

far the largest proportion of cases of fever there treated are cases of typhus. Thus, of the 4,819 cases treated during 1848, 4,694 were cases of typhus; 101 cases of febricula; 3 of dothinerteritis, or typhoid; and 21 of intermittent fever; while of the 313 cases of fever treated in the Royal Free Hospital, during the three years here reported upon, 44 were cases of intermittent fever, a very large proportion were cases of typhoid, remittent or relapsing, or ephemeral fever, and but very few cases of true typhus occurred. At present, however, I am not able to give the proportions of these several forms of disease; though, should leisure permit, I shall hope to do so hereafter.

THE USE OF THE THYMUS GLAND:

AN ORIGINAL THEORY, WITH EXPLANATORY REMARKS.

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THEORY.

I. At the period of evolution of the human fœtus, the upper portion of the body is developed to a very considerably greater extent than the lower, as, during intra-uterine life, the former alone is required for the purposes of existence.

II. After birth, these *hypo*-developed portions of the frame (namely, lower extremities) take on a rapid genesis, to bring them to the comparative standard required for the fulfilment of their presently-to-be-allotted duties; this period of increase, during which they grow with greater rapidity than the rest of the body, extending over about the first two years of mundane life.

III. The source of production of added portions of the human frame, from its earliest intra-uterine cellular genesis, is corpuscular: a strong hypothesis hence arises, that the corpuscular portion of that fluid which supplies animal pabulum for conversion,—videlicet, the blood,—is the source of elaboration into new definite existence.

IV. The increase of the lower extremities, above referred to, goes on with greater rapidity than that of any other considerable portion of the body, in a state of health, at any one period of life; hence the amount of convertible matter required must be proportionally large, whereas no organ has yet been demonstrated as specially endowed with the power of supplying this large required amount of material. The thymus gland, I would suggest, is the organ destined for the supply of pabulum (namely, corpuscles), in order to compensate this large demand.

For the more systematic arrangement of the numerous considerations which the crude theory embraced in the foregoing paragraphs admits of, I will embody, under the following heads, those observations which appear more directly to bear upon, and elucidate, the view above proposed.

1. The structural anatomy of the thymus gland.
2. Its localisation.
3. Its contents and their destination.
4. Its comparative anatomy.
5. Its duration, growth, and wasting.

1 THE STRUCTURAL ANATOMY OF THE THYMUS GLAND has been very variously described by different authors; partly, perhaps, owing to the special views which each laboured to support, partly to the fragile and pulpy nature of the structure, and the arrangement of its parts in the human subject, often baffling the most careful dissectors. Most, however, of the opinions held by more modern observers, would seem to be embodied in the statement, that it is intrinsically constituted of a highly organised germinal tissue, exceedingly vascular, and furnished with a most complete capillary network (Simon), with cerebro-spinal and sympathetic nervous plexus (Pappenheim), and with numerous lymphatics, which communicate "*partim cum mammariis, partim cum iis qui ex pulmone proveniunt*" (Mascagni); these, however, Sir A. Cooper definitely states to terminate, in the calf, in absorbents which form two large lymphatic vessels on the spinal surface of the gland, and which empty themselves into the jugular vein on either side.

This germinal tissue is arranged in lobes divisible into lobules and vesicles, united, and, as it were, strung together by a delicate ligamentous areolar tissue; these communicating each with a common central reservoir, and the larger lobules having a further intercommunication. Such is the mode of its disposal, as related by Sir A. Cooper: more recent anatomists, however, dissent from the statement, that a common reservoir of the size figured in his monograph, exists. In dissections of the gland, I have never been able to see it; the nearest approach to it I have witnessed being a receptacle apparently common to a projecting lobule of vesicles, which, however, could not be traced further than the base of such lobule. I will defer, for a little, any reference to the microscopical arrangement of the ultimate vesicles and their limitary membranes, until the localization of the thymus, and its bearing on the subject of the gland's special use, has been briefly considered.

2. THE LOCALISATION OF THE THYMUS GLAND. The thymus gland obtains, during foetal life, a position which affords it protection from almost every conceivable interference with its development, or the due performance of its function: protected in front by the sternum and clavicle,—the sternal end of which (namely, that which lies over the entrance of vessels, etc., into the gland) has a centre of ossific deposit before any other bone,—and guarded behind by the dense fascia so ably described by Sir A. Cooper, it is, on either side, and below, in such intimate relation with the heart, large vessels, and respiratory apparatus, that any displacement or injury of its substance would, inevitably, by implicating them, interfere seriously with the frail tenure of infantile life.

Here, then, would seem the most fitting place for any suggestions explanatory of the reason why such a site is occupied by the thymus. In offering them, I must somewhat anticipate the next heading of my subject, by referring cursorily to the destination of the products of its vitality. I have above stated my belief that these, when mixed up

with the general circulating fluid, are destined for supplying the diminution which the large amount of pabulum, subtracted by the rapidly increasing lower extremities, gives rise to. Such an hypothesis being admitted, the question naturally arises, why is the organ not situated near the parts for whose nutrition it is destined? In response to such a query, I would argue that, as the mass of blood has its vitality diminished, so to the mass of blood must the compensating power be applied. And where could this be so directly effected as in the locality where the gland is situate? Its contents becoming mixed up with the general circulation, at nearly the same spot which, in after life, receives the educts of digestion, and being in a similar manner churned up, as it were, with the blood in the right cavity of the heart.

Moreover, the situation of the thymus, immediately between the two pleuræ, must in some measure bring it within the mechanical agency of the lungs expanded by inspiration, especially at the first full gasp of the new-born child. This is rendered probable by the large size of the gland in the full-grown foetus before respiration has occurred,—as shown by the following comparisons, calculated from the tables of Hangsted:—

	Age.	Weight.	Weight of thymus.	Relative proportion to body.
Fœtus....	7 months	3½lbs.	33 grains	As 1 to 727½
"	9 "	9 "	240 "	" " 288
Child	4 weeks	6 "	120 "	" " 384

3. OF THE CONTENTS OF THE THYMUS, AND THEIR DESTINATION.

On the outer surface of the germinal membrane, of which the gland is essentially composed, lie the capillary vessels; from the inner surface are secreted the contents of its cavity. In the knowledge of this fact is embodied a great step onwards in physiology, for of such arrangement is the structure of all secreting organs composed, each after its kind. The wall of the liver cell, and the limitary membrane of the thymus gland, are, I take it, but modifications of the same thing, the screen, as it were, on whose surface, and through whose medium, the effects of the phantasmagoria of nutrition are produced; we can move the lantern, we can trim the lamp, but of the power that shifts the slides and modifies the image thrown upon and through the screen, we know nought further than that the secreted products are individualised each by its special characters, this seeming to be effected by an inherent metabolic power in the new-formed cell germ, distinct from that of mere reproduction, *ad infinitum*, of its own physical image. But, of the "primum mobile", by whose influence such changes are wrought, nothing definite is known; the only suggestion which has yet been ventured on, of the agency by which they are brought about, being their reference to that physiological myth "vital affinity"; one of those "provisional hypotheses for which the occasion will cease as science advances" (Graham). Thus the heart of the embryo, whilst yet a mass of cells, connected by amorphous tissue matter, is seen to pulsate; yet no one can imagine that the power which regulates its movement is not identical with that which animates its structure when fully elaborated.

The secreting structure of the thymus gland is composed of an infinitely minute membrane, forming the periphery of numerous vesicles, and the proper seat of secretion of their contents. The mode of

its arrangement for this purpose, seems to me similar to that which obtains, in the ordinary salivary glands; the membrane dipping down between the ultimate vesicles, and the loops thus formed being, in all probability, (although I have not seen such arrangement,) occupied by the minute ramifications of the vessels from which secretion is effected. I have been led to the belief that such is the mode of arrangement, from observing that, in a thin slice of the gland's substance, after maceration for some days, a "smoothing out", as it were, of the originally well-defined polygonal vesicles is noticeable, their dark and well-defined outlines gradually fining off into a continuous and smooth membrane of excessively delicate texture.

With a glass of high power there may be seen spread over the inner surface of the limitary membrane of each vesicle a vast number of round or polygonal bodies; these I believe to be the earliest form of the cells found to exist in the fluid contained in the thymus, thrown off in a manner analogous to that in which other secretions, as epithelium, are produced—the occasional absence of these sometimes noticed at a part of the surface of the membrane, and its consequently bright appearance at the denuded spot, favouring this opinion.

The amount of the contents of the thymus varies greatly, according to the state of the systemic nutrition, and hence the small quantity found on *post mortem* examinations of the gland in the infant. They consist of an "opaque creamy fluid", exuding when the cut surface of the gland is compressed, and seen on the edge of a section of its substance. This fluid is a protein compound; its small quantity, however, renders minute chemical analysis difficult: in cases where it has been undertaken, the glandular substance and contents were examined *en masse*.

On microscopic examination of this fluid, corpuscles, with a granular aspect, varying in size from $\frac{1}{2500}$ to $\frac{1}{5000}$ of an inch, are visible, on which depends the milky appearance of the fluid; these greatly resemble, and, in fact, are stated by Mr. Gulliver to be identical with, the globules of the lymphatic glands in structure, magnitude, and chemical properties, differing, however, slightly, in being of somewhat smaller size; and in them I have in many cases noticed the nuclei, rendered visible by acetic acid, to be situate very near the periphery of the cell. In conformity with these facts, the contents of the thymus may be defined as consisting essentially of

a. Highly developed cells, fitted in every respect for elaboration into the true coloured corpuscles of the blood.

The tracing of the limitary membrane is so far unsatisfactory, that at no point can any mode of egress for its contents be demonstrated to exist: it may be defined as being

β. A cell-secreting membrane, which is peripheral to one or more closed sacs, into which its products are poured.

On these two definitions (*a* and *β*) two adverse opinions are evidently based of the mode in which the products formed in the gland are borne into the general circulation. On the one hand, the high organisation of its corpuscular contents would seem to indicate that such development was not needlessly undertaken, and that their destination was of more extended range than the mere breaking of them up as soon as fully elaborated, which, in the other view, is the change occurring;

this latter opinion being based on the absence of all traces of any proper excretory duct.

Whichever be the orthodox doctrine, it does not at all bear upon the theory advanced, that the products of the secretion of the gland serve a special purpose in nutrition; and, as the opinion I have been led to entertain on this point requires observation, (which it is at present out of my power to undertake), I will at once suppose the contents of the gland passed on into the general circulation. In the fœtus, the blood from which they are received having been previously purified in the placenta, they are at once fitted for their purpose, which, at that period of existence, is most probably (in obedience to the laws of development) similar to that fulfilled by them in the lower animals, and which will be hereafter commented on; when, on the other hand, respiration has been established, these products are submitted to the agency of the lungs, in the manner and for the purpose before mentioned.

It would appear, from the researches of Mr. Hutchinson, that the thymus is not the only organ whose use and adaptation may be supposed to be modified according to the usage of development of the lower extremities; for we learn from his observations that the vital capacity of the lungs is proportioned in a remarkable degree, not to the development of the respiratory apparatus itself, or other contained organ of the body, but to the height of the frame, which height is chiefly, if not entirely, regulated by the length of the lower limbs. Nor does it seem at all an unwarrantable speculation that some relation may exist in the thorax between the lungs and the thymus gland; far different, however, from the view entertained by Putens, Meckel, Arnold, and others, that the latter organ was vicarious to the former. The observations of Hangsted and Becker prove that the greatest activity of the gland is *not* during the period of quiescence of the lungs; and hence we may suppose, in accordance with the theory I have before stated, that the rapid growth of the lower extremities exhausting the nutrient material of the blood, an increased secretion from the thymus is determined, the vivifying agency of the lungs to mould this secretion to a condition fitted for nutrition is more energetically called into action, and action, we know, determines growth.

4. THE COMPARATIVE ANATOMY OF THE THYMUS. The condition of the gland and its relative anatomy in various animals has been made the subject of research by Tiedemann, Meckel, Hangsted, and of special inquiry by Simon. To trace the different and often conflicting opinions by them expressed, would far exceed the limits of this paper. As far as relates, however, to the view which it is my purpose to support, a statement of some few of the results of their observations seems necessary; and to one apparently palpable objection to my theory, which must occur when considering the condition of the thymus in the lower animals, I will at once allude—namely, that, although in them it has a mode of development, and occupies a site similar to that which it obtains in man, yet the ratio between the growth of the extremities and that of the body is very dissimilar. In many animals, however, particularly those which more nearly approach to man, this objection will hardly apply; for we see that a disparity in the rise of the extremities of the offspring does in them

exist for some time after birth, and is, moreover, exceedingly well marked: the slender limbs of the colt, calf, etc., require but mentioning to illustrate this. In these we find the thymus is exceedingly well developed, and how far the increase of the extremities may be influenced by or influence the organ, can be conjectured from the statement of Wharton, who noticed, that if a young ox be yoked to the plough, its thymus rapidly diminishes, and disappears in one, instead of persisting five, years. Again, it has been observed by Mr. Gulliver, that in *over-driven* lambs the thymus will shrink and become nearly drained of its contents, distending again with rest and nourishment; and, not to multiply examples, it may be generally stated that in animals, in whom free use of the limbs is early necessitated, the gland disappears soonest. Thus, in the genus *felis*, perhaps the most active of mammalia, and that in which activity is earliest called into play, the thymus disappears at a very early age, and in the wild (as *f. leo* and *leopardus*) much sooner than in the tame species. The influence of muscular action in determining growth, I need hardly say, would fully explain the wherefore of these changes, and the early disappearance of thymus would seem to as plainly indicate that from it are derived the means of such increase.

The consideration of these facts meets half-way the explanation I propose with regard to the general comparative anatomy of the thymus; it is but to apply in this case as in others the allegory, that all existing beings form the links of a chain, whose last and highest is man. Thus, if the power assigned to the gland, as a nutriment secreting organ, be allowed, it may be well imagined that its products, in the lower class of animals, in which it has been found to exist, serve to feed, as it were, the system at large: ascending in the scale, they become subservient to a purpose, specially foreshadowing their use in man, presiding over the growth of the limbs; and, lastly, in man himself, their use is seen still more limited, serving a similar purpose, it is true, but with regard to only the *lower* extremities.

The thymus gland is found only in those animals which breathe by lungs: an explanation of this may possibly be, that its products require to be submitted to the operation of the pulmonary capillaries, that certain changes may be there effected in them (similar to those which the products of digestion ordinarily undergo) before they are fitted to enter the circulation and minister to actual *growth*.

The existence of the gland is but temporary, like that of man, in all animals, with the exception of those which hybernate; its constant presence in the adults of the latter class, and its increase during the time of winter torpor, has been pointed out by Tiedemann, as also its distension at that period with a "chylous fluid", and its subsequent gradual diminution in size, the period of hybernation being past. This fact seems to support the view I have taken: in the body of an animal, in its winter sleep, absorption continuing unimpaired, oxygenation of the blood and nutrition are reduced to a minimum; hence, when spring reinvigorates and calls its energies again into play, a new birth, as it were, takes place, and a cell-formation is determined as active as that in the new-born infant, the thymus gland being endued, *de novo*, with corresponding activity.

5. THE DURATION, GROWTH, AND WASTING OF THE THYMUS

The existence of an organ, when considering the purposes it is destined to serve, dates only up to that period at which its fitness for the fulfilment of such special function ceases; hence, it may be stated, that the persistence of the thymus gland continues only till about the second year of mundane life, to an age at which the child begins to move actively alone, to walk and run unassisted. The traces of its existence which remain in after life, vary greatly in amount in different individuals, but apparently fulfil no purpose in the economy, and may be considered as continuing only in obedience to a seemingly universal law, which rules that a body, once produced and organised, shall never again be entirely removed. The date of the origin of the thymus is somewhat more obscure. Adopting the view of Mr. Goodsir, that it is essentially a highly developed remnant of the blasto-dermic membrane, it would, of course, be impossible to assign a definite period to the commencement of its growth, unless, indeed, the first existence of the membrane itself in the ovum were considered as such. The first visible sign of the gland's definite presence in the human foetus, is stated by embryologists to occur about the ninth week. At this period, it consists of a simple tube, or "tubulo-vesicular" structure, from which, as growth advances, follicles bud out and gradually develope to form lobes, the walls of which again seem to be pitted into a vast number of ultimate secreting vesicles, as previously described; thus, the general mode of increase of the gland, in its earlier stages, bears a strong resemblance to that of the salivary and other glands.

The growth of the thymus is not uniform, being greatly accelerated towards the termination of intra-uterine existence, and still more during the early life of the infant.

Of the minute changes occurring in the substance of the gland during the period of its wasting, I find but little notice. In those cases which I have myself examined, a perceptible fading of the strong outlines of the ultimate vesicles, and a greater readiness in the "smoothing out", previously noticed, was discernible.

In the life of a human being we can trace a succession of organs, which seem, like the thymus gland, destined to fulfil a temporary function. Thus we may enumerate the vitelline sac, umbilical vesicle, Wolffian bodies, special foetal vessels, and numerous other instances in the embryo, as illustrating this: and in after life, the thymus, the teeth, the hair, and the testicles.

In the circulating system, also, we find many instances of a power adapting it to receive, when needful, increments of normal or abnormal constitution for a varying period, similar to that above imputed to it, in regard to the contents of the thymus gland, the capability being diminished or lost after the fulfilment of such temporary requirement: as instances, the lacteal secretion, the reparation of injuries, the occurrence of the exanthemata, etc., may be adduced.

The purpose served by the thymus gland, according to the foregoing theory, tends to illustrate a physiological circumstance of great interest, slightly adverted to in a previous page, namely,—the progressive perfectionation of the framework of man in obedience to an all-pervading law. A cell or two grows by vital power alone: no heart, no

lungs exist, to replenish or purify, by their mechanism, the stream of life. In beautifully arranged order each part of the body is progressively perfected; the Great Designer "sees that it is good", and finally the last prop is taken away, and the fabric stands completed.

CASE OF INFANTILE PHLEBITIS, WITH PURULENT DEPOSITS, ERYSIPELAS, AND JAUNDICE, ARISING FROM INFLAMMATION OF THE UMBILICAL VEIN.

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HISTORY. Mrs. Jotcham was confined by me on the 24th of February, 1862, with her first child, a fine, healthy male. The labour was comparatively an easy one; everything proceeded perfectly satisfactorily until the sixth day after delivery. A slight hæmorrhage took place from the umbilicus at the period of the separation of the shrivelled remains of the funis, but this would not have been considered worthy of remark, had not other important symptoms subsequently developed themselves.

March 3rd. Some signs of uneasiness; griping and gastric disturbance appeared: the evacuations were scanty and unnatural, consisting chiefly of curdled milk. Vomiting was also present. Castor oil was ordered.

4th. The child improved under the treatment.

6th. As the above-named symptoms reappeared, the oil was again ordered; and as constipation existed, a larger dose was used and again repeated. A carminative was also prescribed, to expel flatulence from the stomach.

7th. The evacuations very scanty, deficient in bile, and chiefly consisted of curdled milk. The two doses of oil had only produced one movement. I ordered one grain of calomel and four of rhubarb; and directed them to be repeated in the morning, if necessary.

8th. Both powders were given, and some evacuations, having a more healthy appearance, resulted. The infant was considerably better. There were occasional spasmodic pains, accompanied by retraction of the limbs: slight shivering and moaning also occurred occasionally. The child was far from easy, but I did not see much to excite alarm.

10th. The nurse called on me to say that the child had become much worse, and "that it appeared swollen all over." Upon visiting it, I found that erysipelas had developed itself upon the index finger of the right hand, and also in the corresponding finger on the opposite side. A slight blush of erysipelas also appeared upon the second toe of the right foot: the knee was tumid, tender, and hot, but not erysipelatic. The little infant appeared to be in considerable pain; was almost constantly crying or moaning; vomiting often, with frequent hiccough: it was feverish, refused the breast, and scarcely slept at all.