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— BY —

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(Preliminary Communication.)



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STUDIES ON THE BIOLOGY OF THE THYMUS GLAND.

WILLIAM MACKENZIE, M.D.

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Structural Co-relation.

It will be generally conceded that the final answer to the solution of many perplexing medical subjects will be along biological lines. Behind the question of what caused infection is the basic one of why infected? Subject to similar influence, why was A attacked and why did B escape? Although the surgery of the appendix has reached such an exact art, it brings us no nearer to the cause and prevention of appendicitis. Physiology, admittedly, has told us much about the body from a study of function, yet concerning many structures our knowledge may be regarded as almost nil—e.g., spleen, thymus gland, glandulæ Cowperi, prostate gland, parathyroids. At the basis of all function study lies not merely a knowledge of structure, but, what is more important still, a knowledge of co-related structure. The doctrine of structural co-relation throws numerous hints not merely on normal, but on so-called "abnormal" or "monstrous" structures. Changes regarded as monstrous in us may be seen in other animals to be co-related to other changes; in other words, Nature has in different members of, say the mammalian class, carried certain of her evolutionary trends further than with us, thus, to my mind, giving us an indication of the intended procedure in homo—e.g., mode of disappearance of the fibula, presence of cervical rib, vital importance or otherwise of the adrenal glands, necessity and mode of disappearance of the appendix, disappearance of

certain muscles. When Arbuthnot Lane speaks of the uselessness of the large gut, and the ideal gut as being a simple, practically reptilian tube, it is as well to reflect that a member of the mammalia (*Dasyurus Ursinus*) has already evolved such a canal, but a study of co-relation shows it to be probably the most degenerate physical type in the class. The "selected" member (*Phascalomys*) of the same order has, it may be mentioned, a large intestine twelve feet in length.

Co-relation with Appearance or Disappearance of Bone.

If Nature produces—and apparently she is doing it frequently—a new rib in the neck, the question naturally arises, as in the case of the disappearance, partial or complete, of a bone usually present, e.g., fibula, is this appearance or disappearance utilitarian and in response to a need? In other words, are there evidences of co-relation of ribs with associated structures indicative of permanency in the effort; and, if symptoms present themselves, are these due to a failure in the co-relating process, either natural or mechanically produced? This must be the test applied to all so-called abnormalities. Nothing in itself should be regarded as abnormal or monstrous, the variation may be a useless one, nevertheless it is a response to an effect or need. The removal of the rib can only be scientifically justifiable when it is proved that removal is the factor necessary to secure adequate co-relation of the adjacent structures. The fact that complete co-relation could occur was demonstrated in Turner's celebrated dissection of a cervical rib extending to the first thoracic costal cartilage in which a complete readjustment of the parts could be demonstrated. Again, it is not enough to say that the fibula is disappearing unless one finds co-relative evidence in the toes and muscles of the leg and foot, apart from the fact that we meet with "fractures" at birth or partial or complete disappearance of the bone indicative of the trend of Nature's evolution. Then a comparison can be instituted with animals, e.g. *Macropus*, showing us the further advanced stages in the disappearance of the bone.

Co-relation Applied to Supreme Types.

The doctrine of co-relation can be applied as follows:—It is recognised that the two big developments of the mammalia, apart from the assumption of the erect position, are seen in relation to the generative system and to cerebral development. Apart from these, what may be considered as a perfected physical system, especially the muscular, was defined millions of years ago and exists to-day. Thus a comparison can be instituted along the lines of the co-relation doctrine between man as representing the supreme intellectual type and an animal low down in the mammalian scale as representing the perfected physical type. I allude, of course, to *Phascolomys*. What has one developed compared with the other? Are structures essential to the physical an accompaniment of the development of the cerebrum? At once—e.g., the significance of the thyroid gland is seen—small in the latter and relatively enormously developed in the former, the spleen practically similar in both types suggesting that this organ is characteristic of neither one type nor the other, and similarly with numerous other contrasts to which I will subsequently refer. In like manner biological comparisons can be instituted between the perfected physical type above stated and other members of the same order presenting physical differences as *Phascolarctus* and *Dasyurus*. *Ursinus*, and in this way curious light can be thrown on the significance of other structures, viz.: Are both adrenals essential for existence? Can a patency from the peritoneum to the tunica co-exist without hernia? Why should the gastric ulcer choose the lesser curvature region proximal to the pylorus; mode of disappearance of the appendix throwing light on the possible failure of the co-relating processes in man.

The Thymus Gland and Co-relation.

Concerning the thymus, we know practically nothing as regards function. It is a characteristic of early life—commences markedly to disappear about the sixth or seventh year, and in the adult,

as a rule, nothing is to be seen macroscopically.¹ Cases of a defined thymus being retained throughout life are recorded, a fact of no little importance. The thymus gland is at its maximum when muscular action and co-ordination are developing; these being well established, it commences to disappear. In the recorded instances of its persistence throughout life its presence has presumably been a necessity, and harmless. Although it commences to disappear at the age of five or six, the question arises, Should it necessarily disappear then?. Is its absence beneficial in all or some? Are conditions superimposed causing its too early disappearance in some to whom, perhaps, thymic secretion may be a necessity? On this question the doctrine of co-relation throws some interesting light:

(1) Apart from any question of hibernation, it is present throughout life in two members each, of two distinct orders,² which may be termed A and B, as a well-defined macroscopic gland presenting histologically all the features of thymic tissue.

(2) In three of these, the two of order A, viz., *Ornithorhynchus Paradoxus* and *Echidna*, and one of order B., viz., *Dasyurus Ursinus*, distinct parathyroid glands are present. In this variety of order B, which I regard as the most important of all, extensive parathyroid development is present.

(3) Of the other member of order B two distinct varieties are known, one of which I regard as the selected variety, viz., *Macropus Ualabatus*, and the other as the non-selected, *Macropus Giganteus*. The non-selected, or comparatively unstable type, has a distinct thymus, and the selected variety shows a gland behind the left precaval vein and vagal nerve in front of the left subclavian artery.

1. At birth it weighs $\frac{1}{2}$ oz. or more and is somewhat heavier at the end of the second year. At 21 it may be a remnant weighing only 40 grains, and after 25 it is extremely difficult to discover any of its structure in the mediastinal tissues.

In describing the dissection of the mediastina in the adult, Parsons and Wright (London, 1912) state: "Some dark-coloured fibro-fatty tissue will now be exposed which represents the remains of the thymus gland."

2. I allude to the orders Monotremata and Marsupialia.

which histologically is not thymic but lymphatic.

The co-related evidence as regards the muscles is extremely interesting. No one animal with a retained thymus represents a fixidity of muscular development as compared with the supreme physical type to which I referred and in which I have failed to find a thymus. In order A we meet with what is practically geneses of muscular actions—nature preparing for her upward development in the mammalian scale; and in order B structural alterations in the muscles are the prominent features. In the variety of order B with a large thymus extending well into the neck, and extensive parathyreoid development, the muscles are in a state of degeneration and present many curious features. The animal may be regarded as a physical degenerate type becoming rapidly extinct. In the other member of order B, of which two varieties were noted, the one with the gland, although a larger animal, has an upper limb with the muscles markedly tendinous in character in contrast with the relative muscularity of the non-thymic variety, the circumference of whose arm, according to dissected specimens in my possession, may be nearly three times greater. This latter variety, I may mention, shows definite changes in the ileo-cæcal region. Its cæcum is about a quarter the size of that in the former variety and in one specimen I have is approaching the appendicular type.

Therapeutic Significance of Thymus Gland.

I regard thymus gland as beneficial in the following:—

(1.) Acute Poliomyelitis.—It is indicated particularly in the early stage, and a child can take 15-20 grs. in 24 hours. Its use is of course accessory to the basic treatment, rest, i.e. the anatomical rest of muscle and a recognition that poliomyelitis represents not a paralysis, but a loss of part of muscular function; that the zero must be found; and that the muscle must be re-educated along the lines of the development of the acquisition of its muscular function; and, above all, that the rest be immediate.

(2) In spastic conditions of childhood, provided deformities, if present, are remedied, and sufficient intellect be present.

(3) In hereditary ataxia, where the ataxic signs develop in the male about the age of six before the ataxia becomes marked; and combined with rest. Its use would be indicated prophylactically, the idea being not that the ataxia is inherited, but some other factor, possibly defective thymic or parathyreoid secretion.

(4) On similar lines it may be of service in pseudo-hypertrophic paralysis and especially prophylactically; this disease being, as I have already pointed out,³ a generalised muscular affection and not confined to a group or groups of muscles.

In conclusion, I may mention that the specimens, both macroscopic and microscopic, together with numerous anatomical plates specially drawn by Mr. Victor Cobb, the well-known etcher, from the original dissections, are available to students of this subject at my private laboratory at St. Kilda. The microscopic sections in connection with this work have been prepared by Mr. W. Owen, of the Melbourne University, and to him and Mr. Cobb I offer my best thanks.

To Dr. Charles Mackay I am indebted for valuable help in the preparation of dissections.

3. Epidemic Poliomyelitis. Some Biological Studies. Aust. Med. Journal, Jan. 25th, 1913.