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Arthur Keith.**

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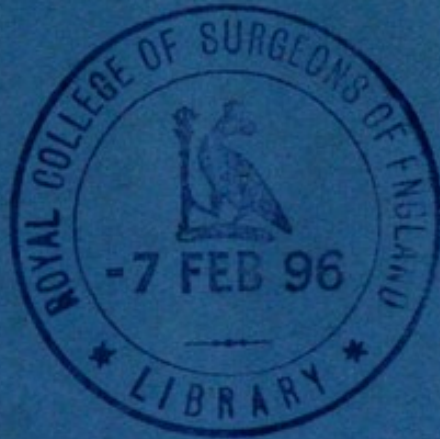
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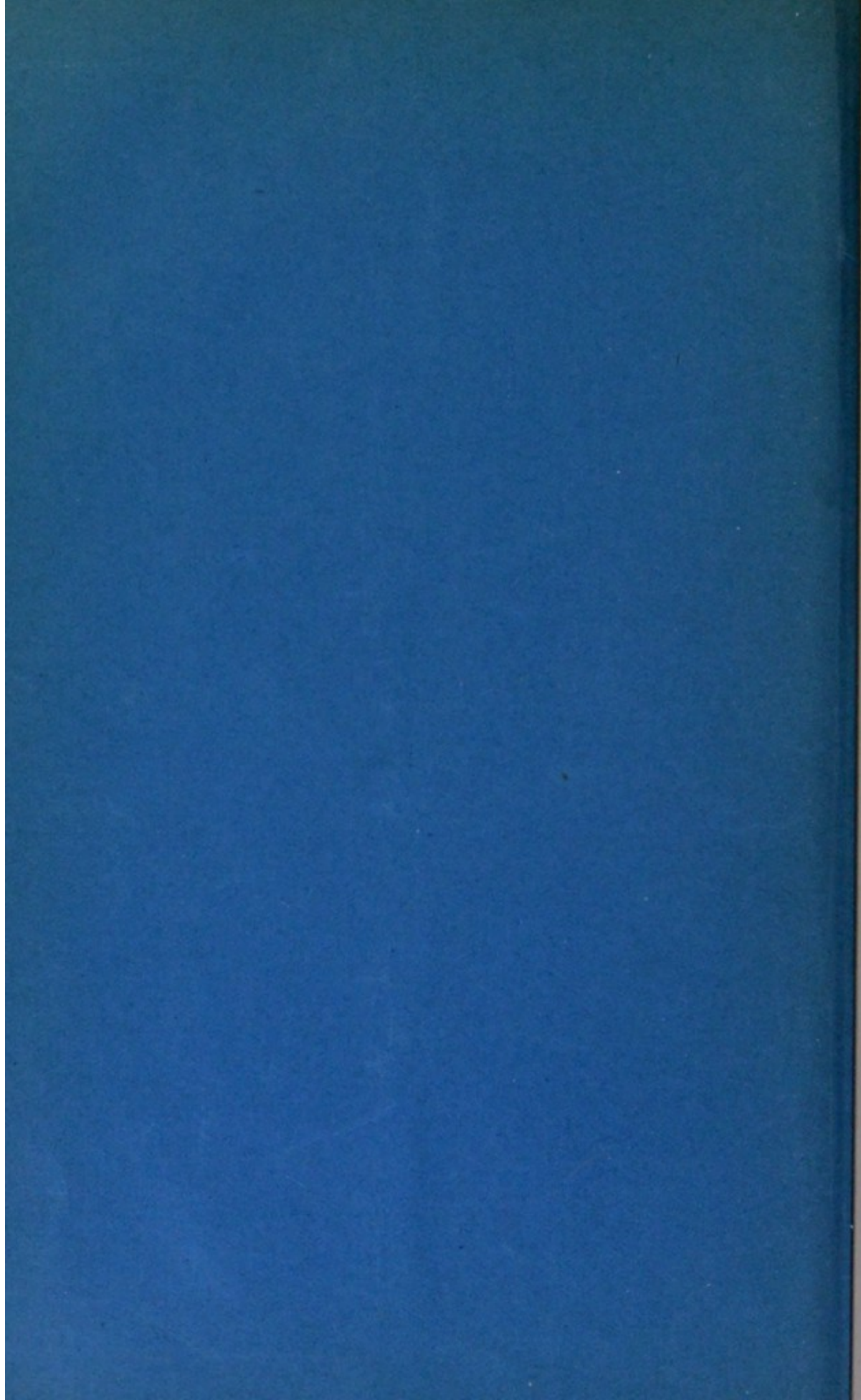
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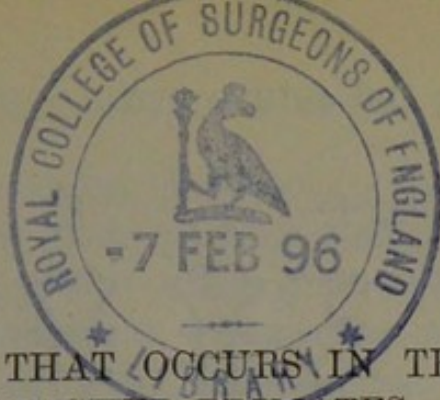


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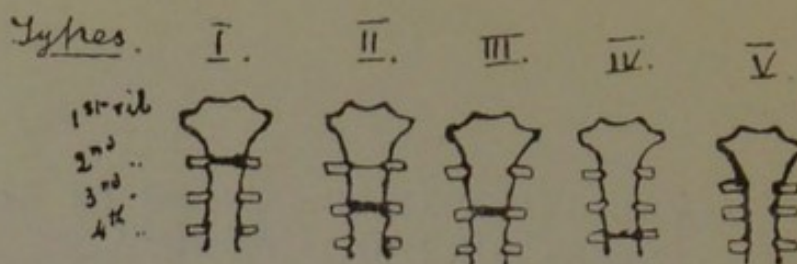




A VARIATION THAT OCCURS IN THE MANUBRIUM
STERNI OF HIGHER PRIMATES. By ARTHUR KEITH,
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Hospital Medical College.*

MECKEL (1), Shepherd (2), Arbuthnot Lane (3), Turner (4), Dwight (5), and Paterson (6), have drawn attention to a variation that occurs in the form of the *manubrium sterni* of men and apes. The variation consists in the enlargement of the *manubrium* or *presternum* by the addition of the first meso-sternal segment. Stated in other words, instead of the joint in the sternum opposite the insertion of the second costal cartilages persisting, as in the ordinary human form (Type I., in the annexed table), the joint opposite the third costal cartilages persists, as is nearly always the case in Gibbons—the hylobatian form (Type III.). In young adults an intermediate form occurs, in which the joint opposite the third pair of cartilages is much wider than that opposite the second pair (Type II.). In the fully adult stage of such individuals, the manubrium sterni becomes of the hylobatian form. In very rare cases, only the joint opposite the fourth pair of cartilages persists (Type IV.). At late stages of life all the joints of the human sternum may be obliterated; this may happen at earlier stages of life in Gorillas and Orangs (Type V.). The prevalence of these various types of manubrium sterni is given in the annexed table.

The percentage with which this variation appears in Man is almost impossible to estimate—probably about 1 per 1000. It is of much interest to note, however, that at least three out of the nine cases recorded were found in dark-skinned people. It occurs amongst Gorillas at about 20 per cent.; Chimpanzees, 30 per cent.; Orangs, 1 per cent.; and in Gibbons about 80 per cent. It is a variation common to the higher Primates, but occurs with widely varying frequency in the different groups.



Number of Individuals
examined :¹—

	Number ?	I.	II.	III.	IV.	V.
(1) Man, ²	?	?	?	9	?	?
(2) Gorilla,	25	16	1	6	...	2
(3) Chimpanzee,	26	17	7	2	...	...
(4) Orang,	23	20	1	1	...	1
(5) Gibbons,	33	6	4	22	1	...
(6) Semnopithecus,	19	18	1	...	...	...
(7) Macacus,	16	16	...	...	...	...
(8) Ateles Geoffroyii, ?	?	...	...	1	...	...

Its occurrence in Man, I think, may be regarded as the persistence in a very few individuals of a simian, or, more properly, a hylobatian character. The fact that it apparently occurs more frequently in negroid people favours such a view. It is further favoured by one of Arbuthnot Lane's cases, in which a septal head to the biceps of the arm and a *chondro-epitrochlearis* muscle were also present in the same man. Both these muscles find their greatest development in *Hylobates* (Gibbons). There is also the further consideration that it is almost impossible to account for the present bodily structure and method of progression of Man, the Gorilla, and Chimpanzee, except by supposing that they have passed through a hylobatian period of existence. It is possible, however, that this variation is a character which may have been independently acquired by each group of the higher Primates.

The prevalence of this form of pre-sternum in *Hylobates* may be taken as evidence that it is for them more advantageous than the ordinary or human form. Its exact advantage is not very evident. Possibly it has to do with the great development

¹ The material from which the above table was compiled is contained in the following Museums :—South Kensington Natural History ; College of Surgeons, England ; University of Aberdeen ; and University College, London. Besides having material of my own, I have used that recorded by Dwight, Deniker, Hervé, Heckel, Embleton, Traill, Tyson, Bischoff, Duvernoy, and Anderson.

² Besides the cases recorded by Meckel, Shepherd, &c., there is one in the Museum of the Royal College of Surgeons, England.

of the pectoralis major in Gibbons. That muscle plays an important part in their peculiar method of progression by brachiation. The greatly enlarged pre-sternum offers a wider surface for the attachment of the upper part of the pectoralis major. The tendon of the sterno-mastoid also reaches on the sternum to the level of the third pair of ribs. A large pre-sternum appears to have been attained in the Orang, which has a method of locomotion very similar to that of the Gibbon, by an enlargement of the manubrium without the addition of a segment of the meso-sternum.

The hylobatian form of pre-sternum is to be regarded, I think, as the ordinary manubrium with the first meso-sternal

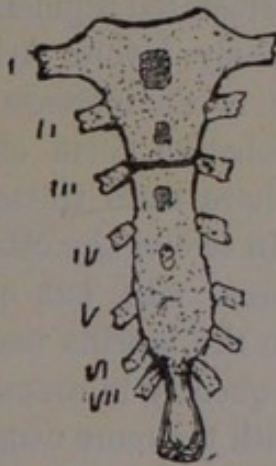


FIG. 1.—Sternum of *Hylobates pileatus* at birth. ♀

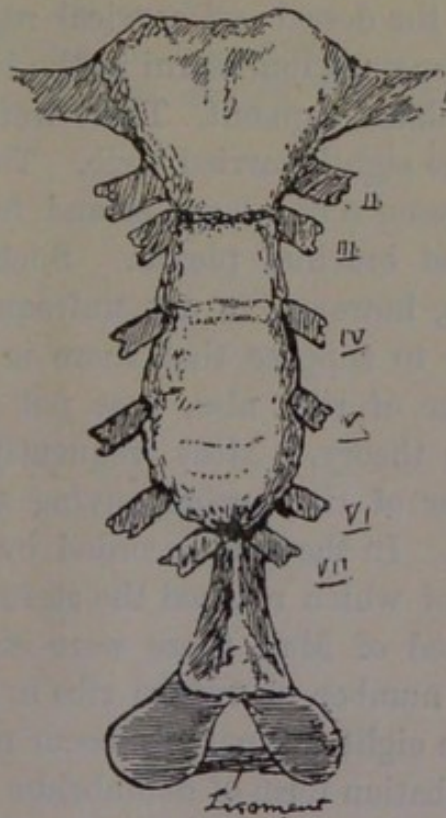


FIG. 2.—Sternum of *Hylobates* lar. ♀

segment added to it. In fig. 1 is represented the sternum of a *Hylobates pileatus* at birth. It will be noticed that four centres have appeared, and that the fibrous septum which lies, in the human sternum, opposite the insertion of the second costal cartilages, lies, in this one, opposite the third pair. The shifting of the fibrous septum from the level of the second to the level of

the third costal cartilages implies a very decided change in the formation of the manubrial joint.

According to Albrecht, and also to Ruge, the manubrium sterni is a composite bone made up of primal elements derived from many bones. Albrecht was of opinion that it always contained segments corresponding to ribs belonging to the seventh cervical vertebra. It is evident, if ribs belonging to that vertebra were present, that the manubrium, as in the hylobatian form, would have $2\frac{1}{2}$ pairs of ribs articulating with it on each side. In none of the cases recorded in the above table were seventh cervical ribs present. No explanation of this form of manubrium is derivable from that source. Arbuthnot Lane, however, suggested that there was a segment intercalated between the dorsal and cervical regions, and that the extra piece of the manubrium sterni in the hylobatian form belonged to the intercalated segment. There were really eight cervical vertebræ, and the eighth carried a rib. This theory was countenanced by the presence of a large strand from the tenth spinal nerve joining the brachial plexus. Such an addition to the brachial plexus, however, is not unfrequently found when there is no reason to suppose that there is an intercalated segment. The number of ribs, also, does not particularly favour Arbuthnot Lane's theory. Most frequently there is no increase in the number of ribs accompanying the hylobatian form of manubrium. In the case recorded by him there were thirteen ribs, eight of which reached the sternum. In two of the other cases recorded of Man there were eight sternal ribs, but only the usual number of twelve ribs in all. In the Gorilla and Chimpanzee eight sternal ribs occur more frequently in animals with a hylobatian form of manubrium than with the more usual form; but in Gibbons neither the total number of ribs, nor the number of sternal ribs, seem to be affected by the occurrence of the enlarged form of manubrium. In that genus the number of sternal ribs varies from six to eight, seven being the most common. This form of sternum, so far as my material goes, is not more prevalent in one species of *Hylobates* than in another.

In conclusion, I beg to take this occasion of acknowledging my indebtedness to the authorities of the South Kensington

Natural History Museum, and the Royal College of Surgeons' Museum, England, for the many liberties they have extended to me. I am also indebted to Professor Thane for references to literature dealing with this subject.

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