

VARIATIONS IN THE CORTICAL LIPOID OF THE MOUSE SUPRARENAL WITH SEX AND AGE

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WHITEHEAD (1931) found that lipid was relatively more abundant in the cortex of female than of male mice, aged about 150 days. In the present paper it is shown that the amount of sudanophil lipid in the mouse suprarenal cortex is most abundant, in both sexes, while the transitory cortex (*X* zone) is present.

MATERIAL AND METHODS

Two hundred and forty-seven glands were taken from 124 mice of various colours, 64 males supplying 127 glands, 60 females supplying 120 glands. The ages of the mice ranged from 15 to 338 days. The age groups in this series are the same as those in the series discussed by Whitehead (1933). All the glands were fixed in 10 per cent. formol saline, cut frozen, stained with haemalum and Sudan III, and mounted in glycerine jelly.

Method of measuring lipid

The term "lipoid band" is used to denote that part of the permanent cortex whose lipid-rich cells stain with Sudan III. The fat of the involuting *X* zone is thus excluded by definition from the measurements. The breadth of the lipid band was measured with a micrometer at one point in a central longitudinal section. Such a section is roughly ovoid, with a blunt end and a sharp end, from which the central vein emerges. If these are termed the paravenous and venous poles respectively, an imaginary straight line joining them may be termed the major axis, and an imaginary straight line intersecting this axis at right angles midway between the poles may be termed the minor axis.

The measurements were made as a rule near the minor axis as here the cortex varies less in thickness over unit distance than near the poles.

The reading on each gland contained, from left to right, the breadth in micrometer units of: (*a*) capsule; (*b*) lipid-free cortex outside lipid band; (*c*) lipid band; (*d*) lipid-free cortex inside lipid band; (*e*) perimedullary fibrous band together with *X* zone when present.

Specimen reading:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1	3	17	4	9

From these figures, the lipid band occupied 0.5 of the width of the total cortex, 0.7 of that of the permanent cortex. Permanent cortex was measured

from the outer margin of the gland capsule to the outer margin of the *X* zone and/or perimedullary fibrous band.

Sources of error

The lipid band is usually of uniform width and density, and it is easy to judge its limits. A systematic error is possible owing to the personal factor. The section was always illuminated by electric light, no filters being used. In a few glands the irregular distribution of lipid prohibited measurement. In frozen sections it may be impossible to locate with certainty the junction between *X* zone and/or perimedullary fibrous band and lipid-free permanent cortex inside the lipid band.

THE RATIO OF LIPOID TO PERMANENT CORTEX (L./P.C.)

The values of L./P.C. are shown in Table I.

P.C. is taken as ten units to avoid a cipher and decimal point before each entry. Each entry represents one gland. For each age group of each sex there are two rows of figures. Those in the top row represent left glands, those in the bottom row the corresponding right glands. The average breadth of the lipid band in all the glands of each group is given to the right of the individual values.

Table II, constructed from Table I, shows the difference between the values of L./P.C. in pairs of glands.

Table II contains three blocks of figures, the first for males, the second for females, and the third for both sexes together. The first column of each block states the number of pairs of glands in which the values of L./P.C. differed by the amount stated in the units column. The second column of each block contains the reduction to percentages of the figures in the first column.

Table II shows that in 84 per cent. of pairs the values of L./P.C. were either identical or differed by only one unit, and that the difference exceeded two units in only 8 per cent. of pairs, i.e. the breadth of the lipid band usually bears the same proportion to the breadth of the permanent cortex in both glands from one mouse.

The results in Table I are shown graphically in figs. 1 and 2 for males and females respectively. Ordinates represent permanent cortex, taken as ten units. Abscissae represent age of mice in months. Each small square indicates one suprarenal gland. Where the ratio of the cortical lipid band to permanent cortex is the same in two or more glands from mice of the same age group, the number of glands is indicated by the size of the rectangular areas. The bases of these areas mark the number of units of permanent cortex occupied by lipid.

Fig. 1 shows that during the first month lipid almost entirely fills the permanent cortex in males. From two months onwards the amount of lipid

is more variable, and the range of variation tends to increase with age. The average amount of lipid oscillates between five and seven units, showing no tendency to increase or decrease.

Table I. Ratios of cortical lipid band to permanent cortex (L./P.C.) in normal mouse suprarenal. P.C. is taken as ten units

Age (days)	Males						Av.	Females						Av.	
	10	8	10	8	10			10	9	10	10	9			
15-17	10	8	10	8	10		10	10	9	10	10	9	10		
	10	10	10	—	10			10	9	10	10	10			
28	9	8	9	9	8	8	8	10	10	10	10	10	10		
	9	9	7	9	8	7		10	10	10	10	10			
57	5	5	8				6	9	9	10	7	6	8		
	5	5	8					9	10	10	7	7			
85-86	4	7	5	8	7		6	10	10	5			9		
	6	6	5	8	8			10	7	10					
111-112	7	1	7	6			5	10	10	8			10		
	7	1	7	6				10	10	10					
141	3	6	7	9	5		6	10	10	10	10	10	10		
	2	8	7	8	8			10	10	10	10	10			
167	8	5	8	7	8		7	9	9	8	9	10	9		
	6	3	7	8	7			9	9	8	9	10			
201	3	7	6				5	9	9	1	9		7		
	2	7	6					7	8	2	9				
227	9	9	5	7	5		7	7	7	8	8	9	8		
	6	8	6	6	6			8	7	8	9	8			
256	2	7	7	6	9		6	6	8	9	8	8	8*		
	2	7	7	8	9			7	8	6	9	7			
280	2	8	5	4	5		5	7	5	1	8	8	6		
	3	8	6	7	6			8	9	1	7	8			
310	7	10	7	9	2		7	5	7	8	7		7		
	8	9	8	8	2			5	8	8	9				
336	5	6	9	5			6	10	8	9	8	1	7†		
	4	7	9	6				10	9	8	7	1			
							Average	6.5						Average	8.4

* 252 days. † 336-338 days.

Table II. Difference between values of L./P.C. in pairs of glands

Units of difference	Males		Females		Males and females	
	Number	%	Number	%	Number	%
0	25	42	35	59	60	50
1	24	41	17	29	41	34
2	7	12	3	5	10	8
3	3	5	2	3	5	4
4	0	0	1	2	1	2
5	0	0	1	2	1	2
Totals	59	100	59	100	118	100

Fig. 2 shows that in females lipid usually occupies the whole of the permanent cortex during the first five months of postnatal life. From six months onwards, the average amount of lipid, though slightly higher than in males, tends to fall and extreme low values occur. The scatter, however, is not so great as in the males.

HISTOLOGICAL TYPES OF LIPOID DISTRIBUTION

For descriptive purposes three groups of glands may be recognised:

(1) Glands with a broad lipid band, occupying not less than half the width of the permanent cortex (fig. 3).

(2) Glands with a narrow lipid band, occupying less than half the width of the permanent cortex (figs. 4 and 5).

(3) Glands in which the lipid is irregular (fig. 6).

Each group contains glands from both sexes. As figs. 1 and 2 indicate, Group I is much the largest.

Frequency of lipid-rich subcapsular rim of cells

The subcapsular rim of cells ("glomerular" zone) is usually lipid-free in both sexes. In the 110 measured glands from mice, aged 201 days and over (55 male and 55 female), lipid extended right to the inner border of the gland capsule in 36 (16 male and 20 female), i.e. 33 per cent.

Site of lipid variation

The histological results demonstrate that lipid is most variable in the inner part of the cortex and least so in the layer of the cells below the subcapsular layer. Wolff (1927) made the same observation.

DISCUSSION

Relation of lipid to X zone

In the paraffin-embedded glands from 119 mice of the same batch and age groups as those described above, it was found that the *X* zone had disappeared from males at two months, and was present in females only occasionally from five months onwards (Whitehead, 1932 *b*). The measurements reported in the present paper indicate that sudanophil cortical lipid is most abundant and least variable in amount while the *X* zone is present. This is true of the suprarenals of both sexes, but owing to the longer persistence of the *X* zone in females, lipid is relatively more abundant in females than in males during the interval between the disappearance of the male *X* zone and the disappearance of the female *X* zone. This must be remembered in interpreting lipid changes in mice from about two to about five months of age.

When the *X* zone has disappeared from both males and females there is no definite evidence of a sex distinction in the amount and range of variation of sudanophil cortical lipid. The lipid phenomena shown by the female from five months onwards are similar to those shown by the male from two months onwards.

The extreme low values of L./P.C.

In seven of the males and three of the females whose measurements are given in Table I the ratio of L./P.C. was under four in one or both suprarenals. It was thought that this might have been the result of spontaneous disease.

In six of the males no macroscopic lesion was found. In the seventh, *cysticercus fasciolaris* was present in the liver. In the other two males presenting this abnormality the values of L./P.C. were the highest found in their respective age groups: 9 and 8, and 9 and 9. Therefore *cysticercus fasciolaris* cannot be the cause of the low value of L./P.C. in the male referred to.

One of the females was pregnant with six foetuses and had *cysticercus fasciolaris* in the liver. In the other two no abnormality was found.

Four males and four females showed irregularly distributed lipid. One of the females was pregnant with two foetuses. The other seven animals showed no abnormality.

One female had a caseous inguinal gland. The ratio L./P.C. was 8 and 8, or one unit above the average for the age group.

From observation of only two pregnant females it is of course impossible to draw any conclusion. The low values of L./P.C. and of irregularly distributed lipid cannot be attributed to the pregnancy.

Spindle cells, apparently identical with those described by Löwenthal (1931), were conspicuous in 26 out of the 230 paraffin-embedded control glands (Whitehead, 1932). These cells indicate inflammation of mild degree. It is possible that such inflammation was present in some of the glands used for lipid measurements. There is, however, nothing in the literature of the suprarenal to justify the attribution of the low values of L./P.C. to inflammation of such low degree. The evidence points rather to increase of lipid in mild intoxications (Deanesly, 1931). Since it is only severe and rapidly fatal infections that appear to be followed by a marked reduction or disappearance of lipid, no pathological explanation can be offered of the low values of L./P.C. in eight mice, nor of the irregular distribution of lipid in seven mice, all of which were clinically healthy and showed no lesions at autopsy. There seems to be no good reason for not accepting the low values of L./P.C. as physiological.

SUMMARY

1. It is shown that in both sexes sudanophil lipid occupies almost the whole width of the permanent cortex while the X zone is present, in males up to one to two months, in females up to about five months.

2. When the X zone has disappeared the average amount of lipid falls, and the amount of lipid present in glands from mice of the same age group is more variable.

3. During the interval between the disappearance of the male X zone and of the female X zone, i.e. from about two to about five months of age, lipid is relatively more abundant in the female than in the male gland.

4. Lipoid is usually present in the same amount and situation in both glands from one mouse.
5. Lipoid varies most in the inner part of the permanent cortex.
6. In one-third of the glands lipoid extended to the gland capsule.

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EXPLANATION OF PLATE I

- Fig. 1. Ratios of cortical lipid band to permanent cortex in normal male mice. Ordinates: permanent cortex (ten units); abscissae: age in months. For details, see text.
- Fig. 2. Ratios of cortical lipid band to permanent cortex in normal female mice. Ordinates: permanent cortex (ten units); abscissae: age in months. For details, see text.
- Fig. 3. The entire cortex is occupied by lipid, stained dark by Sudan III. The fibrous capsule and the medulla appear light. The edge of the medulla is smooth, as in all adult mice. From a male aged 201 days. $\times 80$.
- Fig. 4. Sudanophil lipid forms a narrow dark strip in the outer part of the cortex. The rest of the cortex appears lighter than the medulla. From a female aged 201 days. $\times 30$.
- Fig. 5. From the same gland as fig. 4, showing a narrow strip of lipid-free cortex between lipid band and capsule. The edge of the medulla is smooth. $\times 80$.
- Fig. 6. The sudanophil lipid is irregularly distributed. It is most irregular in the inner part of the cortex. Lipoid reaches the capsule at a few points. From a male aged 141 days. $\times 60$.

Photographs by H. C. Taylor.

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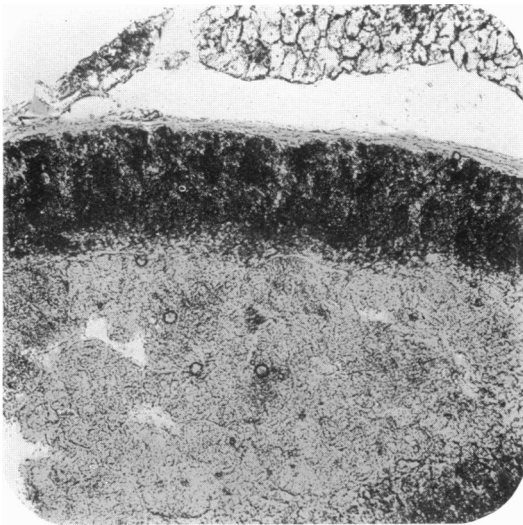
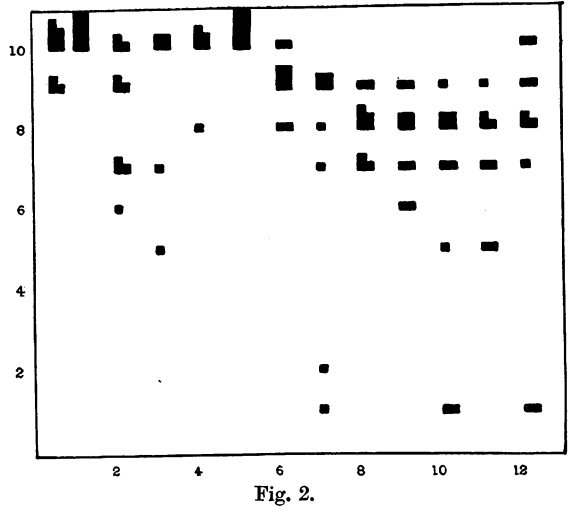
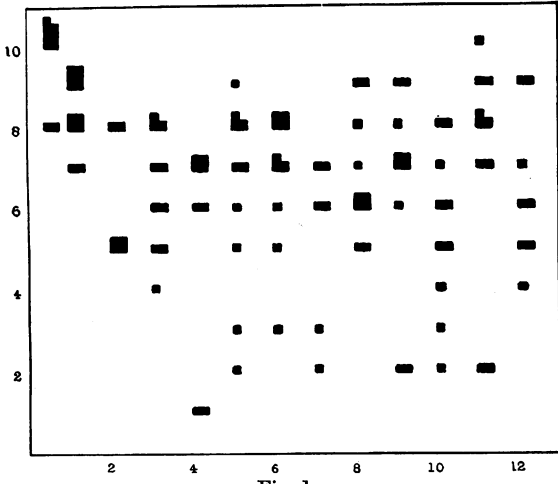


Fig. 3.

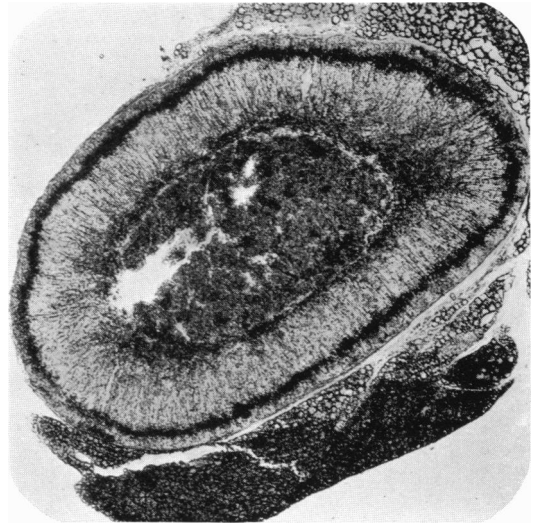


Fig. 4.

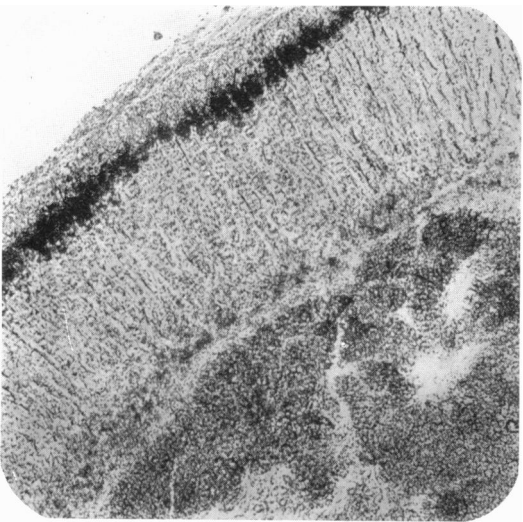


Fig. 5.

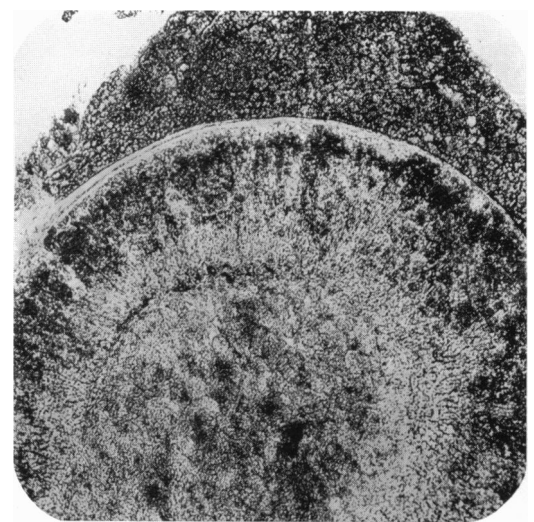


Fig. 6.