IX. *Observations intended to show that the progressive Motion of Snakes is partly performed by means of the Ribs.* *By* Everard Home, *Esq. F. R. S.*

Read February 27, 1812.

On a former occasion I laid before the Society a description of the mechanism of the hood of the cobra de capello snake of the East Indies, the coluber naja of Linnæus, in which the ribs of the neck are shewn to be formed in a particular manner; so that when they are raised, the skin becomes stretched out, and puts on the appearance of a hood.

The ribs so employed have several peculiarities, which, I took for granted, were confined to those of the neck, for I was not in possession of the bodies of the snakes, and therefore could not examine the others; but have since found that many of these peculiarities are not only common to all the ribs of this snake, but to those of the whole tribe.

This fact, as it escaped my observation at that time, would have still done so, had it not been for the following circumstances.

A coluber of unusual size, lately brought to London to be exhibited, was shewn to Sir Joseph Banks; the animal was lively, and moved along the carpet briskly: while it was doing so, Sir Joseph thought he saw the ribs come forward in succession like the feet of a caterpillar. This remark he immediately communicated to me, and gave me an opportunity of seeing the snake and making my own observations.

The fact was readily established, and I could feel the ribs with my fingers as they were brought forward; when a hand was laid flat under the snake, the ends of the ribs were distinctly felt upon the palm, as the animal passed over it.

This becomes a more interesting discovery, as it constitutes a new species of progressive motion, and one widely different from those already known.

In the draco volans the ribs form the skeleton of the wings, by means of which the animal flies, the five posterior ribs being bent backwards and elongated for that purpose, so that in that instance the progressive motion is performed by the ribs, but those particular ribs are superadded for this purpose, and make no part of the organs of respiration; whereas in the snake the ribs are so constructed, as to perform their office with respect to the lungs as well as progressive motion.

That ribs are not essential to the breathing of all animals, whose lungs are situated in the same manner as in snakes, is proved by the syren having no ribs; but as this animal has also gills, and can breathe in water as well as in air, the lungs are not so constantly employed, and probably a less perfect supply of air to them may suffice.

In animals in general, the ribs are articulated to the back bone by means of a convex surface, which moves upon a slightly concave one formed upon two of the vertebræ, partly on the one and partly on the other, so that there is a rib situated between every two vertebræ of the back; but in the snake tribe, the head of the rib has two slightly concave surfaces which move upon a convex protuberance belonging to each vertebra, so th a there is a rib to each of the vertebræ.

One advantage of this peculiarity is, that it prevents the ribs from interfering with the motion of the vertebræ on one

another. The vertebræ are articulated together by ball and socket joints (the ball being formed upon the lower end and the socket on the upper one), and have therefore much more extensive motion than in other animals.

The muscles, which bring the ribs forward, consist of five sets, one from the transverse process of each vertebra to the rib immediately behind it, which rib is attached to the next vertebra. The next set goes from the rib a little way from the spine just beyond where the former terminates, it passes over two ribs, sending a slip to each, and is inserted into the third: there is a slip also connecting it with the next muscle in succession. Under this is the third set, which arises from the posterior side of each rib, passes over two ribs, sending a lateral slip to the next muscle, and is inserted into the third rib behind it.

The fourth set passes from one rib over the next, and is inserted into the second rib.

The fifth set goes from rib to rib.

On the inside of the chest there is a strong set of muscles attached to the anterior surface of the vertebræ, and passing obliquely forwards over four ribs to be inserted into the fifth rib, nearly at the middle part between the two extremities.

From this part of each rib a strong flat muscle comes forward on each side over the viscera, forming the abdominal muscles, and uniting in a beautiful middle tendon, so that the lower half of each rib, which is beyond the origin of this muscle, and which is only laterally connected to it by loose cellular membrane, is external to the belly of the animal for the purpose of progressive motion; and that half of each rib next the spine, as far as the lungs extend, is employed in respiration.

At the termination of each rib is a small cartilage in shape corresponding to the rib, only tapering to the point. Those of the opposite ribs have no connection, and when the ribs are drawn outwards by the muscles, are separated to some distance, and rest through their whole length on the inner surface of the abdominal scuta, to which they are connected by a set of short muscles: they have also a connection with those of the neighbouring ribs by a set of short straight muscles.

These observations apply to snakes in general; but they have been particularly examined in a boa constrictor, three feet nine inches long, preserved in the Hunterian Museum. In all snakes, the ribs are continued to the anus, while the lungs, seldom occupy more than one-half of the extent of the cavity covered by the ribs. These lower ribs can only be employed for the purpose of progressive motion, and therefore correspond in that respect with the ribs in the draco volans superadded to form the wings.

The parts of which a description has been attempted, will be better understood by an inspection of Plates IV. and V. than by any explanation that words can convey.

In Plate VI. the joints between the vertebræ and ribs are represented of the natural size from the skeleton of a large boa, sent from the East Indies by the late Sir WILLIAM JONES and deposited in the Hunterian Museum. On the under surface of the vertebra is a protuberance for the attachment of muscles peculiar to this genus, it varies in size in the different species, and explains the power attributed to the boa constrictor.

When the snake is going to put itself in motion, the ribs of the opposite sides are drawn apart from each other, and the small cartilages at the ends of them are bent upon the upper surfaces of the abdominal scuta, upon which the ends of the

ribs rest; and as the ribs move in pairs, the scutum under each pair is carried along with it. This scutum, by its posterior edge, lays hold of the ground and becomes a fixed point from whence to set out anew. This motion is beautifully seen when a snake is climbing over an angle to get upon a flat surface.

When the animal is moving, it alters its shape from a circular or oval form, to something approaching to a triangle, of which the surface on the ground forms the base.

The coluber and boa having large abdominal scuta, which may be considered as hoofs or shoes, are the best fitted for this kind of progressive motion; there is, however, a similar structure of ribs and muscles in the anguis and amphisbæna.

In the anguis the ribs are proportionally weaker, and as these have nothing to correspond with the scuta, it is probable this mode of progressive motion is less necessary to them.

The rings of the amphisbæna are a near approach to the large scuta.

DESCRIPTION OF THE PLATES.

PLATE IV.

A lateral view of the muscles of the boa constrictor.

A A. The straight muscles of the back.

B B. The first set of muscles which arises from the transverse process of each vertebra, and is inserted into the rib behind it close to its head.

C C. The second set.

D D. The third set.

E E. The fourth set.

F F. The fifth set.

G G. Short muscles which pass from cartilage to cartilage.

H H. A set of oblique muscles which passes from the anterior side of the bony extremity of each rib to the posterior edge of each scutum.

I I. Muscles which pass from the ribs near their heads obliquely backwards, to be inserted into the skin at the edge of each scutum.

K. Muscles of the scuta.

PLATE V.

An internal view of the abdominal muscles of the boa constrictor.

A A. The muscles which pass from cartilage to cartilage of the different ribs.

B B. A set of muscles which passes from the point of each rib over two ribs to the middle of the third.

C C. A similar set of muscles continued from the opposite side of the rib, passing over three ribs to the body of the vertebra.

D D. The abdominal muscles which arise from the anterior edge of each rib, and pass to the linea alba.

E E. The linea alba.

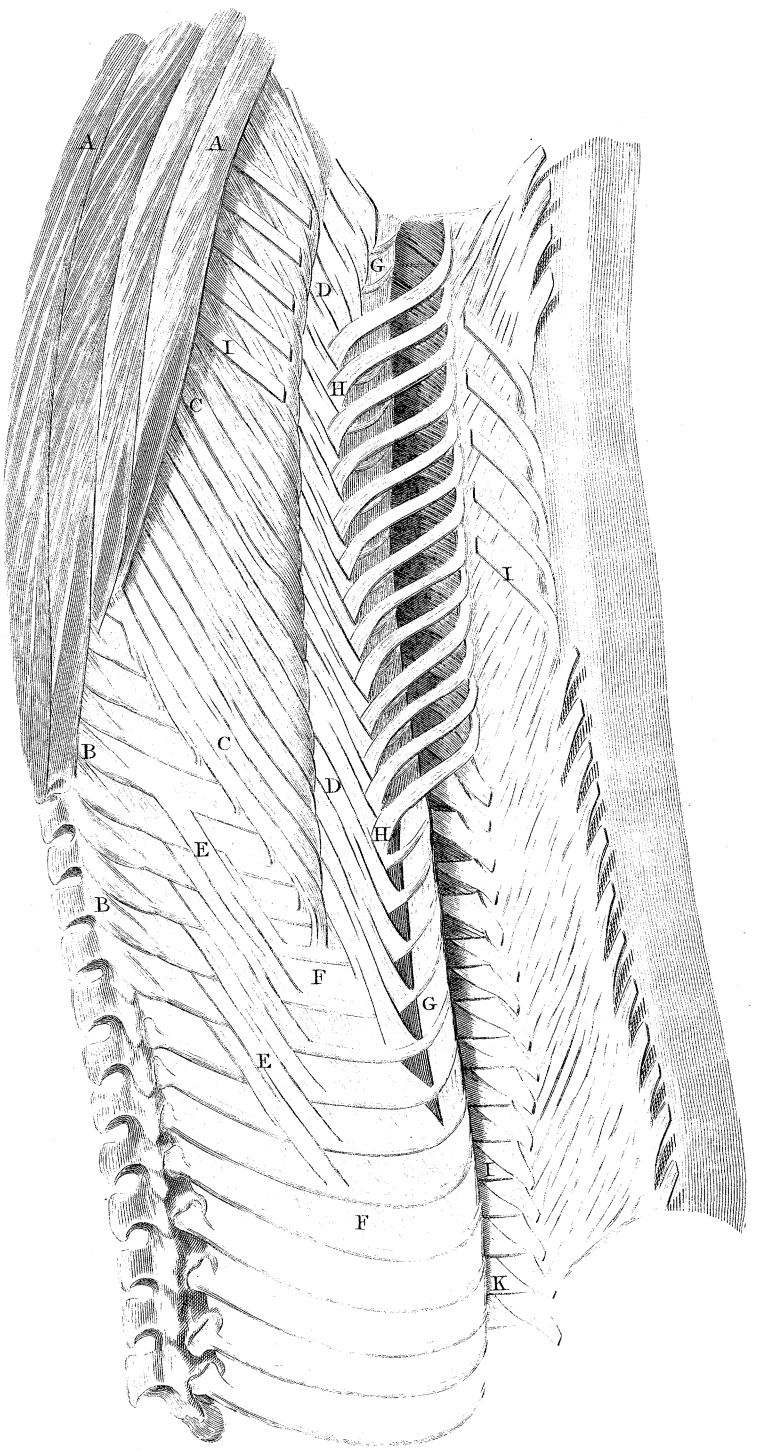
F F. The termination of the set of oblique muscles which passes from the bony extremities of the ribs to the edges of the scuta.

G G. The muscles of the scuta consisting of two sets which decussate each other.

PLATE VI.

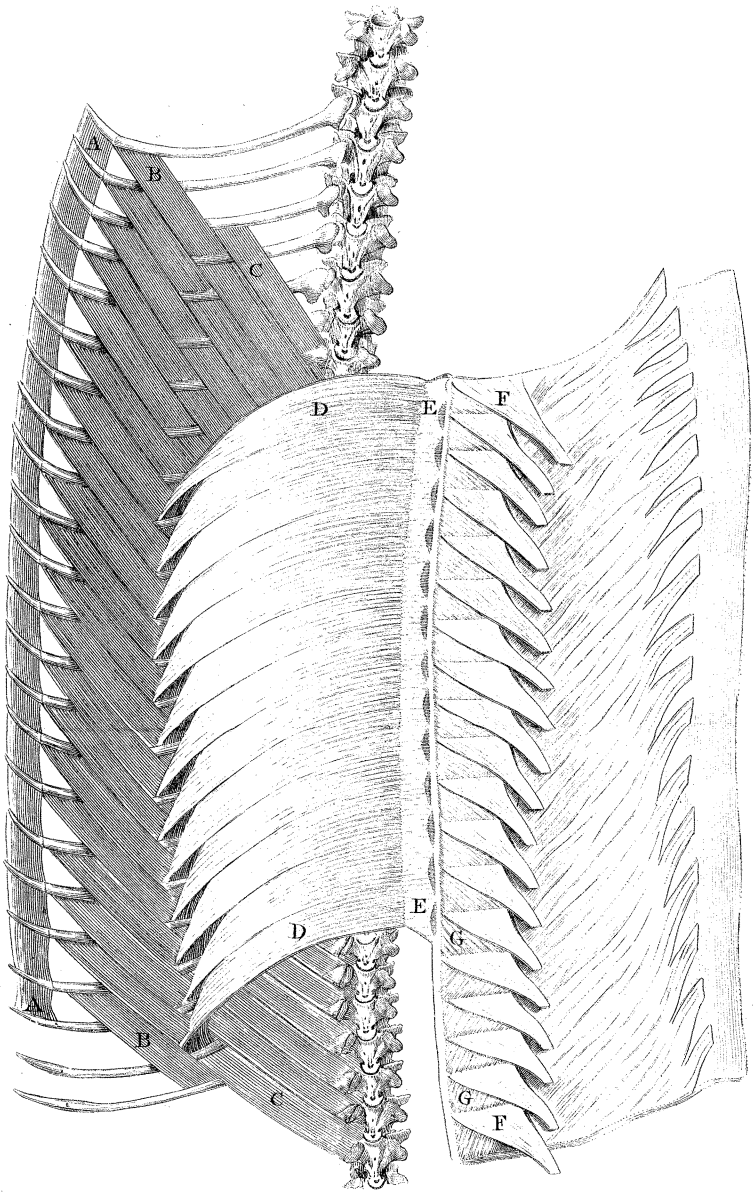
Represents two vertebræ and portions of ribs of the large boa to show their articulating surfaces.

a a. The process peculiar to the vertebra of the boa.



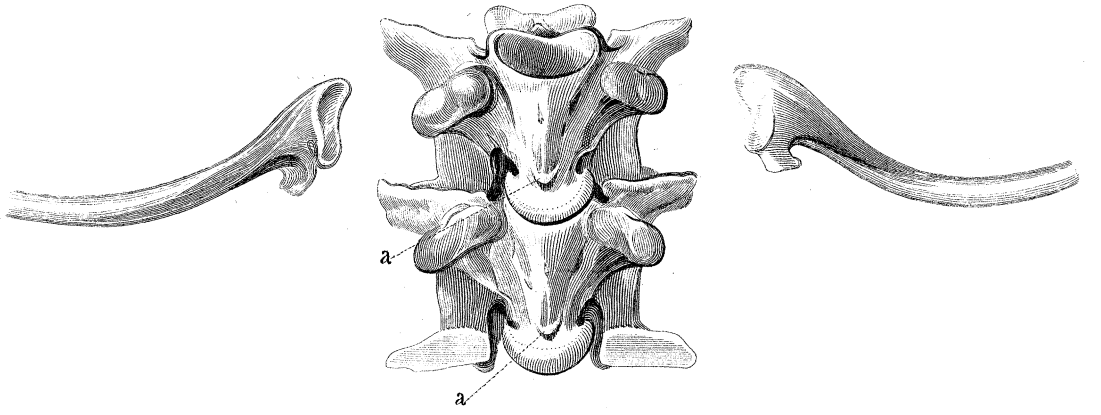
W. Clift del.

P. Basire sc.



W. Clift del.

J.ᵒ Basire sc.


a
a