

## “STATUS THYMICO-LYMPHATICUS” CONSIDERED IN THE LIGHT OF RECENT WORK ON THE THYMUS.

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### I. INTRODUCTION.

IN the year 1911 the heading “Status Lymphaticus” was first used in the publications of the Registrar-General of England and Wales and, in that year, 121 deaths were assigned primarily to this heading; Status Lymphaticus was also mentioned in the certificates relating to 25 of the deaths which occurred under anaesthesia. The heading was retained in the published tabulations as first introduced until 1921, when certifications of Status Lymphaticus were classified under the heading of “Diseases of the Thymus,” of which statistical group they have, so far, formed the whole. Between 1911 and 1924 (inclusive) the annual deaths—inclusive of those associated with anaesthesia—have fluctuated between 145 and 273. In the last four years there has been little variation, 209 in 1921, 204 in 1922, 200 in 1923 and 199 in 1924. Most of the deaths are in the age group 0–5 and a considerable majority are of males. Thus in the last two available years, 1923 and 1924, of 399 deaths 289 were at ages 0–5 and 258 were of males (respectively 72 and 65 per cent.). If the 85 deaths in which anaesthesia was an associated condition are excluded, 81 per cent. are of children aged 0–5 and 64 per cent. of males (Table I).

The action of the Registrar-General first in admitting the diagnosis of Status Lymphaticus to separate tabulation and later in assigning deaths so certified to the group of Diseases of the Thymus is in conformity with current medical opinion. That there is a morbid state sufficiently well defined to deserve a separate name or group of names, Status Lymphaticus, Status Thymico-Lymphaticus or Status Thymicus, and that a very important element in the diagnosis of such a condition is an abnormality of the thymus, are propositions laid down in most of the text-books of medicine read by the English students who will become certifying practitioners. Of the criteria of Status Lymphaticus or Thymicus other than enlargement of the thymus, we shall speak later; that enlargement of the thymus is the one diagnostic sign to which medical practitioners have attached most importance is not likely to be disputed. For instance, taking inquests reported in the first six months of 1924, we have the following record. At an inquest reported in the *Birmingham Post* of March 18th (the subject of the inquiry was the death of a woman aged 29) the medical witness testified that Status Lymphaticus was due to enlargement of the thymus and could not be diagnosed during life. Similar evidence was tendered at an inquest (concerned with the death of a woman

Table I. *Deaths from Status Lymphaticus in England and Wales and deaths under anaesthetics in which Status Lymphaticus was noted. (These are not included in all deaths from Status Lymphaticus.)*

	Ages	1911		1912		1913		1914		1915		1916		1917	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Deaths	0-	51	46	76	50	70	62	104	73	91	57	91	67	59	55
"	under anaesthetic	1	4	4	1	7	2	9	1	4	3	6	.	9	2
"	5-	2	5	9	4	12	5	19	9	13	8	15	9	5	9
"	under anaesthetic	4	1	6	2	2	2	2	3	3	1	6	2	2	1
"	10-	5 (110)	1	5 (146)	2	18 (168)	1	10 (221)	6	9 (183)	5	4 (191)	5	3 (134)	3
"	under anaesthetic	3	2	2	3	3	1	6	3	2	.	5	3	1	.
"	15-	3	1	3	2	1	2	4	4	2	5	1	.	2	3
"	under anaesthetic	3	1	3	1	4	1	3	3	4	.	1	2	2	.
"	20-	1	2	1	.	2	3	1	2	1	2	.	.	.	.
"	under anaesthetic	3	2	.	.	.	1	1	1	1	1	2	1	2	2
"	25 and up	3	1	2	1	1	3	5	1	4	2	5	1	.	5
"	under anaesthetic	1	.	3	4	3	1	2	1	3	1	2	1	1	2
"	all ages	65*	56	96	59	104	76	143	95	120	79	116	82	69	77
"	under anaesthetic	15	10	18	11	19	8	23	12	17	6	22	9	17	5
		(145)		(184)		(207)		(273)		(222)		(229)		(168)	

  

	Ages	1918		1919		1920		1921		1922		1923		1924	
		Male	Female												
Deaths	0-	54	41	55	34	71	45	89	47	82	47	88	40	78	48
"	under anaesthetic	5	2	10	3	15	6	10	5	6	3	12	3	14	6
"	5-	7	5	5	2	4	8	6	11	6	7	7	3	9	1
"	under anaesthetic	1	4	3	3	1	2	3	2	5	1	4	5	7	1
"	10-	7 (120)	6	3 (101)	2	5 (136)	3	3 (160)	4	5 (154)	7	4 (147)	5	3 (142)	3
"	under anaesthetic	3	1	2	2	4	2	4	1	.	3	7	3	1	1
"	15-	2	2	2	1	3	.	3	2	6	3	.	2	1	1
"	under anaesthetic	.	.	2	2	.	1	1	1	.	1	1	.	3	2
"	20-	.	2	1	2	1	.	3	1	2	2	3	.	3	1
"	under anaesthetic	1	.	2	1	2	.	3	1	1	2	3	1	1	2
"	25 and up	3	3	2	1	1	2	2	4	5	4	4	2	1	7
"	under anaesthetic	5	1	5	1	2	2	2	1	1	5	2	1	2	3
"	all ages	73	59	68	42	85	58	106	69	106	70	106	52	95	61
"	under anaesthetic	15	8	24	12	24	13	23	11	13	15	29	13	28	15
		(155)		(146)		(180)		(209)		(204)		(200)		(199)	

\* One death under anaesthetic included in deaths from Status Lymphaticus.

aged 22) reported in the *Yorkshire Post* of January 22nd, 1924, and at an inquest into the death of a boy aged 5 reported in the *Newcastle Daily Chronicle* of May 27th, 1924. We may, we think, affirm that so far as a large majority of the certified cases of Status Lymphaticus ending in death are concerned, much importance has been assigned to the supposed abnormality of the thymus which has usually been thought to be unduly large. Therefore a first step in the investigation of the concept Status Lymphaticus must be a study of the thymus under various conditions. Until one knows, for instance, what the average normal weight of the thymus really is and how variable that weight is amongst persons of the same age under similar conditions, and again what may be the effect of other factors, such as the general nutrition of the body, the length of illness leading up to death or the environmental conditions preceding a sudden death, it clearly cannot be sensible to assert in such or such a particular case that the weight of the thymus is abnormal.

## II. PROFESSOR J. A. HAMMAR ON THE THYMUS.

For some time past we have, when time served, been working on one of these questions, viz. the relation of thymus weight to body weight, stature, age and weights of other viscera.

In the course of this biometric study other questions emerged upon which Prof. H. M. Turnbull, to whose kindness we owe the use of the data subjected to statistical analysis, is carrying out further investigations. Prof. Turnbull and one of us hope, at no distant date, to publish a joint memoir on the results of this inquiry. In the meantime, however, the appearance of the first volume<sup>1</sup> of Prof. J. A. Hammar's work, the fruit of more than 20 years' study, authorises a critical examination of a curious phase of modern medical teaching.

At the outset, mention should be made of the characteristic feature of Hammar's investigations. His aim has been to provide a *complete* specification of the characters of each organ examined by him. He has not been content with a record of the gross weight and form of a thymus, not even with the figuring of a typical microphotograph. He has attempted to measure (1) the proportion of parenchymatous substance to total weight, (2) the ratio of cortical to medullary substance, (3) the frequency distribution, classified by diametral measure, of Hassall's bodies in the whole organ and per milligramme of parenchymatous and of medullary substance. To this end exact measurements of sample sections, using either a gravimetric or a planimetric method, have been employed. The fundamental idea is simple enough. If one determines, in a sample of sections of known thickness, the respective limits of cortex and medulla, it is possible to estimate the total weight of cortex (or medulla) in the whole organ. One might, for instance, actually trace the areas on the plane of the section with a planimeter, or one might make the drawing on paper, cut out the parts as in a dress pattern, and by weighing the parts determine the ratios. The enumeration by such methods of the numbers of Hassall's corpuscles, involves special difficulties. One has given a semi-solid substance embedded in which are irregular or ellipsoidal bodies. A plane section of the matrix parallel to some axis of reference will present contours of such bodies as are intersected by the plane. From a knowledge of the frequency and dimensions of the contours we seek to infer the frequency and dimensions of the ellipsoidal bodies in the containing substance. A solution of this problem, which is simple enough when the bodies are assumed to be spheres, has been obtained by Wicksell (Wicksell 1925 and 1926). Hammar has used an empirical method, *i.e.* he has worked out what corrections of the section count must be made in order to agree with a complete enumeration performed by means of an examination of a complete series of sections of a

<sup>1</sup> *Die Menschenthymus in Gesundheit und Krankheit; Ergebnisse der numerischen Analyse von mehr als Tausend menschlichen Thymusdrüsen.* Teil I: *das Normale Organ—zugleich eine kritische Beleuchtung der Lehre des "Status Thymicus."* Von J. Aug. Hammar. Leipzig, 1926, pp. 570 (with 352 illustrations and 64 tables) Akademische Verlagsgesellschaft (price 81 Marks).

piece of thymus. In his opinion, this empirical formula is adequate. (See also Santesson and Wålinder, 1925.) One has then, in Hammar's book, an exhaustive description of the thymus in 337 cases, 199 concerned with post-foetal life. For the foetal series material was only used where it appeared that no disease was present, either in mother or foetus, which could reasonably be supposed to affect the size or structure of the thymus. For the post-foetal data a still more stringent criterion was adopted and a very large majority of the protocols relate to apparently healthy persons who died violent deaths. In respect of each case information is given of which the following is a typical example (summarised). No. 1748. A boy of 5½ years, killed by fall from the sixth story of a building, ruptured right lung. Pale, well-nourished boy of normal development; all internal organs without pathological changes. Weight of thymus (after fixation in formalin) 28·8 gm. Parenchyma 24·83 gm. Cortex 17·14 gm. Medulla 7·69 gm. Connective tissue 3·97 gm. Ratio of cortex to medulla (index) 2·2. There follows a frequency distribution of the Hassall bodies in five classes and the numbers of bodies decalcified after partial or complete calcification. These frequencies are also expressed per mg. of parenchyma and of cortex. The protocol ends with a histological description and is illustrated by a microphotograph. Protocols such as this occupy more than 300 pages of the work and the principal results are summarised in a long series of tables. So much information respecting the characters of the thymi of healthy persons has never before been assembled. Some may regret that the author has not given any other biometric constants of the subjects (*e.g.* body weight, stature, weight of other viscera) in the protocols and we do not consider that Prof. Hammar is quite happy in his attempt to distinguish between the statistical and what he terms the numerical method. He seems to believe that the statistician is completely obsessed by the idea of computing means. In truth a mean is only *one* of the instruments employed in seeking to do what Prof. Hammar seeks to do, *viz.* to summarise the salient features of an assemblage which is too numerous for one to be able to hold before the mind's eye at once all the peculiarities of individuals. Prof. Hammar has found it necessary to retain so many typical classes that, as a means of summarisation, his own statistical method is not, we think, very successful.

Such criticisms, however, which a worker in one special field is always apt to pass upon the labours of a specialist in another field, detract little from the value of the achievement. Hammar's book makes an epoch in the history of researches upon the thymus and of morbid states in which the thymus is supposed to be involved; it can be made the subject of many statistical analyses.

We propose now, before noticing the special relevance of the new material to the subject of this paper, to describe briefly the history of the doctrine of Status Lymphaticus. In doing so we base ourselves upon our own examination of the relevant literature interpreted in the light of Hammar's and our own work. In the list of references we include only such of the papers

as, having been read by one of us, we believe to be important. When the work of any author is mentioned *without* such citation it may be assumed that our knowledge of it is at second-hand and derived from Wiesel, Hart or Hammar, whose bibliographies are extensive.

### III. THE CONCEPT OF STATUS THYMICO-LYMPHATICUS.

Before 1890 the rôle of the thymus in clinical medicine and pathology was a modest one; it was generally believed that by directly pressing upon the trachea, the cervical nerves or the roots of the great vessels, the thymus might do harm. Such a case was described almost 100 years ago by Astley Cooper; a woman of 19 years had long had a swelling in the neck, the swelling increased acutely, dyspnoea ensued and death occurred within a few days. The autopsy revealed a thymus converted into a tumorous mass. Such cases were admittedly pathological curiosities. The largest thymus on record is probably that in H. D. Rolleston's case. The subject was a boy of 6 who died suddenly; thymus and trachea together weighed no less than 11 oz. Here part of the thymus structure was still histologically normal but the mass was chiefly composed of a small round-celled sarcoma.

Less rare than these, but still very uncommon, were deaths of young children in attacks of "Laryngismus," when the event was attributed again to pressure exerted by an abnormally large or unusually situated thymus and such cases were usually grouped under the title Thymic Asthma. One of the motives of the first good book on the thymus, that of Friedleben, was to scrutinise the basis of this attribution and Friedleben himself concluded there was no such thing as Thymic Asthma and doubted whether an enlarged thymus *could* mechanically cause death. In spite of Friedleben's unfavourable judgment, a judgment which deserved attention because it was really based upon careful study, thymic death as a mechanically induced phenomenon continued to be orthodox and alleged examples have continued to be reported down to our own time. But only within the last 40 years has the thymus been cast for a more sinister pathological rôle than that of a mere casual obstructor.

In 1889–90, A. Paltauf of Vienna published in two instalments a short paper which, in the strict sense of the words, was epoch-making. Paltauf, like Friedleben 31 years earlier, had been unconvinced by the evidence that mechanical pressure of the thymus could kill, and closely scrutinised the anatomical peculiarities of those cadavera wherein the immediate causes of death were, to ordinary inspection, insufficient—*e.g.* in the bodies of seemingly healthy men who died during or after a bath—seeking for some other common characteristic than the apparently inexplicable death. He concluded that a frequent characteristic was an enlarged thymus, and that, he suggested, was *one* indication of a general faulty habit of body; other indications were over-development of the lymphatic system and a narrowing of the aorta. The general habit of body of which these were the stigmata was, he inferred, such that stimuli ignored or favourably interpreted by the normally constituted

microcosm were unfavourably interpreted even to the point of death. One had, in fact, an *Entartung* in Nordau's sense.

From this modest essay has sprung a remarkable crop of "literature." Of the 820 papers cited in the late Carl Hart's monograph (1923) on *Status Thymico-Lymphaticus*, only one had been published before 1889.

The immense effect of Paltauf's work was due to many motives. In the first place we have the influence upon the collective medical mind of an aetiological doctrine never formally repudiated but become obsolete—especially in Germany and England—which had once dominated medical thought; the doctrine of crases or, as usually latinised, temperaments. This doctrine is older than Hippocrates but its formally most logical enunciation and development are due to Galen. Galen's treatise *de Temperamentis* in the elegant Latin of Linacre has probably been more and more recently read than any other book by Galen—save the *Ars parva*—and is still worth reading. In it we find enunciated the doctrine that man's power of resistance to external noxious stimuli, to procatartec causes, depends upon the balance, or crasis, of four elementary principles, labelled Hot, Cold, Moist, Dry. Since Hot and Cold are opposites and Moist and Dry also opposites, this amounts to saying that if we take coordinates in a plane, a Hot-Cold axis intersecting a Moist-Dry axis, the point of intersection, the origin, being taken as the position of perfect equilibrium, that is to say, perfect crasis, then all possible human crases or temperaments are represented by points in the plane. Any point upon one of the axes represents a simple excess, any point not upon an axis a linked excess. Galen spoke of *nine* temperaments, viz. perfect harmony (the origin or point of intersection of coordinates), four simple excesses (points on the axes above or below or to right or left of the origin), four linked excesses (points within any of the four quadrants into which the axes divide the plane). His object was to teach how the various temperaments might be recognised clinically and to what illnesses each might predispose.

To the modern English or German physician Galen's treatment of both topics is antipathetic; its merit—a logical system of deduction from certain general principles—is, as M. Painlevé has recently said, not attractive to the empirical Englishman; its vices—of adapting facts or of ignoring facts to satisfy a theory—are a cardinal sin which the natural historian of disease who, in spite of tremendous failings, has been the creator of modern scientific medicine cannot forgive. Indeed the very merits of the exposition are obscured by the fact that few readers of Galen (certainly not the present writers) are sufficiently versed in Hellenistic philosophy resolutely to refrain from attaching to Galen's principles those naïf physical ideas which the formally equivalent English words, hot, cold, moist, dry, bring up (see Greenwood).

With the return to scientific empiricism, which was a late consequence of the revival of learning, and the triumphs of the 16th and 17th century anatomists and physiologists, the *a priori* logic of Galen fell into contempt and it was agreed that, even if there were a kernel of truth in the doctrine

of temperaments, Galen had wholly failed to establish any practically useful diagnostic criteria. At no time, of course, did the doctrine of temperaments pass wholly into oblivion. Sylvius for instance (Benedetti, p. 6) and the physicians of Montpellier attempted to provide more satisfactory criteria, but it is roughly true to say that by the first half of the 19th century the doctrine had ceased to be taken very seriously by a large majority of physicians. We had by then entered a materialistic age and acquired a habit of demanding something "on a plate," greatly encouraged thereto by the really very important objects that such men as Laennec, Louis and Rokitansky were actually able to hand round on plates. It was to be expected that only when the machinery of temperaments *could* be handed round on plates would temperaments again be taken seriously. This actually happened. Rokitansky and Virchow concluded that certain temperaments<sup>1</sup>, viz. the lymphatic and chlorotic, did have a perfectly definite anatomical basis (Hart, p. 41). It thus appeared that there was after all nothing really irreconcilable between modern empiricism and the old doctrine; that the *a priori* attractive idea that as in intelligence, beauty and wealth all men are obviously not born equal, so they are not all equally liable to fall sick, had, or might have, a material explanation which could be put upon a plate or preserved in a bottle of spirits. Consequently the scientific world was not unfavourably disposed to Paltauf's doctrine.

It may be that another motive also had, and has, more influence than we should like to admit.

It is never pleasant to have to confess one is wholly ignorant of something, to be obliged to admit one does not know why such or such a person died when he did or what it was that killed him. If we could "explain" by a doctrine of temperaments made verbally orthodox the sudden deaths for no sufficient reason which are within the experience of all medical men in large practice, we should flatter our professional sense of self-esteem. To the arm-chair philosopher this may appear a small or unworthy motive but to nobody else. If the public will demand infallibility in its medical advisers, particularly in its medico-legal experts, and will assume ignorance and incompetence to be synonyms, a medico-legal expert would be inhuman unless:

illud  
quod mecum ignorat solus vult scire videri.

An apparently robust lad of 12 has enlarged tonsils; the family physician advises their removal. Under the anaesthetic, breathing stops and the child dies. A master boxes the ears of an idle apprentice who dies within ten minutes. In both cases suppose it can be shown, on a plate or a scale pan,

<sup>1</sup> In modern papers, the word *status* is invariably used, e.g. Status Thymicus, Status Lymphaticus, etc. The choice is not, from an historical point of view, happy, because in Latin translations of the Greek writers *status* is mostly used as the equivalent of the Greek *katastasis*, and *temperamentum* as the equivalent of *crasis*. The idea is virtually that of *crasis* and it would have been better to retain *temperamentum*, but *status* in the sense of *temperamentum* has obviously established itself now.

that there are stigmata of an abnormality not revealed in life by anything but the fact of low resisting power to stimuli usually harmless or even salutary, surely something has been gained; a suggestion of incompetence is rebutted and a crime becomes a misfortune. These various motives provided the foundation upon which the modern doctrine of Status Thymico-Lymphaticus has been built.

“The doctrine of Status Thymico-Lymphaticus,” wrote Hart in 1923, “has shared the fate of so many other doctrines. Only reluctantly adopted at first by medical men, it has become more and more the prey of uncritical application and exaggeration and at last a great receptacle for everything (zu einem grossen Sammelbecken geworden) into which every conceivable morphological and functional appearance is thrust, so practically the whole field of pathology is covered by the Status Thymico-Lymphaticus. It is, to use an expression of Pfaundler’s, denatured into a ‘pandiatheosis’” (Hart, p. 1).

All medical men, and most other men, are familiar with the child which, at first sight, one might be tempted to call a fine child but qualifies the praise, adding “rather pasty perhaps.” A child well up to its weight for age, on the fat side, perhaps; inclined to be sluggish intellectually and physically. Suppose the experience of all men were pooled or better that one of Clerk Maxwell’s demons watched a large batch of such children from the cradle to the grave and reported as follows. They are, on the whole, dull children and they develop sexually rather late; they suffer much from scrofulous troubles, from “glands,” but do not often go under with a frank phthisis. In acute infections they are very bad patients and it is dangerous to subject them to even trifling surgical operations. When they do grow up, they are still subject to various minor ailments and to graver disorders, especially “nerves,” and liable to die when subjected to psychological or physiological shocks—for one of them to be surprised in illicit but practical love-making is very dangerous (for the lover), to plunge into cold water on a hot day not much safer. Such is the general symptomatology. One has the impression of a variety of mankind sluggish in development and abnormally feeble in resistance to the ordinary chances of life. Thus far we have nothing very strange, nothing but what a not very imaginative man might have deduced *a priori*, for all we have said is that children who do not develop normally in time and degree are not good average specimens and will probably, on the average, fail where the ordinary man succeeds, a proposition which those who still believe in adaptation and selection will surely regard as a truism. As a practical contribution to medical knowledge, it is nothing; it is subject to the usual objection that the only test of survival value is survival. Clinical *intra vitam* signs of the type are few.

Many authors have attached importance to the blood picture, to the presence of a lymphocytosis, but the value of this from the diagnostic point of view is not great because a frequency of lymphocytes far beyond the textbook “normal” can and does occur in so many physiological and pathological conditions. Here is an abridged list of the conditions in which reputable

authors have found and attached importance to a lymphocytosis; diabetes, effect of castration (in women), constitutional achylia gastrica, chronic diseases of stomach and intestine, chronic polyarthritis, tuberculosis, dementia praecox, functional diseases of the nervous system, Graves' disease. It does not appear that we have *any intra vitam* means of diagnosing the Status Thymico-Lymphaticus. Indeed, to quote Hart, "So careful an observer as Kolisko has expressed the opinion that the existence of a Status Thymico-Lymphaticus cannot ever be established before the sixth year of life. But one may go further and assert that in children down to puberty there are the greatest difficulties in the way of recognising with certainty the existence of this pathological type of constitution and that if searching criticism in Lubarsch's sense is applied very few cases indeed remain where with a really abnormally large thymus there was perhaps some primary individual peculiarity of the constitution" (Hart, p. 30). This passage includes a stigma, the enlarged thymus, usually—not of course always—inaccessible to *intra vitam* methods of diagnosis. It seems, in spite of the optimism of some compilers of text-books, that down to puberty the Status Thymico-Lymphaticus cannot be diagnosed in life. In Italy a fresh impulse has been given to the anatomical differentiation of constitutional types by de Giovanni and Viola. Viola, basing himself upon observations in the clinic of Padua University, claims that there are two fundamental types of maldevelopment, the apoplectic habitus (megalo-splancnia) and the phthisical habitus (microsplancnia), the former characterised by a high and the latter by a low ratio of mass to surface; the former are metabolically torpid, the latter metabolically active. Around these fundamental types cluster subvarieties. It is possible that work on these lines might result in the *statistical* definition of the constitutional subtype we are considering in a way which would have some *intra vitam* diagnostic use (see Boldrini, p. 10). So far as we know, but little work of this kind having particular reference to the Status Thymico-Lymphaticus has yet been published.

If, then, this type cannot be diagnosed in life, can we after death but *without reference to the cause of death*, certainly recognise its presence from anatomical stigmata? This is much the most important part of our present examination. It is not sufficient to show that such or such abnormalities of structure are to be found post mortem even frequently, unless we can show that they are more frequently found amongst the particular cases of death otherwise inexplicable than in the general population, *not* merely the hospital dead-house population. This distinction was fully grasped by Paltauf and brought out in his original communication.

Broadly speaking we may say that the following stigmata, and in the order of importance set out, have been assigned diagnostic value by competent observers.

1. Hypertrophy of the thymus.
2. General hyperplasia of the lymphatic system.
3. Atresia aortae and endocardial signs of degeneration.

4. Sexual neutrality; external sexual characters of a male subject tending to the usual female type and conversely.

Reserving for closer examination the first criterion, we may review the others.

So far as the second criterion is concerned, experience gained particularly by German pathologists during the war has demonstrated that very incorrect ideas as to the "normal" amount of lymphatic tissues in healthy persons had been formed from hospital autopsy material.

The third item is of much historical interest because of Virchow's claim that atresia of the aorta was a stigma of the chlorotic constitution.

Hart devoted particular attention to this point and, in his opinion, modern work has fully refuted Virchow's contention. The investigations of Luise Kaufmann and of Jaffé and Sternberg have made it appear that the calibre of the aorta is highly variable in healthy persons while "in 30 cases of accentuated Status Thymico-Lymphaticus (mostly suicides) the average circumference of the aorta ascendens was slightly less than the general average, namely 6.3 cm., so that here there could be no question of aorta angusta" (Hart, p. 43). The critical value of endocardial thickening is subject to the same or similar objections.

Lastly we come to the sexual characters, a point much emphasised by a number of writers. Schridde, for instance, says that at the first glance at a body of a thymolymphatic one is struck by these things: normal or above normal stature associated with a short neck, a fine pale skin, no axillary hair and little or no beard; in men the arrangement of the pubic hair tends to the form normal in women (p. 1674). Criticism of these differentiae has taken the line not of denying the occurrence of "infantile" sex characters amongst thymolymphatics but of pointing out that they occur frequently enough without association with other features of the alleged constitution.

In the preceding paragraphs we have, of course, only referred to certain salient characteristics and anyone familiar with the literature may object that we have confused a number of distinct types or constitutions. Wiesel, for instance, differentiates a Status Thymicus from a Status Thymico-Lymphaticus, while the Status Hyperplasticus and the Status Exsudativus of Bartel and others cross and re-cross one another and the Status Thymico-Lymphaticus in a perplexing way. There is indeed no difficulty in making such sharp distinctions *on paper*. But only their inventors seem to rate them high.

It will be found that the most telling criticism of these stigmata is that they are to be found very often in the bodies of persons whose deaths need no constitutional explanation. It seems only common sense to say that if a so-called hypertrophy of the lymphatic system is just as frequently found in young soldiers killed during the war as in the bodies of those dying with less apparent provocation, that hypertrophy of the lymphatic system is of no diagnostic importance.

It is, however, easy to over-estimate the importance of such arguments;

they are essentially statistical arguments and, as usually happens, are either totally ignored or treated with exaggerated respect by the non-statistical. One sometimes forgets the cumulative importance of arguments each essentially weak. Let it be admitted that not a single one of these criteria is in itself of decisive or even great importance; their cumulative value *might* be overwhelming. Red hair is common enough, squinting is common enough, stammering is common enough, but the fortuitous concurrence in one person of red hair, stammering and squinting might, by the rule of independent probability, be quite uncommon. Now suppose we found that persons characterised by this rare combination of qualities were also marked in some other way; the significance of the association must be judged by a more refined analysis. It cannot be dismissed with the remark that the several characters are each common enough.

The crux is whether the *combination* of anatomical characters held to define Status Thymico-Lymphaticus is so much more frequent in the universe of discourse defined as "inexplicable deaths" than in the universe defined as "explicable deaths" that we may assert that the difference is not likely to be due to mere luck of sampling.

We seem first to require knowledge of the frequency of the anatomical combination in the universe "explicable deaths" and the results on samples of men killed in the war are widely discordant. Groll states that in an examination of 131 cadavera of soldiers where any factors calculated to modify the lymphatic system were excluded 56 per cent. presented the anatomical stigmata of Status Thymico-Lymphaticus or, when the investigation was limited to youths aged 19 to 20, no less than 85.7 per cent. (see Groll). Rössle seldom found Status Thymico-Lymphaticus and R. Benecke in only 15 per cent. Forni from records of 245 autopsies made in Italy in 1916 found Status Thymico-Lymphaticus in but five cases, four in persons over 30 years, one in a girl of 8 who had died of tetanus. A second series of 200 reported on in 1917 contained only three cases (see Benedetti, p. 58).

Groll's proportion is much larger than Bartel's, deduced not from war deaths but from 530 autopsies in the Pathological Institute at Vienna. Bartel recognised Status Lymphaticus in 253, 44.3 per cent. (see Benedetti, p. 75). But Bartel's percentage is in turn much larger than that reached by Zellweger using, at Basel, rigorously the same technique as Bartel. He found Status Lymphaticus 83 times, 16.6 per cent., in 500 cases (Benedetti, p. 75). The mere recital of the figures from war-time material proves that, either the anatomical criteria adopted were different, the material not homogeneous (state of physical exhaustion, nutrition, previous health, immediate cause of death, etc.) or that the variability of the character is enormous; no doubt *all* these factors are involved. In very much simpler instances, *e.g.* the state of dentition of school children, it has proved impossible to make accurate comparisons of the results of competent observers in different places.

These criticisms do not, however, apply to the confrontation of Bartel's

and Zellweger's results. From these we must infer that in a dead-house population an anatomical complex which corresponds to what is called Status Thymico-Lymphaticus is of very common occurrence; unless therefore it can be shown that in a sample of deaths *without apparent justification*, there is, statistically speaking, a very large excess indeed of bodies marked with this stigma, we have not even a *prima facie* case for the incrimination of the anomaly as a *vera causa* of the death. Schridde has offered the required demonstration. His paper deals essentially with a series of 97 violent deaths. The cases, he says, may be sharply divided into two classes, those in which the condition of the thymus is characteristic and those in which it is not. To the former group belong 56 of the 97 (not very substantially more than Bartel's proportion of Status Lymphaticus in a hospital series) and in all the members of this group the extrinsic cause of death was less severe than in the remainder. Thus 36 of the 56 persons were killed by an electric current of 220 volts, while not a single case of death at this voltage occurred in the group without characteristic signs in the thymus. Schridde then reduces the 56 to 30 which he considers really typical and describes their characteristics. The mean weight of the thymus in the group was 39 grm. (the ages were 16-39 years) and, for the rest, the stigmata are those which have been mentioned above, with this addition, that Schridde attaches great importance to hypertrophy of the medulla of the thymus (therein dissenting from Hammar). Schridde adds that at birth enlarged thymi are accompanied by the other stigmata of the Status Thymico-Lymphaticus in 4.5 per cent. of cases and that such thymi are characterised by medullary enlargement.

This is a clearly written and, apparently, quite decisive paper by an author of repute. The statistician, who has had painful experience of the fallacies lurking in the plainest arithmetical statements, must be pardoned for wondering whether it is not almost *too* clear. We might first think, having regard to Bartel's results, that it means that the Status Thymicus is really very common, but then we have the staggering fact that 36 of the 56 thymics were killed by electric currents of voltage 220 (which is the ordinary voltage of a house current), and that (in Schridde's experience) nobody who was not a thymic was killed by such a voltage at all. It almost suggests that sensibility to electric shocks would be a quite workable definition of Status Thymico-Lymphaticus. But if this is really so, surely some or all of the stigmata of Status Thymico-Lymphaticus should be noted by those who have had experience of deaths from electric shocks. A perusal of works on this subject has revealed nothing of the kind. According to Oliver there were in England and Wales in 1902-8 three deaths due to a continuous and 30 due to an interrupted current of 250 volts or less; but this author makes no reference to the thymus.

We do not suggest that Schridde has not accurately reported the results of his examinations. We do however suggest that the 97 cases of violent death upon which he has based his conclusions are not and cannot possibly be a

random sample of all the violent deaths occurring in a great industrial area. That more than a third of the total were due to low voltage electric currents is, we think, sufficient to establish that proposition. But if Schridde's material is not a random sample, it goes no further than to confirm the view that in healthy subjects dying suddenly these stigmata are very common. We know from Bartel's and others' results that they are common in many samples of the dead. We do not know that they are any more common in one group than the other.

One might suggest that the annual tribute now paid to the god in the motor car is so large that it should not be difficult to ascertain in many more than 36 cases whether enlargement of the thymus is more frequent in the victims of the humble Ford than in those hurried to eternity by the more powerful Rolls-Royce.

Several authors of credit, Bartel, Miloslavich, Hart, Jaffé and Sternberg, have reported the stigmata of Status Thymico-Lymphaticus in a large proportion of deaths by suicide. Bartel found Status Thymico-Lymphaticus in 36 per cent., Status Lymphaticus in 26 per cent. and partial symptoms in a further 20 per cent. Miloslavich's percentages are even larger. Jaffé and Sternberg reached the more modest figures of severe Status Lymphaticus in 29 per cent. and less severe in 14 per cent., slight signs in 15 per cent. (see Hart, p. 99).

These results have encouraged several authors to suggest that in the group of persons who kill themselves we are dealing *ab initio* with abnormal types and that the anatomical stigmata are correlated with the psychological. This is an arguable position; but it is one thing to say that the stigmata of Status Thymico-Lymphaticus indicate a peculiarly labile organism and another to say that they indicate a psychological make-up which urges the victim to do himself violence. It does not appear to have been demonstrated that the suicides who were sealed with the thymico-lymphatic seal employed less effective means of self-destruction than others. Perhaps psychological analysis is likely to throw more light upon the aetiology of suicide than any method of pathological anatomy<sup>1</sup>. The conclusion we draw from the evidence tendered with respect to general lymphatic hyperplasia, to ill-development or degeneration of the cardio-vascular organs and to the external sexual characters, is that nothing has been brought to light justifying the recognition of a particular anatomical or physiological type corresponding to the Status Lymphaticus of the certifying practitioner. We return, therefore, to that criterion which, quoted in all the text-books, can at least be made the object of direct study, the thymus itself.

<sup>1</sup> We do not overlook the fact that Prof. S. J. Morris of the West Virginia University, from an examination of 192 cadavera, including 20 criminals (17 actually hanged), which revealed the existence of a "persistent thymus" in all the criminals, has felt "justified in drawing the conclusion that the 'persistent thymus' is in some way accountable for the mental state that caused these men to be criminals." This grisly surmise will, let us hope, be taken to heart by anybody who thinks of putting a thymus extract on the market.

*The normal weight of the thymus.*

In the joint study with Prof. Turnbull, the data of some 3500 autopsies on persons up to the age of 16 were available. A majority of the deaths were due to causes which might have influence on the weight of the thymus but a proportion of the record cards were noted as indicating no relevant abnormality. The biometric constants of these are shown in Table II, they differ little from those deduced by Bratton from a slightly larger sample of the same data, and, at ages over 1, they agree with Hammar's results. Under 1, Hammar's averages are larger and their variability smaller than those of the London Hospital series. After this series had been analysed, Prof. Turnbull subjected the data to a still closer scrutiny and provided us with a smaller sample from which had been excluded reports recording any trace whatever of disease. This winnowed sample has been dealt with so as to obtain a precise comparison with Hammar's series. The latter is too scanty to admit of separating the sexes, so we have not divided our more extensive data. For each age group the regression of thymus weight on age has been deter-

Table II. *London Hospital and Hammar's data. Mean age and weight of thymus.*

	Full-time foetuses. Thymus (grm.) (31)	Under 1 year		Ages 1-5		Ages 6-10		Ages 11-15	
		Age (months) (43)	Thymus (grm.) (16)	Age (years) (66)	Thymus (grm.) (24)	Age (years) (40)	Thymus (grm.) (27)	Age (years) (21)	Thym (grm.) (27)
<i>London Hospital</i>									
Normal males:									
Means	10.52 ± .60	2.23 ± .33	16.25 ± 1.67	2.98 ± .11	24.9 ± .76	7.85 ± .13	27.6 ± 1.16	13.14 ± .21	27.2 ± 7.0
Standard dev.	4.95	3.23	9.98	1.38	9.10	1.26	10.91	1.42	
Normal females:									
Means	9.94 ± .61	2.30 ± .40	12.95 ± .85	2.76 ± .13	23.29 ± .83	7.67 ± .23	28.62 ± 1.79	12.78 ± .33	28.56 ± 8.6
Standard dev.	4.41	3.34	7.14	1.33	8.60	1.55	12.18	1.47	
<i>Hammar</i>									
Males and females:									
Means	15.19 ± .78	2.17 ± .56	20.49 ± 1.68	4.01 ± .16	25.24 ± 1.04	8.89 ± .19	30.44 ± 1.14	12.96 ± .22	29.10 ± 7.0
Standard dev.	5.30	2.20	6.11	1.27	8.12	1.40	8.42	1.53	

Table III. *Revised Series. Turnbull's selection. Excluding all children with any trace of disease. London Hospital and Hammar's data. Mean age and weight of thymus.*

	Full-time foetuses. Thymus (grm.) (52)	Under 1 year		Ages 1-5		Ages 6-10		Ages 11-15	
		Age (months) (71)	Thymus (grm.) (14)	Age (years) (90)	Thymus (grm.) (23)	Age (years) (41)	Thymus (grm.) (29)	Age (years) (18)	Thym (grm.) (30)
<i>London Hospital</i>									
Normal males and females:									
Means	10.26 ± .45	2.23 ± .24	14.09 ± .61	2.94 ± .09	23.54 ± .60	7.71 ± .15	29.24 ± 1.26	13.28 ± .24	30.4 ± 8.2
Standard dev.	4.82	3.06	7.67	1.21	8.47	1.44	11.93	1.50	
Equation		$t = 1.4467a + 10.8670$		$t = -.3889a + 24.7817$		$t = .8040a + 23.0473$		$t = .3056a + 26.34$	
		where $t$ = weight of thymus and $a$ = age							
<i>Hammar</i>									
Normal males and females:									
Means	15.19 ± .78	2.17 ± .56	20.49 ± 1.68	4.01 ± .16	25.24 ± 1.04	8.89 ± .19	30.44 ± 1.14	12.96 ± .22	29.10 ± 7.0
Standard dev.	5.30	2.20	6.11	1.27	8.12	1.40	8.42	1.53	

\* Figures in brackets are predicted values for mean age of Hammar's series from equations calculated from London Hospital d

mined, that we might allow for the differences of mean age between the two samples (in our data allowance could be made for body weight but not, unfortunately, in Hammar's). The series are compared in Table III. The difference in the group of full-time foetuses persists; it persists, but having regard to errors of sampling, with much less certainty in the age group 0-1. At ages over 1 there is complete agreement between our results and those of Hammar. Our relative variability is somewhat greater than his but not significantly so.

There is therefore no reason to doubt that, at ages between 1 and 16 years, the normal weight of the thymus has been well determined and that a racial difference between the material used by Hammar and us has had little effect. We shall now examine some statistical consequences of our work.

We propose to ask, within what limits can the weight of the thymus of a child of known age, height and body weight be fairly described as normal. This question cannot be answered precisely without more knowledge than we have and cannot be answered at all unless we define our terms. If we find a pack of cards arranged in suits and the cards in each suit in sequence we infer that they have been deliberately arranged in that order because that is, to the ordinarily constituted mind, an easier explanation than to believe that an event, the odds against the occurrence of which "by chance" are immense, has happened. Actually of course the odds against any other particular arrangement of the cards are precisely the same, but *this* particular arrangement is one which there might be many intelligible reasons for deliberately making.

If we were informed that the heart of a man had been found to weigh two pounds, we should, in the absence of further information, find it easier to believe that the heart was in some way pathological than that it was a mere normal "chance" variant, because we know from past experience that most hearts weighing two pounds do differ from healthy hearts in some other way than mere bulk. But we might be forced to conclude that this heart was abnormal in nothing but weight.

Similarly with respect to the thymus, we must try to ascertain the frequency distribution of different weights when other variables are known. Of these variables, sex, age, body weight, and stature are important. As, however, our data are scanty, we can only form an inadequate idea of the frequency distribution defined by the associated variables. We can really do no better than to define the weight of the thymus by a first degree relation between the deviations of thymus weight, body weight, stature and age from their respective norms and from this obtain an appreciation of the frequency with which such or such deviations from the "expected" value are likely to occur. This determination can, of course, be only a crude approximation because we do not know that the relations between the deviations are adequately represented by an algebraical equation of the first degree and have even less warrant that the scale of frequencies of deviations given by the

*Status Thymico-Lymphaticus*

Table IV. *London Hospital data. Normal males.*

Variables	Ages under 1 year (excluding foetuses)		Revised selection	
	Means	Standard deviations	Means	Standard deviations
No. of observations	43		40	
Age	8.94 weeks	12.96	8.46 weeks	13.07
Body weight	3.93 kg.	2.20	3.77 kg.	2.18
Height	54.30 cm.	9.63	53.96 cm.	9.86
Weight of thymus	16.26 grm.	9.98	14.78 grm.	8.02

Coefficients of correlation

	<i>r</i>	<i>r</i>
Thymus and body weight	.617 ± .064	.625 ± .065
Thymus and height	.599 ± .066	.693 ± .055
Thymus and age	.520 ± .075	.605 ± .068
Age and body weight	.890 ± .021	.894 ± .021
Age and height	.883 ± .023	.926 ± .015
Height and body weight	.919 ± .016	.884 ± .023

Partial correlations

Thymus and body weight. Age and height constant	.246 ± .097	-.059 ± .106
Thymus and height. Age and body weight	.143 ± .101	.369 ± .092
Thymus and age. Height and body weight	-.130 ± .101	.005 ± .107
Age and height. Thymus and body weight	.378 ± .088	.305 ± .097
Age and body weight. Thymus and height	.438 ± .083	.427 ± .087
Height and body weight. Age and thymus	.560 ± .071	.624 ± .065

Equations. Weight of thymus in terms of height, body weight and age.

Ages 0-1.  $y$  (weight of thymus) =  $-9.065 + 2.490 w$  (body weight) +  $.316 h$  (height) -  $.184 a$  (age).  
 Partial standard deviation:  $\sigma_{y.wha} = 7.74$ . Mean error of prediction = 5.4. Theoretical mean error = 6.2.

Revised:  $y = -18.704 - .455 w + .652 h + .005 a$ .

Partial standard deviation:  $\sigma_{y.wha} = 5.87$ . Mean error of prediction = 4.5. Theoretical mean error = 4.6.

Table V. *London Hospital data. Normal females.*

Variables	Ages under 1 year (excluding foetuses)	
	Means	Standard deviations
No. of observations	32	
Age	9.21 weeks	13.35
Body weight	3.56 kg.	2.08
Height	53.26 cm.	9.74
Weight of thymus	12.95 grm.	7.14

Coefficients of correlation

	<i>r</i>
Thymus and body weight	.782 ± .046
Thymus and height	.836 ± .036
Thymus and age	.466 ± .093
Age and body weight	.729 ± .056
Height and body weight	.909 ± .021
Age and height	.703 ± .060

Partial correlation

Thymus and body weight. Age and height constant	.212 ± .114
Thymus and height. Age and body weight	.537 ± .085
Thymus and age. Height and body weight	-.359 ± .104
Age and height. Thymus and body weight	.304 ± .108
Age and body weight. Thymus and height	.353 ± .104
Height and body weight. Age and thymus	.558 ± .082

Equation. Weight of thymus in terms of height, body weight and age.

Ages 0-1.  $y$  (weight of thymus) =  $-19.721 + .956 w$  (body weight) +  $.576 h$  (height) -  $.155 a$  (age).  
 Partial standard deviation:  $\sigma_{y.wha} = 3.64$ . Mean error of prediction = 2.8. Theoretical mean error = 2.9.

Table VI. *London Hospital data. Normal males. Ages 1-16.*

Variables	First selection		Revised selection	
	Means	Standard deviations	Means	Standard deviations
No. of observations	127		90	
Age	6.70 years	3.99	6.13 years	3.93
Body weight	19.24 kg.	8.18	18.20 kg.	7.50
Height	109.41 cm.	21.65	106.64 cm.	20.10
Weight of thymus	26.04 grm.	9.40	26.85 grm.	9.72
Coefficients of correlation and correlation ratio (corrected)			Coefficients of correlation	
	<i>r</i>	$\eta$	<i>r</i>	
Thymus and body weight	.097 ± .059	.113 ± .059	.258 ± .066	
Thymus and height	.069 ± .060	.137 ± .059	.223 ± .068	
Thymus and age	.062 ± .060	.141 ± .059	.218 ± .068	
Age and body weight	.924 ± .009	.936 ± .007	.922 ± .011	
Age and height	.934 ± .008	.990 ± .001	.923 ± .011	
Height and body weight	.922 ± .009	.938 ± .007	.905 ± .013	
Partial correlations				
Thymus and body weight. Age and height constant		.100 ± .059	.139 ± .070	
Thymus and height. Age and body weight	„	-.016 ± .060	.002 ± .071	
Thymus and age. Height and body weight	„	-.051 ± .060	-.045 ± .071	
Age and height. Thymus and body weight	„	.549 ± .042	.537 ± .051	
Age and body weight. Thymus and height	„	.457 ± .047	.528 ± .051	
Height and body weight. Age and thymus	„	.434 ± .049	.362 ± .062	
Ages 1-16. $y$ (weight of thymus) = 24.443 + .334 $w$ (body weight) - .022 $h$ (height) - .372 $a$ (age). Partial standard deviation: $\sigma_{y.wha}$ = 9.33. Mean error of prediction = 7.8. Theoretical mean error = 7.4.				
Revised: $y$ = 20.675 + .432 $w$ + .003 $h$ - .319 $a$ . Partial standard deviation: $\sigma_{y.wha}$ = 9.07. Mean error of prediction = 7.7. Theoretical mean error = 7.2.				

Table VII. *London Hospital data. Normal females. Ages 1-16.*

Variables	First selection		Revised selection	
	Means	Standard deviations	Means	Standard deviations
No. of observations	77		59	
Age	5.36 years	3.66	5.15 years	3.66
Body weight	17.07 kg.	8.82	16.86 kg.	9.15
Height	105.00 cm.	22.16	104.25 cm.	23.32
Weight of thymus	25.30 grm.	9.84	24.46 grm.	9.57
Coefficients of correlation and correlation ratio (corrected)			Coefficients of correlation	
	<i>r</i>	$\eta$	<i>r</i>	
Thymus and body weight	.441 ± .062	.419 ± .063	.505 ± .057	
Thymus and height	.363 ± .067	.299 ± .070	.415 ± .064	
Thymus and age	.296 ± .070	.499 ± .058	.364 ± .067	
Age and body weight	.893 ± .016	.923 ± .011	.894 ± .015	
Age and height	.934 ± .010	.940 ± .009	.938 ± .009	
Height and body weight	.906 ± .014	.948 ± .008	.907 ± .014	
Partial correlations				
Thymus and body weight. Age and height constant		.342 ± .068	.380 ± .066	
Thymus and height. Age and body weight	„	.089 ± .076	.046 ± .077	
Thymus and age. Height and body weight	„	-.240 ± .072	-.201 ± .074	
Age and height. Thymus and body weight	„	.658 ± .044	.668 ± .043	
Age and body weight. Thymus and height	„	.364 ± .067	.345 ± .068	
Height and body weight. Age and thymus	„	.386 ± .068	.391 ± .065	
Ages 1-16. $y$ (weight of thymus) = 8.121 + .874 $w$ (body weight) + .108 $h$ (height) - 1.697 $a$ (age). Partial standard deviation: $\sigma_{y.wha}$ = 8.54. Mean error of prediction = 6.9. Theoretical mean error = 6.8.				
Revised: $y$ = 11.059 + .896 $w$ + .050 $h$ - 1.353 $a$ . Partial standard deviation: $\sigma_{y.wha}$ = 8.03. Mean error of prediction = 6.0. Theoretical mean error = 6.4.				

Gauss-Laplace function is applicable. But to reach a better result we should need a vastly greater range of data than we are ever likely to possess.

In the preceding tables (Tables IV to VII) we provide the equations for prediction and the respective standard deviations of the predictions. They lead to this conclusion: that for males a child aged 9 weeks, weighing 3.9 kilos and measuring 54 cm. would have on the average a thymus weighing 16 gm., and that only once in a thousand should we expect to have a greater weight than 40 gm. A boy aged 7 years weighing 19 kilos and measuring 109 cm. might be expected to have a thymus weighing 26 gm. and only once in a thousand trials should we expect a thymus of 55 gm.

A thymus of 40 gm. or more would be expected in 7 or 8 per cent. of children of this age and dimensions. In girls, taking precisely the same ages and dimensions (these happen to be the approximate means for the boys) we should expect thymus weights of 13.7 and 24.6 gm. respectively and one in a thousand of each class to exceed 25.6 and 48.8 gm. respectively.

These are rough indications of the order of magnitude of the thymus which may be deemed abnormal. Let us follow this a little further. In our series of records there are 21 instances (17 males, 4 females) where the actual weights of the thymus exceeded that predicted from the other measurements and the age by as much as twice the standard error of the prediction, an event likely to occur in 2.3 per cent. of trials (Table VIII). Do we find that the proportion of stated causes of death which seem *prima facie* inadequate to account for an *exitus letalis* is large in this series? Of the 4 girls two were run over by street vehicles, one fell from a second story window, one was burned to death and her body charred. Of the 17 boys, five were run over, one had a fall, one was burned over almost the whole surface of the body, one was suffocated, two had diphtheria, one purulent bronchitis and bronchopneumonia, one catarrhal gastritis and enteritis, two infantile convulsions and rickets. Of the three remaining cases death in one was, in the opinion of a skilled anaesthetist, undoubtedly due to unskilled management of the case, one had mastoid disease and died during anaesthesia, and in the other death was attributable to an acute bacteriemia<sup>1</sup>. Hence in every instance of an abnormally large thymus in our experience the cause of death was adequately determined.

We have also inquired whether the proportion of dubious causes of death in all "normal" subjects presenting a thymus weighing 40 gm. or more differed from the general proportion of the group (Table IX). No difference was disclosed. There is no indication that the causes of death when the thymus was large differed systematically from the causes of death when the thymus was near the average weight. The answer to the question raised on p. 319 is that it is *not* easier to believe that the abnormally heavy thymi in our series had a pathological significance than that they were merely normal variants. This is virtually the conclusion reached nearly 70 years ago by

<sup>1</sup> Full details of these cases will hereafter be published.

Table VIII. *Cases with thymus weighing 40 grm. or over.*

Equations used for prediction calculated from revised normal series:

			Partial standard deviations	
Males.	Ages 0- 1.	$y = -18.704 - .455 w + .652 h + .005 a$	5.77	
"	" 1-16.	$y = 20.675 + .432 w + .003 h - .319 a$	9.06	
Females.	" 1-16.	$y = 11.059 + .896 w + .050 h - 1.353 a$	8.03	

where  $y$  = weight of thymus,  $w$  = body weight,  $h$  = height and  $a$  = age.

		Thymus				
		Observed weight	Predicted weight	Difference	Diff./partial S.D.	
Males ages 0-1	No.	542	47	21.0	26.0	4.51
		386	50	15.3	34.7	6.01
		151	45	22.9	22.1	3.83
		132	54	20.1	33.9	5.88
		509	42	20.8	21.2	3.67
		88	45	9.9	35.1	6.08
Males ages 1-16		65	42	25.2	16.8	1.85
		226	45	27.4	17.6	1.94
		206	40	33.3	6.7	0.74
		612	41	25.8	15.2	1.68
		308	44	25.2	18.8	2.07
		1080	46	24.8	21.2	2.34
		604	43	24.0	19.0	2.09
		370	42	23.6	18.4	2.03
		280	48	27.5	20.5	2.26
		87	40	30.6	9.4	1.04
		194	45	28.4	16.6	1.83
		68	47	27.7	19.3	2.13
		670	45	26.2	18.8	2.07
		631	45	27.7	17.3	1.91
		298	45	26.4	18.6	2.05
		41	46	30.6	15.4	1.70
		354	40	26.6	13.4	1.48
		304	40	26.8	13.2	1.46
		233	48	28.7	19.3	2.13
		281	52	27.5	24.5	2.70
		373	41	25.4	15.6	1.72
		371	47	29.0	18.0	1.98
	380	40	26.5	13.5	1.49	
	561	45	24.5	20.5	2.26	
Females ages 1-16		505	45	47.6	2.6	0.32
		566	40	33.9	6.1	0.76
		492	41	33.5	7.5	0.93
		254	62	29.0	33.0	4.11
		135	40	21.9	18.1	2.25
		153	43	27.8	15.2	1.89
		771	41	28.9	12.1	1.51
		532	45	22.8	22.2	2.76
		379	45	24.7	20.3	2.53

Table IX. *Causes of death.*

	All normals ages 1-16			All normals with thymus weighing more than 40 grm. Ages 1-16		
	Males	Females	Total %	Males	Females	Total %
Accident	93	35	128 (63)	12	7	19 (73)
Burns or scalds	23	42	65 (32)	3	2	5 (19)
Convulsions	3	—	3 (1)	2	—	2 (8)
Resp. obs. or suffocation	3	—	3 (1)	—	—	—
Other causes	5	—	5 (3)	—	—	—
<b>Total</b>	127	77	204 (100)	17	9	26 (100)

Friedleben who wrote: "It is therefore unmistakable that for no period of life are absolute maxima or minima for the weights of the thymus admissible, but that even in homogeneous material endless individual variations, in the direction of an increase or a decrease and in the most various combinations may be encountered" (Friedleben, p. 18).

The previous sections are based upon material, part of which is from English records. Hammar has compared the protocols of 31 cases of suicide with those of violent deaths not self determined and it is clear from his results (Hammar, p. 496) that the thymi of the suicides do not differ gravimetrically in any significant way from those of other persons.

To summarise: If the criterion be mere weight of the thymus, then Status Lymphaticus, Status Thymico-Lymphaticus and Status Thymicus are mere verbalisms. Diagnoses established wholly or mainly upon an alleged abnormality of weight of the thymus have no more value than affirmative evidence in cases of witchcraft. Since it can seldom be possible for a certifying practitioner to have *more* knowledge of the thymus than he will acquire by putting it in the scale pan—some may even content themselves with a visual appreciation—it follows that, for practical purposes, the diagnosis ought to be abandoned. In cases of sudden death, the old inquest verdict of "Died by the visitation of God" is at least as scientific as and more modest than "Status Thymicus" or "Lymphaticus"; "Cause unknown" is to be preferred to either.

#### *Structural evidence of a Status Thymicus.*

The whole of the above discussion has been based upon one character only of the thymus and that the easiest to measure. But the existence of less easily applied anatomical criteria of the Status has been alleged by workers of repute. Schridde for instance has attached great diagnostic importance to medullary hyperplasia. This is a subject of which we have no first-hand knowledge, but Hammar's histological studies of normal cadavera, of children who had died suddenly without any pathological changes save some bronchitis or follicular enteritis and of 18 cases of Graves' disease, have led him to conclude that the conceptions of a characteristic medullary hyperplasia in Status Thymicus not only were based upon inexact observations but have not survived practical experience (Hammar, p. 468).

We cannot add anything to this statement.

#### GENERAL CONCLUSIONS.

The conclusion of our present investigation is as follows. The concept of a Status Thymico-Lymphaticus in so far as it is scientific belongs at present wholly to the statistical order of ideas and is *in pari materia* with the concept of racial susceptibility to disease. It is *possible*, for instance, that Swedes are more susceptible to pulmonary tuberculosis than English. A practitioner confronted with a case of pulmonary tuberculosis might reasonably take the

racial factor into account and, other things equal, give a more cautious prognosis when the patient was a Swede than when he was an Englishman. But if the case had ended fatally much sooner than his general experience of the physical signs and symptoms of phthisis had led him to expect, he would hardly enter on the death certificate: phthisis—Swedish nationality.

The present use in certification and in evidence in coroners' courts of the phrases Status Lymphaticus and Status Thymico-Lymphaticus is, we suggest, a good example of the growth of medical mythology. A nucleus of truth is buried beneath a pile of intellectual rubbish, conjecture, bad observations, rash generalisation. This heap of rubbish is described in the current scientific jargon and treated as an orthodox shrine. Indeed when we find men of science speculating as to the nature of the anti-adrenalin produced to excess in Status Thymico-Lymphaticus we feel how well merited was the rebuke administered to some clinical endocrinologists by G. N. Stewart who in discussing certain papers on "hypoadrenal" constitutions said: "In reading this paper and many others by 'clinical endocrinologists,' especially the French and the Italians, the physiologist can scarcely escape the feeling that here he has broken through into an uncanny fourth dimension of medicine, where the familiar canons and methods of scientific criticism are becoming foolishness, where fact and hypothesis are habitually confounded and nothing is but what is not."

At the present moment we have not sufficient knowledge of the frequency of the single and combined anomalies which have been thought to define *anatomically* Status Lymphaticus or Status Thymico-Lymphaticus in a healthy population to permit us to assign the least importance to the recognition of these stigmata in the bodies of those whose deaths, apart from Status Lymphaticus, would in more pious, but not more superstitious, days have been attributed to the visitation of God.

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