

On the convolutions of the trachea in birds / by W.B. Tegetmeier.

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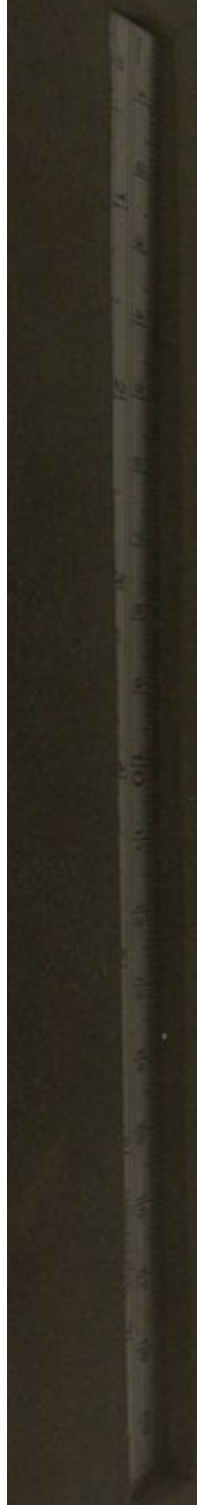
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ON THE

CONVOLUTIONS OF

BIRI

REPRINTED

"THE NATURAL HISTORY

W. B. TEGETME

Editor of the British Ornithological Union: Great



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1881.

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ON THE
CONVOLUTIONS OF THE TRACHEA
IN
BIRDS.

REPRINTED FROM
"THE NATURAL HISTORY OF THE CRANES."

BY

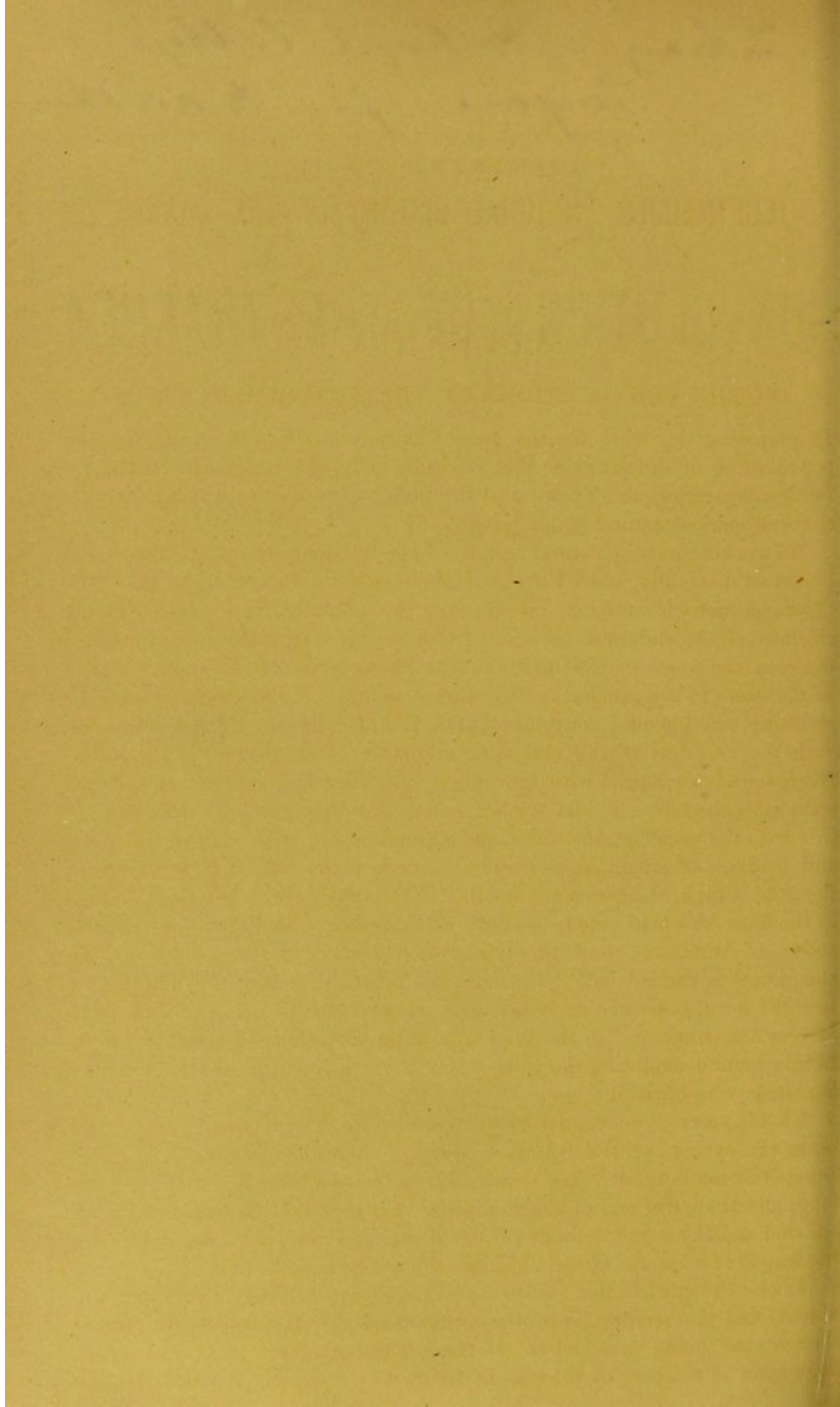
W. B. TEGETMEIER, F.Z.S.,

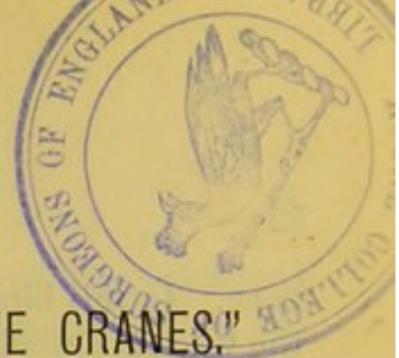
Member of the British Ornithologists' Union; General Editor of the Willughby Society.



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TEGETMEIER'S "NATURAL HISTORY OF THE CRANES."

APPENDIX.

ON THE CONVOLUTIONS OF THE TRACHEA IN BIRDS.

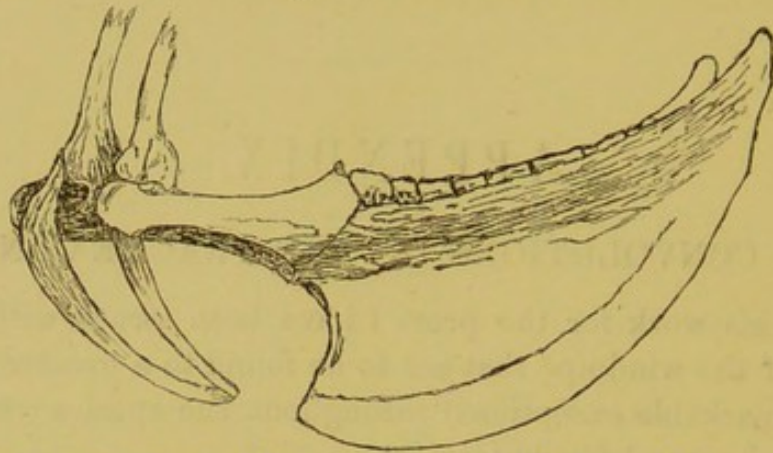
IN preparing this work for the press I have been struck with the singular convolutions of the windpipe that are to be found to a greater or less extent (with a few remarkable exceptions) throughout the species which constitute the well-marked natural family Gruidæ.

In working out the natural history of the different cranes, I endeavoured by actual dissection, when I could obtain recent specimens, or by the study of preparations in museums, to discover the amount of convolution in the tracheæ of the different species. I then essayed to trace the connection between the voice of the bird and the character of the windpipe, and I finally came to the conclusion that the elongation of the windpipe (and the resulting twisting and convolution if it is much elongated) was connected with the deepness of the note and resonance of the sound of the voice. Everyone is acquainted with an ordinary post horn, a keyless conical tube open at both ends. To the smaller end of the tube the lips—which are in this case the vocal organs—are applied, and a note is produced, the pitch and loudness of which depend on the length of the tube. In a short tube the note is high, the resonance small. If the tube is lengthened, as is done in the horn of a mail coach, the note becomes lower, louder, and of greater power of diffusion; and these alterations occur in proportion as the elongation is carried out. But there is a practical limit to the length of a straight horn, inasmuch as it becomes inconvenient to use, and difficult to carry without injury. In the French hunting horn this evil is got rid of by twisting and convoluting the tube, which is curved around the body of the huntsman who blows it.

This is precisely analogous to what occurs in nature in the Cranes. In birds the syrinx, or lower larynx, which is the chief organ of voice, is situated in the interior of the thorax, where the two bronchi, one from each lung, join the lower end of the windpipe; it is here that the vocal cords are situated and the sound is produced, its depth and resonance depending on the length of windpipe along which the vibrations have to pass.

In the Crowned Crane, *Balearica chrysopelargus*, these convolutions are absent, and the sternum is of the usual character, the furcula or merrythought not being attached to the keel, although there is a very slight depression in the base of the keel in front, where it joins the body of the

bone. In this bird the loud resounding voice of the Cranes is wanting, and the voice is described as a "delightful mellow note."

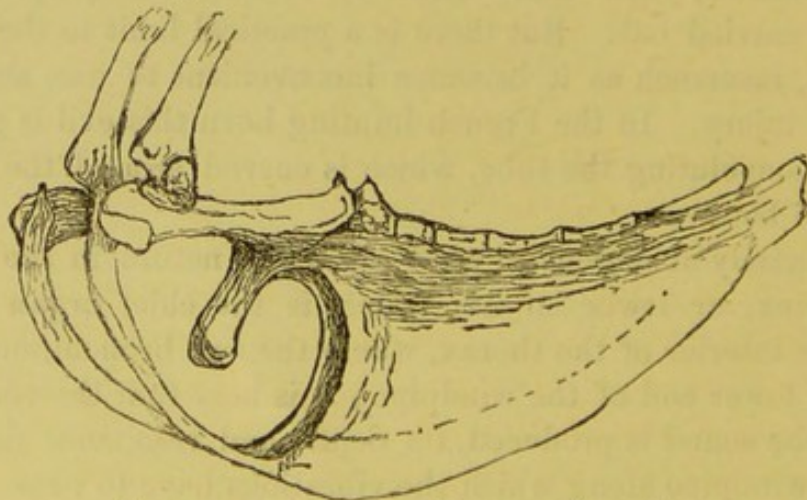


STERNUM OF THE KAFFIR CROWNED CRANE. *Balearica chrysopelargus*.

Of the Western Crowned Crane, *B. pavonina*, I can gain no special information as to the voice, although in Griffith's edition of Cuvier's "Animal Kingdom" it is said to make a noise with its wing (?) somewhat like the sound of a French horn.

In the true Cranes belonging to the genus *Grus* we are informed by Mr. A. O. Hume that one species, the Asiatic White Crane (*G. leucogeranus*), differs remarkably from all the other species in its trachea not being convoluted nor entering into a cavity in the breast bone; that its note is, for so large a bird, a mere chirrup, and even when most alarmed, and soaring round and round, the cry is very feeble as compared with that of any other of the Cranes.

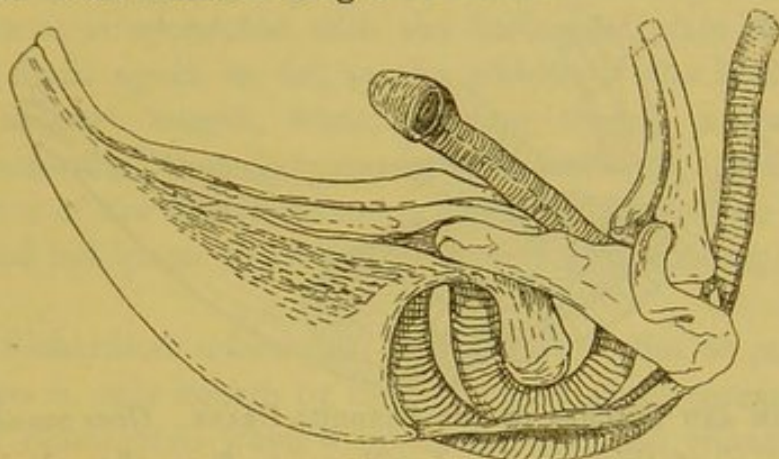
In the Stanley or Paradise Crane, the blue Crane of South Africa (*G. paradisea*) the keel is hollowed out into a cavity open at the sides, as shown in the following sketch from a sternum in the Museum of the



STERNUM OF STANLEY CRANE. *Grus virgo*.

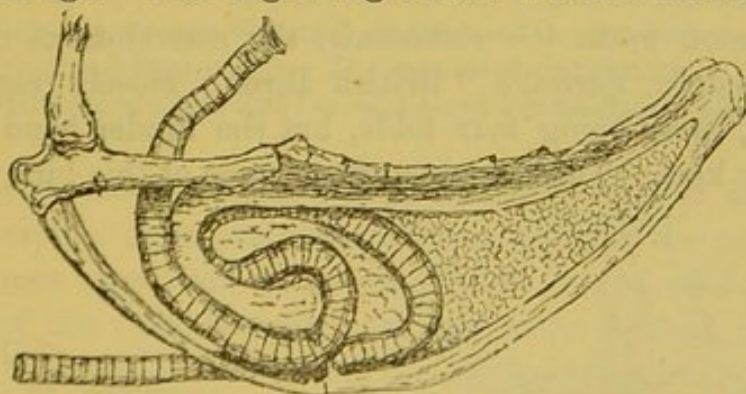
University of Cambridge. The margins of this cavity are deeply grooved for the reception of the trachea, which is disposed as shown in the following figure, which is copied from a drawing by Yarrell in the fifteenth volume of

the "Transactions of the Linnean Society." The voice of this species is described by Mr. Ayres as a loud guttural note, which is uttered when the birds have risen to an immense height in the air.



STERNUM AND TRACHEA OF STANLEY CRANE. *Grus virgo*.

The Saras Crane of India, *G. antigone*, I am fortunate in having had an opportunity of dissecting. The subject of my *post mortem* investigation was an old male that died in the Zoological Gardens, Regent's Park, in 1879. In this species the convolutions of the trachea are carried out to a much greater extent. In the adult the keel of the sternum is formed of two vertical plates, with an interval varying from an inch to half an inch between them. This is partly filled with cancellated, spongy cells, in which the trachea is embedded, gradually becoming more and more convoluted as the bird advances in age. The engraving shows the left side of the keel cut

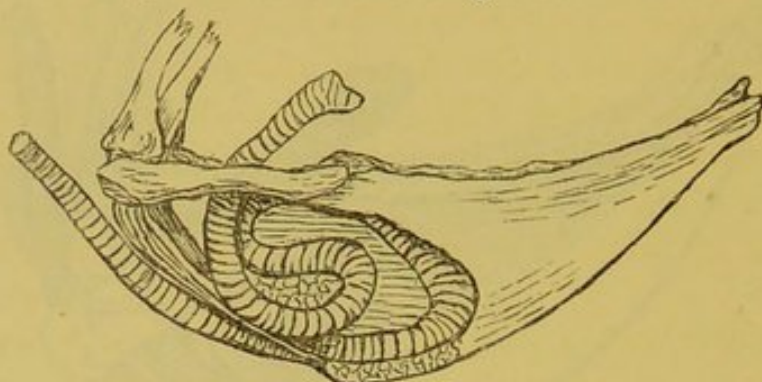


STERNUM AND TRACHEA OF SARAS CRANE. *Grus antigone*.

away, with the trachea curled up within it. It may be noticed that there are four folds of the windpipe contained within the keel, whereas there are only two in the Stanley Crane. For the voice of this Crane I may quote Col. Tickell, who writes: "One of my party having shot a female near the camp, I was distressed throughout the night by hearing the wailing, trumpet tones of the bereaved male calling fruitlessly for the dead."

The Sandhill Crane of North America (*G. canadensis*) has been described as having no convolutions of the trachea within the sternum; but Mr. T. S. Roberts, writing in the *American Naturalist*, 1880, has shown, by the dissection of several specimens, that this view is incorrect, the error possibly

depending on the age of the bird examined. In adult birds the entire length of the trachea is twenty-seven inches, there being about eight or nine inches in the keel, as shown in the diagram.

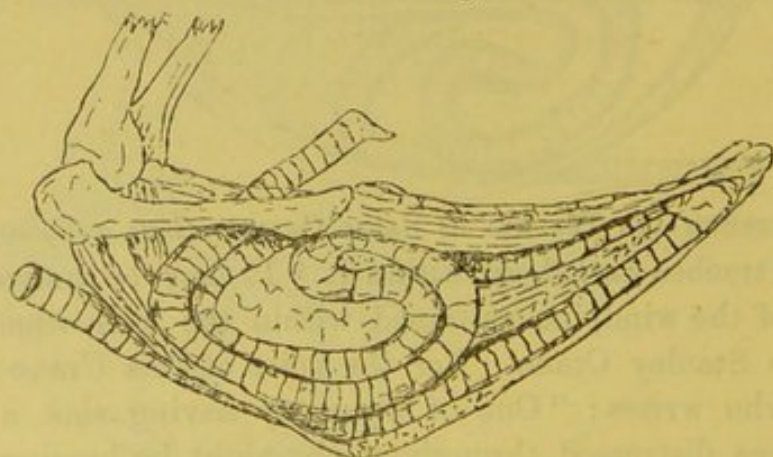


STERNUM AND TRACHEA OF THE SANDHILL CRANE. *Grus canadensis*.

For the voice of this species I will quote from the admirable account given by Dr Elliot Coues in his "Birds of the North-West," in which we are informed that :

When proceeding from one favourite resort to another, or when migrating, the flight is high, and not unfrequently their approach is heralded, before they are in sight, by their incessant, whooping clamour. . . . We found them always exceedingly shy and difficult of approach, but not unfrequently the files of their tall forms stretching above the prairie grass, or their discordant and far-sounding screams, suggested the presence of the human inhabitants of the region, whose territory was now, for the first time, invaded by the white man. . . . Let the least sound or movement betray an unwelcome visitor, the crane spreads his ample wings and springs heavily into the air, croaking dismally in warning to all his kind within the far-reaching sound of his voice.

In the common crane (*G. communis*) the convolutions of the trachea, which are figured in Yarrell's "British Birds," closely resemble those of the saras crane, there being four folds, but the hinder bend passes to the extremity of the keel. The far-resounding voice of this bird is well known.



STERNUM AND TRACHEA OF WHOOPING CRANE. *Grus americana*.

The most extreme development of the trachea in the cranes is to be seen in that one which is frequently termed the whooping crane of America (*G. americana*). It has a windpipe between four and five feet long, of which no less than twenty-eight inches are coiled up in the keel of the breast-bone, as shown in the foregoing diagram.

The windpipe enters the keel below, at the junction of the furcula or merrythought, passes along just above the edge to the extreme end of the bone, then turns forward, and comes to the front along the upper edge of the keel, where it is connected with the horizontal plate of the sternum; it then turns back again as far as the middle of the keel, again comes forward for a short length, when, curving sharply upwards on itself, it proceeds backwards, then downwards, then forwards, and finally upwards into the interior of the thorax, where it divides into the two bronchi going to the right and left lungs, the syrinx or organ of voice being situated at the bifurcation.

Sir John Richardson informs us that the bird flies at such an altitude that its passage is only known by the peculiarly shrill screams it utters—a fact not so remarkable when we consider that the vibrations of sound produced by the syrinx are conveyed through a convoluted trumpet nearly five feet in length.

So much for the convolutions of the trachea in the adult cranes. I think that this account will in the main bear out my suggestion that the result of these elongated curves corresponds to that of those in a French horn—namely, they increase the depth and sound of the voice:

With regard to the young birds, Mr T. J. Roberts informs us that,

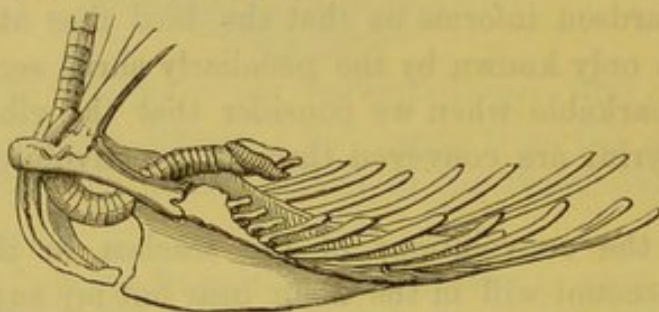
In the embryo crane just about to break the shell the trachea does not enter the sternum at all, and is perfectly simple. But the anterior part of the keel, which is entirely cartilaginous and diminutive, is much thickened, and a cross section of it shows it to consist of two thin walls, separated by a marrow-like substance. In this feature of the sternum we see the only indication in the embryo of the singular structure to be developed later in life. The degree of complexity of the trachea is thus shown to be dependent upon age, and the variations are no doubt fully accounted for by this fact.

As might be expected, in the young birds the voice is entirely wanting in resonance, being a mere plaintive cheep; and just in proportion as the windpipe becomes more and more convoluted in the adult birds, so does the resonance of the voice become more and more marked, from the feeble tone of the Asiatic white crane, with its straight trachea, through all the various grades up to the resonant clang of the whooping crane of North America.

The convolutions of the trachea in birds are not confined to the Cranes, but are to be found in many other families. In several of the swans (*Cygnus*) the trachea enters into the keel of the sternum very much in the same manner as it does in the Cranes. This, however, as might be expected, is not the case in the tame or mute swan (*Cygnus olor*), which, as its English name implies, is nearly voiceless, and does not even sing as fabled when dying. In other species of the genus, as the Hooper, the *Cygnus musicus* of Bonaparte, the trachea is contained in the keel, as in the Cranes, and the result is that the bird has a loud, melodious, far-reaching, hooping or whooping voice, from which its English name, is derived.

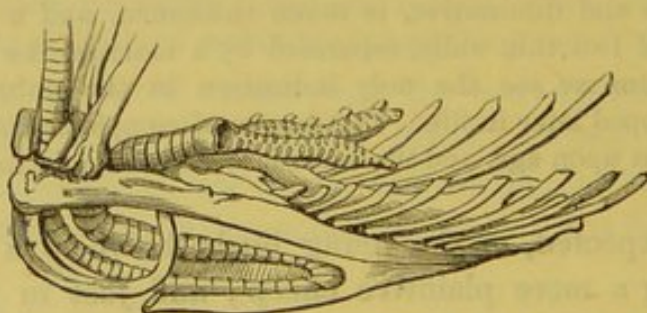
Yarrell says of a very old and large male, that its "note resembled the sound of the word 'hoop,' repeating it loudly ten or twelve times in succession." Low, in his "Natural History of Orkney," says "Like the wild geese, these birds fly in the fashion of a wedge, making a fine melodious clang." Macgillivray says the trachea is 3ft. 2in. in length, and that he has seen, when in Harris, a flock come in from the Atlantic after a gale, and listened with delight to their loud and clear trumpet-like cries as they sped their way in lengthened files.

The accompanying engravings, after Yarrell, show the difference of the sterna and windpipe in the two species.



STERNUM AND TRACHEA OF MUTE SWAN. *Cygnus olor*.

In Bewick's swan (*Cygnus bewicki*) the trachea is convoluted in the keel of the sternum, and, as might be expected, its note is described as having a deep tone, and the bird as being exceedingly clamorous.



STERNUM AND TRACHEA OF HOOPING SWAN. *Cygnus musicus*.

Other birds belonging to perfectly distinct natural families, neither related to the cranes or the swans, are characterised by elongations of the trachea, which are very differently placed.

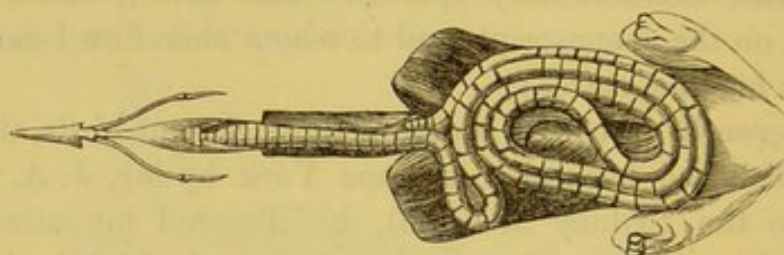
Dr. Latham, in an essay on this subject published in "The Transactions of the Linnaean Society," vol. iv., 1798, figured the tracheas of several birds, as the Guan and others, in which the trachea is convoluted under the skin of the breast, between it and the large pectoral muscles; but these and all previous known examples fade into insignificance when compared with that which occurs in Keraudren's crow shrike (*Manucodia keraudreni*). This, which is a well-marked New Guinea form, is also found in the adjacent parts of Australia. A male specimen from Cape York is to be seen in the British Museum; this is of a uniform brilliant green-black plumage, with slightly lengthened ear-plumes pointing backwards. This specimen is

figured in the supplementary volume of Gould's folio on the Birds of Australia; but of the mode of life, voice, &c., only a very brief account was given, as nothing was known of its habits. Some time since, the following most interesting communication was forwarded to the late Professor Garrod, Prosector of the Zoological Society, whose early death is so deeply deplored by all who knew him or his valuable scientific work. This was placed at my disposal by his successor, Mr. W. A. Forbes, and I have much pleasure in publishing what I believe to be the first account of the habits of this extraordinary species. The writer, whose name unfortunately is not on the manuscript, and to whom therefore I cannot give the credit which is his due, states:

"Having recently purchased a pair of those elegant birds, the *Manucodia keraudreni*, which had been shot at Cape York by Mr. J. A. Thorpe (now Taxidermist to the Sydney Museum), he directed my attention to the peculiar formation of the trachea in them, some of which he had preserved in a dried state and presented to me. Of these I have sent you three, one female and two from males; that of the female is much smaller in size than those of the males; and even in the males the convolutions assume different forms, some being perfectly cylindrical, others are very much elongated; the convolutions are very numerous and large in comparison with the size of the bird, and constitute a singular formation. By moistening the specimens I have sent, you will be able to observe more accurately the peculiarity of the structure, and the elasticity and power of contraction and dilatation of the tube, than can be done by an examination of the dried specimens. If you consider them of sufficient interest, they could be drawn and brought before the Society. I shall make every effort to procure some of these birds in spirits, so as to enable an accurate dissection of this formation to be made and described. From Mr. Thorpe's account, the trachea forms the convolutions between the skin and breast (but not on the bone itself), and then enters the cavity of the chest to the lungs. This formation of the vocal organs enables the male bird to utter a very loud and deep guttural sound—indeed, more powerful and sonorous than anyone would suppose so small a bird could be capable of producing. Mr. Thorpe states to me that it was a long time before he could believe that so powerful a sound emanated from this bird. No information could be obtained respecting the note of the female, as only that of the male bird was heard. Mr. Thorpe gave me some information respecting the habits of these birds, as follows: "During a residence of seventeen months at Cape York in 1867-68, I shot several of the *Manucodia keraudreni*, and took particular notice of their habits. They frequent the dense palm forests, and are usually seen high up in the trees; they utter a very deep and loud guttural note, rather prolonged, and unlike that of any other bird with which I am familiar. Their movements are particularly active and graceful; on

approaching them they evince more curiosity than timidity, looking down at the slightest noise, and apparently more anxious to obtain a full view of the intruder than for their own safety. They are almost invariably in pairs, and both birds can generally be secured."

I have seen and examined the tracheæ sent by Prof. Garrod's correspondent, but, being in a dry state, they do not give so good an idea of the wonderful complexity of the convolutions as the following woodcut, reduced from a lithograph accompanying an article by Professor Pavesi, of the



CONVOLUTIONS OF TRACHEA ON THE BREAST OF KERAUDREN'S CROW SHRIKE.

University of Genoa, which appeared in the "*Annali del Museo Civico*," vol. vi.

That a bird the size of a missel-thrush should be able to produce a sound so loud as that described is, I think, a conclusive proof that the effect of the elongation and convolution of the trachea is the deepening of the tone and the increase of the loudness of the voice, which is the proposition that I have endeavoured to demonstrate; but why certain birds should require such a deep-toned and far-reaching voice, which is not possessed by closely allied species, is a matter still to be determined.

