the anal region, behind the two ventral bands of the inferior tract which unite in an arch in front of the anus, is also a peculiarity of the Flamingo. In the long wings, the length of which is especially caused by that of the humerus, I find on the upper surface a rather large wing-space, whilst the lower surface is almost entirely a space, down which runs the strong hypopterum consisting of eighteen flat feathers. The number of remiges is thirty-four, of which *eleven* are seated on the pinion; the first three, which are nearly equal, are the longest, and have a sharp emargination near the apex of the inner vane. On the thumb I found only three feathers, and in the tail *fourteen* remarkably small and weak rectrices. The large and broad oil-gland has a dense circlet of feathers on its truncated apical surface, and perhaps more than two orifices.

6. Hemiglottides.

Two genera of Waders, *Platalea* and *Ibis*, one of which has been generally united with the Storks, whilst the other has been sometimes placed with the Storks and sometimes with the Snipes, I propose to unite in a distinct family under the above name, which refers to the surprising smallness of their tongues. I regard it as forming a transition group between the *Pelargi* and *Limicolæ*, to both of which, but more particularly the latter, it is very nearly allied. Leaving out of consideration the other characters of the family, which, however, are not unimportant, we need only occupy ourselves here with the pterylosis. The characters of this, even to the smallest details, are exactly as in the indigenous Storks, and therefore require neither a pictorial representation nor a detailed description.

1. *Platalea leucorodia* has a continuous plumage down to the lower extremity of the neck; there is no lateral neck-space, and the inferior space only commences immediately in front of the furcula, as does the spinal space near the level of the shoulders. Everything else is as in *Ciconia alba*. In the wing I counted thirty remiges, of which ten are placed on the pinion; of these the second is the longest. The tail bears twelve feathers. Down-feathers were not wanting among the contour-feathers. On the short, but broad and thick oil-gland, I found three orifices in each half; these lay together in a bowl-like depression.

2. *Ibis*.—Judging from an examination of *I. falcinellus*, *rubra*, *leucon* and *sacra*, this genus has exactly the pterylosis of the Storks, especially on the ventral surface, and also presents the same difference in the plumage of the neck, which we detected in *Ardea*. The only deviation in the inferior tract consists in a somewhat stronger formation of the two or three outer rows of feathers of the pectoral bands in the region of the outer branch, by which the latter is rendered rather more distinct, especially when, as in *I. sacra*, the feathers close to it are very weak. However, there

is never a freely separated outer branch, such as occurs in all the *Scolopacinæ*. The dorsal tract is also quite Stork-like as far as the pelvis, but the two limbs of the posterior part unite earlier, even at the commencement of the pelvis, and consequently form a long uropygial band, which is distinguished only by the closer arrangement of its feathers from the general sparse plumage of the entire pelvic region, with which the lumbar tracts are also connected. In other respects I find everything as in the Common Stork. In the wing, the humeral portion of which has a very long Stork-like form, I found various numbers of remiges, namely, twenty-seven in *I. falcinellus*, twenty-five or twenty-six in *I. rubra*, and thirty in *I. leucon* and *I. sacra*: there were, however, always ten on the pinion, and the second and third were the longest, although certainly often scarcely longer than the first, fourth and fifth. The tail always contains twelve feathers. The oil-gland had the same form as in the Storks, but I could only discover *one* orifice in each half.

7. Limicolæ s. Scolopacinæ.

Next to the *Passerinæ* and *Gallinaceæ*, this group appears to present the smallest pterylographic differences. This is very remarkable when we consider that it is composed of so many members often differing so widely from each other in external characters. In its general conditions it has all the characters of a Wading Bird, but a proportionally larger after-shaft and more scanty down-feathers, these being entirely wanting on several spaces, *e. g.* the inferior space in the region between the outer branch and the main stem, during the breeding season. In the form of the tracts it most closely approaches the *Rallinæ*, or still more exactly some *Alectorides* (*Psophia*, *Grus*), from which the *Scolopacinæ* only differ in the comparatively greater width of the tract-bands. Among these agreements may be mentioned particularly the complete division of the dorsal tract into two halves; an anterior stronger one, which is forked between the shoulder-blades; and a much weaker hinder one, which contains the rather narrow longitudinal space. The inferior tract presents a still greater similarity, inasmuch as it forms a broad but perfectly free outer branch, which lies about in the middle of each half of the breast, whilst the narrower inner main stem is placed quite close to the sternal crest, and only turns more outwards in a bow on the belly. Here, also, it is usually dilated and more sparsely feathered exteriorly, which is an approximation to the type of many Natatores (see the next Chapter), and in many cases is more distinct than is shown in the figure of *Charadrius pluvialis* (Plate IX, fig. 8). The lumbar tract is weaker than in the *Rallinæ*; but it is also long, and usually composed of two rows of feathers. In the true Snipes alone (Plate IX, fig. 10) I have seen it united to the hinder part of the dorsal tract; this is due to its remarkably oblique position. One species of this genus (*S. rusticula*) presents a difference in that the hinder part of the dorsal tract is completely coalescent with the anterior part, which is distinguished as a separate portion only by its rather strong plumage; the other species of *Scolopax*, on the contrary, follow the ordinary type, although the division of the hinder part is somewhat longer than in *Charadrius*. Sometimes—as, for example, in *Rhynchæa capensis*—there is no true division of the hinder part of the dorsal tract, this being scarcely indicated by the very sparse position of the feathers in the middle of the tract. The commencement of the hinder part also extends between the limbs of the anterior part; a character which also occurs in those genera in which the longitudinal space is only narrow

in the hinder part (*Hypsibates, Recurvirostra, Hæmatopus, Thinocorus*). Such deviations from the type of the family are, however, rare, and I have not met with them except in the genera just mentioned. On the other hand, there is a perceptible and constant difference in the plumage of the neck. In this respect, also, the genus *Rhynchæa* constitutes an exception, as it possesses a *ptilosis continua* on the whole of the neck, has no lateral neck-space, and the inferior space only just passes beyond the level of the furcula. In all the other genera there is a lateral neck-space; and this, indeed, is very distinct, as it bears few or no down-feathers. In *Charadrius, Scolopax, Numenius, Totanus, Limosa, Tringa, Phalaropus*, and the majority of the genera, this space runs almost or quite up to the head, and thus pretty completely separates the dorsal tract from the inferior tract (Plate IX, figs. 9 and 10). In other genera, such as *Hypsibates* and *Recurvirostra*, it appears not to extend beyond the middle of the neck, thus leaving the upper extremity continuous. With this the division of the inferior tract-bands agrees to a certain extent. In no single genus does this extend further up the neck than the lateral neck-space, but in many cases it is shorter. Examples of this are furnished by the genera *Scolopax, Tringa, Phalaropus*, and *Tachydromus*, in which the bands of the inferior tract only separate immediately in front of the furcula, whilst the lateral neck-spaces reach to the head. On the other hand, however, there are examples of an equal extension of these spaces, which sometimes, as in *Charadrius* and *Numenius*, reach the head, sometimes only passes a little beyond the middle of the neck, as in *Hypsibates, Recurvirostra, Hæmatopus, Chionis, Thinocorus*, and *Glareola*. These distinctions are the only ones that struck me in the numerous species of all the genera examined; in all other respects the closest agreement prevails. In the structure of the wings, moreover, although not perhaps in their form, one and the same fundamental type is presented. This consists in the posterior secondaries being pretty nearly of the same length as the anterior primaries, so as to give the wing a bilobed appearance. The total number of remiges varies from twenty-three to thirty, but there are always *ten* on the pinion, of which the first is the longest with but few exceptions (*e. g. Scolopax*). The humerus, although not very long, bears rather strong paraptera, of which the upper is more acute than the lower one, but consists of fewer feathers; the latter passes on to the breast, and is connected with the point of the outer branch of the inferior tract. The hindmost feathers of the generally strong axillary tract exceed the paraptera in length, and in the extended state of the wing, as indeed always, lie immediately within them, between them and the trunk. On the wing itself the upper space is not very broad; but the lower one is continued over the greater part of the humerus, the wing-membrane, and the forearm. In the tail I usually found *twelve* feathers, but in *Rhynchæa* only *ten*, and in some species of *Scolopax* more than twelve, even as many as twenty-six. The moderately large oil-gland has a strong circlet of feathers on the mamilla, but never more than two orifices, one in each half: the latter, however, are generally very wide.

Considering these multifarious accordances, any special description of the genera and species seems to be superfluous; I shall therefore confine myself to mentioning those examined, and referring under each to any peculiarity that may occur in it.

1. *Numenius*.—Very remarkable for the profound division (reminding us of the Stork-type) of the anterior part of the dorsal tract: this extends far beyond the middle of the neck, but is inferior in length to the lateral neck-space and inferior space, which reach to the head. I found this condition in *N. arquatus* and *tenuirostris*, both of which possess thirty remiges.

2. *Rhynchæa capensis*.—The peculiarity of the *ptilosis continua* of the neck, and the absence of a space in the posterior part of the dorsal tract, have already been mentioned: of the latter,

however, I found a faint indication above the lumbar vertebræ. The remarkably short wings contain about twenty obtuse remiges, of which the second is the longest. In the tail I found only *ten* feathers.

3. *Scolopax.*—The coalescence of the lumbar tracts with the posterior part of the dorsal tract, and the remarkably large space which this tract encloses, are the most important pterylographic characters of this genus (Plate IX, fig. 10). The lateral neck-space extends to the head; the inferior space, only to the lower extremity of the neck; the spinal space, as usual, scarcely to the level of the shoulders. In the species examined I found the following numbers of feathers :— *S. rusticula*, twenty-six remiges, sometimes only nine on the pinion, and twelve rectrices. *S. major*, twenty-five remiges, sixteen rectrices. *S. gallinula*, twenty-four remiges, twelve rectrices. *S. stenoptera*, twenty-five (?) remiges, of which ten are certainly on the pinion, but twenty-six rectrices, of which the *eight* outer ones on each side are of a remarkably narrow, linear form, and terminate in rounded ends. *S. minor*, twenty-six remiges, the first three singularly narrowed and curved into a sabre-like form, the fourth and fifth the longest; fourteen rectrices. *S. grisea*, twenty (?) remiges and twelve rectrices. The oil-gland in this genus is also very remarkable for its broad cordate form and long cylindrical mamilla, which is held extended by the tubes of the feathers of the circlet, as in the Hoopoe; but the cavities of the two halves are separated, each reaching far into the substance of the gland, and becoming pointed behind.

4. *Tringa.*—The pterylosis has nothing remarkable about it; all the species possess twelve rectrices, and the smaller ones from twenty-three to twenty-four, the larger ones from twenty-five to twenty-six remiges, of which the first is the longest. The spinal space reaches to the caudal pit, and the inferior space appears not to pass far beyond the base of the neck. The species examined were—*T. subarquata*, *minuta*, *temminckii*, *platyrhyncha*, *islandica*, *alpina*, and *pugnax*.

5. *Limosa.*—The inferior space is continued as far as the middle of the neck, otherwise everything as in *Tringa;* the number of rectrices is also the same, but the remiges amount to twenty-eight. *L. rufa* and *L. melanura* were examined.

6. *Totanus.*—The pterylosis agrees exactly with that of *Limosa*, even to having, as in *Tringa*, the undivided uropygial band very broad and sparsely feathered, but not connected with the long, narrow lumbar tracts. Of rectrices I always find twelve; but the remiges are sometimes twenty-four (*T. hypoleucus*), sometimes twenty-five (*T. ochropus*), twenty-six (*T. glareola* and *bartramius*), or twenty-seven (*T. glottis* and *maculatus*), of which the first appears to be always the longest.

7. *Phalaropus.*—The dorsal tract is narrow and weak; but the main bands of the inferior tract are broad, and only separate close in front of the furcula. The lateral neck-space reaches a little beyond the middle of the neck. I always found twelve tail-feathers, and twenty-five long, pointed remiges, of which those on the pinion are much longer than those on the ulna; the first is the longest of all. The hypopterum unites, not with the tip, but with the middle of the outer branch. *P. fimbriatus*, *platyrhynchus*, and *hyperboreus* were examined. The brood-spots which I have observed in this bird have been already mentioned.[1] They are situated between the main stem and the outer branch of the inferior tract, and are produced by the want of the down-feathers, which fall out spontaneously. Brood-spots formed in precisely the same manner have been met with by me in several other species of this family.

[1] Footnote, ante, p. 33.

8. *Hypsibates himantopus* (*Himantopus rufipes*, ALIOR.).—On the head, and as far as the middle of the neck, the plumage is uninterrupted; at this point the broad lateral neck-space commences, and soon afterwards also the inferior space. The rest of the pterylosis is not peculiar, but the tracts are narrow. The posterior part of the dorsal tract is divided almost as far as the caudal pit, and the following simple uropygial band is not dilated, although the limbs in front of it are widened. The long lumbar tract is pretty strong. In the wing I counted twenty-nine remiges, of which the first is the longest; the tail contains twelve rectrices.

9. *Recurvirostra avocetta*.—The lateral neck-space and inferior space reach only to the middle of the neck. In the inferior tract I was struck by the much greater distance of the two main stems from the crest of the sternum. The posterior half of the dorsal tract is at first sparsely feathered, perhaps without any longitudinal space, and extends far within the branches of the fork of the anterior part. The simple uropygial band is more densely feathered, and commences as far forward as the middle of the pelvis; it has scattered contour-feathers beside it, especially in front, but remains quite separate from the lumbar tracts. The contour-feathers which stand between the branches of the fork of the anterior part of the dorsal tract are as long as the large feathers of the axillary tract, which is very remarkable. In the wing I counted thirty remiges, and the first, as usual, was the longest; in the tail there are twelve feathers.

10. *Dromas ardeola*.—The pterylosis exactly as in the Avocet, even to the dorsal tract, remiges, and rectrices. The oil-gland remarkably thick and large, like that of the Stork, but with only two wide orifices. It is, however, provided with equally wide apertures also in *Recurvirostra*, *Hypsibates*, *Limosa*, *Scolopax*, and *Numenius*.

[11. *Chionis alba*.—This singular bird, which I have recently examined carefully as to its pterylography, belongs to the *Scolopacinæ* in every particular, as was first stated by Blainville ('Ann. Sci. Nat.,' nouv. sér., tom. vi, p. 99), and, in my opinion, stands in the same relation to *Hæmatopus* as *Dromas* to *Recurvirostra*. It has exactly the pterylosis of *Recurvirostra*, although both the lateral neck-space and the inferior space extend higher up on the neck,[1] and in the dense continuous plumage of the head there is a naked spot, covered with warts, extending beneath the eye from the angle of the mouth nearly to the ear. The tract-bands are remarkably broad and strong, especially the main stem of the inferior tract, which is placed closer than usual to the outer branch, exactly as in *Recurvirostra*. The dorsal tract I could not accurately distinguish, the skin having been divided down the middle of its upper surface. I noticed only the strong limbs of the anterior part, and that the posterior part was of weak formation, especially in front. The lumbar tracts, which are very strong, are not in contact with the posterior part. In the wing, which is rendered remarkable by a short, thick spur situated at the wrist-joint, there are twenty-five very acute remiges, of which the posterior on the ulna are as long as the anterior on the pinion, but, during repose, are almost completely covered by the long axillary feathers. The tail bears twelve feathers, of which the middle ones are somewhat abbreviated, so that it appears slightly furcate; the outermost on each side is, however, shorter than the following one, which is the longest. The oil-gland was remarkably thick and large, and the entire plumage was everywhere perhaps stronger and denser than in any other Scolopacine Bird. The legs are short, and naked only from the heel-joint; they are closely covered with small verruciform scales, but on the

[1] This appears to be a peculiarity of all short-necked genera, a *ptilosis continua* occurring in the long-necked forms, at least on the upper part.—BURM.

surface of the toes with numerous small half-rings of equal size. The hinder toe is of moderate size, and touches the ground.—Burm.]

[12. The pterylosis of *Hæmatopus ostralegus*, which Nitzsch had not investigated, appeared to me, on account of the near affinity of this bird to *Chionis*, to require a more exact consideration; and I found it to be perfectly similar, all the tracts, especially, being equally close and strong, with the exception of the posterior part of the dorsal tract, which is weak and has a narrow longitudinal space, reaching to the caudal pit. The outer branch and ventral part of the inferior tract are very broad, and consist of from six to eight feathers in each oblique row. The axillary tracts are only three feathers in breadth, and are united in front to the outer branch of the inferior tract by a narrow band. The long lumbar tracts are perfectly free. In the wing I found twenty-nine remiges; the twenty-sixth is situated at the elbow, and is of equal length with the third primary. The large oil-gland was furnished with a circlet of contour-feathers, and on its mamilla there were numerous grey oil-feathers. The tail bore twelve rectrices.—Burm.]

13. *Strepsilas interpres.*—The contour-plumage is almost exactly as in *Tringa platyrhyncha*, but the main stem of the inferior tract is dilated somewhat more outwardly on the ventral surface, and the branches of the fork of the anterior dorsal tract are narrower, although the other tract-bands are on the whole somewhat broader and stronger. In the wing I counted twenty-five remiges, and in the tail twelve rectrices.

14. *Charadrius.*—The representation of the pterylosis of *C. pluvialis*, given in Plate IX, figs. 8 and 9, shows that this genus possesses all the characters of the family, and, as regards subordinate differences, belongs to that group in the members of which the lateral neck-spaces and the inferior space extend up to the head. A greater peculiarity is to be found in the short furcation of the hinder part of the dorsal tract, and the long, narrow form of the uropygial band of this portion, from which the rather strong lumbar tracts are far removed. In the species examined, such as *C. minor*, *hiaticula*, *pluvialis*, and *morinellus*, I found from twenty-five to twenty-six remiges, among which, in *C. morinellus*, the first secondary is remarkably broad, and is obliquely and sinuously truncated at the end, whilst the first primary has a singularly thick shaft. The Lapwing (*C. vanellus*) also presents precisely the same characters as the other Plovers; but *C. œdicnemus* (*Œdicnemus crepitans*, Temm.) has twenty-nine remiges, and, if I have observed correctly, a more sparse and scattered plumage on the uropygial band. All the species above mentioned possess twelve rectrices.

In this genus I also examined the nestling-plumage in the case of the Common Peewit (*C. vanellus*); and it appeared to be exactly analogous to that of the other Waders. The nestling-down here also consists of downy barbs, which are seated upon the first perfected barbs of all the contour-feathers, even upon the merely downy ones on the sides of the trunk, and subsequently fall off. The upper extremities of these deciduous nestling down-feathers have rather long hair-like points, which are differently coloured, and produce the well-known markings of the young nestlings. As this is similar in all the *Scolopacinæ*, this structure of the nestling-coat appears to belong to the whole family.

15. *Tachydromus isabellinus* is distinguished from *Charadrius* only in having the hinder part of the dorsal tract more deeply divided as far as the caudal pit, and the axillary tracts very broad, rounded off posteriorly, and united anteriorly to the commencement of the pectoral branch of the inferior tract by a narrow band. The number of remiges amounts to twenty-seven or twenty-eight.

16. *Thinocorus rumicivorus*, Eschsch., *Zool. Atl.* (*Ocypetes torquatus*, Wagl., *Isis*, 1829, p. 762).—This remarkable bird, which Wagler very improperly compares with the Sand Grouse (*Pterocles*), (is in every particular an aberrant Scolopacine form, related to *Glareola* in exactly the same way as *Chionis* to *Hæmatopus*, or *Dromas* to *Recurvirostra*.—Burm.).[1] Its pterylosis differs from the form represented for *Charadrius* only as follows :—the outer branch of the inferior tract is more closely approximated to the main stem, and lies exactly upon the middle of the breast; the ventral portion of the same tract is very strongly arched, and dilated externally; the hinder part of the dorsal tract has its longitudinal space extending further down, is rather wider on the whole, and comes in contact anteriorly with the fork of the anterior part; the inferior space extends up beyond the middle of the neck; and, lastly, the axillary tracts, as in *Tachydromus*, are broadly rounded and united anteriorly with the inferior tract. In the wing, which is nearly as long and pointed as in *Glareola*, I counted twenty-six remiges; the somewhat cuneate tail consists of twelve feathers.

17. *Glarcola*.—In both species of this genus I found exactly the same pterylosis as in *Thinocorus* and *Tachydromus*; the number of remiges is also the same, as is that of the rectrices, although the tail is very remarkable for its furcate form. However, I could discover no down-feathers among the contour-feathers in *G. orientalis*; hence the outer branch of the inferior tract appeared to be somewhat broader, and to be rather more connected with the main stem anteriorly.

CHAPTER VIII.

SWIMMING BIRDS—NATATORES.

The most general pterylographic character of this last main division of the class of Birds consists in the very broad form of their tracts, with which is combined a comparatively narrow form of the spaces. Nevertheless, the arrangement of the plumage approaches much less to an uninterrupted feathery covering than in other broad-tracted birds, especially in those *Picariæ* in which, as in the Maccaws, Hornbills, and Colies, there is nearly a *ptilosis continua*; because in the Natatores the contour-feathers stand remarkably close together, and form such dense tracts that even a very narrow space may be distinctly recognised. In the tracts, moreover, the contour-feathers are inserted perfectly regularly in parallel rows, which are always placed obliquely to the longitudinal axis of the body, and meet, on the margins of the perpendicular median plane which would divide the body into two symmetrical halves, in such a manner as to form an acute angle, when they are not separated by a space situated at that part. This oblique direction of

[1] Nitzsch was inclined to refer it to the *Alectorides*—a view which is admissible inasmuch as the *Alectorides* themselves are only aberrant forms, which belong partly to the *Scolopacinæ* (*Otis*), partly to the *Fulicariæ* (*Dicholophus, Grus, Psophia,* and *Palamedea*).—Burm.

rows of contour-feathers in the tracts is the rule not only in the case of every tract, whether broad or narrow, in this family, but also in all other birds, and occurs equally in the Aërial, Terrestrial, and Wading Birds, but cannot always be recognised with equal distinctness in all these on account of the narrowness of the tracts. Essentially the natural direction of these rows appears to be from within and in front, outward and backward, so that the angle formed by each pair of rows at their point of contact in the median line opens posteriorly; but as this contact is always deficient on the ventral surface, and is only distinct on the dorsal surface when the dorsal tract contains no longitudinal space, the rows of feathers not only appear to run in an opposite direction in many places, but two rows may even seem to meet and intersect each other, forming acute angles with their obtuse complementary angles—of course because the distance of each two feathers in each row being the same, these mutually corresponding feathers themselves again form rows. These rows may be very distinctly recognised on birds plucked quite clean, by the follicles in which the feathers are inserted, and the small cutaneous muscles which pass from the interior lower extremity of each contour-feather towards all the four neighbouring feathers, and are inserted on the inner surface of the skin in the circumference of the follicle in which the feather is inserted. These feather-muscles, which are employed in the erection and depression of the contour-feathers (see p. 13), are seen most distinctly, on account of their size, in the Natatores, and especially in those with a pneumatic skin, such as *Dysporus* and *Pelecanus*. But no one can overlook them even in our Domestic Goose, when the inferior tracts of this bird, beautifully cleaned, are brought to table with the smoked breast. The regular serial position of the contour-feathers is so distinctly expressed as to be unmistakeable.

Between each four feathers, which together form a rhombus, there is always at least one down-feather, and this is exactly in the middle of the space just indicated; but besides these we not unfrequently find others which appear to be intruded between each two contour-feathers of each row, so that in such a case the rows consist of alternate contour- and down-feathers; or they are seated upon the surface of each individual rhombus, but still in the same direction with regard to the contour-feathers. These down-feathers are then always smaller than those which occupy the middle of the rhombic spaces; but neither of these positions can be recognised after the down has been pulled out, partly because the down-feathers have much smaller tubes, but partly because they are entirely destitute of the above-mentioned feather-muscles. The difference between the down-feathers is, however, usually a comparative one, those occupying the middle being larger than those between the contour-feathers; nevertheless in *Anas penelope* I have found the larger down-feathers to be of a darker colour than the smaller ones. Of course, this difference must disappear when all the down-feathers are white, as in the white Domestic Goose, Swans, or other white Swimming-birds; but in those with varied colours the down-feathers are, as usual, grey. As regards the spaces of the Natatores, these likewise have a dense downy covering, which perhaps also consists of double down-feathers. I need scarcely remark, as it has already been stated in the first section, that each contour-feather has its filoplumes about it, and that there may be as many as *ten* in this group, *e. g.* in the Geese. In such cases, although they have a similar structure, they are of very various lengths.

The very frequent, although not universal deficiency of the after-shaft on the contour- and down-feathers appears to arise from this closely approximated position of the feathers, which, without it, form a very dense and securely protective covering; for it is exactly in those Swimming-

birds in which the plumage is very dense, such as the genera *Diomedea* and *Halieus*, and the family of the *Unguirostres*, that the aftershaft is entirely wanting. In harmony with this is its remarkable size in those birds which are without down-feathers, whether only between the contour-feathers or also on the spaces, such as the *Gallinæ*, *Passerinæ*, and many *Picariæ*. In these groups also it is lost when dense down-feathers make their appearance, as in *Alcedo*. The Pigeons alone, of which, however, the tracts are broad and very densely feathered, have neither down-feathers nor aftershafts, whereas the Diurnal Birds of Prey, like most of the Waders, are provided with both; but their tracts are narrow, and the bands of which they are composed consist often only of two, and at the utmost of five or six rows.

The general outlines of the tracts in the Natatores agree much more in all their members than is the case, for example, in the Wading Birds. The general rule is, that the inferior tract does not possess a distinct and perfectly free outer branch, and the dorsal tract is not interrupted by a true gap. The *Longipennes* form exceptions to both rules, and thus approach the *Scolopacinæ*. Then *Diomedea*, *Colymbus* and *Eudytes* have a true gap in the dorsal tract, and *Uria*, *Alca*, and *Mormon*, a half-free outer branch reaching as far as the knee-covert. A trace of this is found in the *Unguirostres*, and more distinctly in the *Tubinares*. In all these cases the ventral portion, which is often independent only from the extremity of the sternum, is usually not only very broad, but dilated towards the sides in the middle of the belly; a structure which occurs only in Water Birds, and has already been very distinctly recognised among the *Scolopacinæ* (see p. 134). The relative numbers of the remiges and rectrices are more various in this group. The former here attain their greatest number, namely fifty, in *Diomedea;* they are usually thirty, and rarely decrease to twenty-five, as in the small species of *Colymbus*. Of the tail-feathers it may be asserted in general, that they are very small, soft and numerous, but nevertheless often vary in number. Thus among the *Unguirostres* there are usually twelve, fourteen, sixteen, eighteen, twenty, or twenty-four rectrices—but also fifteen, seventeen, nineteen, twenty-one, or twenty-three; in which cases there is one more on one side than on the other. I found the largest number in *Aptenodytes*, namely thirty, but they are remarkably small. Twelve large, strong rectrices are possessed without exception only by the *Longipennes:* the small Petrels appear to possess ten, as the smallest number; but even among these the majority have twelve, and *Procellaria gigantea* has fourteen. Among the *Unguirostres* and *Pygopodes* nearly every species has its own characteristic number; but among the *Steganopodes*, in which again they become stronger, the usual number is *twelve*, *Phaëton* having sixteen, some species of *Halieus* fourteen, and *Pelecanus* twenty-two, twenty-three, or twenty-four. In those birds which are constantly swimming, such as the *Tubinares* and *Steganopodes*, the oil-gland is very large, and frequently furnished with more than two orifices; in the other families it is of smaller size, and has only two apertures. Neither the circlet of oil-feathers, nor the gland itself, is ever wanting in this division.

1. Longipennes.

The pterylosis of this family approaches very closely to that of the *Scolopacinæ*, and can hardly be distinguished therefrom with certainty by any character. It consists, on the head, of a continuous plumage, in which I only find spaces about the eye and the orifice of the ear. From

this two tract-bands originate—a rather broad one on the back, and a narrow one at the angle of the throat. These are separated by the rather broad lateral neck-spaces. The former remains simple as far as the scapulæ, and then divides into a fork, the tolerably strong branches of which terminate before reaching the extremities of the shoulder-blades. At this point the dorsal tract is usually interrupted by a true gap, but in *Lestris parasitica* this is either entirely wanting or very imperfect. The following posterior part is at first weakened in proportion as the gap appears more distinctly; it then commences with two parallel rows of feathers between the arms of the fork, and these become widened on the outside posteriorly, and at the same time grow somewhat stronger, only coalescing at the caudal pit to form a short, strong stem, which runs to the oil-gland, and apparently terminates at it. From this posterior part the lumbar tracts are generally quite separate; in *Lestris catarrhactes* alone, in which they stand much more obliquely, they touch the stem of the uropygial band. The inferior tract which, as we have seen, issues simple from the plumage of the throat, remains undivided as far as the middle of the neck, when it separates into two divergent limbs, and continuing in this condition over the middle of the furcula, passes on to the pectoral surface. Here it immediately forms an outer branch, sometimes quite free, sometimes free only in its posterior half; this is somewhat stronger than the main band, and terminates rather far back, at the margin of the *musculus pectoralis major*. The somewhat narrower and weaker main band at first turns inwards, and approaches nearest to its fellow at the middle of the sternal crest; from this point the two bands diverge, form a curve on the belly, where they become rather broader and stronger, and terminate close to the anus. The rest of the plumage presents no special peculiarities. On the humerus, which is remarkable for its great length, there is beneath a strong hypopterum, which also appears upon the breast, but is not actually connected with the outer branch of the inferior tract. This part of the wing is in other respects a mere space; but the upper surface has a continuous plumage, separated from the strong axillary tracts by a small space which is particularly insignificant behind. On the contour-feathers I observed a weak, fluffy aftershaft. The large, broad oil-gland, which is strongly truncated behind, bears a dense circlet of oil-feathers, and has frequently, perhaps always, several orifices in each half.

1. *Sterna* (Pl. IX, figs. 11 and 12).—In this genus, in consequence of the slender and elegant form of the body, the tracts are very narrow, and perfectly Scolopacine; but in other respects correspond with the general description above given. Of the species examined, namely, *S. caspia*, *leucopareia*, *hirundo*, *arctica*, Temm., *fissipes* and *minuta*, the first has thirty-three remiges, the following three twenty-nine, and the last two only twenty-six, of which the first is always the longest, and ten are seated on the pinion. The tail contains *twelve* feathers, and is generally furcate, although the two outermost feathers are not always the longest, but sometimes two others; for example, in *S. stolida*, the fourth on each side counting from without. In *S. hirundo* the first secondary, the eleventh feather in the wing, is remarkable for its broad form, and for being sinuously truncated at the end. This species also has three orifices on each half of the oil-gland, whilst in *S. fissipes* I only found one.

2. *Rhynchops*.—From an examination of *R. nigra* and *R. albirostris*, Licht., this genus seems to have exactly the pterylosis of *Sterna*; but the down-feathers appeared to be smaller, and entirely deficient among the contour-feathers of the tracts. Both species have twelve tail-feathers and from twenty-nine to thirty remiges, of which ten are seated on the pinion, and the first is the longest.

3. *Larus*.—The smaller species of this genus, such as *L. minutus*, *ridibundus*, and *canus*, have precisely the pterylosis of *Sterna;* but in the larger species, such as *L. argentatus*, *tridactylus*, *eburneus*, and *marinus*, the tract-bands appear perceptibly broader, although exactly similar in pattern, from which it follows, as a matter of course, that the spaces must be of less extent. Nevertheless, the outer branch and main stem of the inferior tract are not partially coalescent, but, on the contrary, the space separating them is broader in proportion than in *Sterna*. I found down-feathers all over the body, even decidedly between the contour-feathers. Even upon the body of the oil-gland, which is not very large, there are several rows of semiplumes. The mamilla of this gland is somewhat longer than in *Sterna*, and has *three* orifices in each half; these open close together in a bowl-shaped depression. I found this structure in *L. marinus* and *tridactylus*, and believe we may assume that the same occurs in all other species of *Larus*. Of the species examined *L. minutus* had twenty-eight remiges, *L. ridibundus* thirty, *L. canus* and *tridactylus* thirty-one, *L. argentatus* and *marinus* thirty-four. In all there are ten on the pinion, and the first is the longest throughout. The number of rectrices is *twelve*.

4. *Lestris*.—This genus differs from the other *Longipennes* especially in having the outer branch of the inferior tract united with the main stem in the first part of its course (Pl. IX, fig. 13), and all the tracts still broader and stronger than in *Larus*. In *L. catarrhactes* and *pomarinus* the dorsal tract agrees with the type of the *Longipennes*, although its longitudinal space is proportionally broader, on account of the stouter formation of the thorax in the Skuas. Hence also, probably, it happens that the lumbar tracts are placed more obliquely than in the Gulls, and coalesce posteriorly with the uropygial band of the dorsal tract (Pl. IX, fig. 14). I have already mentioned with regard to *L. parasiticus* that the anterior part of the dorsal tract is not distinctly separated from the posterior. I may add that the arms of the former pass directly into the two branches of the latter, thus producing a form which appears to be very similar to the type of the *Rallinæ* (see p. 125). Combined with this is an increased separation of the outer branch from the main stem of the inferior tract. All three species have twelve tail-feathers, and from twenty-six to twenty-eight remiges, of which ten are situated on the pinion, and the first is the longest. In *Lestris catarrhactes* the large oil-gland agrees perfectly in structure with that of *Larus marinus:* it has semiplumes on its surface, but only at the base; a very broad, short mamilla, and *three* orifices in each half.

2. Nasutæ seu Tubinares.

In this family the tract-formation of *Lestris* is elevated into the type of a group, undergoing scarcely any change in the form of the inferior tract, but showing some little modification in the dorsal tract. We find, therefore, on the head, a uniformly dense plumage, from which the two principal tracts issue. The latter are separated from each other by the lateral neck-spaces, which extend high up, nearly to the head. The inferior tract is divided near the head, becomes of considerable breadth whilst still on the neck, and passes in this condition on to the breast, the surface of which is covered by each band in a rather broad, parallel-sided form, emitting no branch as far as the margin of the *musculus pectoralis major*. Here it is divided by a space

starting from the knee-covert, in such a manner that a short continuation of the tract, which is to be regarded as an outer branch, passes near the knee into the lateral space of the trunk, runs on over the thigh, and soon afterwards terminates. The other, inner branch, which represents the main band, then proceeds upon the belly, turns in a somewhat arcuated form outwards, dilates considerably in the middle of the bow, and terminates near the anus. By this means the inferior tract acquires nearly the appearance of that of the genera *Hæmatopus, Chionis, Dromas, Recurvirostra, Thinocorus,* &c., among the *Scolapacinæ,* departing chiefly from the type of these birds only in having a much shorter outer branch, which is free only at its extremity. The dorsal tract is at first broad, becomes narrower towards the middle of the neck, then expands to the shoulder, and divides at that point, or from the middle of the scapulæ, into two limbs. In most of the *Tubinares* these limbs pass uninterruptedly into the posterior half of the dorsal tract; and this circumstance forms their family character as distinguished from the *Longipennes.* In the present group the posterior half of the dorsal tract encloses a longitudinal space as far as the caudal pit, dilates a little outwardly upon the pelvis, and thus usually becomes united with the very oblique lumbar tracts, and grows rather strong in the simple uropygial band, also covering the base of the oil-gland. The latter is always of very remarkable size, and has a strong circlet of feathers on the mamilla, but rarely more than two orifices. *Diomedea,* which possesses a greater number, also differs in having the anterior part of the dorsal tract separated from the posterior simple part, and presents several deviations from the type of the family, especially in the length of its wings and some other characters. The same fact is likewise expressed in its very broad and strong axillary tracts, and the comparatively small size of its hypopterum.

1. *Procellaria.*—The tract-formation in *P. glacialis* (Pl. X, figs. 1 and 2) may be regarded as well representing of the general character the family, from which, however, some species differ in particular points. It may be seen from the figures, that the inferior space actually reaches to the angle of the throat, that the emargination in the inferior tract at the knee-covert is moderately deep, that the ventral portion of this tract is but little widened, and that the dorsal tract is connected posteriorly, where it becomes broad, with the lumbar tracts, which are neither very strong, nor separated from the plumage of the tibial regions. In the wing I found thirty-two remiges, of which ten are seated on the pinion, and the first is the longest. The tail contains *fourteen* rectrices. The pterylosis in *P. capensis* is precisely similar; but the notch in the inferior tract near the knee is deeper, and the ventral portion broader. The number of remiges is only thirty-one, but that of the rectrices is fourteen. *P. gigantea* exhibits no difference in the inferior tract, except that it is broader, and the notch is consequently deeper in proportion. In the dorsal tract, however, the anterior part can be clearly distinguished from the posterior by its stronger and more densely feathered formation, although the two parts pass directly into one another. The posterior part consists of two converging rows of strong contour-feathers, which become parallel from the caudal pit, and form the simple uropygial band, but have scattered, weaker contour-feathers beside them, by which they meet the biserial and rather strong, but short lumbar tracts. The anterior part is comparatively more deeply cleft, and the spinal space reaches the level of the shoulders. The number of remiges amounts to thirty-eight or forty, their relative length continuing the same; the number of rectrices is *sixteen.* In the large oil-gland I think I detected several orifices in each half. *P. pelagica* is characterised by narrower tract-bands, but has a dorsal tract of precisely the same form as in *P. gigantea,* except that the scattered contour-feathers near the hinder part are wanting. In the wing I counted

twenty-two remiges, of which the first was equal to the fourth, and the second was the longest.[1]

2. *Pachyptila cærulea* presents exactly the pterylographic characters of *Procellaria*, except that the short lateral neck-space advances but little forward, and the notch in the inferior tract is so deep that its posterior or ventral half is completely separated from the anterior. The dorsal tract presents nearly the same character as in *P. gigantea*, but the division of the anterior part is not so deep, and the lumbar tracts join the posterior part in the same oblique direction that I have shown in *Puffinus obscurus* (Pl. X, fig. 3). The number of remiges is twenty-eight, and of these the second is the longest. The rectrices are only *twelve* in number.

3. *Puffinus obscurus* (Pl. X, fig. 3).—The feather-tracts of this genus differ from those of *Procellaria* only in that the spinal space is situated higher up, reaching to the level of the shoulder, but not passing beyond the commencement of the pelvic region. Here this tract, which does not divide into two parts either as regards the position or the strength of the feathers, becomes simple, and receives the somewhat sparsely feathered lumbar tracts, which are prolonged obliquely from behind forwards. By this means they present precisely the reverse of the form represented in *Procellaria*, and closely approach the formation of *Pachyptila;* a resemblance which is still further increased by the short lateral neck-space, reaching only to the middle of the neck. *Puffinus obscurus* has thirty remiges, of which the first is the longest; and *twelve* tail-feathers, which, again, furnishes an analogy with the second genus mentioned.

4. *Diomedea.*—This genus, judging from an examination of *D. exulans* (Pl. X, fig. 4) and *D. chlororhyncha*, has on the ventral surface precisely the pterylosis of *Procellaria*, except that the inferior space only commences at the middle of the neck. The dorsal tract, however, presents many peculiarities. The most important character is unquestionably the complete separation of the anterior part from the posterior, the former being at the same time very strong and coarse, and the latter weak. The former is broad, densely feathered, and furcate from the shoulder-joint, with the extremity of each branch of the fork rounded off. The posterior part forms a weakly feathered ellipse, extending from the extremity of the anterior part to the caudal pit; its feathers are placed, as usual, in oblique rows, converging in the middle, and running outward and backward. At the caudal pit the ellipse contracts into a parallel-sided, strongly feathered uropygial band, the extremity of which touches the large oil-gland. The latter is covered at the base with semi-plumes, and has a strong circlet of feathers round the five openings of each half, which are arranged in a perpendicular row. To these peculiarities are added very weak uniserial lumbar tracts, closely approximated to the rump; and proportionately stronger, broad, sex-serial axillary tracts, which, in repose, entirely cover the enormously long wings. The length of the wings is caused by the unexampled extent of the humerus and ulna. Hence also the number of remiges, which amounts to *fifty*, is the greatest which I have ever observed in any bird. Nevertheless, only ten of them are seated on the pinion, and of these the first is the longest; the remaining forty occupy the ulna in a row, and are consequently very small. These are followed on the humerus by a large parapterum, consisting of about twenty feathers, corresponding with which there is an equally strong hypopterum on the lower surface. The number of rectrices is only twelve.

[1] The University collection [at Halle] also contains *P. oceanica*, a species very nearly allied to the last-named one. In this *twelve* rectrices are certainly present; in a specimen of *P. pelagica* I only find nine, but some are wanting on the left side.—Burm.

The contour-feathers are entirely destitute of aftershafts, but have a very thick, inflated quill.

3. Unguirostres *seu* Dermorhynchi.[1]

The form of the tracts in this family, which is very uniform also in other respects, follows a very definite type, and is perfectly alike, with the exception of a slight difference in the length of the spinal space, in all the species examined by me. The head is clothed with a continuous plumage, which extends to the middle of the neck. Here the inferior space commences (Pl. X, fig. 5) as a narrow stripe, which widens a little upon the breast, and runs, continuing uniform in breadth, exactly over the crest of the sternum, to the belly, where it becomes a little broader, and continues so until it terminates at the anus. Corresponding with this space in position and form is a somewhat narrower spinal space (fig. 6), which is always shorter, both before and behind, than the inferior space, but generally extends from the lower extremity of the neck to the caudal pit, although sometimes it is limited to the interscapulium. The dorsal tract enclosing this space is of equal strength in all parts, never interrupted anywhere, but not of uniform breadth throughout, being at first very narrow, then broader, and at last so broad as to be completely united to the lumbar tracts, presenting no difference in texture either from these or from the plumage of the tibial region. Besides the two spaces just described, there is a rather broad lateral trunk-space (fig. 7). From this a continuation passes forward between the dorsal and axillary tracts up to the level of the shoulder, and, reaching the lower extremity of the neck, forms the very short lateral neck-space. Another prolongation passes along by the outer margin of the inferior tract and beneath the wing, the base of which it surrounds, and unites with the lateral neck-space, completely separating the axillary tract from the inferior tract. Posteriorly the lateral trunk-space extends to the knee, proceeds on the inside of the tibia beside the ventral portion of the inferior tract, and reaches to the tail-feathers, bounded on its two sides by the dorsal and inferior tracts. But before it reaches the region of the knee-covert a very strong prolongation of the inferior tract, starting from the margin of the great pectoral muscle, penetrates into it, and this must be regarded as an indication of an outer branch. It must therefore be assumed, with regard to the latter, that it is completely united on the breast with the main stem of the inferior tract, although it does not terminate in an oblique truncation at the margin of the breast; but, as in the *Procellariæ*, extends beyond the breast, and is continued on the sides of the trunk almost to the knee. This very considerable length of the outer branch occurs in many Waders, and has also already been noticed in *Crypturus* (p. 117). This short outer branch, and the broad, obtuse, axillary tract, constitute the strongest portion of the entire plumage of the trunk. Of the feathers themselves there is little to be said. In their position they exactly follow the laws laid down for the Natatores in the introductory remarks; and as there are always not only one, but usually several down-feathers between each four contour-feathers, the aftershaft destined to thicken the plumage is here regularly altogether deficient. The contour-feathers of the truncal portion of the

[1] See on the general structure of this family the article under the same title in 'Ersch und Gruber's Allgem. Enzykl.,' Erste Sekt., Bd. xxiv, p. 206.

inferior tract are generally very broad, rounded, particularly strongly curved, and elastic. By this means they lie very close together, and completely repel the water during natation. The oil-gland, which, by its secretion, promotes this property of the contour-feathers, is of a cordate form and of considerable size. Each half contains only *one cavity*, and opens by a separate orifice on the pointed mamilla, which is crowned by a circlet of oil-feathers. The powerful remiges vary in number from twenty-four to thirty-four, but there are always ten on the pinion, and the first of these is generally the longest, more rarely the second, and very seldom (in *Anas moschata*) the fourth. The rectrices are remarkably soft, small, and very variable in number, ranging between twelve and twenty-four.

Of the five genera of this family there is only one—*Cereopsis*,[1] that I have been unable to examine; of the other four the following were accessible to me:

1. *Cygnus*.—Contour-feather-tracts exactly as in *Anser cinereus;* the spinal space, also, is of the same length, at least in *C. olor* and *musicus*, which I examined. Both species have more than thirty remiges, the second certainly thirty-four, of which ten are seated on the pinion; the *second* is the longest. The first three have a strong angular emargination on the inside of the vane. In the tail I found twenty-four feathers in *C. musicus*, in *C. olor* only twenty-one, and on one occasion only sixteen. The large oil-gland has long and strong oil-feathers and *two* wide orifices (see p. 41).

2. *Anas*.—This genus is distinguished by the longer and stronger terminal branch of the inferior tract, and has a still shorter lateral neck-space than the rest. Notwithstanding a great general similarity, two pterylographic groups may be established in it, and these differ also zoologically from each other in the form of the hinder toe.

a. The Pochards (*Hydrobates*, Temm.) have a shorter spinal space, which is generally limited to the interscapulium (as in *Dysporus*, Pl. X, fig. 9), and never extends beyond the commencement of the pelvis. In other respects they are distinguished by a still denser plumage, and by the presence of the aftershaft, which, indeed, is often very small, for example, in *A. fuligula*. I have seen it more distinctly in *A. lobata*, Temm., and *A. clangula*, in which it is of considerable dimensions. Most of the species, such as *A. lobata*, *fuligula*, *ferina*, *leucophthalma*, *rufina*, *mollissima*, *marila*, *nigra*, *clangula*, and *glacialis*, have twenty-six or rarely twenty-seven remiges, of which ten are seated on the pinion, and fourteen rectrices; but of the latter *A. lobata* possesses twenty, *A. leucophthalma* eighteen, *A. rufina* and *nigra* sixteen, and exceptionally *A. clangula* has seventeen and *A. leucophthalma* fifteen.

b. In the true Ducks the spinal space generally reaches from the base of the neck to the caudal pit (Pl. X, fig. 6), and is somewhat shorter only in particular species, for example, in *A. tadorna* and *crecca*. I have never observed an aftershaft in them. In the wings I have usually counted twenty-six remiges, of which the second is generally the longest; in *A. moschata* alone the fourth was the longest, and the preceding three were graduated. *A. tadorna* has thirty remiges, and *A. crecca* only twenty-four. In the tail I found fourteen feathers in *A. penelope*, *tadorna*, *boschas*, *querquedula*, and *clypeata;* sixteen in *A. crecca* and *acuta;* but the curled feathers of the male individuals are true tail-feathers, and not tail-coverts, and these raise the number to *twenty*, at least in *A. boschas*. The females have the same number.

3. *Anser*.—The spinal space extends to the commencement of the pelvis, and the lateral

[1] I have only ascertained the number of tail-feathers in this bird, which is *sixteen*.

neck-space nearly to the middle of the neck. At the same time the outer branch of the inferior tract (Pl. X, fig. 7) is smaller and weaker, and, like the hinder part of the dorsal tract, more sparsely feathered. In the wing there are twenty-nine remiges in *A. cinereus*, *canadensis*, *cygnoides*, *albifrons*, and *leucopsis*, and thirty in *A. torquatus*; in the tail I find fourteen feathers in *A. torquatus* and *pollicaris*, sixteen in most species, and exceptionally seventeen, but eighteen only in *A. canadensis*. *A. gerrhia*, an East Indian species, very similar to *A. madagascariensis*, has twelve rectrices and twenty-five remiges.

4. *Mergus*.—This genus, from the absence of the lateral neck-space and the shortness of the spinal space, approaches most closely to the Pochards; but the spinal space rises higher upon the neck, even reaching to its middle. *M. merganser*, *serrator*, and *cucullatus*, have eighteen rectrices; *M. albellus* possesses only sixteen; but all four have the same number of remiges, namely, twenty-seven.

Lastly, I have to notice the nestling plumage in this family, and to state with regard to the Domestic Goose, in which I carefully examined it, that the down-feathers of which it consists are true feathers, provided with shafts and tubes, which, however, are probably seated upon the points of the future contour-feathers, just as we have seen them to be among the Cursorial Birds (p. 119). The shaft and barbs of these down-feathers are rigid and of a yellow colour, and terminate in fine capillary tips. The barbules attached to the lower part of the barbs are likewise thin, filamentous, or capillary, but have a short, laminar basal piece, although no trace of knots or hooks. The barbs stand very far apart on the shaft, and are, therefore, not numerous.

4. Steganopodes.

This family, like the preceding, has a very persistent type of pterylosis, and presents no generic differences, except, perhaps, a variation in the density of the plumage, which appears to be dependent on the climates in which the birds live, and is much more considerable in northern than in tropical genera. The latter, such as *Phaëton*, *Tachypetes*, and *Halieus*, have certainly no aftershaft on the contour-feathers; but even in the other genera I have not met with it, and it is therefore probably generally wanting. With regard to the feathers and tracts, the *Steganopodes* are, however, clearly enough distinguished from the *Unguirostres*. The feathers are here always smaller, more pointed, and far less curved than in the Ducks and Geese. Nevertheless, they are not placed closer together, but, on the whole, are rather wider apart and more sparse. In the tracts the chief difference presented is the complete absence of a pectoral branch on the inferior tract, the latter gradually becoming narrower from the commencement of the breast, and passing, without the least break, from the pectoral surface to the ventral. Connected with this is an abbreviation of the very narrow inferior space, for this never passes forward beyond the point of furcation of the furcula, although posteriorly it attains the anus. The lateral space of the trunk is broader, at least in *Dysporus*, where it is continued between the lumbar and dorsal tracts, and reaches the true tail, which is the case in no other genus. To make up for this, *Dysporus* has quite a short spinal space on the interscapulium; but the axillary tracts are connected with the sparse lateral portions of the dorsal tract. This occurs in a still higher degree in all the other genera,

although even here the axillary tracts may be very clearly distinguished by the greater closeness of their plumage from the dorsal tract. The space observed in the dorsal tract in *Dysporus* is deficient in the Cormorants (*Carbo*) and Darters (*Plotus*); all other genera have a very distinct spinal space, extending from the shoulder-joint to the commencement of the pelvis. A short, but broad and insulated lateral neck-space is also generally present, but, with this exception, only the inside of the thighs and wings are free from contour-feathers; the latter, however, contains the large strong parapterum. The number of the powerful remiges is considerable, varying between thirty-six and forty; their form is very elongate and narrowly pointed, and the first is always the longest. In the tail we usually find twelve, fourteen, or sixteen powerful rectrices. *Pelecanus* alone has twenty-four small and weak ones. This genus is remarkable for the large size of the oil-gland and the six orifices of each of its halves. *Phaëton* appears to possess three apertures, but the other genera only one. After these statements there remain only a few peculiarities to be described under the different genera.

1. *Pelecanus*.—This genus approaches most closely to the *Unguirostres*, in the above-mentioned great number and soft texture of its tail-feathers. The covering of contour-feathers is almost uninterrupted, being deficient only on the very narrow inferior space, in the region of the axilla, on the under surface of the arm in the neighbourhood of the wing-membrane, and on the inside of the tibia. I found in the wing thirty-nine true remiges, and about fifteen feathers in each parapterum, of which the lower one especially is very strong. The oil-gland is nearly as large as a hen's egg, and perfectly cordate in form. On the convex upper surface, a little behind the middle, a small cordate space is circumscribed by the oil-feathers, and upon this the two sets of six orifices stand close together in two parallel longitudinal rows. The pneumatic texture of the skin already repeatedly mentioned presents the same characteristics as in *Dysporus*, under which I shall describe it in detail.

2. *Halieus*.—The species examined by me, *H. carbo* and *africanus*, present precisely the same characters of pterylosis as *Pelecanus*, and have, besides the spaces there mentioned, only one other on each side of the pelvis behind the thighs, which I did not observe in *Pelecanus*. The aftershaft was entirely wanting. In the wing I found thirty-two remiges in *H. carbo*, but only twenty-six in *H. africanus*; in the former the *parapterum superius* consisted of nine and the *p. inferius* of six flat principal feathers, and the thumb bore four feathers. Of rectrices I counted fourteen in *H. carbo*, and in one individual abnormally fifteen; *H. africanus* has twelve. I have already spoken (p. 15) of the white spots which the old Cormorants possess in spring on the tibiæ and neck, and I repeat that these consist of filoplumes; but I cannot say whether the larger white spots on the thighs, the feathers of which appear exactly like contour-feathers, are also produced by such filoplumes.

3. *Tachypetes aquila* has exactly the pterylosis of *Halieus*, but has a remarkably sparse arrangement of the feathers, and a distinct spinal space, which reaches from the shoulder-joint to the pelvis. Even a division of the dorsal tract into two halves is indicated by a much stronger structure of its contour-feathers in the interscapulium, but no interval is observed behind these strong feathers. Indeed, as the Frigate-bird differs from the type of the *Natatores* in many other points,[1] it does so also in its pterylosis, especially in the slight elasticity, the curvature, and par-

[1] One of the most remarkable peculiarities of *Tachypetes* is the shortness of the tarsi, which is particularly perceptible in the skeleton, and probably occurs in an equal degree in no other bird.

ticularly in the distant position of its contour-feathers. I observed down-feathers between these, but, indeed, as also in *Pelecanus*, only umbellate down-feathers. In the wing I counted thirty-four remiges, of which the ten inserted on the hand are remarkable for their very powerful structure and strong quadrangular shafts. The paraptera consist of from six to eight feathers, and the tail of twelve.

4. *Dysporus*.—Of this genus I have examined *D. bassanus* and *D. sula*, two species well distinguished by the colour of the naked skin of the face, although they are very similar, and also agree perfectly in their pterylosis. The representation of the pterylosis of *D. bassanus* given in Pl. X, figs. 8 and 9, shows all the peculiarities of the family, and appears to indicate a distinct genus only in the short and proportionally broad spinal space in the interscapulium near the axillary tracts. The oil-gland is, however, also remarkable on account of its flat shield-like form, which renders it impossible to distinguish it through the skin as a definitely limited body; and as the plumage is not deficient at this point, it takes some trouble to discover it. The two orifices which occur on the hinder part of the gland at some distance from its extremity are also very small and difficult of detection, although the closely placed white oil-feathers soon indicate their position. The body of the tail upon which the gland covering the greater part of it lies is remarkably long, and projects considerably behind beyond the gland. On this I found in *D. bassanus* only twelve, but in *D. sula* fourteen rectrices, which form a cuneiform tail; in the wing I counted from twenty-eight to twenty-nine remiges, of which ten are seated on the pinion; the hypopterum consisted of eighteen feathers. A young specimen of *D. bassanus* examined by me, although already nearly as large as a Goose, was clothed all over with snow-white down, except on the naked black skin of the face, on which, however, there were also a few minute down-feathers.

I must dwell a little longer on this genus, in order to describe more particularly the remarkable pneumaticity of the body, which has already been repeatedly referred to, and which extends over a great part of the skin. In the interior of the trunk the air-cells are in their ordinary position, but the large lateral cells are of very considerable size. On the other hand, the hepatic cells are very small, and, as usual, contain no air. Their partition is not firmly attached to the commissure of the liver, but only lies loosely upon it, and, as it were, surrounds it, which I have also found to be the case in the Crane. The smaller or anterior air-cells I only recognised indistinctly, because these air-holders were broken into more divisions than usual. From the latter the air gets under the skin through the axillary cavity, and diffuses itself hence over the entire pectoral and ventral regions, from the furcula to the pubis. These large air-spaces form two cells on each side, but these are connected together and run in a parallel direction side by side. One of them occupies the region of the ribs from the axillary cavity, the other the regions of the sternum and belly, and the latter is contiguous to its fellow of the opposite side, but is separated from it by an aponeurotic partition starting from the crest of the sternum. Consequently, at those places where these air-cavities are situated the skin does not actually rest on the body, but hangs round it and shakes to and fro when the cavities are not full of air. It is, however, particularly remarkable that the skin does not form the immediate outer covering of the above-described air-spaces, but that another thinner and very delicate membrane is stretched between the tips of the contour-feathers inserted in the skin. By this means there is produced between this inner membrane, which forms the true covering of the air-spaces, and the external skin of the body a space of the same height as the portions of the feather-tubes penetrating into

the skin. This space also contains air, which it receives through small apertures in the inferior delicate membrane, situated close to the anterior side of each contour-feather. Now, as the small cutaneous muscles between each four contour-feathers are constantly drawn to and fro, and the interspaces of these muscles are also filled up by a delicate membrane which coats the muscles themselves, membranous sacs are formed between them, into which the air can penetrate from the large cavity by the orifices above described. There is not even a trace of fat between the membranes, which are doubtless formed of delicate layers of cellular tissue, and all the spaces which elsewhere usually contain this matter in abundance here contain only air. I observed precisely the same structure in *Pelecanus crispus*, which I obtained in spirits from Vienna, and in this case found the spaces, otherwise filled with air, already partly filled with the fluid in which the specimen was immersed.

5. *Phaëton*.—The pterylosis has no peculiarities, and is very similar to that of *Dysporus*, but the narrow spinal space reaches to the caudal pit, and the bands of the dorsal tract do not touch the axillary tracts. On the other hand, the whole posterior dorsal region over the pelvis is uniformly feathered, and on the thighs two rows of stronger contour-feathers make their appearance as femoral tracts. In the wing I counted thirty-two remiges and in the tail sixteen rectrices. The oil-gland has a very short, nearly perpendicular mamilla, and three orifices on each side; of these the anterior is distinctly larger than the posterior ones. Among the many concordances of this genus with the preceding are the pneumaticity of the skin on the breast and the presence of the small air-cells between the contour-feathers. The latter, moreover, are much more elastic and curved than in *Tachypetes*, and rather resemble those of the Geese.

6. *Plotus*. — The Darter in its plumage to a certain extent resembles the Penguins, inasmuch as its body is nearly uniformly clothed with small and rather soft contour-feathers and very delicate down-feathers. The feathers only begin to be more rigid on the sides of the lower part of the neck, but become still more so on the axillary tracts, into which those neck-feathers pass. Besides these only the upper wing-coverts, the primary coverts, the very acute remiges, and the rectrices, are of a stronger formation. The number of rectrices is twelve, that of the remiges is twenty-six. Besides the lateral spaces of the trunk, I found only a narrow inferior space; all other spaces are wanting.

5. Pygopodes.

Among the Natatores this family is indisputably the most strongly marked pterylographically, both by the form of the tracts and by the texture of its plumage. The latter, wherever feathers stand (and this in many forms is the case over the whole surface of the body except the bill and feet), is denser and more closely packed than in any other bird, and consists, of course, of contour- and down-feathers, except on the spaces where down-feathers alone occur. Nevertheless, both the contour- and down-feathers possess a distinct aftershaft, and this is not wanting even on the nearly scale-like contour-feathers of the Penguins. The object of its presence here is evidently to render the plumage of these birds, which are more constantly in the water than any others, as dense as possible. As regards the forms of the tracts, there are in this family three types, which are very definitely distinguished from each other, and correspond with the groups of the Divers (*Colymbus* or *Podiceps*, and *Eudytes*), the Guillemots (*Uria, Alca, Mormon*), and the

Penguins (*Spheniscus* and *Apterodytes*), and may be distinguished from each other as follows, by their chief characters.

A. *The plumage separated into definite tracts by several spaces.*

a. The inferior tract-bands with no trace of an outer branch.

This division includes the Grebes and Divers. In the form of their tracts they approach pretty closely to the *Steganopodes*, especially in the perfeetly branchless inferior tract, which is formed exactly as in the latter. The chief distinction of the two groups lies in the dorsal tract, inasmuch as here a division into the usual two parts may be clearly recognised, and this is absent in the *Steganopodes*. The anterior part is stronger, and cleft at least from the commencement of the trunk; the posterior, much weaker part, certainly reaches to the anterior part, but is readily distinguished from it by the sparser distribution and weaker structure of the contour-feathers. The neck is uniformly feathered, unless the spinal or inferior space is still continued upon it; the lateral neck-spaces are entirely wanting. The lateral space of the trunk is larger than in the *Steganopodes*, and is particularly extended upon the back, completely separating the dorsal tract, not only from the strong axillary tracts, but also from the weak lumbar tracts. An upper wing-space is present beside the axillary tracts, but is very narrow behind. The wing-feathers present nothing remarkable; but the small and soft, frequently indistinguishable, tail-feathers remind us of the structure of the Ducks. With these the oil-gland is also in harmony in its size and form, and especially in its small delicate mamilla, which has never more than two orifices.

1. *Colymbus* (Pl. X, figs. 10 and 11).—This genus, of which I have carefully examined the large species, *C. cristatus*, and compared with it the smaller species, such as *C. rubricollis*, *minor*, &c., is especially distinguished from the following one by the length of the two median spaces. Both the inferior space, which becomes very broad posteriorly on the belly, and the spinal space, reach far up upon the neck. Hence it may be that the limbs of the anterior part of the dorsal tract advance but little beyond the commencement of the shoulder-blades, and the remarkably weak, narrow, posterior part extends forward far between the shoulder-blades. The oil-gland, on which this tract strikes, is much elongated, deeply divided, pointed anteriorly on each half, furnished at the obtuse posterior extremity with a high, perpendicular mamilla, and occupied internally in its greater part by a wide cavity. The circlet of oil-feathers is seated on the middle of the conical mamilla, and at the apex of this we may with some trouble detect two small orifices. I could not discover true (or rather well characterised) rectrices on the small conical tail; in the wing I counted in *C. cristatus* thirty-two remiges, of which eleven are seated on the pinion, and the first is the longest; the paraptera are of considerable size, and consist of from eight to ten feathers. In *C. rubricollis* I counted thirty remiges, of which eleven were on the pinion; in *C. minor* there were only twenty-six, but still eleven primaries. The latter species has also a much broader oil-gland, which is obtuse and thicker in front, and its inner cavity is remarkably small.

2. *Eudytes* (Pl. X, fig. 12).—From an examination of *E. arcticus* and *septentrionalis* (sive *rufogularis*), this genus is to be distinguished from the preceding by the following points:—1. The inferior space is very narrow, remains of equal breadth throughout, and extends forward only to the furcula. 2. The anterior part of the dorsal tract is cleft only to the shoulder, and its rather

strong limbs reach to the end of the shoulder-blades; the very broad posterior part is much shorter, and does not attain the shoulder-blades. 3. The broader tail bears definitely distinguishable rectrices, the number of which is eighteen or twenty. 4. On the pinion of the wing there are probably only ten feathers, and the total number of remiges is more than thirty.

b. The inferior tract-bands have a distinct, and even long, but narrow outer branch.

In the members of this group, to which the genera *Uria, Alca, Phaleris,* and *Mormon* belong, the *ptilosis continua* extends to the middle of the neck. Here it is interrupted by the lateral neck-spaces which reach to this point, and soon afterwards the inferior space also commences, whilst the spinal space does not advance beyond the limits of the trunk. The inferior tract, the division of which thus becomes visible a little in front of the jugular region, consists of two broad, densely feathered bands (Pl. X, fig. 13), the feathers of which present the ordinary arrangement of oblique rows, which run parallel to each other and to the crest of the sternum as far as the anus, in front of which they terminate, separated only by the very narrow inferior space. Exteriorly each band is from the first as broad as the entire pectoral surface, and is, therefore, connected by its anterior extremity with the axillary tracts. From this point the band is continued beneath the axillary cavity, embraces the shoulder-joint in front, and extends over the sides of the trunk as far as the knee-covert, gradually becoming somewhat broader behind. This greater breadth is, however, only apparent, for a continuation of the lateral space of the trunk pushes itself from the knee-covert into the tract in such a manner that the latter is divided into two approximated parallel bands. The inner of these bands, which passes without interruption from the surface of the breast upon the belly, and here usually increases somewhat in width, is unquestionably the main stem; the outer one, on the contrary, must be described as the pectoral branch, which is elsewhere usually much shorter and comparatively wider. In *Alca torda*, which has been selected for the pictorial representation of these conditions, the main stem is rather narrow in comparison with the branch, but still evidently broader than the latter. This proportion is greatly increased in *Alca impennis,* but is less marked in *Uria* and *Mormon,* in which both bands have nearly the same width. In every respect *Alca impennis* differs more from its relations in the group, especially in the remarkable dilatation of the main stem upon the ventral surface, which penetrates backwards in an acute angle into the inguinal region, and gives the ventral portion of the two bands the appearance of a broad arrow-head. This species has also the narrowest inferior space; indeed, all its spaces are very narrow.

The spinal space in this group does not differ essentially from that of the *Unguirostres* and *Steganopodes;* it is uninterrupted, of equal strength throughout, and widened behind, where it is coalescent with the lumbar tracts, and through these with the plumage of the tibia. In *Mormon arcticus* the spinal space appeared to be wanting; but in the other genera it made its appearance in the dorsal tract, between the shoulder-blades, in the form of a narrow band, which usually reached to the caudal pit (Pl. X, fig. 14), but in *Alca impennis* only to the commencement of the pelvis. This species, which is so remarkable for the small size of its wings, has, nevertheless, from twenty-nine to thirty remiges, ten of which are primaries. I found the same number of remiges in *A. torda* and *Uria grylle;* but *U. troile* and *U. alle* have only twenty-six, of which eleven appeared to be primaries, as also in the other species. The number of tail-feathers in the

Guillemots, such as *Uria troile*, *U. grylle*, and *U. alle*, is decidedly *twelve*. I found the same number in *Phaleris cristatella* and *Alca torda;* but *Alca impennis* has eighteen, which, however, are but small and weak. The oil-gland in all these genera is of comparatively small size, broadly cordate, deeply bilobed, and rounded off anteriorly; its body bears semiplumes, and its short thick mamilla a strong circlet of oil-feathers round the orifices, the number of which amounts to four on each half, at least in *Uria troile*. I have, however, been able to examine the organ in question carefully only in this species.

B. *The plumage shows no distinction between tracts and spaces, but is of uniform structure throughout.*

In the genera *Spheniscus* (*demersus*) and *Aptenodytes* (*patagonicus*) the contour-feathers stand with the most perfect uniformity over the whole surface of the body, and not the smallest trace of a space can be detected anywhere, even in the axillary cavity. They are very closely approximated, but arranged, in the manner previously described, in definite rows. The feathers themselves have a narrow lanceolate form, and a very broad flat shaft, convex beneath, in which the ordinary furrow of the lower surface is wanting, and from which the barbs issue like splinters of the superior horny lamella. At the extremity of the feather the barbs are rigid, and rather bristle-like, although flat; at the lower part they become softer and downy. The distinctly recognisable aftershaft has exactly the same texture. Beneath the latter follows the short, fusiform, inflated tube, discriminated from the shaft by a deep constriction; the main shaft does not, as usual, meet with this in the same axial direction, but at a decided and very perceptible angle. Between the contour-feathers there are, of course, down-feathers everywhere. True, specially formed remiges cannot be detected in the close scaly covering of the wings, but in the tail stiff rectrices may be distinguished. Their number in *A. patagonicus* is thirty-two or more. The oil-gland is not wanting, but is difficult to find on account of the dense and rigid covering of feathers which conceals it. When it is discovered the dense circlet of oil-feathers is also soon recognised; its feathers are distinguished from the rest of the plumage by finer but still rigid shafts, and much longer, capillary, soft barbs, which are downy below. I could not exactly ascertain the number of orifices.

Besides these two species I have been unable to examine any member of the group of Penguins.

APPENDIX.

Note I, p. 38.—Some additional information on the powder-down tracts in various birds will be found in the following paper, reprinted from the 'Proceedings of the Zoological Society,' and in the paper given in Note II.

ON THE AFFINITIES OF BALÆNICEPS. By A. D. Bartlett.[1]

On appearing before you this evening with new evidence of the affinities of this bird, and in endeavouring to aid in settling a subject so long disputed and frequently discussed, I beg to refer, first, to the elaborate and carefully written paper by Mr. Parker, in which this bird, after the most careful examination and comparison of its bones, is considered to be an *Ardeine*.

I have, then, to observe, that from an entirely different course of examination, and by the consideration of its other structures, I have arrived at the same conclusion; and I hope, with the assistance of my friend Mr. Stewart, to prove to the satisfaction of our ornithological friends, that there is no longer any doubt in the matter.

The death of the survivor of the two birds brought home by Mr. Consul Petherick has afforded me the opportunity of making a more accurate examination of its structure, and this has led me to the discovery of two remarkable powder-down patches which, it will be remembered, I stated on a former occasion[2] I had failed to find in the living bird.

Upon removing the skin from the body of this bird, I was so struck by its close resemblance to the Herons, that I immediately killed a Heron and removed its skin also, in order to form a fair opinion by a close comparison of all the parts of these two birds. The exact form of the body and limbs was most remarkable; the structure of the hind toes (upon which so much stress has been laid) was alike, these turning backwards, forwards, or sideways in both species. The head and neck, however, of *Balæniceps*, when compared with the same parts of the Common Heron, present some very considerable differences. These differences consist, first, in the much larger head, and consequently stronger neck, in *Balæniceps* as compared with the Heron. Doubtless these modifications have reference to the food and the mode of obtaining that food. Many illustrations can be found of similar modifications; I may refer to one in the group under

[1] From the 'Proceedings of the Zoological Society of London,' 1861, p. 131.

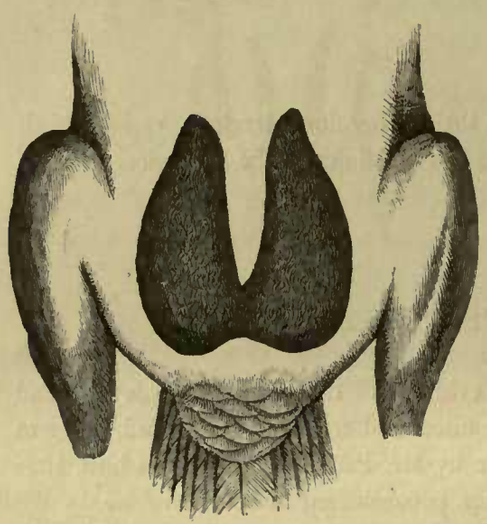
[2] See P. Z. S. 1860, p. 461.

consideration, which results from the comparison of *Cancroma* with *Eurypyga*, and which presents, perhaps, the most extreme modification in the form of the bill in two birds of the same family.

As far as I was able to examine the viscera of the *Balæniceps*, I could discover nothing that would lead me to doubt its Ardeine affinities; the stomach, liver, intestines, &c., of the two birds appeared exactly to correspond in structure and arrangement.

Directing my attention to the skin of *Balæniceps*, I was surprised at finding on the lower part of the back, reaching from the end of the scapulars to the base of the tail, two large, well-defined powder-down patches. The drawing (fig. 1) represents these two patches *in situ* on the body of the bird stripped of its feathers. These remarkable patches are dark-coloured on the inside of the skin, and on the outside the down is of extreme thickness, and the quantity of white or grey powder very great. This powder, when examined under the microscope, appears excessively oily, and will not mix with water. It is greasy to the touch, and is evidently produced by the growth of the down. It appears, in fact, to be the quill-shafts of the down broken up; or perhaps the down roots secrete this powder, which is distributed over the entire plumage, rendering the feathers impervious to water, in the same way that the oil-glands effect this in other birds. In this bird, however, the oil-glands are extremely small, not larger than the oil-glands of a Sparrow.

Fig. 1.



With reference to these patches, it is my intention to point out in the birds that I consider allied to *Balæniceps* the existence of these patches of down; and I may remark, that the attempt to arrange animals by such means is not new; as, for instance, in the case of the Ruminants, some of the genera are distinguished by peculiar patches of hair, which are said to be glandular, upon the legs, &c.; and again the *Viverridæ* are distinguished by the existence or otherwise of anal and other glands and pouches.

I therefore proceed to point out the species more or less allied to *Balæniceps* that exhibit these singular structures. In the New World form (*Cancroma*) this structure appears to be most fully developed, this bird having four pairs of these powder-down patches, as shown in fig. 2, which represents the upper, and fig. 3, which gives the lower surface of the body of this bird; while in the Old World form (*Balæniceps*) one pair only exist, as we have seen in fig. 1.

It is worthy of notice, that the true Herons, which inhabit both the Old and New World, and which have generally been regarded as the type of the group, have three pairs of these patches; the little and certainly aberrant form of Heron, *Eurypyga*, has only one pair of these down patches; while intermediate between this bird and the Herons come the Bitterns, in which two pairs of these patches exist.[1]

[1] Having had many opportunities of studying the habits of the living examples of *Eurypyga* and *Botaurus*, I have observed a striking resemblance in these birds, particularly in the drooping and

By these remarks one is naturally led to observe the often-noticed correspondence of forms in the Old and New World; as, for instance, the Ostrich of Africa represented by the Rhea of

Fig. 2.

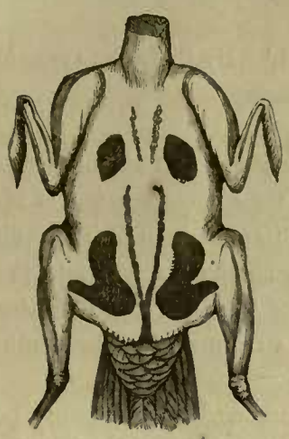
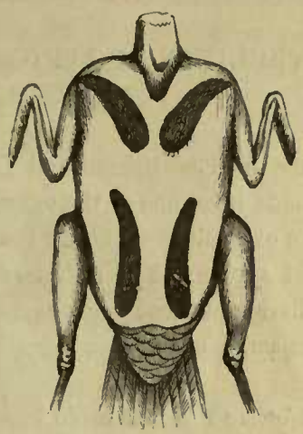


Fig. 3.



America, the Camel of the Old World by the Llama of America, the Lion by the Puma, and many other similar representations.

In the work on 'Pterylographie,' published by Ch. L. Nitzsch, the author, who evidently has paid great attention to the subject, says, that "these powder-down patches are found (but in a much smaller degree) in the genus *Tinamus*, one or two Parrots, and also in some of the Birds of Prey." I have not, however, met with them in any group except the *Ardeæ* and their allies. I can assert most positively that no traces of these patches exist in the Pelicans, Storks, or Cranes. I have also taken considerable trouble with *Scopus*. This bird is considered by Prof. Reinhardt to be closely allied to *Balæniceps*. I cannot find anything to justify such a belief; the skins and skulls of the two birds are so entirely different, that it is useless to enter into any further details respecting them.[1]

There is one thing, however, that I wish to remark, and I do so with considerable uneasiness lest I should be accused of casting a doubt upon the veracity of the gentleman to whom we are indebted for the first living specimens of this rare bird; and this consideration would have prevented my making the remark, had not my great desire been to call attention to the subject in the hope of obtaining a truthful explanation of what appears to me inexplicable—I refer to the statement, made by Mr. Petherick, that *Balæniceps* runs about in search of food immediately after it is hatched. If this is true, it is one of the most extraordinary facts I have yet met with.

spreading out of the wings, in which position the beautiful markings upon every feather are finely displayed. I have so frequently seen this attitude assumed by both these birds, that I am satisfied it is not merely an accidental thing.

[1] I may remark that I cannot agree with Mr. Bartlett's views as to the affinities of *Balæniceps*, which, in spite of its powder-down patches, must, I think, be referred to the Storks (*Ciconiidæ*).—P. L. S.

Note II, p. 92. The following paper, reprinted from the Zoological Society's 'Proceedings' (1865, p. 682, et seq.), furnishes some further details concerning the structure of this remarkable form.

ON THE STRUCTURE OF LEPTOSOMA DISCOLOR.[1] By P. L. Sclater, M.A., Ph.D., F.R.S., *Secretary to the Society.*

Since the time of Brisson and Levaillant, I am not aware that any original observations have been made upon one of the most abnormal types of the strange avifauna of Madagascar—the *Leptosoma* of Vieillot—although several attempts have been made to fit it into different parts of the natural system. The collectors who have recently obtained access into the interior of Madagascar have sent home many examples of both sexes of this bird, and I am thus enabled to offer a few remarks upon some remarkable points in its structure which have hitherto escaped observation.

The *Leptosoma* was first made known to science by Brisson,[2] who describes both sexes in his usual accurate manner from specimens in the museum of M. l'Abbé Aubry. Brisson remarks upon the obvious differences between this bird and the ordinary *Cuculi*, which might entitle it to constitute a genus by itself.[3] Buffon figures both sexes in the 'Planches Enlumineés' (pl. 587, 588), and in the text thereto copies parts of Brisson's description.

Levaillant also figures both sexes of this bird in his 'Oiseaux d'Afrique,'[4] and pretends to have met with it in 'Cafferland," as in the many other cases where the falsehood of his statements is equally glaring.[5] Several scientific appellations have been bestowed upon the bird upon the faith of these authors, such as *Cuculus afer*, Gm. S. N. i. 418, *Cuculus discolor*, Hermann, *Bucco africanus*, Stephens (Zool. ix, p. 25), and *Leptosomus viridis*, Vieill. Enc. Méth. iii, p. 1342.[6] Of these it becomes necessary to adopt *discolor* as the permanent specific designation of the species, although not the first given (as Gmelin's term involves a gross error in the locality), and to combine it with Vieillot's generic term *Leptosoma*, so that the correct name of the bird will be *Leptosoma discolor*.

Lesson in 1831 (Traité d'Ornithologie, p. 134) conceived the unhappy idea that the older authors had been wrong in regarding the somewhat dissimilar sexes of this bird as belonging to the same species, and accordingly made of the female a separate species under the name *Leptosoma*

[1] From the 'Proceedings of the Zoological Society of London,' November 28th, 1865.

[2] Ornith. iv, p. 160, pl. xv, f. 1 and 2.

[3] "*Species ista rostro donatur multo rectiore quam reliquæ omnes hujus generis species: quod rostrum nequaquam est superne convexum, sed angulosum. Nares habet longas, et versus mediam longitudinem mandibulæ superioris oblique positas. Ab aliis speciebus insuper discreput cauda duodecim rectricibus confluta, dum in alteris decem tantum nec amplius unquam observavi. Hæc species posset suum genus constituere.*"

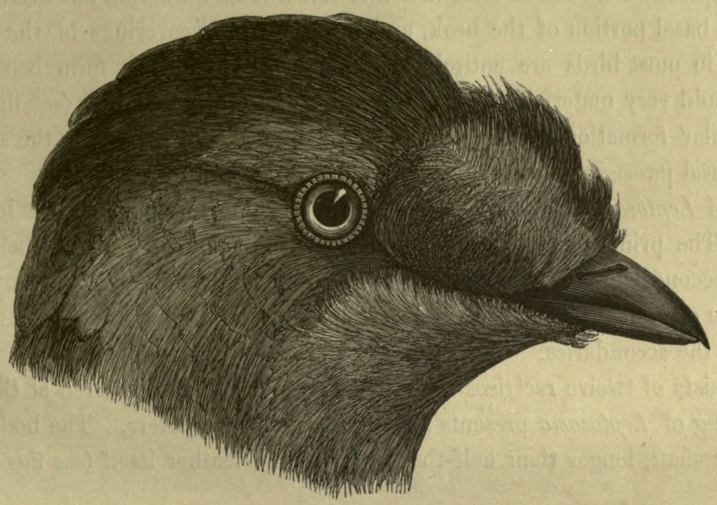
[4] 'Le Vourougdriou,' v. t. 226 et 227.

[5] Cf. Sundevall's 'Commentary on Levaillant in Kong. Sv. Vet. Ak. Handl.,' n. s., ii, pt. 1.

[6] Here and in his 'Analyse' Vieillot writes the name *Leptosomus*. But *Leptosoma* is correct.

crombec. Prof. Reichenbach, not satisfied with this, has gone so far[1] as to establish a new genus (*Crombus*) on the female, and to place it in a different part of the system! In his 'Conspectus,' Prince Bonaparte retains this form near the *Cuculidæ*, but makes an independent family of it (*Leptosomidæ*). In his more recent 'Conspectus Systematis Ornithologiæ'[2] he has removed it into the neighbourhood of the American *Bucconidæ*. Before attempting to solve the question as

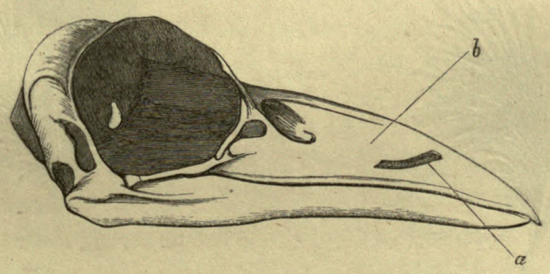
Fig. 1.



Head of male *Leptosoma*

to which of these two views is most correct, I must ask leave to call the Society's attention to some remarkable points in its structure, which appear to have been hitherto unnoticed.

Fig. 2.



Outline of the skull of *Leptosoma*.

The first thing which strikes one as remarkable in examining the external characters of *Leptosoma discolor* is the extreme elongation of the feathers of the lores and their projection forward over

[1] 'Handb. d. Sp. Orn.,' ii, p. 51.

[2] 'Ann. d. Sc. Nat.,' ser. 4, 'Zool.,' i, 1854.

the bill on each side (see fig. 1, p. 159). The bill is in reality long and strong, and the gape very wide; but the basal half is entirely concealed from view by this extraordinary development of the loral plumes. It is, I suppose, for the purpose of getting the nostrils out of the way of these that the openings of them are carried so far forward. They are placed laterally, rather nearer the apex of the beak than the front (where the feathering commences), and consist of a narrow diagonal slit, just as in the genus *Eurystomus*. But in *Eurystomus* the apertures lie, as is the case in the majority of birds, at the base of the beak close to the frontal plumes. On examining the skeleton of *Leptosoma* we see at once that this remarkable formation has been effected by the elongation of the basal portion of the beak, and that the lateral coverings of the nasal passages (alæ nasi), which in most birds are entirely membranous, have in this form become completely ossified, so as to add very materially to the strength of the upper mandible (see fig. 2, p. 159).

A very similar formation occurs in *Eurystomus*, but is not carried to the same extent, the covering of the nasal passages remaining membranous in this form.

The wings of *Leptosoma* are of moderate length, reaching to about half the length of the tail from its base. The primaries are ten in number, the third, fourth, and fifth being nearly equal and longest, the second half an inch shorter, and the first more than an inch shorter again, being about equal to the eighth. The first six are narrowed towards the apex; the remaining four are broad-tipped like the secondaries. The secondaries are twelve in number.

The tail consists of twelve rectrices of nearly equal length, and squared at the apices.

The feathering of *Leptosoma* presents some remarkable characters. The body-feathers have a long downy aftershaft, longer than half the length of the feather itself (see figs. 3 and 4). In

Fig. 3.

Fig. 4.

Feathers of *Leptosoma*.

Eurystomus there is a similar auxiliary plume, but not quite so highly developed. In the *Cuculidæ*, I believe, the aftershaft is always deficient.[1] The upper ptilosis also appears nearly similar to that assigned by Nitzsch to *Coracias* and *Eurystomus*. The spinal tract bifurcates between the

[1] Cf. anteà, p. 90 et seq.

shoulders, leaving a wide featherless space. The branches are then discontinuous for a short distance, but reappear in two gradually converging lines, which unite on the rump. But here a very abnormal feature presents itself, which is found neither in the *Coraciidæ* nor in any other family of the Order Picariæ. This is two large and highly developed powder-down patches (fig. 5, *p*, *p*), which are placed on the flanks, on each side of the rump. They are of an oval shape, and measure about $1\frac{3}{4}$ inch in length by an inch in breadth. The development of these lubricating organs may perhaps account for the atrophy and almost total disappearance of the oil-gland, which can scarcely be recognised in the minute papilla (*o*, fig. 5), situated at the base of the two medial tail-feathers.[1]

Fig. 5.

The sternum of *Leptosoma* (figs. 6 and 7, p. 162), a specimen of which Mr. A. Newton has kindly lent me from his extensive collection of these objects, does not, I must admit, present us with any very close resemblance to that of *Coracias*. At the same time I do not see that it is in any respect more like that of the *Cuculidæ*.

The two posterior fissures so characteristic of the greater number of forms of the order Picariæ are here run together, forming but one large opening, the apophysis between them not reaching to the line of the posterior margin, and the outer fissures being smaller and not so deep as the inner pair. In *Coracias* and *Eurystomus* the outer fissures are deeper, and the separating apophysis advances quite to the posterior margin. There are two other points in which the sternum of *Leptosoma* differs considerably from that of the *Coraciidæ*. These are the very rudimentary condition of the episternal process (*e. p.*, fig. 7), and the remarkable thickening of the rami of the furcula at their anterior extremities, and their attachment to the front of the coracoid by a massive head. In *Coracias* and *Eurystomus*[2] the episternal apophysis is well-developed and terminates in a point, which advances some way forward between the coracoids, nor are the rami of the furcula thickened to any noticeable extent where they join the coracoids. It may also be noticed that the coracoids of *Leptosoma* overlap one another a little at their junction with the sternum, as is the case with some of the Accipitres.

[1] This is, I believe, the first instance of powder-down patches having been noticed to occur in any species of the Order Picariæ. Nitzsch (anteà, pp. 37, 38) describes them as met with in the following genera:—

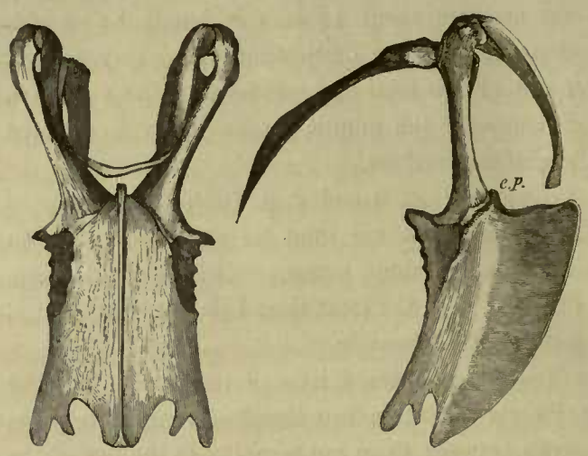
	Order.
Nauclerus	Accipitres.
Elanus	
Cymindis	
Artamus	Passerinæ.
Tinamus	Gallinæ.
Ardea and its affines	Grallæ.
Cancroma	
Eurypga	

Mr. Bartlett has determined their presence in *Balæniceps* (see anteà, p. 165, and *Rhinochetus* ('P. Z. S.,' 1862, p. 218).

[2] Cf. Blanchard, "Recherches sur les Caractères Ostéologiques des Oiseaux," 'Ann. d. Sc. Nat.,' Zoologie, ser. 4, vol. xi, p. 127.

The tongue of *Leptosoma*, of which Mr. Newton has also kindly lent me a specimen, is remarkable for its thin horny nature and pellucid appearance, and (as far as I can tell, the

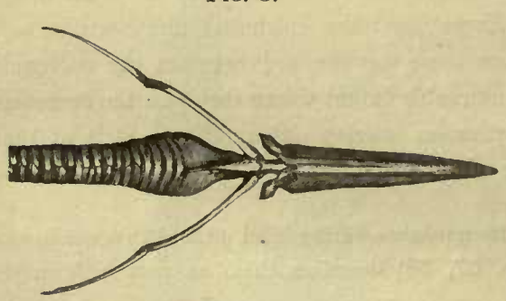
Fig. 6. Fig. 7.



Sternum of *Leptosoma*.

example not being quite perfect) for being without any traces of laceration at its extremity. It is much lengthened, and of nearly uniform thickness throughout; but the sides are bent upwards, leaving a deep medial channel, which grows shallower towards the base, where it terminates in two simple lateral projections without any traces of papillæ.

Fig. 8.



Tongue of *Leptosoma*.

In a note to his 'System der Pterylographie' (anteà, p. 92), Nitzsch has stated that in two examples of *Leptosoma* examined by him the outer toe "*appeared* to have *four* phalanges," instead of five, the normal number. This, however, is not the case: *Leptosoma* does not diverge from the ordinary rule among birds in this respect. The structure of its feet may be described as follows:—

The tarsus is rather longer than the second digit, measuring 1·2 in. in length. It is covered in front with a series of ten or twelve irregular oblong scutes, which are divided in the upper and lower portion of the tarsus, but entire in the middle. On the outer side is a series of smaller similar scutes. Behind, the tarsus is covered with numerous small irregular hexagonal scutes, which extend over the lower surface of the planta.

The first or posterior digit measures 0·63 in. in length, including the nail, and is placed behind in its usual position. The second and third digits are placed directly in front, and measure 0·63 and 1·5 in. respectively (with the nail). They show no appearance of syndactylism, being separated nearly to the base. The fourth digit measures 1·11 in. in length, and, as I have

already stated, has the normal number of five phalanges—the first two being very short, each measuring only about 0·5 in. in length. It is articulated not in a directly reversed position, as among the more typical *Zygodactylæ*, but laterally, rather more behind than in front. It will therefore be seen that *Leptosoma*, even in this respect, diverges widely from the *Cuculidæ*, *Bucconidæ*, &c., in which the fourth digit is placed in a directly reversed position.

So much, then, I am at present able to say concerning the peculiarities of this remarkable type. In order to refer *Leptosoma* decisively to its proper place in the natural series, an examination of the soft parts of its structure still remains to be made, which as yet I have had no opportunity of doing. But it appears to me that sufficient is known to show that *Leptosoma* can no longer be left as a genus of the family *Cuculidæ*, from which it differs in many important points, particularly in the form of the nostrils, in the presence of an auxiliary plume on the body-feathers, in having twelve tail-feathers, and in the structure of its feet. As far as I can at present form an opinion, a more natural situation for *Leptosoma* would be as the type of a separate family in the neighbourhood of the *Coraciidæ*. The singular structure of the nostrils very much resembles that of *Eurystomus*. *Eurystomus* also has the aftershaft, and the same number of tail-feathers—although differing from *Leptosoma* in the form of the sternum and the structure of the feet, so that they could hardly be associated together in the same family.

I have as yet had no opportunity of seeing more than a stuffed specimen of another singular Madagascar type—the *Brachypteracias leptosomus;* but I think it very probable, from the superficial examination I have made of it, that this, as suggested by Lesson, may be the missing link which connects *Leptosoma* with the *Coraciidæ*.

Explanation of the Figures.

Fig. 1. Head of *Leptosoma*, showing the projection of the loral and frontal plumes, and the position of the nostrils.

Fig. 2. Outline of the skull of *Leptosoma*, showing the position and form of the nasal apertures (*a*) and the ossified covering (*b*).

Fig. 3. Lower surface of a feather from the back of a male *Leptosoma*, with part of the inner web removed, so as to show the auxiliary plume more clearly.

Fig. 4. Lower surface of a feather from the breast of a female.

Fig. 5. Upper surface of *Leptosoma* with feathers removed (reduced), showing the bifurcation of the spinal tract and the position of the two powder-down patches (*p*, *p*) and oil-gland (*o*).

Figs. 6, 7. Sternum of *Leptosoma*.

Fig. 8. Tongue and hyoid bones of *Leptosoma*.

Note III.

LIST OF NITZSCH'S ORNITHOLOGICAL WORKS AND MEMOIRS.

1. Pterographische Fragmente (Mit 1 Taf.). Voigt's Magaz., Bd. ii, 1806, p. 393.
2. Beiträge zur Naturgeschichte der Eulen. Voigt's Magaz., Bd. xii, 1806, p. 397.
3. Osteografische Beiträge zur Naturgeschichte der Vögel. Leipzig, 1811, 8vo.
4. Ueber die Knochenstücke im Kiefergerüst der Vögel. Meckel's Deutsch. Arch. f. Physiol., Bd. i, 1815, p. 321.
5. Ueber die Bewegung des Oberkiefers der Vögel. Meckel's Deutsch. Arch. f. Physiol., Bd. ii, 1816, p. 361.
6. Ueber die Nasendrüse der Vögel. Meckel's Deutsch. Arch. f. Physiol., Bd. vi, 1820, p. 234.
7. Ueber die Haare im Magen des Kuckuks. Meckel's Deutsch. Arch. f. Physiol., Bd. viii, 1823, p. 559.
8. Ueber das Vorkommen einer Epiglottis bei Vögeln. Meckel's Deutsch. Arch. f. Physiol., 1826, p. 613.
9. Ueber die Pneumaticität und einige andere Merkwürdigkeiten des Skeletts des Kalaos (*Buceros*). Ibid., p. 618.
10. Observationes de Avium arteria carotide communi. Halæ, 1829, 4to, 26 pp.
11. Pterylographiæ Avium pars prior (Diss. Inaug.). Halæ, 1833, 50 pp.

Posthumous Works.

12. System der Pterylographie von C. L. Nitzsch nach seiner handschriftlich aufbewarteten Untersuchungen verfasst, von Hermann Burmeister. Halle, 1840, 4to, 228 pp.
13. Vergleichung des Skeletts von *Dicholophus cristatus* mit dem Sklettypus der Raubvögel, Trappen, Huhner u. Wasserhühner. Abhandl. d. Naturf. Ges. in Halle. Bd. i, 1853, Quart. i, p. 53.
14. Anatomische Notizen über die Papageien. Zeitschr. f. d. Ges. Nat. Bd. xiii, 1859, p. 118.
15. Zur Anatomie der Papageien, nach Chr. Nitzsch's Untersuchungen mitgetheilt von C. Giebel. Zeitschr. f. d. Ges. Nat., xix, 1862, p. 133.
16. Ueber die Familie der Passerinen. Ibid., p. 389.
17. Zür Anatomie von *Vultur fulvus*. Zeitschr. f. d. Ges. Nat., 1863, xxi, p. 131.

Note IV.

OBSERVATIONES DE AVIUM ARTERIA CAROTIDE COMMUNI. Auctore Chr. Lud. Nitzsch, Medic. et Philos. D., in Universit. Lit. Halensi Hist. Nat. Prof. P. Ord.; Musei Zool. Direct.; Plurium Academ. et Societ. Liter. Sodali. Halæ, 1829. In Bibliopolio Gebaueriano.

Caput Primum.

Auctorum exponuntur observationes de avium arteria carotide communi editæ.

Carotides arterias binas communes sive primitivas, dextram nempe et sinistram, unam et alteram ex subclavia sui lateris arteria oriundam in avibus adesse, viri celeberrimi Cuvierus[1] et Tiedemannus[2] aliique eos secuti docuerunt ita quidem, ut nullius exceptionis mentionem fecerint vel ejus suspicionem moverint.

Illustris autem Meckelius; cujus indefessa et fructuosa opera anatomiæ comparatæ nova usque accedunt augmenta, in promptuarii sui, anatomiæ et physiologiæ dicati particula prima, initio anni 1826 edita[3] retulit, se quidem arteriæ illius duplicitatem, in mammalibus solemnem, ejusque cursum ab auctoribus laudatis indicatum sæpe reperisse in avibus ipsisque in Grallis collo procero insignibus, *Rheam* tamen et *Phœnicopterum* alius structuræ maxime notabilia exempla obtulisse, unicam nempe arteriam carotidem communem, in Rhea e sinistra, in *Phœnicoptero* e dextra arteria subclavia ortam, in eadem linea colli media, qua binæ alias arteriæ exsurgant, sursum tendentem et brevi demum a capite distantia in dextram et sinistram rursus divisam. Addit auctor celeberrimus, hanc singularem conformationem a natura quasi præparatam esse eo, quod in binas arterias carotides habentibus uterque truncus arteriosus se invicem longo tractu proxime tangat, illamque verisimiliter ab ingenti, quæ colli dictarum avium est, longitudine pendere.

Ad calcem ejusdem libri particulæ primæ,[4] ubi observationem priorem publicavit laudatus auctor, novam prodidit, non minus memorabilem; nimirum vidit in *Ardea stellari* arteriam carotidem communem dextram et sinistram separatam quidem ex sui lateris arteria subclavia originem ducere, sed eo loco, ubi in aliis avibus, carotidum communium pari instructis, una alteri proxime apponitur, utramque in unicum truncum coalescere, qui demum in capitis vicinia rursus divideretur in dextram arteriam et sinistram; atque hanc structuræ rationem eo magis memoria dignam omni jure censet, quod neque in alia ejusdem generis specie, nempe *Ardea cinerea*, neque in *Ciconia*, utpote duplici a. carotide primitiva nec in unam confluente præditis, locum habeat.

Eodem circiter tempore, ubi Meckelius illa typis exscribenda curavit, in lucem emissa est

[1] 'Leçons d'Anatomie Comparée,' iv, p. 266.

[2] 'Zoologie,' vol. ii, p. 581 et seqq.

[3] 'Archiv für Anatomie u. Physiologie,' Jahrg., 1826, p. 19. '— Beitrag zur Geschichte des Gefäfssystems der Vögel.'

[4] L. c., p. 157.

clar. Baueri dissertatio[1] observationes valde laudabiles de avium arteriis, sub illustris Rudolphii et cel. Schlemmii auspiciis factas continens. Ex quo libello cognoscitur, non solum ipsam unius arteriæ carotidis communis observationem in *Hirundine* factam auctorem inprimis instigasse ad arteriarum avium accuratius examen, sed etiam in pluribus aliis volucrum generibus et speciebus illam arteriæ carotidis unitatem eidem esse visam. Leguntur enim pagina sexta libelli citati hæc verba: "Quivis truncus anonymus (ita subclaviæ arteriæ primus tractus auctori appellatur) extrorsum sursumque progrediens prope bronchum sui lateris in arteriam carotidem communem et arteriam subclaviam discedit et quidem in avibus majoribus, uti in *Anate, Gallina, Falcone Milvo,* &c. In nonnullis vero, inprimis minoribus, truncus anonymus sinister in arteriam carotidem communem et art. subclaviam uti in majoribus avibus, dexter autem in art. vertebralem et subclaviam discedit. Arteria carotis communis dextra hic deest. Hoc reperi in *Sitta europæa, Corvo Cornice, Pica* et *glandario, Oriolo Galbula, Alauda arvensi, Turdo viscivoro, Loxia, Emberiza citrinella* et *miliaria, Fringilla cœlibe* et *linaria, Motacilla Ruticilla* (*?phœnicuro*) *Paro majori, Hirundine urbica* et *apode* et *Colymbo cristato.*"

Præter illas nullæ mihi innotuerunt observationes publice editæ de arteriæ carotidis communis rationibus apud aves diversis.

Caput Secundum.

Traduntur observationes generales de avium arteriarum carotidum communium numero ortu et cursu diverso.

Equidem, si numerus tantum et origo spectatur, quatuor arteriæ illius rationes in avibus inveni, neque in majori observationum copia plures ill. Meckelio indicatis; siquidem plures cogitari vix posse videntur. Etenim arteria carotis communis:

1. Vel duplex est (dextra atque sinistra a principio et postea;
2. Vel simplex est longiori tractu, sed duobus truncis, dextro et sinistro, mox in unum confluentibus oriunda, dein rursus divisa;
3. Vel una tantum est eaque dextra;
4. Vel denique unica eaque sinistra.

Quartam rationem non minus ac primam vulgatissimam esse, secundam vero, uti tertiam rarissime inventam, postea patebit. Sed antea, quam de illis rationibus seorsum dicatur, generalia quædam exsequenda reor.

In omnibus avibus, si *Psittaci* quædam species excipiuntur, cursus et situs arteriæ carotidis communis, sive sit unica illa sive duplex, fere idem sunt. Quemadmodum enim, ubi adest a. carotis communis dextra et sinistra, quælibet ex arteria subclavia sui lateris orta, postquam præter alios ramos arteriam vertebralem emisit, mox ad mediam anticæ colli faciei lineam vergit, ibique cum altera, sibi proxime apposita musculis colli anticis longo tractu[2] tecta sursum tendit, ac demum in capitis vicinia ex hac occultatione rursus exit et ad id latus, quo exorsa est, vertitur, ut denique in ramos, arteriæ carotidis facialis et cerebralis vicem implentes, dispescatur;

[1] 'Disquisitiones circa nonnullarum avium Systema Arteriosum,' auctore Frid. Bauer. Berolini, 1825.

[2] Quo quidem tractu in aliis avibus ramusculos plures, in aliis nullos edit arteria carotis, sive sit duplex illa sive simplex.

—ita simplex quoque et unica arteria carotica, sive sit e dextra arteria subclavia, sive e sinistra, sive ex utraque orta, pariter longiori vel longo tractu penitus absconditur musculis illis, in eadem linea colli antica media caput versus pergens ; haud procul vero a capite rursus prodit, divisa in duos truncos, quorum unus ad dextrum alter ad sinistrum latus (eodem modo, quo aliarum volucrum dexter et sinister inde a principio sejunctus) se convertit et in arterias diversis capitis partibus sanguinem subministrantes dividitur, de quarum cursu et divisione ad TIEDEMANNI et BAUERI scripta lectorem liceat ablegare.

Neque tamen solo musculorum operimento tutus et munitus est ille carotidum arteriarum truncus vel duplex vel unus, sed etiam in ipsis vertebrarum corporibus via ei facta est plus minusve cava et ad anticam vertebrarum singularum partem tuberculorum pari limitata, quod sæpius in pontem transversum confluit, vel ex toto osseum, vel media parte cartilagineum aut membranaceum. Pontibus ejusmodi sive retinaculis plane osseis in pluribus colli vertebris, quæ inter priores et ultimas sunt, radicantibus tectam vidi arteriam carotidem communem, v. c. in *Picorum*, *Ardearum*, *Colymborum*, et *Eudytarum* generibus, ideoque hic fere eodem modo absconditam et munitam ac vertebralem arteriam. Atque hanc rationem tam in avibus, quæ duplici, quam in iis, quæ simplici art. carotide communi utuntur, inveniri, citata exempla probant.

Extra mediam autem colli lineam illam arteriam nonnisi in *Psittacorum* quibusdam speciebus, nimirum in *Psittaco erithaco*, *ochrocephalo*, *leucocephalo*, *caniculari et Macavuanna* sitam et decurrentem videre mihi contigit. Etenim in his, quibus utraque (dextra et sinistra) arteria carotis communis utique distincta est, dextra sola vulgari modo in illa linea media musculis tecta ad caput tendit, sinistra vero longe remota a dextra, ipso sinistro colli latere ascendit, omni musculorum tegmine destituta et cute sola tecta. Quæ quidem singularis arteriarum carotidum ratio in pluribus illorum Psittacorum exemplis mihi dissectis cernebatur constans, sine dubio præterea in multis aliis ejusdem generis speciebus reperiunda.

Omnino numeri, originis et decursus carotidum arteriarum ratio nunquam ex lusu quasi naturæ variare videtur, sed, mea saltem experientia, constantissima et in cunctis ejusdem speciei exemplis prorsus eadem est. Quanquam enim plurium specierum (v. c. *Falconis Buteonis*, *lagopodis*, *Nisi*, *Corvi Cornicis*, *frugilegi*, *Lanii Excubitoris*, *Pari majoris*, *Fringillæ Montifringillæ*, *Emberizæ citrinellæ*, *Cypseli apodis*, *Columbæ domesticæ* et *Galli domestici*) decem ad viginti circiter ; aliarum (e quarum numero *Falco Albicilla*, *Subbuteo*, *Æsalon*, *Strix Aluco*, *brachyotos*, *passerina*, *Corvus Monedula*, *Bombycophora garrula*, *Sitta europæa*, *Fringillæ*, *Emberizæ*, *Sylviæ*, *Turdi*, *Hirundines plures*, *Caprimulgus europæus*, *Coracias garrula*, *Cuculus canorus*, *Yunx Torquilla*, *Upupa Epops*, *Charadrii*, *Totani*, *Anates* et *Colymbi varii*) quinque ad minimum specimina examinavi (eas enim omitto species, quarum minorem individuorum numerum observavi), tamen nullam unquam arteriæ illius diversitatem intra unius avium speciei limites reperire potui.

Neque etiam ipsas ejusdem generis species hac vasorum sanguiferorum parte inter se differre animadverti, exceptis *Ardearum* et *Psittacorum* generibus. Alia quippe in *Ardea cinerea*, alia in *Ardea stellari*, MECKELIO, uti supra relatum est, atque etiam mihi carotidis arteriæ communis ratio visa est. *Psittacinum* autem genus triplicis quodammodo differentiæ exemplum memoria dignissimum mihi obtulit. Alii nempe *Psittaci* binos truncos arteriarum carotidum usque distinctos ac solito more in linea colli mediana proxime sibi sursum tendentes, alii binos quidem, sed, uti paullo antea indicavimus, sinistrum longe remotum a dextro et ad colli latus ascendentem, alii denique solam sinistram arteriam carotidem primitivam habent.

Sed probe notandum est, hanc et illam ejusdem generis specierum diversitatem cum aliis quibusdam differentiis esse conjunctam, ita ut, quæ illius arteriæ ratione dissideant species, etiam subgeneris fere gradu diversæ esse videantur.

Familias autem quod attinet avium, aliarum genera illa re inter se differre, jam ex supra dictis patet, aliarum vero ea convenire putandum est, si quidem ex observationibus hucusque factis concludere licet. *Accipitrinæ* v. c. itemque *Gallinaceæ*, *Limicolæ*, *Longipennes*, et *Unguirostres* nunquam non arterias carotides communes binas,—*Passerinæ* semper tantum sinistram arteriam,—*Cuculinarum* contra genera alia binas, alia nonnisi unam mihi obtulere, atque in his genera sibi valde affinia, *Meropis* puta et *Galbulæ*, art. carotidum communium ratione differre vidi; ut alia exempla taceam.

Causam, cur avibus aliis alia a natura concessa sit art. carotidum primitivarum ratio, nullo modo potui eruere. Hanc enim diversitatem a colli longitudinis gradu haud pendere, simplicemque truncum caroticum minime longicollibus tantum quibusdam avibus (in quam opinionem ill. Meckelius propensus fuit) a natura datum, sed in ipsis collo brevi, immo brevissimo utentibus maxime solemnem esse, utique certum est. Erunt fortasse, qui in colli quadam motione vel directione magis continua illius diversitatis causam aliquam quærendam esse opinentur, cum observent, *Psittacos* alios nonnisi dextri, alios sinistri pedis ope cibum ori admovere, ideoque collum, ubi vescantur, hos magis ad sinistrum, illos ad dextrum latus flectere; vel si animadvertant, avibus dormientibus aliis sinistræ, aliis dextræ, aliis neutri alæ caput submittendi consuetudinem esse. At illa colli perseverantius ad latus flectendi consuetudo neque in Psittacis escam su entibus, neque in avibus his et aliis dormientibus satis observata affatimque in singulis et multis determinata est (auctores enim de hac re fere nihil omnino prodiderunt), neque ubi est, respondere videtur carotidum arteriarum rationibus, quas indicavimus diversis; neque cur hæ propter illam consuetudinem ita nec aliter differant, sive qui inter has et illam obtineat nexus facile perspicitur. Certum est diversimode institutam esse arteriam carotidem communem tam in iis, quæ eodem modo caput in somno abscondunt, quam in illis, quæ, veluti *Striges* et *Cypseli*, capite usque libero nec alis submisso dormiunt. Volucrum autem plures species vel specierum exempla, dum dormiunt, sine certa regula caput nunc hac, nunc altera ala tegere, diligenter observantibus facile patebit.

Sinistram solam arteriam carotidem communem sæpissime inveniri in avibus quodammodo explicari posse videtur eo, quod in plurimis horum animalium sinistrum corporis latus etiam circa alia nonnulla, inprimis sexus organa prævalet præ dextro. Ac talis asymmetriæ vestigium leve in illis quoque nonnunquam mihi vidisse videor, quæ tam dextro quam sinistro truncо carotico instructa sunt, ita ut sinister dextro paullulum præstet amplitudine.

Ceterum id, quod ad amplitudinem attinet, silentio non transmittendum est, carotidem arteriam communem, si una adest sola, duplo ampliorem esse semper singula quaque in binas habentibus obvia.

Caput Tertium.

Familiæ avium consignantur addita indicatione rationis arteriæ carotidis communis in quaque illarum observatæ.

Antea vero quam singula exempla cujuslibet art. carotidis communis differentiæ proferam, familias avium secundum systema meum (diuturno quidem labore præparatum, sed, licet sæpius

mutatum, tamen ob magnam rei difficultatem minime absolutum), quam brevissime potero, consignare, simulque art. carotidum rationem cuique familiæ propriam, quantum ex meis observationibus liceat, indicare, idoneum et necessarium esse videtur.

Avium igitur familiæ hæ sunt:

I. *AVES CARINATÆ*, Merremio dictæ.

A. Aves carinatæ aereæ.

1. Accipitrinæ (*Accipitres* Linn., excepto *Lanio*, sive *Raptatores* Illig., *Rapaces* Temminckii), in *diurnas* et *nocturnas* subdividendæ. Harum quæcunque dissecare potui genera, dextram et sinistram carotidem arteriam undique distinctam obtulere.
2. Passerinæ. Familia omnium longe numerosissima, cui accenseo aves illustri Cuviero[1]) "*passereaux*" dictas, exceptis tamen *Trochilo*, *Cypselo*, *Caprimulgo*, *Podargo*, *Todo*, *Prionita*, *Coracia*, *Merope*, *Bucerote*, *Upupa*, *Epimacho*, *Alcedine*, *Dacelone* et *Colio*, utpote ab hoc ordine prorsus alienis. In veris Passerinis dextram arteriam carotidem communem desideravi semper. Sinistra, quæ sola adest, sero demum musculis nec unquam retinaculis ex toto osseis tegitur.
3. Macrochires (*s. longimanæ*) in duas dividendæ tribus, quarum una continentur *Trochili*, altera *Cypseli* et *Hemiprocnes N.*[2]) genera. Hæ aves itidem dextra arteria carotide communi semper carere videntur.
4. Cuculinæ, rursus in tres tribus dispescendæ, quarum primæ insunt *Caprimulgus*, *Nyctornis N.* [cujus species *Caprimulgus grandis*[3])], *Podargus*—secundæ: *Todus*, *Prionites*, *Coracias*, *Merops*, *Galbula*—tertiæ: *Cuculus*, *Phœnicophanes*, *Coccygius*, *Centropus*, *Crotophaga*, *Scythrops*, *Leptosomatus*, *Prodotes N.* (*Indicator* auctorum) et *Trogon*[4]). Hujus familiæ quinque tantum genera respectu carotidis arteriæ observavi, quorum unum sinistram solam, reliqua dextram et sinistram undique discretam obtulere.
5. Picinæ, continentes altera tribu genera, quorum nomina: *Bucco*, *Micropogon*, *Pogonias*, *Capito*, *Monasa*, *Rhamphastos*, *Pteroglossus*—altera: *Picos*, *Picumnos* et *Yunges*. Quæ ex utraque tribu examinavi genera nonnisi sinistram arteriam obtulere.
6. Psittacinæ.—Genera: *Psittacus* et *Microglossus*. Quomodo illius species arteriæ carotidis ratione differant, supra dictum est.
7. Lipoglossæ, quæ constituuntur *Bucerote*, *Upupa*, *Epimacho*, *Alcedine* et *Dacelone*. Aliæ nonnisi sinistram, aliæ utramque habent arteriam.

[1] Vid. ejus *Régne animal*, vol. i, edit. prima p. 334 seqq.—edit. scc. p. 347 seqq.

[2] *Hemiprocnes* genus, cui *Cypselos*, qui ill. Temminckio *longipennis*, *comatus*, *fuciphagus*, *torquatus* vocantur, aliosque accenseo, a veris discrepant *Cypselis* et hallice, sive digito pedum primo, retrorsum semper verso, et digitorum phalangum numero eodem, qui in ceteris avibus solemnis est.

[3] Differt a *Caprimulgi* genere et aliis rebus et digito pedum quarto quinque-articulato.

[4] Genus oppido notabile, cui, ut videtur, soli inter omnes aves pedibus, quos vocant, scansoriis præditas, minime digitus quartus, sed secundus, tri-articulatus cum hallice retro versus est.

8. Amphibolæ[1]), quibus accensenda reor genera *Musophagæ*, *Colii* et *Opisthocomi*, respectu art. carotidis mihi nondum observata.

B. Aves Carinatæ Terrestres.

1. Columbinæ, duabus tribubus compositæ, quarum prior *Columbas*, altera *Pteroclem*[2]) et *Syrrhapten* continet. Vulgarem arteriarum carotidum bigam mihi monstrarunt.
2. Gallinaceæ, in duas quoque dividendæ familias, quarum priori insunt *Tetrao*, *Perdix*, *Cryptonyx*, *Pavo*, *Polyplectron*, *Gallus*, *Phasianus*, *Lophophorus*, *Argus*, *Meleagris*, *Numida*, *Urax*, *Crax* et *Penelope*;—secundæ: *Hemipodius*, *Crypturus*, *Megapodius*. Itidem arteriam carotidem dextram et sinistram habent, quascunque cultro subiecimus, omnes.

C. Aves Carinatæ Aquaticæ.

* *Grallæ Linn.*

1. Alectorides, quæ *Otide* et *Dicholopho* componuntur. Dextram et sinistram arteriam c. c. exhibuit prior.
2. Gruinæ, quibus insunt *Gruis*, *Psophiæ* et *Palamedeæ* genera. Pariter carotides arterias binas Gruis exemplo ostendunt.
3. Fulicariæ, quarum genera: *Parra*, *Crex*, *Rallus*, *Gallinula*, *Porphyrio*, *Fulica*. Omnibus mihi examinatis binæ sunt arteriæ.
4. Herodiæ, quibus insunt *Ardea*, *Cancroma* et *Eurypyga*. Horum generum primum supra dictas arteriæ c. c. rationes mirifice diversas exhibuit.
5. Pelargi.—Genera: *Ciconia*, *Tantalus*, *Anastomus*, *Scopus* et appendicis loco *Platalea*. Arterias carotides binas in Ciconia vidimus.
6. Odontoglossæ. *Phœnicopteri* genus hanc familiam constituens nonnisi dextram arteriam habet.
7. Limicolæ (olim *Scolapacinæ* nobis nuncupatæ), quarum genera: *Ibis*, *Numenius*, *Limosa*, *Machetes* Cuv., *Tringa* (cum qua *Calidris* utique conjungenda), *Phalaropus*, *Eurynchus*, *Strepsilas*, *Recurvirostra*, *Dromas*, *Œdicnemus*, *Charadrius* (*Vanellos* auctt. quoque complectens), *Typanus N.* (cujus species Charadrius ægyptius), *Hæmatopus*, *Hypsibates N.* (Himantopus auct.), *Totanus*, *Rhynchæa*, *Scolopax*. Appendicis loco *Tachydromus* quoque et *Glareola* huc referantur. In his avibus binas semper arterias reperi, serius musculis colli anticis conditas.

[1] Hæc familia cum quinque antecedentibus olim nobis conjungebatur in unam, *Picariarum* titulo insignitam.

[2] Hoc genus, cui persimilis *Syrrhaptes*, tum forma alarum, tum ratione pterylarum sive plagarum pennatarum (quibus in avibus quam plurimis explorandis a longo inde tempore operam dedi), tum figura sterni (ut alia taceam) magis ad *Columbas*, quam ad aves *gallinaceas* accedit, præterea phalangum digiti pedum quarti numero quaternario memorabile.

* * *Palmatæ.*

8. Longipennes *Illig.* addita *Vaginali.* Hæ dextram et sinistram arteriam habere videntur omnes.
9. Nasutæ (*Tubinares* Illigeri), respectu arteriæ c. c. nondum exploratæ.
10. Unguirostres, quarum genera: *Cereopsis, Anser, Cygnus, Anas, Hydrobates, Mergus.* Itidem dextram et sinistram arteriam nobis obtulere semper.
11. Steganopodes, *Illig.* addita *Podoa* appendicis loco. Binas arterias c. c. *Halieus* saltem exhibuit.
12. Pygopodes (*Pygopodes* et *Impennes* Illig.) Ex his *Colymbus* Illig. sive *Podiceps* Lath. sinistram arteriam solam, reliqua autem, quæ dissecui, genera dextram et sinistram obtulerunt.

II. AVES RATITÆ, Mærr.

Generum, quæ hanc familiam, Illigero *Procerarum* titulo appellatam constituunt, quorumque nomina *Struthio, Rhea* et *Casuarius*, nullum circa vasorum sanguiferorum systema examinavi. In *Rhea* sinistram tantum arteriam carotidem ex Meckelii observatione adesse dictum est.

Caput Quartum.

Enumerantur volucrum genera et species, quæ singulæ cujusque rationis arteriæ carotidis communis exempla hucusque exhibuerunt.

Jam vero cujusque earum art. carotidis c. rationum, quas supra indicavi, exempla mihimet ipsi observata singulatim recensenda sunt, in qua re exequenda hanc mihi scripsi regulam, ut in horum numero nulla alia ponam, nisi in adversariis accurate notata. Sic certissime haud plura, sed facile pauciora proferentur, quam revera vidi. Nam ubi ordinis vel generis alicuius normam respectu arteriæ illius pluribus jam exemplis satis cognovisse mihi visus sum, in notandis observationibus posteris, quæ mihi cognita tantum confirmarunt, paullo negligentiorem me fuisse, haud diffiteor. Ceterum in sequentibus tabulis exarandis versabor ita ut, quæ ad eandem avium familiam pertineant, exempla illius nomine præmisso componam, sed gradus inferioris tantum familias respiciam, nisi hæ, quod in *Ratitis* solis accidit, desint.

Prima ratio.—*Arteriæ carotides communes adsunt binæ, dextra et sinistra, cursu toto distinctæ.*

Hanc rationem sæpissime et in omnibus fere avium familiis plura genera continentibus, exceptis *Passerinarum, Macrochirium* et *Picinarum* ordinibus, nobis esse observatam tabula priori capite exhibita docuit. Sed utrum sæpius, i. e. in pluribus volucrum speciebus occurrat, quam arteria carotis unica, dubium maxime est. Species, in quibus illud arteriæ carotidis duplum vulgare ipse reperi, hæ sunt:

1. *ex* ACCIPITRINIS :
   Falco Albicilla, fulvus, lagopus, Buteo,—palumbarius, Nisus,—æruginosus, Pygargus, cineraceus.
   Pernis apivorus,
   Pandion Haliaëtos,
   Rhynchodon (*Falco* auctt.) *peregrinus, Subbuteo, Æsalon, Tinnunculus,*
   Strix Bubo, Otus, brachyotos—Aluco,—nisoria, passerina,
   Ulula (*Strix* auctt.) *flammea ;*
2. *e* CUCULINIS :
   Caprimulgus europæus,
   Coracias garrula,
   Galbula longicauda,
   Cuculus canorus ;
3. *e* PSITTACINIS :
   Psittacus Macavuanna, ochrocephalus, Erithacus, leucocephalus, canicularis (quibus sinistra a musculorum tegmine libera est et sinistro colli latere sursum tendit) et *hæmatodus,* in quo ambæ arteriæ contiguæ et carne tectæ surgunt ;
4. *e* LIPOGLOSSIS :
   Alcedo Ispida.
5. *e* COLUMBINIS :
   Columba livia domestica, Turtur, risoria,
   Pterocles senegalensis ;
6. *e* GALLINACEIS :
   Tetrao Tetrix,
   Perdix cinerea,
   Gallus Bankiva domesticus,
   Phasianus colchicus,
   Meleagris Gallopavo,
   Numida Meleagris,
   Crypturus variegatus ;
7. *ex* ALECTORIDUM familia :
   Otis tarda ;
8. *e* GRUINIS :
   Grus cinerea s. *communis ;*
9. *e* FULICARIIS :
   Parra Iassana,
   Rallus aquaticus,
   Crex pratensis,
   Gallinula chloropus,
   Fulica atra ;
10. *ex* HERODIIS :
    Ardea cinerea ;
11. *e* PELARGIS :
    Ciconia alba et *nigra ;*

12. *e* LIMICOLARUM familia:
    Numenius phæopus,
    Machetes pugnax,
    Tringa alpina, subarquata, Temminckii,
    Phalaropus hyperboreus et *fimbriatus* (spec. mexicana),
    Strepsilas Interpres,
    Charadrius Morinellus, Vanellus, Œdicnemus crepitans,
    Totanus Glottis, Calidris, hypoleucos,
    Scolopax Rusticola, Gallinago, Gallinula,
    Glareola austriaca;
13. LONGIPENNIUM:
    Lestris parasitica,
    Sterna macrura N. (*artica* TEMM.) *minuta,*
    Larus argentatus, ridibundus;
14. STEGANOPODUM:
    Halieus Carbo;
15. *ex* UNGUIROSTRIBUS:
    Anser cinereus domesticus, ægyptius,
    Anas Boschas, Querquedula, Crecca,
    Hydrobates (*Anas* auctt.) *marilus, glacialis, clangulus,*
    Mergus Merganser, Serrator;
16. PYGOPODUM;
    Eudytes arcticus,
    Uria Grylle et *Troile,*
    Alca Torda.

SECUNDA RATIO.—*Arteria carotis communis longo tractu una est, sed a sinistro et dextro trunco, mox in unum medium confluentibus, orta, in capitis vicinia rursus divisa.*

Hæc singularis structura illustri MECKELIO in binis, mihi in tribus *Ardeæ stellaris* speciminibus (ita ut de ejus constantia haud possit dubitari), nec tamen præterea in ulla alia avium specie adhuc visa est. Sed in ceteris Ardearum speciebus collo crassiore instructis, *Butionis* subgenus constituentibus, si cultro subiiciantur, eandem rationem facile inventum iri, persuasissimum mihi habeo. Quare Ardeam *minutam*, licet ut ejus avis, in vicinia nostra habitantis, specimen recens mihi compararem, omnem, quam potui, operam dederim, jam incidendi occasionem me haud nactum esse, maximopere doleo.

TERTIA RATIO.—*Art. carotis communis una tantum adest eaque dextra.*

Ea ratio a MECKELIO in *Phœnicoptero antiquorum* inventa nobis quoque in hujus avis exemplo e Sardinia misso (quod museum nostrum academicum benevolæ debet curæ cel. RUDOLPHI WAGNERI, M.D., nunc Erlangensis), nec in ulla alia avium specie adhuc animadversa est. Dextra, quæ sola adest, *Phœnicopteri* arteria carotis communis oppido ampla est. Vix ex subclavia sui lateris orta jam colli, pone claviculas etiam latentis, musculis anticis submittitur,

quibus tecta et præterea vertebrarum ansis, medio membranaceis, ad latera vero osseis, firmata ad caput tendit, ut in ejus vicinia solito more in dextram et sinistram dividatur.

QUARTA RATIO.—*Arteria carotis communis unica adest eaque sinistra.*

Quartam denique art. carotidis communis rationem supra indicatam, cujus MECKELIUS unum exemplum laudavit, quamque haud ita raram esse jam ex BAUERI, septemdecim ejus exempla citantis, observationibus colligi potest, vulgatissimam esse nullus dubitavi, simulac vel in una ave passerina illam mihi contigerat reperire. Etenim tantam respectu fere omnium reliquarum internarum corporis partium in Passerinarum, quam dico, familia cognovi convenientiam ut cuncta genera, ad eandem jure referenda, illa quoque re inter se convenire, verisimillimum, nisi certissimum, mihi videretur. Neque ea opinio postea me falsum habuit unquam. Quascunque enim illarum avium species cultro subjecerim, omnes unam tantum, et quidem *sinistram* arteriam carotidem communem obtulerunt, ut deinde fere tæderet, rei tot exemplis jamiam confirmatæ ergo plures examinare. Passerinarum autem familia, ut minimum dicam, *cunctarum avium tertiam saltem partem, nisi dimidiam, continet.* Neque tamen hujus familiæ finibus circumscriptus est numerus volucrum sinistram solam art. carotidem c. habentium. Nam uti MECKELIUS in *Rhea americana*, sic BAUERUS in *Cypselo* (genere a Passerinarum ordine plane diverso), et in *Colymbo cristato*, ILLIG. structuram dictam invenit. Equidem non minus in his, sed præterea in nonnullis aliorum ordinum generibus, quorum inprimis duo, *Pici* nempe et *Trochili*, permagnam specierum numerum complectuntur, illam arteriæ rationem animadverti.

Nomina autem generum et specierum, quæ sinistram solam arteriam carotidem communem mihi obtulerunt, hæc sunt.

1. e PASSERINIS:

Corvus Corax, Cornix, frugilegus, Monedula, Pica, glandarius,
Lanius Excubitor, Collurio,
Bombycophora garrula,
Muscicapa luctuosa, grisola.
Turdus pilaris, musicus, iliacus, Merula,
Sylvia Luscinia, suecica, Rubecula, hortensis, Curruca, atricapilla, Phœnicurus, Hypolais, Fitis, Turdus arundinaceus, phragmitis — cachinnans (*Turdus leucurus* L.), *gutturalis* (*Saxicola gutturalis*, LICHTENST., ex Ægypto missa) *Œnanthe, Rubetra,*
Motacilla alba et *flava,*
Anthus[1] *pratensis* et *rufescens,*
Accentor modularis,
Sphenura Acaciæ, LICHTENST, (e Nubia allata).
Troglodytes verus, murarius (species *Americana*),
Regulus verus et *pyrocephalus,*

[1] Usum solemnem secuti *Anthos* a *Motacillis* et *Turdos* a *Sylviis* hic distinximus, revera generis gradu haud distinguendos.

Parus major, cæruleus, ater, caudatus, biarmicus,
Certhia familiaris et *brachydactyla*, BREHM.,
Nectarinia metallica,
Cœreba cærulea,
Sitta europæa,
Oriolus Galbula,
Icterus varius,
Alauda cristata, arvensis, bifasciata,
Emberiza miliaria, citrinella, Schœniculus, hortulana,
Fringilla Coccothraustes, Chloris, punctularia, oryzivora, cucullata, canaria, cannabina, montium, cælebs, Montifringilla, domestica, montana, Hispanica, carduelis, Spinus, linaria, Amandava,
Pyrrhula vulgaris,
Hirundo rustica, urbica, et *riparia;*

2. *e* MACROCHIRIBUS *s.* LONGIMANIS :
Cypselus Apus,
Trochilus moschitus et alia quædam species mihi haud definita;
3. CUCULINARUM :
Merops Apiaster;
4. PICINARUM :
Pteroglossus Aracari,
Picus martius, viridis, major, medius,
Yunx Torquilla;
5. *e* PSITTACINIS :
Psittacus galeritus;
6. *e* LIPOGLOSSIS :
Upupa Epops;
7. PYGOPODUM :
Colymbus (*Podiceps* auctt.) *cristatus, rubricollis* et *minor.*

Denique hic citandum est exemplum MECKELIO observatum in genere ordinis :
8. RATITARUM, nempe :
Rhea americana.

Ex præcedentibus tabulis, computatione facta, apparet, in censum nostrum vocatas esse 188 volucrum species, earumque

91 primam,
1 secundam,
1 tertiam,
95 quartam

arteriæ carotidis communis rationem obtulisse.

EXPLANATION OF THE PLATES.

PLATE I.[1]

Fig. 1. A dorsal feather of *Argus giganteus* of the natural size, seen from beneath, in which the left series of barbs on the main shaft, and also the right series on the after-shaft, have been removed, in order to render the relations of the two shafts more distinctly perceptible. *a*. The thickened portion of the main shaft, with its longitudinal furrow. *b*. The after-shaft. *c*, *c*, *c*. The barbs of both shafts. *d*. The short, obtuse tube.

Fig. 2. Four barbs of the same feather from the upper part, with their barbules, seen from above under a moderate magnifying power. *a*. The barbs. *b*. Barbules of the anterior series, on which the hooklets are seated. *c*. Barbules of the posterior series, without hooklets.

Fig. 3. Six barbs (*a*, *a*, *a*) in transverse section, viewed from the cut surface, with their anterior (*b*, *b*, *b*) and posterior (*c*, *c*, *c*) barbules. From the outer side of the vane of one of the remiges of a goose, moderately enlarged.

Fig. 4. An anterior barbule of the same feather, strongly magnified, with its hooklets (*b*) and cilia (*a*).

Fig. 5. A posterior barbule of the same feather, equally magnified.

Fig. 6. A portion of the feather shown in fig. 1, seen from above, in which *a* is the main shaft, and *b*, *b*, two of its barbs, from which issue the curiously curved laminar barbules, still without hooklets or cilia. This figure is particularly intended to show that even the main shaft bears barbules when the barbs stand far apart.

Fig. 7. The filoplume of a goose, moderately enlarged.

Fig. 8. The upper extremity of the same, with the tips cut off, more strongly magnified.

Fig. 9. A barbule of the same feather, very strongly magnified. The cavities of the cells may still be recognised in it.

Fig. 10. A young goose-feather, seen from in front, just protruding the apex of the vane (*b*) from the follicle (*a*).

Fig. 11. The same from behind, opened longitudinally. *a*. The follicle. *b*, *b*. Feather-material. *c*. Matrix, with its blood-vessels. *d*, *d*. Cast-off and desiccated portions of the latter.

Fig. 12. An immature barbule, of the posterior series, of a grey pigeon's feather.

Fig. 13. An immature barbule of the anterior series of the same feather.

Fig. 14. The lower portion of a barb, in which no distinction can yet be recognised between it and its barbules, consisting of homogeneous cells and their nuclei. Taken from the feather represented in fig. 10.

Fig. 15. A portion of an immature barb, in which the barbules are already indicated, but not yet divided off; on the left those of the hinder and on the right those of the anterior series. Taken from a grey pigeon's feather.

Fig. 16. Modified cells, becoming converted into solid horny substance, from the uppermost layer of a young barb of this same feather.

Fig. 17. The cells of the epithelium of which the follicle consists, with their nuclei and nucleolar corpuscles.

Fig. 18. The lower extremity of one of the wing-feathers of a pigeon, in which the tube has been laid open by a cut, and the main shaft and barbs are cut off short; the lowest barbs immediately above the tube are also removed. *a*. Dry cast-off remains of the matrix which project from the upper opening of the tube and lie in the furrow of the shaft. *b*. The position of the orifice, which has been removed by the cut. *c*. Dry cast-off portions of the matrix in the interior of the tube, which, like the preceding, are placed one within the other, like a row of thimbles. *d*. The outer, and *e*, the inner, side of the vane.

Fig. 19. White down-barbules of the domestic Duck, magnified 100 diameters. Taken from Nitzsch, in 'Voigt's Magazin,' &c., Bd. xi, Taf. 6.

Fig. 20. Down-barbules from the lower part of a contour-feather of the same Duck. Ibid.

Fig. 21. Beginning of a down-barbule from the lower part of a contour-feather of *Corvus glandarius*. Ibid.

Fig. 22. The same from *Sylvia rubecula*. Ibid.

Fig. 23. The same from the domestic Duck. Ibid.

Fig. 24. The same from *Strix otus*. Ibid.

Fig. 25. The same from the Turtle Dove. Ibid.

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[1] This Plate has been drawn by me chiefly from nature, and from my own investigations. Nitzsch was, even to the last moment, undecided, as he told the publisher, whether he should represent upon it the different parts and kinds of feathers, or give a diagrammatic representation of all the tracts, with their denominations. I chose the former, as being in my opinion the most necessary and valuable, inasmuch as the position of the tracts is sufficiently clear from the other plates. The latter I found completed; they have been engraved from Nitzsch's own drawings. —Burmeister.

PLATE II.

Figs. 1, 2. *Gypaëtos barbatus*, p. 44.
3. *Falco fulvus*, p. 59.
4. *Falco apivorus*, p. 64.
5. *Falco brachypterus*, p. 57.
Figs. 6. *Rhynchodon peregrinus*, p. 55.
7. *Pandion haliaëtus*, p. 54.
8, 9. *Strix bubo*, p. 68.
10, 11. *Hybris flammea*, p. 71.

PLATE III.

Figs. 1, 2. *Motacilla alba*, p. 83.
3. *Certhia familiaris*, p. 84.
4. *Ocypterus leucorrhynchus*, p. 80.
5. Pteryl. spin. *Campephagæ novæ Guineæ*, p. 80.
6. Pter. spin. *Kittæ thalassinæ*, p. 76.
7, 8. *Oriolus Galbula*, p. 79.
Figs. 9, 10. *Coracina cephaloptera*, p. 76.
11, 12. Pterylæ *Menuræ*, p. 82.
13. *Paradisea apoda*, p. 75.
14. *Hirundo urbica*, p. 85.
15. *Eurylaimus nasutus*, p. 77.
16, 17. *Cypselus apus*, p. 86.
18, 19. *Trochilus moschitus*, p. 87.

PLATE IV.

Figs. 1, 2. *Caprimulgus europæus*, p. 87.
3, 4. *Nyctornis grandis*, p. 88.
5, 6. *Coracias garrulus*, p. 89.
7, 8. *Galbula viridis*, p. 90.
9, 10. *Todus*, p. 89.
Figs. 11, 12. *Cuculus canorus*, p. 91.
13, 14. *Centropus philippensis*, p. 91.
15. *Scythrops*, p. 91.
16, 17. *Prodotes*, p. 92.
18—20. *Trogon*, p. 93.

PLATE V.

Figs. 1, 2. *Bucco armillaris*, p. 93.
3. Pt. spin. *Bucconis rosercollis*, p. 94.
4. *Micropogon cayennensis*, p. 94.
5. *Microp. erythropygos*, p. 94.
6, 7. *Pogonias sulcirostris*, p. 94.
8. Pt. gastr. *Pogon. senegalensis*, p. 94.
Figs. 9, 10. *Capito Tamatia*, p. 94.
11. Pt. spinal. *Mosnastæ fusci*, p. 95.
12, 13. *Rhamphastos erythrorhynchos*, p. 95.
14, 15. *Picus viridis*, p. 96.
16—18. *Psittacus pertinax*, p. 99.

PLATE VI.

Figs. 1, 2. *Buceros abyssinicus*, p. 102.
3, 4. *Upupa epops*, p. 103.
5, 6. *Alcedo ispida*, p. 105.
7. *Dacelo gigantea*, p. 106.
Figs. 8, 9. *Musophaga Paulina*, p. 106.
10, 11. *Colius capensis*, p. 107.
12, 13. *Opisthocomus cristatus*, p. 108.

PLATE VII.

Figs. 1, 2. *Columba livia*, p. 109.
3, 4. *Pterocles exustus*, p. 110.
5, 6. *Gallus bankiva*, p. 115.
Figs. 7, 8. *Pavo cristatus*, p. 115.
9, 10. *Meleagris gallopavo*, p. 114.
11, 12. *Crypturus tataupa*, p. 117.

PLATE VIII.

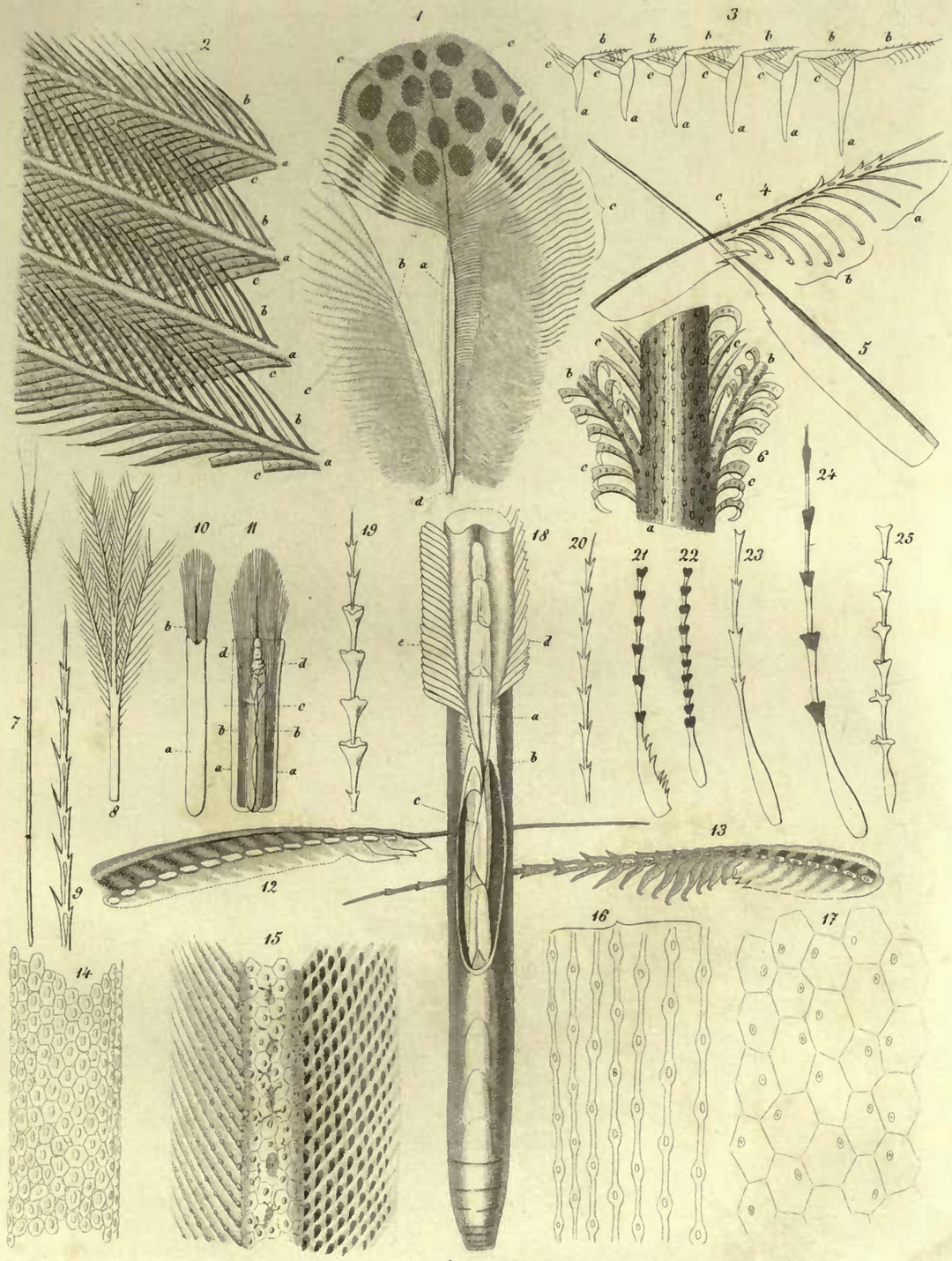
Figs. 1, 2. *Otis tarda*, p. 121.
3, 4. *Psophia crepitans*, p. 123.
5, 6, 7. *Rallus aquaticus*, p. 125.
8. *Fulica atra*, p. 126.
9. *Podoa surinamensis*, p. 127.
Figs. 10, 11. *Ardea stellaris*, p. 128.
12. *Ardea cinerea*, p. 128.
13, 14. *Cancroma cochlearia*, p. 129.
15. *Eurypyga helias*, p. 129.

PLATE IX.

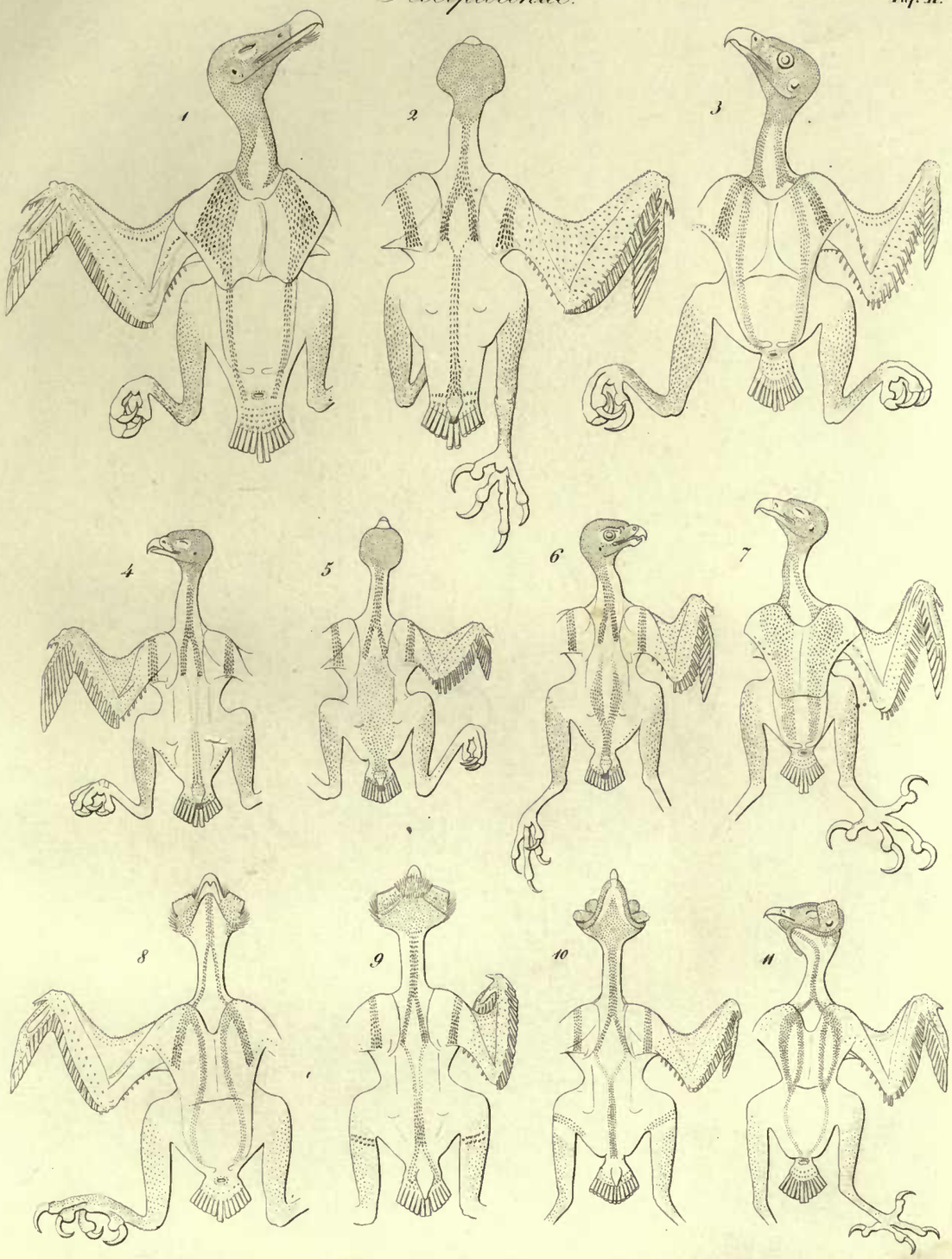
Figs. 1, 2. *Ciconia alba*, p. 130.
3, 4, 5. *Scopus umbretta*, p. 130.
6, 7. *Phœnicopterus antiquorum*, p. 132.
8, 9. *Charadrius pluvialis*, p. 138.
Figs. 10. *Scolopax rusticula*, p. 136.
11, 12. *Larus ridibundus*, p. 143.
13, 14. *Lestris catarrhactes*, p. 143.

PLATE X.

Figs. 1, 2. *Procellaria glacialis*, p. 144.
3. *Puffinus obscurus*, p. 145.
4. *Diomedea exulans*, p. 145.
5, 6. *Anas penelope*, p. 147.
7. *Anser cinereus*, p. 147.
Figs. 8, 9. *Dysporus bassanus*, p. 150.
10, 11. *Colymbus cristatus*, p. 152.
12. *Eudytes arcticus*, p. 152.
13, 14. *Alca torda*, p. 153.

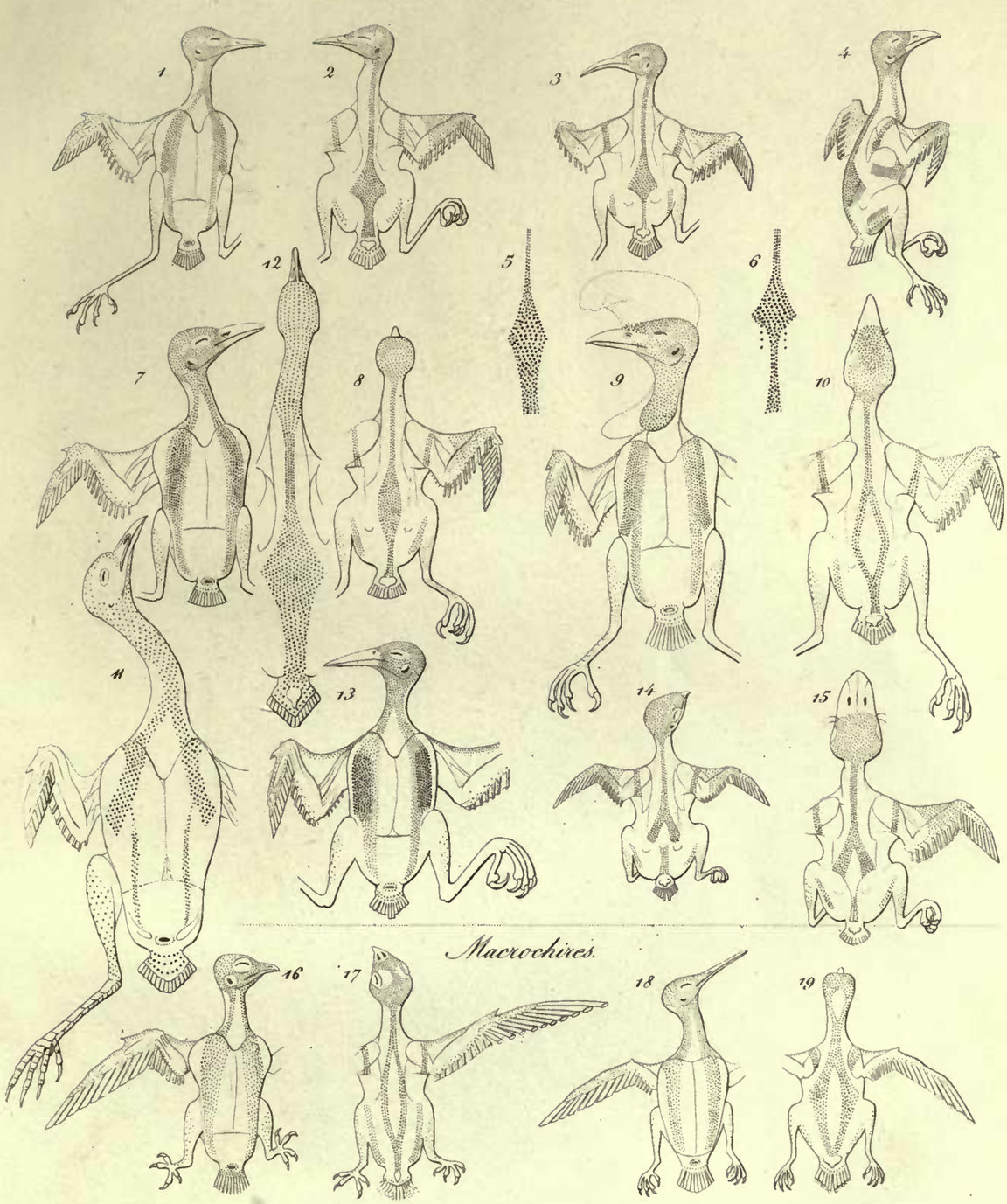


O. Steven sc. Halle



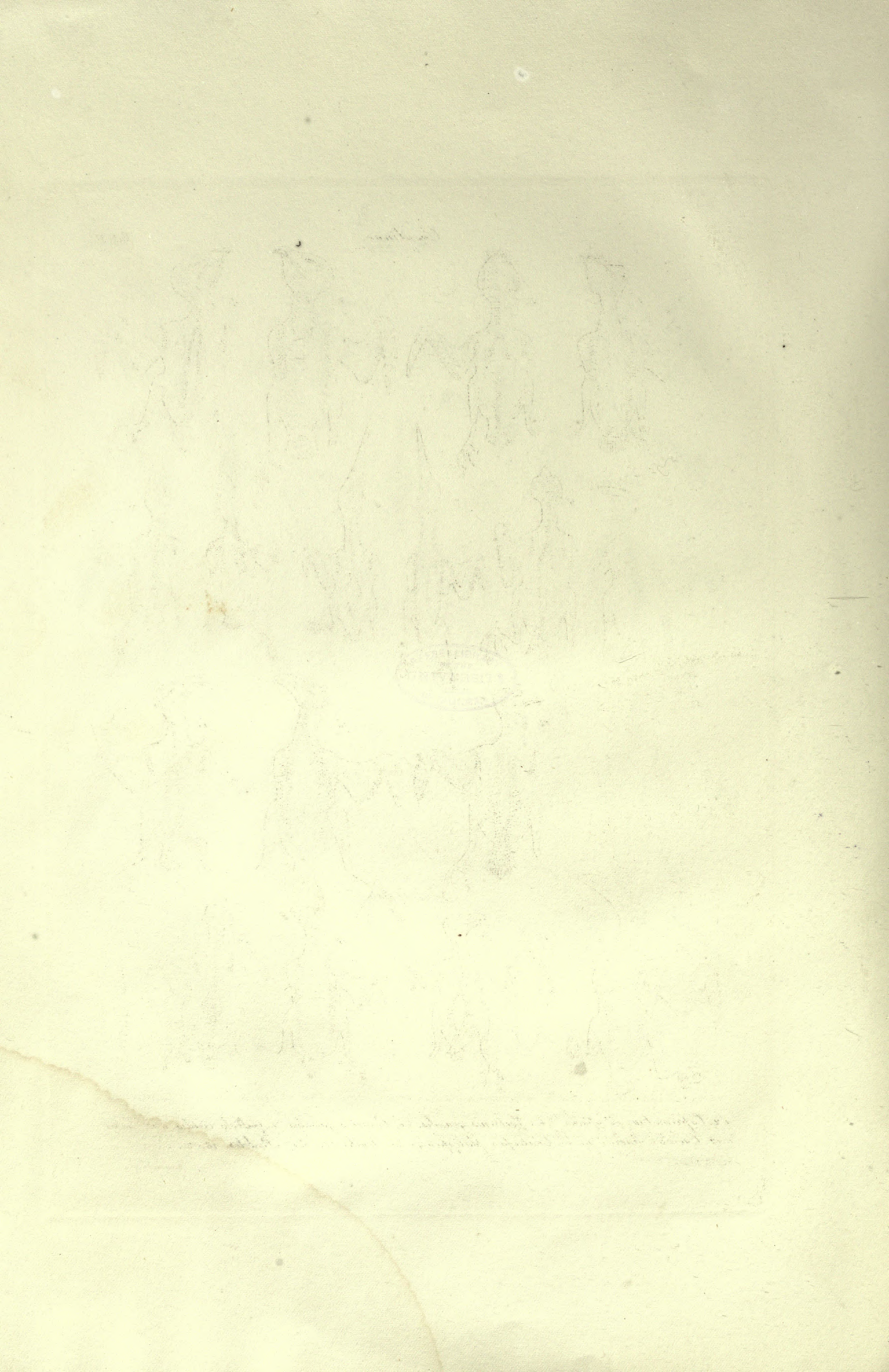
1. 2. Gypaetos barbatus. 3. Falco fulvus. 4. Falco apivorus. 5. Falco brachypterus. 6. Rhynchodon peregrinus. 7. Pandion Haliaetos. 8. 9. Strix Bubo. 10. 11. Hybris flamea.

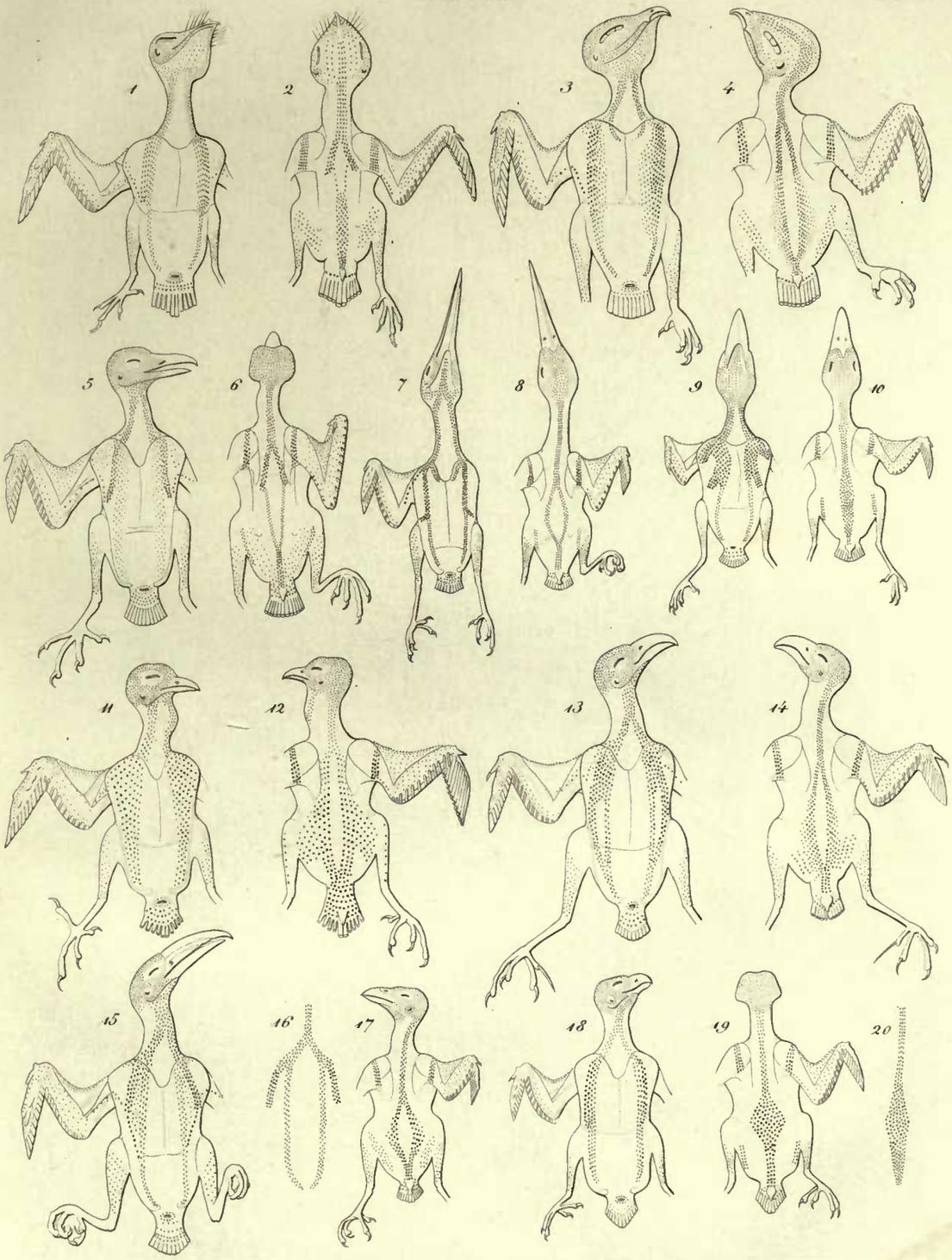
Nitzsch delin. ad nat. *G. Sturm sc. Holz.*



1. 2. Motacilla alba. 3. Certhia familiaris. 4. Ocypterus leucorrhynchus. 5 pteryl. spin. Campephagae nov. Gain. 6. pter. spin. Tiliae thalassinae. 7-8. Oriolus Galbula. 9-10. Coracina cephaloptera. 11. 12. pterylae Menurae. 13. Paradisea apoda. 14. Hirundo urbica. 15. Eurylaemus nasutus. 16-17. Cypselus apus. 18-19. Trochilus moschitus.

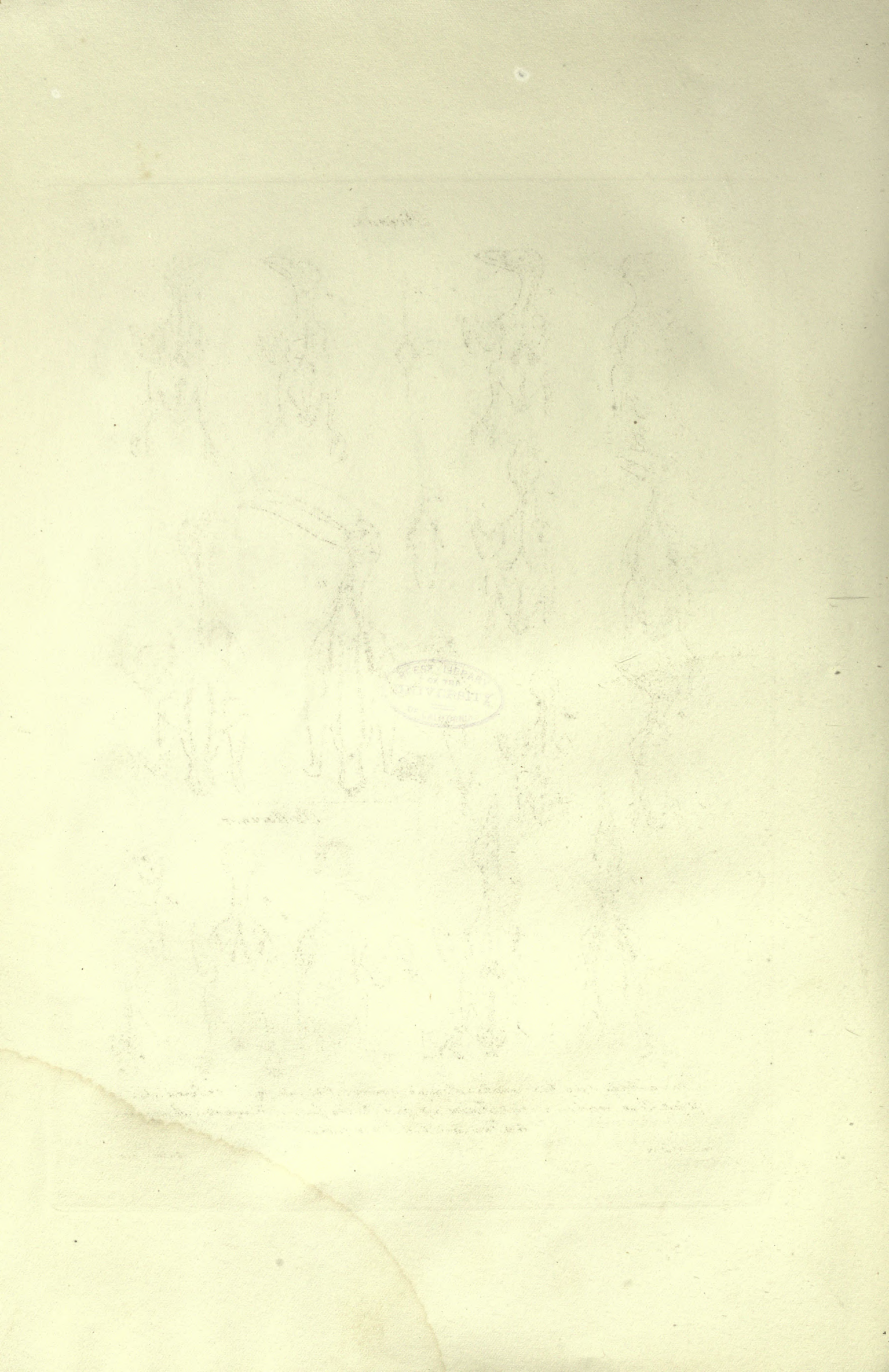
Nitzsch del. ad nat. *G. Sturm sc. Halae.*

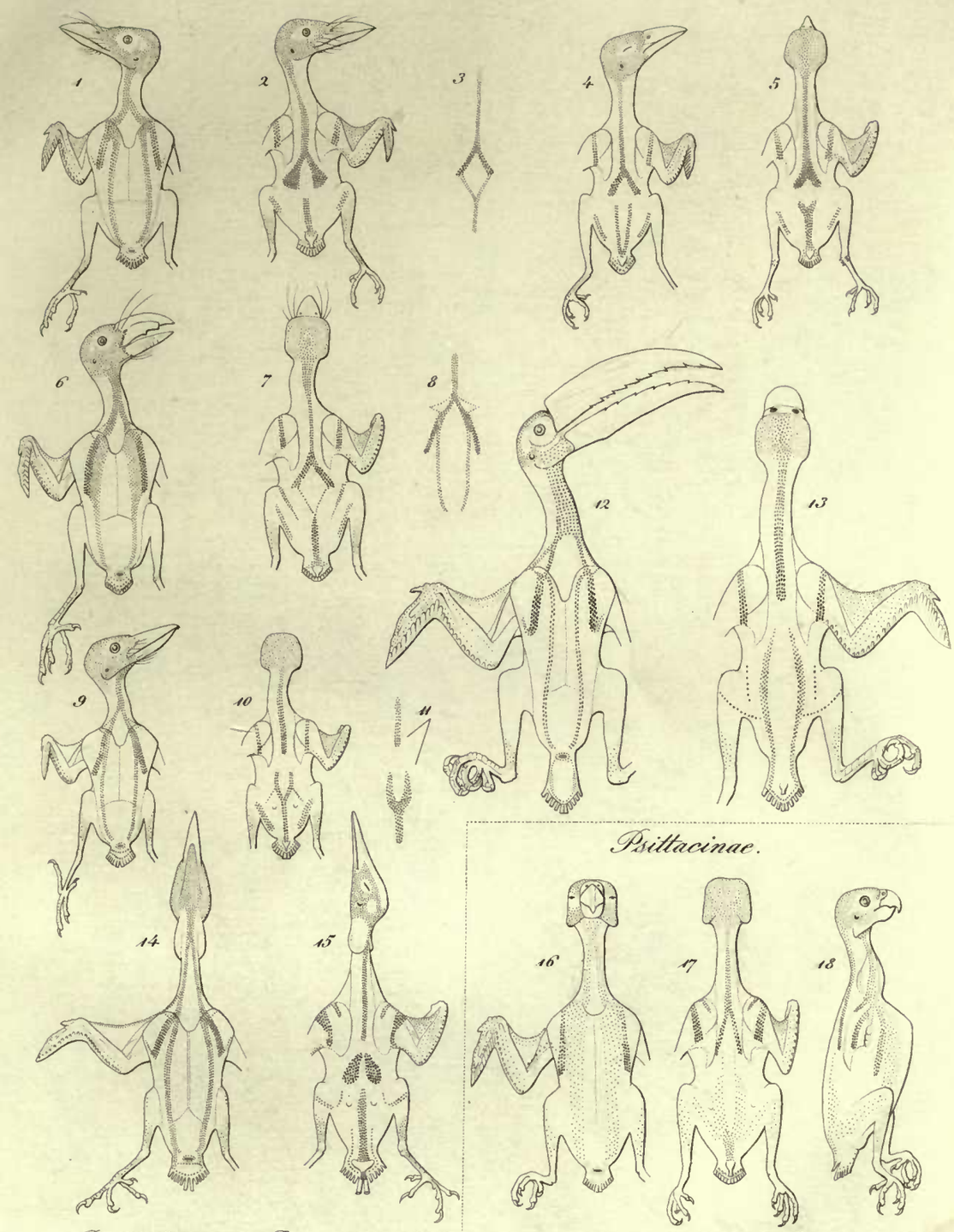




1. 2. Caprimulgus europaeus. 3. 4. Nyctornis grandis. 5. 6. Coracias garrulus. 7. 8. Galbula viridis. 9. 10. Todus. 11. 12. Cuculus canorus. 13. 14. Centropus philippensis. 15. Scythrops. 16. 17. Prodotes. 18.–20. Trogon.

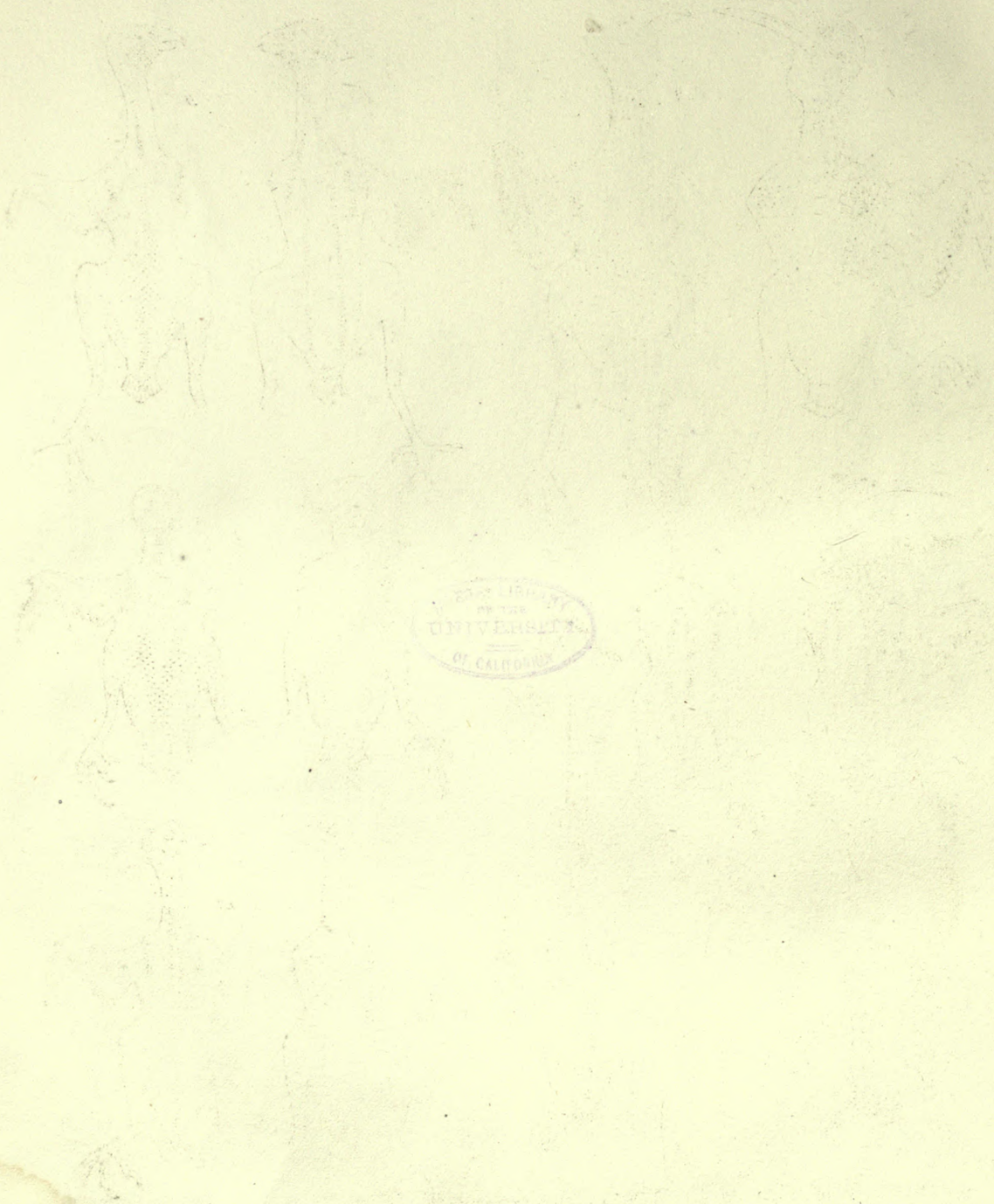
Nitzsch. del. ad nat. *G. Sturm sc. Halae.*





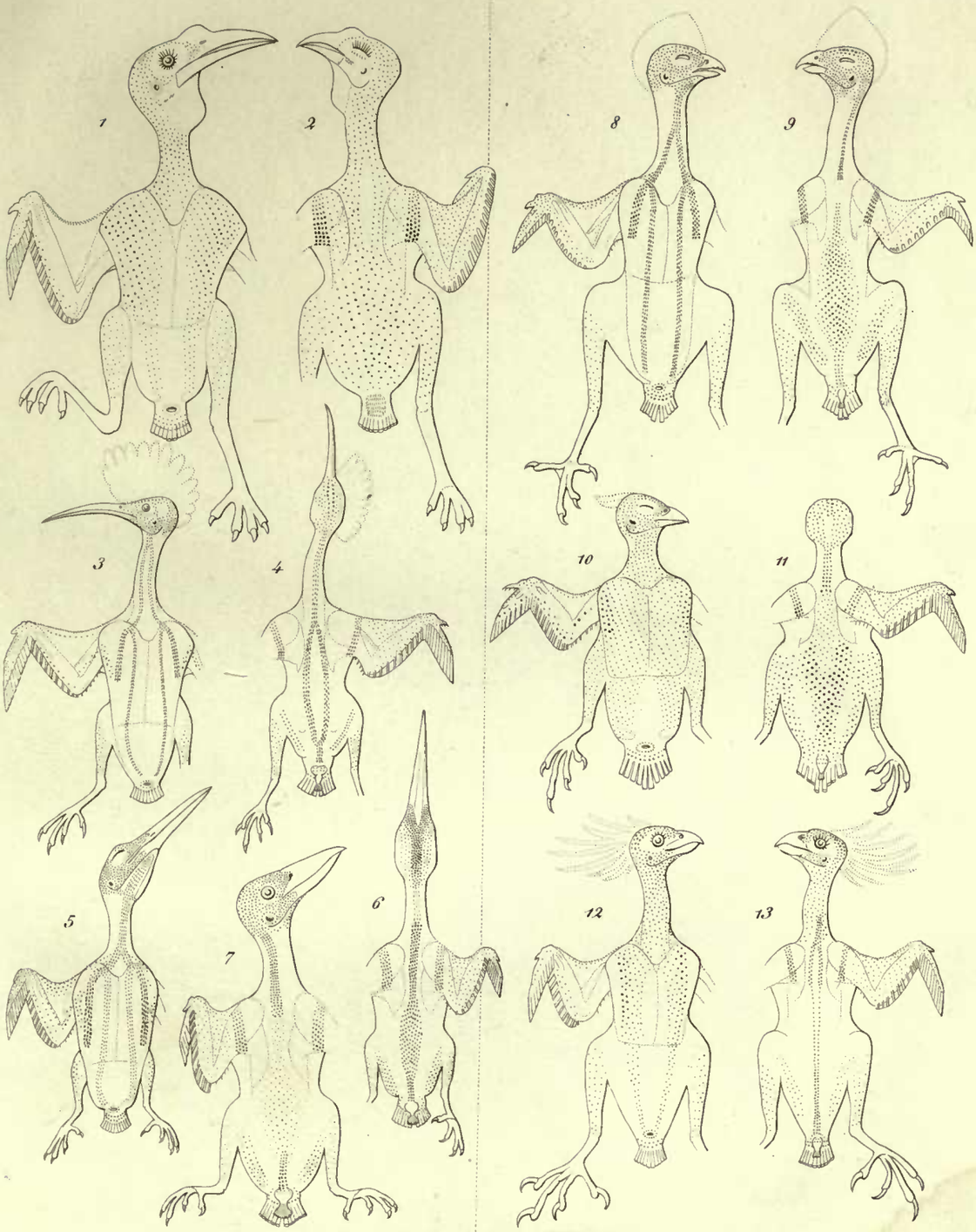
1.2. Bucco armillaris. 3. pt. spin. Buccon. roseicollis. 4. Micropogon cayennensis. 5. Micrp. erythropygos. 6.7. Pogonias sulcirostris. 8. pt. gaste. Pogon. senegalensis. 9. 10. Capito Tamatia. 11. pt. spinal. Monastae fusci. 12. 13. Rhamphastos erythrorhynchos. 14. 15. Picus viridis. 16–18. Psittacus pertinax.

Nitzsch del. ad nat. *G. Sturm sc. Halae.*



Lipoglossae.

Amphibolae.

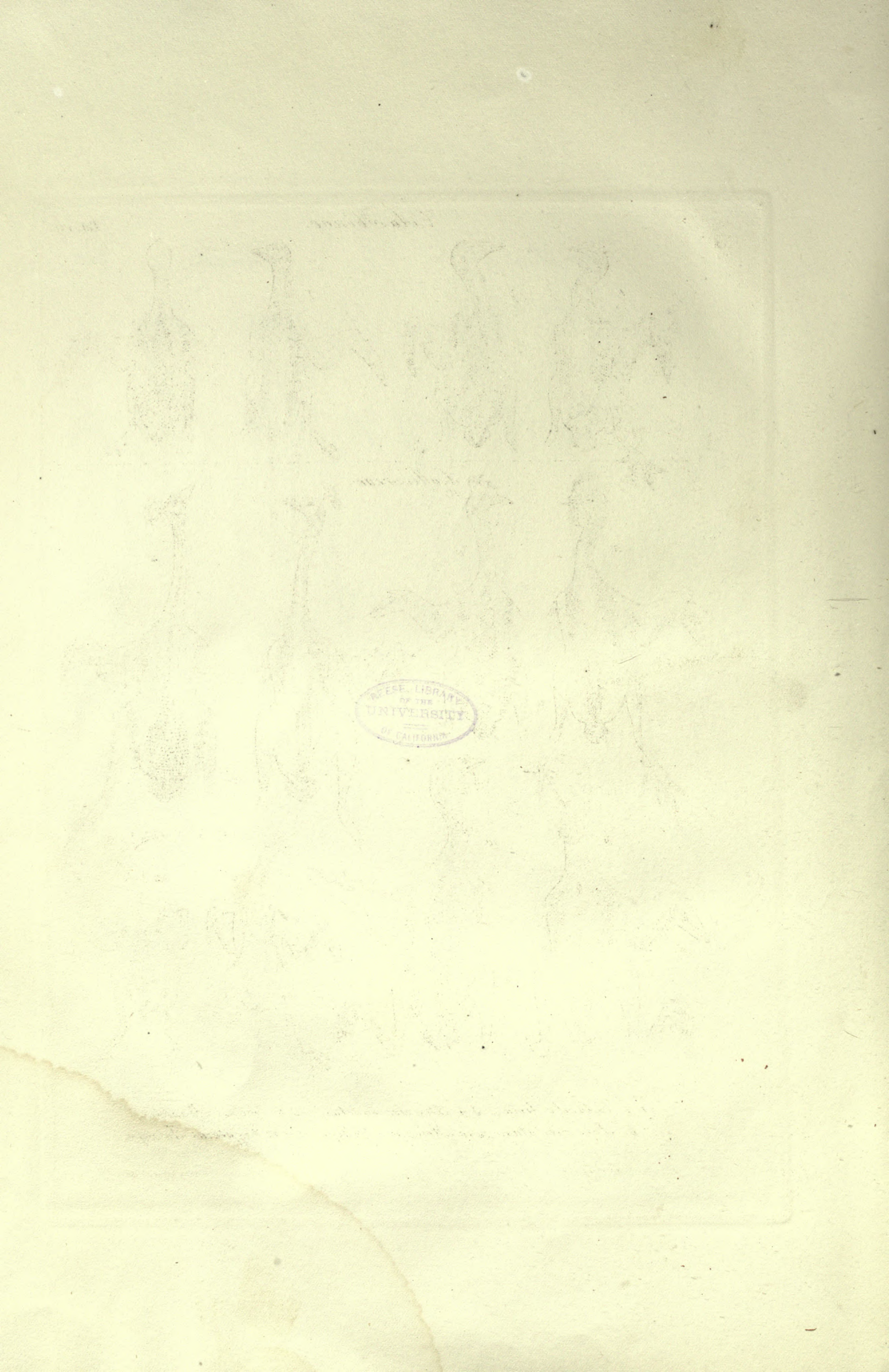


1. 2. *Buceros abyssinicus.* 3. 4. *Upupa Epops.*
5. 6. *Alcedo Ispida.* 7. *Dacelo gigantea.*

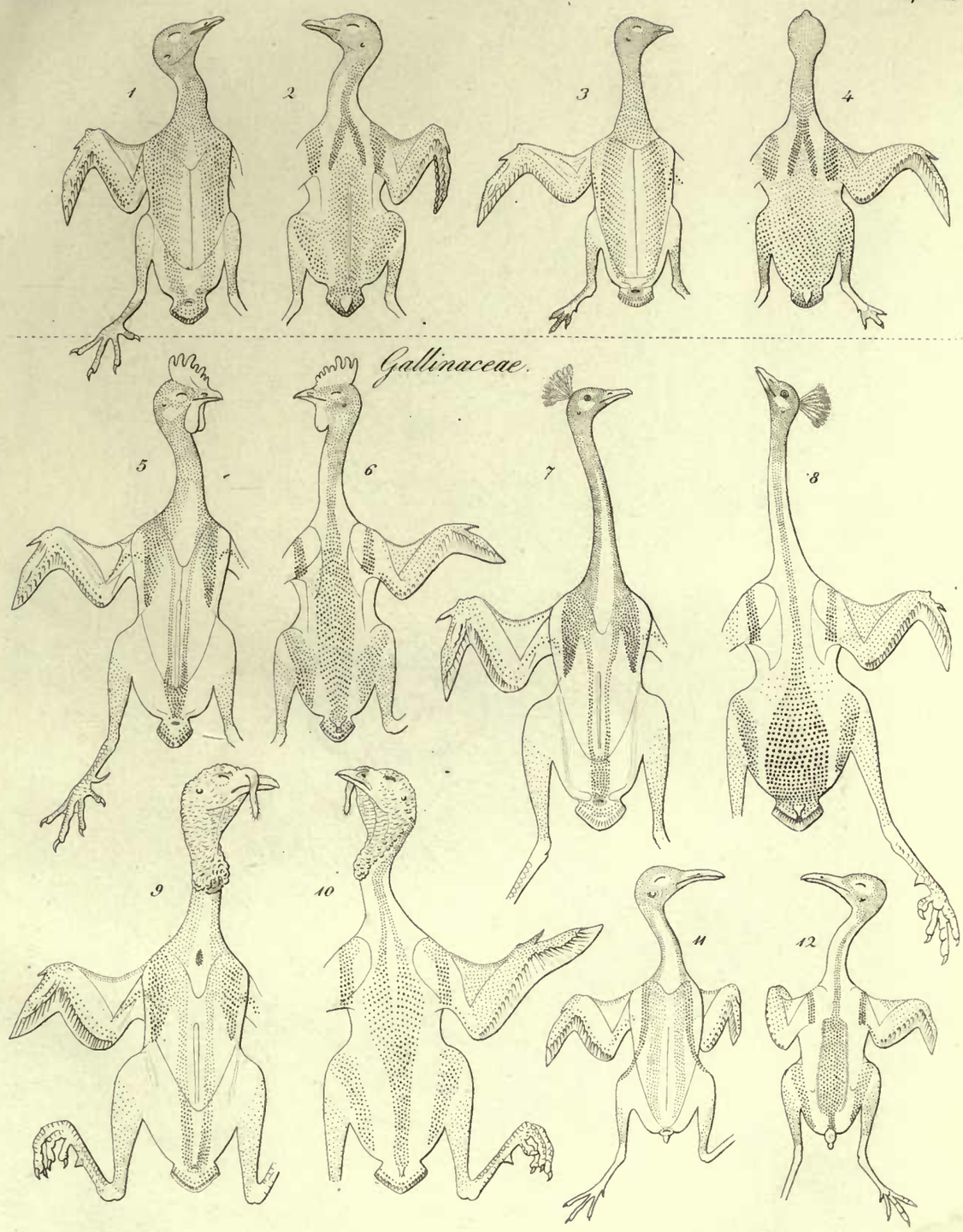
8. 9. *Musophaga Paulina.* 10. 11. *Colius capensis.*
12. 13. *Opisthocomus cristatus.*

Nitzsch del. ad nat.

G. Sturm sc. Halæ

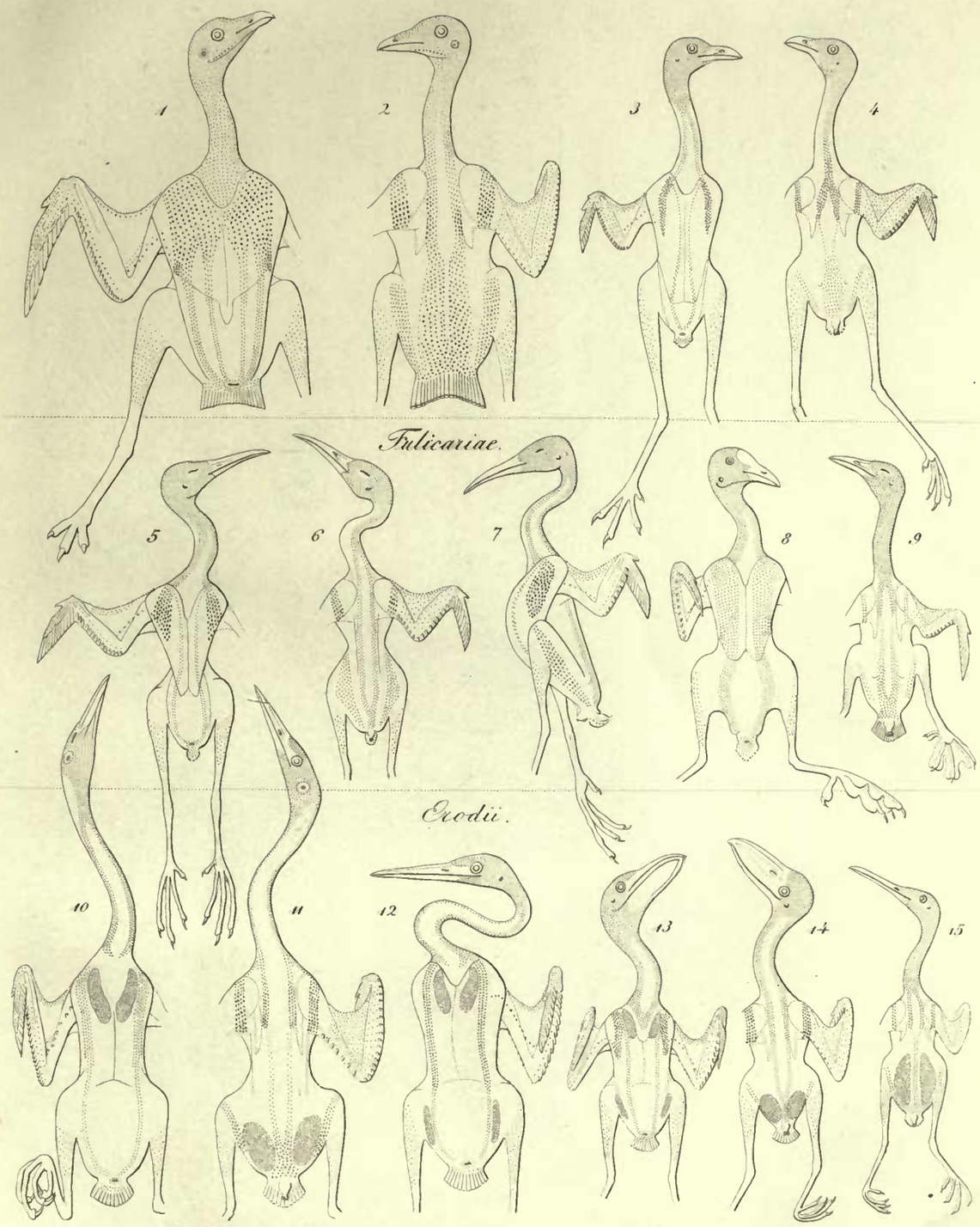


Columbinae. *Taf. VII.*



1. 2. Columba livia. 3. 4. Pterocles exustus. 5. 6. Gallus Bankiva.
7. 8. Pavo cristatus. 9. 10. Meleagris Gallopavo. 11. 12. Crypturus Tataupa.

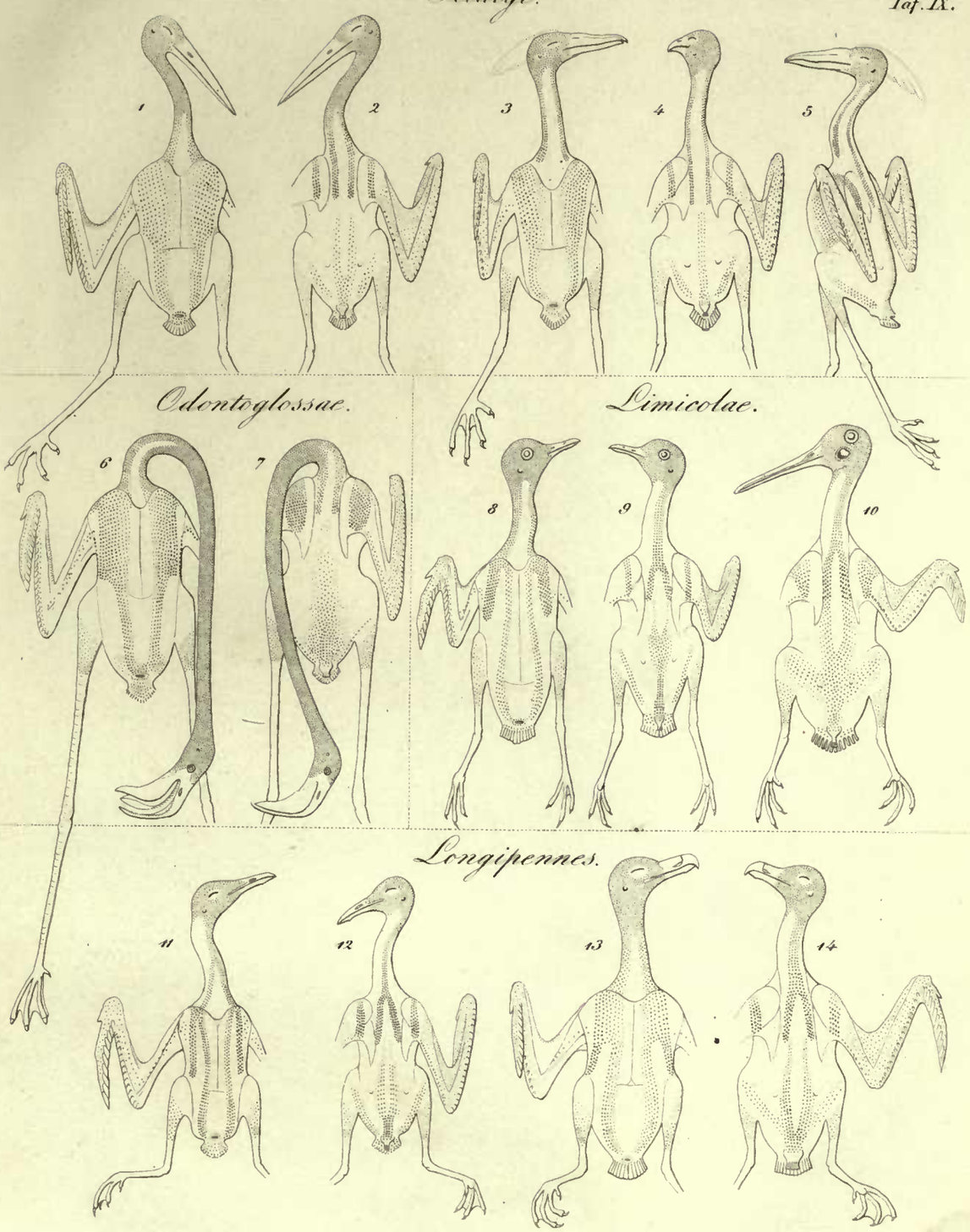
Nitzsch del. ad nat. *A. Sturm sc. Halæ.*



1.2. Otis Tarda. 3.4. Psophia crepitans. 5–7. Rallus aquaticus. 8. Fulica atra. 9. Podoa surinamensis. 10. 11. Ardea stellaris. 12. Ardea cinerea. 13.14. Cancroma cochlearia. 15. Eurypyga Helias.

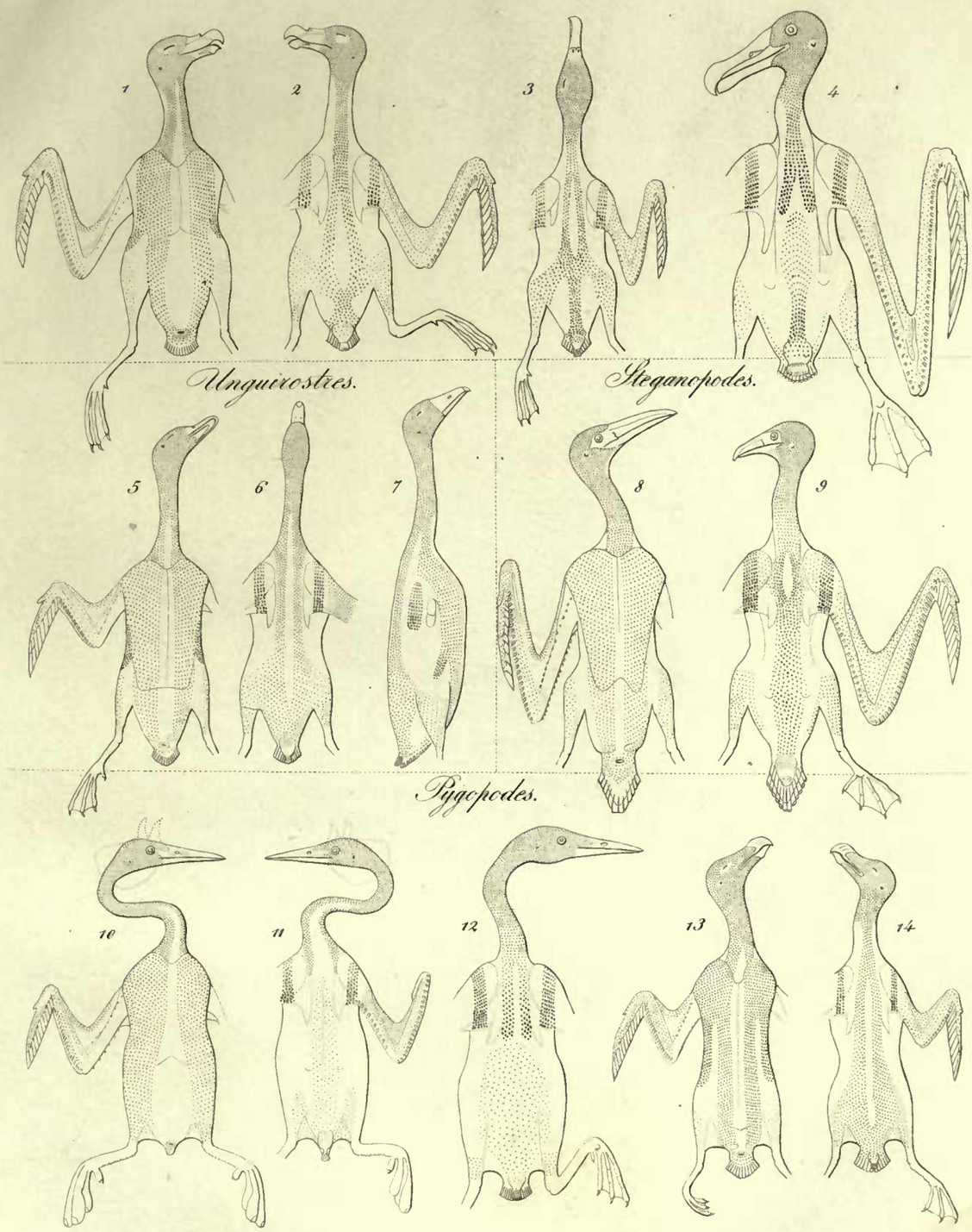
Nitzsch del. ad nat. *C. Sturm sc. Halae.*

Pelargi. Taf. IX.



1. 2. Ciconia alba. 3. 4. 5. Scopus Umbretta. 6. 7. Phoenicopterus antiquorum.
8. 9. Charadrius pluvialis. 10. Scolopax rusticula. 11. 12. Larus ridibundus. 13. 14. Lestris cataractes.

Nitzsch del. ad nat. C. Sturm sc. Halæ.



1. 2. Procellaria glacialis. 3. Puffinus obscurus. 4. Diomedea exulans. 5. 6. Anas Penelope. 7. Anser cinereus. 8. 9. Dysporus bassanus. 10. n. Colymbus cristatus. 12. Endytes arcticus 13. 14. Alca Torda.

Nitzsch del. ad nat. G. Sturm sc. Halae.

INDEX.

FINIS.

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