Hemopoietic System.

Lymphatic Glands.

The lymphatic glands of the neck, the only ones which I examined, vary in size from quite minute bodies, to glands the size of a kidney bean, which they resemble in shape. They are surrounded by a capsule of fibrous tissue which is reflected in at the hilus around the blood vessels which enter the gland at that point; it is composed of two layers; the outer fibrous, dense and full of fat cells; the inner more delicate, devoid of fat, but full of, unstriped muscle fibres, and lymphatic spaces.

This capsule sends upwards delicate lamelliform processes which divide the gland up into wedge-shaped masses in the cortex, but which break up into a fine cord-like network in its medulla.
These processes are extremely fine and difficult to see, the only conspicuous fibrous tissue being that round the larger blood vessels, which contains numerous unstriped muscle fibres and many connective tissue corpuscles, it is an eminently cellular connective tissue in many cases.

The gland substance proper lying in the loculi of the cortex is arranged in a nodular form, and consists of numerous lymphatic corpuscles lying in the meshes of a delicate plexus of connective tissue. These masses do not come into close contact with the fibrous tissue of the peptid being separated from them in all cases, as also from the capsule, by a lymphatic space or pericaps, which is peculiar in being bridged across by numerous fine strands of connective tissue continuous with the capsule or peptid on the one hand and with the reticulum on the other.
In the medulla of the gland where the fibrous tissue is split up into a network, the gland substance proper is also split up into a branching network of thick strands, conspicuous by the deep stain which they exhibit when treated with nuclear dyes.

This gland substance proper is everywhere separated from the connective tissue by lymph channels, bridged across, like those of the cortex, by strands of fibrous tissue. This network arrangement gives a very open appearance to the medulla of the gland, as compared with that of the cortex, which only comes to the surface at the hiles.

Stroma of the Gland.

Kolliker (51), Leydig (52), Soldt (53), Frey (54), Krause (55), Orth (56), Schäfer (57), and others, state that the fine reticulum found in the gland substance proper, and bridging over the lymph sinuses is composed of branched cells which anastomose by their
processes, most of the cells being im-
celed 8. Ellenberger (5-8) Svedofh
Prezioso (5-9) Ranvier (60) Klein (47-63)
and Hoye (61) state that this reticulum
is composed of connective tissue fibres
on which clasping cells of connective
tissue may be found. Hoye (61) especial-
ly by digesting the gland in glycerin-
pancreatic extract, and washing, was
able to get rid of all the cellular
elements, leaving a beautiful fine
network of fibrils of connective tissue
which he figures. I concur with
this latter view, and though I have
not digested any glands, I have
seen the cells distinctly clasping
the fibres, and have even seen,
both in the ox and cat, though not
distinctly in the hedgehog, cells
partially detached from the fibres,
holding on only by the tips of
their clasping wings.

**The Cortical Modules.**

These modules which vary considerably
in size present three well marked
and fairly distinct parts. In the centre there is a pale-looking area, called by Flemming (62) the "Kelvin continuum," that is "Germinal Centre," which varies in size in different cases and consists of cells with a relatively large amount of protoplasm, surrounding a centrally placed nucleus. Between these cells ordinary lymph corpuscles may sometimes be seen. Many karyoskemetic figures are seen in this centre, both of small pipe and imperfect, nevertheless with appropriate nuclear staines they may be recognized in large numbers. This was pointed out by Flemming in the ox, etc., and owing to the great amount of mitosis which he observed in the pale areas, he spoke of them as germinal.

Immediately outside this a zone of densely packed, small lymph corpuscles may be seen, which with nuclear staines stands out as a conspicuous and distinctly marked
circular band from the enclosed germinal centre. Mitotic figures may be seen in this zone, but only spar-

singly scattered.

Outside this zone and extending to the edge of the nodule there is a tissue similar to that of the zone, but less densely packed, where many mitotic figures may again be seen, but not in such numbers as in the germinal centre.

Hemming (62) believes that the lymph corpuscles are produced here by indirect nuclear division, and are then pushed outwards towards the lymph perivas, into which they eventually penetrate, some of them again dividing just before reaching it. He bases this theory on the fact, that blood capillaries are as numerous in the germinal centres as elsewhere, and that the walls of these vessels are loose, and open readily, to allow of the escape of per-

sum. In the larger germinal areas,
I have observed arterioles as well as capillaries, a fact not noticed by
this system observed in the case of the ox by Hemming (6). This porosity
of the capillary walls would, according to the latter author, produce
increase of extravasation, and so increased pressure in the centre of
the modula, which would necessarily
drive the young cells from it towards
the periphery; this great increase
of plasmas might also account for
the greater activity of the cells in
this region.

The lymph sinuses.
These channels vary considerably
in pig and are lined throughout
by endothelial cells as shown by
Klein (47) and others, by the injection
of silver nitrate. They contain besides
the fibrous threads which stretch
across them, and the connective
tissue cells clamping the threads;
many cells; pie different kinds
having been pointed out by Hoger (6).
which are as follows:

(1) Lymphocytes proper (a fig. 24 Pl. xvn.)
in large numbers.

(2) Somewhat larger corpuscles (b, fig. 24.
Pl. xvn.), similar to the lymph corpuscles
except in size and amount of
surrounding protoplasm, they resemble
those of the germinal areas,
without however necessarily being
identical with them.

(3) Granule cells of Heidenhain (49),
which are identical with the eosino-
philous cells of Elsleich (48 b),
which he looks upon with Heidenhain as de-
generating white blood corpuscles.

(4) Lymphocytes in process of degenera-
tion or disintegration of Heidenhain (47),
which are not numerous.

(5) Phagocytes (a, b, c & d, fig. 30. Pl.xvn.)
which vary in form and size and contain
either red blood corpuscles or some pro-
duct of their decomposition, usually
in the form of yellow coloured gra-

ules, also breaking down leucocytes,
and other effete matter. When treated
with Barretts reagent or ammonium sulphide they give no iron reaction.

Of these five sorts of cells (1) and (2) are found in all parts of the gland, (3) only in very small numbers in the glands of the neck, and confined to the pedicles and medullary stromas, chiefly congregated round the larger blood vessels; (4) in pedicles and medullary stromas, often in little clusters, and (5) in pedicles and medullary stromas, either isolated or in clusters, and very common in the glands of the neck. Remarking (6) mentions that pigment holding cells are found in, though not confined to, the germinal centres, which are in doubt identical with Heyer's phagocytes.

In the hedgehog all these cells exist as described by Heyer (1 and 2) abundantly, (3) and (4) only in very small numbers; (5) in abundance, though as often as not devoid of pigment, and fairly numerous in the sinuses,
medullary strings, and germinal centres, rarely in the zone or outer part of the cortical nodules.

Besides these another form of cell may occasionally be met with in the prineses, cortical nodules, medullary strings, capsule and trabecular, that is in all parts of the gland with the exception of the germinal centres, where I have never seen them; they are the coarsely granular corpuscles, the nucleus of which remains almost unstained though their large granules become deeply tinted with any basic amilin dye. (C fig. 30 Pl. XVIII). These cells which have been described in other parts under the name of plasma cells, are not very numerous in the lymph glands of this animal.

How Hoeger came to overlook these cells is surprising, as they are present in large numbers in the lymph glands of most animals.

The Medullary Stripes or Cylinders. They have the same structure as
the cortical modules but present no
germinal areas in their interior,
many mitotic figures may be seen
in them as well as blood vessels.
They are large when compared with
the size of the gland and are surround-
ed by wide perimeses.

**Blood Vessels.**

The arteries enter the gland at the
hilus, break up into branches that
run in the fibrous tissue of the medul-
la and finally penetrate the cortical
modules as arterioles, to reach the
germinal centres where they finally
break up into capillaries; other branches
center the medullary stroma which
by their means are richly supplied
with blood.

The blood of the organ is returned
by veins, which for the most part
accompany the arteries and leave the
gland at the hilus.

**Lymphatic Vessels.**

The lymphatic vessels enter the
 gland at many points, breaking
up into a dense network of lymph
channels and passages in the inner
layer of the capsule, they eventually
open into the cortical lymph sinuses,
and as these communicate directly
with the meshes of the gland sub-
tissue proper the whole tissue is
bathed in lymph. The lymph is
carried away from the organ by
a single large lymphatic vessel
which leaves it at the hilus. The
outgoing lymph is richer in lymph
corpuscles than that entering the
gland.

I see no reason to doubt the conclu-
sion arrived at by Forbes (67) that
lymph glands not only produce lymph
corpuscles, but also help to destroy both
old lymph corpuscles and red blood
corpuscles, by which means they
act as very efficient filters of the
lymph stream.
Changes occurring in the lymph glands during hibernation.

The germinal centres of the cortical nodules are as a rule rather larger in winter than in summer and present hardly any karyokinetic figures, showing that they are, like most other tissues of the body resting, perhaps their large size may indicate that they are stores, so to speak, ready, on the awakening of the animal, to produce rapidly great numbers of young lymph corpuscles, to replace those that may have been destroyed during the long repose of winter.

Of the various cells, both the large and the small lymph corpuscles appear to be undiminished in number; but the phagocytes have become very numerous indeed and may be seen in all parts of the gland, with the exception perhaps of the capsule; they often occur in groups of several together, (as fig. 31 Pl. xix) each cell may
contain one or more nuclei, usually only one, which is large, elongated, and oval and stains of a faint lilac colour with haematoxylin. Cells with two or even four nuclei are not uncommon. They vary much in shape and size and contain debris of every description, such as red blood corpuscles in various stages of degeneration, pigment in great quantity, dispersed throughout the protoplasm, which possesses an indistinct network, or accumulated into little masses apparently lying in vacuoles. (a, b, c, d, fig. 30 Pl. XVIII.) The pigment may be yellow, orange, or brown in colour, and is usually granular in form, the granules varying in size, some being hardly visible, others being very large and conspicuous objects, even however appears to give the characteristic zinc reaction with ammoniacal sulphide or Barretts reagent.

That red blood corpuscles are broken down in these cells there seems to be no doubt, for they can be seen
in them in all stages of disintegration, but the fact that no iron-holding granules, which one would expect to result from the destruction of such cells, are to be seen is remarkable, possibly the iron of the haemoglobin may be converted into some soluble form, and so disappear, or may be stored up in some way for future use, either in these glands, or in some distant part of the body where it may be available for the reproduction of haemoglobin when required.

Colourless crystals are present though rarely in some of the cells, which may likewise contain bodies resembling degenerating white blood corpuscles, and others which stain either eosin yellow, violet, blue or red with the various stains in common use, whilst these bodies may be it is almost impossible to say; they have all been described by Hugo, and no doubt vary considerably in composition.
Occasionally cells may be found, during liberation, which are very large, and present an accumulation of nuclei; I have named these cells "giant-cells." The nuclei, in each of which is a nucleus, are gathered either to one side or lie in the centre of the cell; they suggest a very rapid nuclear division accompanied by division of the protoplasm. (Fig. 32 & 33 Pl. XIX).

This rapid proliferation may possibly be caused by the ingestion of some irritating, stimulating or poisonous substance from the lymph, which, by acting on the cell would cause some alteration in its nutrition.

Giant-cells are by no means common and occur as a rule in the genera only; they vary much in size and number of nuclei; and their protoplasm may or may not contain pigment granules and other debris like that of the usual phagocytes, but whether they are derived from these or are to be...
looked upon as separate elements. I am at present unable to state, but I am inclined to think that they are in reality derived from phago-
cytes, as they contain similar bodies and behave in a similar manner in the presence of staining reagents; moreover they are entirely absent from the glands in summer.

Besides the pigment granules contained in the phagocytes and granular cells, there are also numerous, highly refractile, bright yellow granules floating free in the lymph stream or attached to the cells of the stroma in various parts of the gland. They do not show any acid reaction, and may eventually find their way into the phagocytes to become digested or altered by them. I have not observed these free granules during summer.

The great increase of coarsely granular cells which occurs in these glands during hibernation is
also remarkable, as in other parts of the body they either disappear or diminish greatly in numbers during this period, but in the lymph glands they may be found sometimes in great quantities both in the perivasae and in the tuberculae around the large blood vessels. I am quite at a loss to account for this, as they do not appear to be dissolving or undergoing any other change.
Spleen.

The spleen of the hedgehog is surrounded by a capsule of fibrous tissue in which numerous elastic and un-striped muscle fibres are scattered, and on the outer surface of which there is a covering of somewhat cuboidal-adhesive cells belonging to the general peritoneum of the body cavity.

The capsule is reflected in at the hilus around the blood vessels and nerves which enter or leave the organ at this point; from it, numerous somewhat coarse trabeculae penetrate into the gland, forming a fine connective tissue network throughout it. The trabeculae which vary in size are most numerous and largest near the hilus; like the capsule they consist of ordinary connective tissue elements, the elastic being present in large amount, but the most conspicuous feature is the number of unstriped
muscle fibres which they contain, so numerous indeed are they, that at first sight one would be apt to think the trabeculae almost entirely composed of them. Nerves, blood vessels, and a few lymphatics are found in the trabeculae, and lymphatics are also present in the capsule.

**Maltzeglein Corpuscles**

When the arteries leave the trabeculae to enter the general spleen substance or pulp, they break up into fine branches which have somewhat large masses of lymph follicular tissue developed in connection with their walls.

These masses of lymph follicular tissue, the Maltzeglein corpuscles, present a loose, pale staining centre, composed of somewhat large cells, loosely packed together and in which numerous lymphokinetic figures may at times be seen, which, though imperfect, mark the development of lymph corpuscles in this region, hence
the term "germinal centre" has been applied to it.

Outside this central mass a more deeply staining zone is seen, which consists almost entirely of closely packed, small, uninucleated cells, the nuclei of which stain very deeply with nuclear dyes and are surrounded by only a very small amount of faintly staining protoplasm. Some of these cells may also be seen undergoing indirect division.

At the outer edge of this zone but by no means distinctly marked off from it, is a slightly less dense mass of similar cells, which constitutes the peripheral part of the Maltzian corpuscle.

Each Maltzian corpuscle is surrounded by a capsule of unstriped muscle fibres, arranged in two or three layers, but forming a by no means continuous coat, there being very numerous intervals between the fibres giving the capsule a spine-like appear-
ance. The corpuscles are mostly
rounded or oval in shape, and capil-
aries ramify in them.

The Pulp.

The interstices between the tra-
beculae are filled with a soft red
material, the splenic pulp, which
consists of red blood corpuscles, mixed
with other cells; in it there is a
reticulum of connective tissue cells,
the long processes of which anastomose
to form a fine network, continuing
in many places with the fibres of
the trabeculae. This reticulum
appears very similar to that of the
lymph glands, though all agree that
it is composed of branching cells and
not of fibres with clasping cells on
them; it is difficult to believe
however that such long strands,
as occur in some parts of the boc-
hog's spleen, can be merely cell
processes, and I am inclined to
think that ultimately some of them
may prove to be connective tissue
jellies.

The pulp contains about ten different kinds of cells, as follows:

1. Red blood corpuscles.
2. White blood corpuscles of the usual type, of which however there are comparatively very few.
3. Lymph corpuscles similar to those of the Maffei-Leitzen body, already described. (A fig. 34 Pl. xx)
4. Somewhat larger cells, the nuclei of which are more conspicuous, of larger size, and present greater affinities for various nuclear dyes; they are surrounded by more protoplasm than the lymph corpuscles proper. (B fig. 34 Pl. xx)

These cells are very numerous in the splenic pulp and are similar in appearance to those of the germinal centres.

5. Cells very like lymph corpuscles and of the same size, which however unlike them, stain very deeply with

Brewster's triple stain, their nuclei becoming of a rich emerald green and
their protoplasm a deep red; with eosine they stain bright pink, they are found in the sulci and germinal centres, but are most numerous just under the capsule of the organ; they are probably identical with the cells described by Heidenhain (49) as degenerating hemocytoblasts. (lymph corpuscles?)

(b) Eosinophilous Cells.

Cells of rounded form, larger than any yet described, the protoplasm of which appears to be composed of small granules, that readily take on a deep red stain with eosine and other similar anilin dyes; they present usually two or more nuclei and are identical with those described by Heidenhain, Ebner, and others. (fig. 34 pl. xx)

They are said to be degenerating cells.

(c) Cells which stain of a bright orange red with eosine and of hyaline appearance, which seem to be composed of large granules, and contain a single deeply staining nucleus.
They are irregular in shape and seem almost entirely confined to the point of junction between the germinal centres and condensed zone of the Malpighian corpuscles. They are very rarely met with, only one or two being seen in each section. (e fig. 34 Pl. xx)

(8) Splenic Cells.

In this animal the splenic cells are small and very inconspicuous objects, that stain of an orange colour with eosine and haematoxylin, and present one or more violet-staining nuclei; they are rounded or oval for the most part, in shape, and contain various substances in their protoplasm.

These consist of various debris, such as, golden yellow or brown pigment granules, bodies which stain pink with eosine, and others which stain pale blue-violet with haematoxylin; their function appears, as is usually believed, to be that of phagocytes.

They are scattered throughout the pulp of the organ, but are most me...
merous just under the capsule, they
seem to be absent from the multi-
glandular bodies. (F fig. 34 Pl. xx).

(G) Giant Cells.

Very common in the spleen of some
animals, though entirely absent from
that of man. They consist of a large
irregular mass of granular protoplasm,
staining deeply purple in eosine and
haematoxylin and containing numer-
ous nuclei, which stain of a violet col-
our and appear irregularly placed
in the cell. (D fig. 34 Pl. xx) When
however these paraffin-cut section are
examined, the arrangement of the
nuclei seems more definite; there is
generally one, sometimes two oval nu-
clei situated in the centre, around
which the others are grouped, apparently
in the form of a more or less perfect
sphere, while in sections they the
form of an irregular ring. All the
nuclei resemble each other and con-
tain single nucleoli, they may be
situated in the centre or near the
surface of the cell. (fig. 35 Pl. xx).

The protoplasm of the cell often presents an appearance of vacuolation, which may however be artificial, due to change of the cell in the process of hardening. These vacuoles are irregular in shape, and for the most part colorless, but in specimens stained with benzol-purpurin 15 and acid haematoxylin, some which have a rounded appearance, stain of a citron-yellow color, which is highly suggestive of red blood corpuscles. (fig. 36 Pl. xx)

Besides these, various bodies like nuclei may be seen in the protoplasm, which stain of a faint blue-violet color with the same dyes; they are irregular in shape, clear in appearance, and present at their edges what seems to be remnants of a broken-down plasma.

From the foregoing it would appear that these large cells also play the part of phagocytes, eating up the effete cells of the blood; they are en-
tinely confined to the splenic pulp, and are often found in groups of three or four cells, but are never so numerous as the splenic cell, and appear to contain no pigment granules; from which I think we may conclude that the granul cells attack the cells of the blood and destroy them whilst the splenic cells are chiefly concerned in the elimination of the products of already broken down blood corpuscles. Time has failed me however to fully work out this problem at present.

(10) Coarsely granular basophilic cells exist in small numbers in the splenic pulp, and may be recognised by their granular appearance, irregular shape, and pale nuclei. (E fig. 34, Pl. XX)

Immediately under the capsule of the spleen is an irregular, coloured mass, which in places is almost wanting, but in others is very thick. This tissue which is present in the spleen of many animals, though apparently different from that of man,
seems to consist of a condensed stroma, the meshes of which are filled with altered blood corpuscles. Many nuclei are present in it, suggesting at times, by their enormous numbers, a subcapsular Mallphagan body. This tissue behaves towards different staining agents as shown in the table on the following page, from which we see that the stroma stains in a similar manner to that of the pulp generally, that the nuclei stain very deeply, and with Giemsa's fluid appears similar to the nuclei of the cells described as (5). The colored pulp consists of blood corpuscles or figures, and this region through which an account of its function, and the closeness of its network, the blood can only circulate very slowly, would appear to be the pulp where the most active destruction of the blood elements is carried on, which is further supported by the fact that the splenic cells are very numerous in it, as are
Table of the effect of various staining agents on the Pigmented zone of the Spleen.

<table>
<thead>
<tr>
<th>Name of the Stain</th>
<th>Effect on the Stromata</th>
<th>Effect on the Nuclei</th>
<th>Effect on the Pigment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haematoxylin &amp; Rice Acid</td>
<td>Deep yellow</td>
<td>Deep Violet</td>
<td>Bright orange</td>
</tr>
<tr>
<td>Alum Carmin &amp; Rice Acid</td>
<td>Dark yellow</td>
<td>Carmine</td>
<td>Greenish yellow</td>
</tr>
<tr>
<td>Sonie &amp; Haematoxylin</td>
<td>Deep pruine</td>
<td>Deep Violet</td>
<td>Deep Citron</td>
</tr>
<tr>
<td>Safranin</td>
<td>Pink</td>
<td>Deep pruine</td>
<td>Pale orange</td>
</tr>
<tr>
<td>Alum Carmin</td>
<td>Very pale flesh colour</td>
<td>Carmine</td>
<td>Pale green base</td>
</tr>
<tr>
<td>Periodic fluid</td>
<td>Pale blue</td>
<td>Jade green</td>
<td>Pale orange yellow</td>
</tr>
<tr>
<td>Thiorhics acid haematoxy</td>
<td>Magenta</td>
<td>Deep Violet</td>
<td>Deep yellow</td>
</tr>
<tr>
<td>&amp; Benz-purpurin 15</td>
<td>Magenta</td>
<td>Magenta</td>
<td>Deep yellow</td>
</tr>
<tr>
<td>Thiorhics acid haematoxy</td>
<td>Deep pruine</td>
<td>Deep blue-green</td>
<td>Yellow</td>
</tr>
<tr>
<td>washed in acid alcohol</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Also the granulocytes diffusely stain. We have noted that certain stains, such as safranin, stain the granulocytes distinctly of red blood.
Veins.

The veins of the spleen take origin in the pulp as sinuses which are small and unnoticeable in the medullos; their walls are peri-lymph and consist of phagocytic cells which pass by invisible degrees into those of the endothelial lining of the larger veins.

The sinuses contain red and white blood corpuscles, lymph corpuscles, etc., mononuclear leukocytes, and here and there a splenic cell, but as far as I could see, no granular cells.

**Effect of hibernation on the spleen.**

The capsule and trabecular show no change; the germinal centers of the Malpighian bodies are less active, that is, fewer mitotic figures are to be seen in them. Of the elements of the pulp the large lymph corpuscles appear to be slightly more numerous whilst the of the ordinary ones has not changed; the degenerating lymphocytes of Heidenhain are somewhat increased in number, as are also the eosinophilous cells.
The phagocytes appear in large numbers just under the capsule as do also the granul cells which are much more numerous than during summer. Plasma cells however are hardly visible at all. It would be very difficult to pay whether or not there is any increase in the sub-capsular pigmented coat, for owing to its irregularity of arrangement, it appears now increased and now diminished in thickness. The reticulum of the pulp undergoes no evident change.

At the end of hibernation therefore the spleen seems chiefly concerned in the elimination of waste materials from the blood.
The suprarenal is a somewhat round-ed, elongated conical, pyramidal colored body situated immediately above the kidney, which presents a pale colored cortex and a deep purple-red medulla; the relative amounts of these two parts varies, the cortical region only slightly, but the medulla which is almost wanting at the apex of the cone, occupies the greater part of the organ at its broad end. The gland is abundantly supplied with blood vessels which are similar to, and enter the organ in the same way, as in other mammals.

The suprarenal is surrounded by a capsule of fibrous tissue in which fat, and ganglion cells, and numerous blood vessels may be seen. From the capsule fine plexure of ordinary fibrous tissue pass in towards the medulla, they are very thin, difficult to see, and become continuous with the more conspicuous connective tissuestroma of the medulla.
All blood vessels entering the gland are surrounded by a certain amount of connective tissue derived from the capsule, which unites with the thin peptic tissue alluded to, to complete the fibrous framework of the organ, which consists of ordinary connective tissue containing some elastic fibres and connective tissue capsules.

The Cortex

The cortex may be divided into three zones, in the usual manner, i.e., zona glomerulosa next the capsule, zona reticularis next the medulla, and the zona fasciculata between these.

Zona Glomerulosa

This layer which is very thin is divided into indistinct loculi which contain numbers of small, coarsely granular, irregular cells, each of which contains a nucleus that stains deeply with haematoxylin, and appears devoid of a nucleolus. The protoplasm of the cells stains deeply with eosine. (Cf. fig. 27 Pl. XXI.) The cells are arranged round capillary
blood vessels, not in horse-shoe shaped columns as in the dog and horse, but irregularly, and their shape is consequently polyhedral, instead of columnar, thus resembling somewhat those of the same region in the guinea-pig.

Some places among these cells would appear not to be portions of blood capillaries, as they contain a colloid-looking material, that stains pale-blue with haematoxylin, similar to that described by Klein as occurring in the same locality in the human fetus and adult guinea-pig.

The cells contain no pigment granules.

Zona Fasciculata.

The zona glomerulosa fades gradually into the zona fasciculata, which is at first composed of cells closely packed together giving a solid look to the tissue, which however soon opens out, the cells arranging themselves in vertical columns with blood vessels and lymphatic vessels between.

The cells vary much in shape, towards
the cortex they are very long, (f. fig. 37 pI.XX1)
but gradually become smaller to-
wards the inner zone; whereas their
prize they are all polyhedral in shape,
perforated by an envelope, granular
in appearance due to their somewhat
coarse protoplasmic network which
which stains deeply with hemine and
contains a single nucleus.
The nuclei vary in size, some less
depth, than those of the outermost
layer, exhibit a capsule and nuclear
network and usually a single, sometimes
a pair of deeply staining nucleoli.
No pigment granules are found in
the cells of this zone in the hedgehog.
Now and again a larger cell may
be seen: the nucleus of which is sur-
srounded by much protoplasm. (g. fig. 38
Pl.XX.11), or the nucleus may also be
increased in size, nearly filling the
enlarged cell, and contain two nucleoli,
either separated from each other, or
united, by a strip of nuclear material,
suggesting the occurrence of recent
division, the chromatin substance of the nucleus at the same time be-
ing more visible, giving it a very
coarsely granular appearance (cf. fig. 38
Pl. XXII). Such large cells are to be
met with, though sparingly, in every
section.

In the neighbourhood of the zona
reticularis, a little golden-yellow pig-
ment may be seen in the spaces be-
tween the cells, which are not neces-
sarily blood capillaries, but appear
rather to belong to the lymph system
as suggested by Klein (47a).

The line of junction between this
zone and the zona reticularis is ir-
regular, as these layers encroach
upon one another alternately.

Zona Reticularis.

This zone, which is narrow varies
in thickness, as it projects into the
zona fusculcularis in an irregular man-
ner; its cells may be easily distinguished
by their small size and conspicuous
nuclei; they are closely packed into
columns which anastomose with each other to form a network.

Each cell is small, polyhedral in shape, faintly granular in appearance, owing to the fine nature of the cell network, which does not stain at all readily with eosine, and contains in its centre a single large, granular nucleus, smaller in size than those of the zona fasciculata, but which, owing to the small size of the cell, appears relatively very large and is more deeply stained than those of that zone, but less deeply than those of the zona glomerulosa. (R. fig. 37 Pl. xxI).

By the close packing of the cells, this zone appears distinctly blue when viewed with a low magnifying power, by which it is at once recognised, as the other zones appear pinkish in colour.

Between the columns of cells are numerous capillary and lymph vessels, in the latter mass of pigment ground, more occasionally be seen, but the cells
themselves contain no pigment.

When any large blood vessel penetrates the cortex, it is surrounded by cells of the zona fasciculata, which extend through the zona reticularis into the medulla of the organ, and may there be seen as little clusters of granular cells irregularly arranged round the large central vein.

**Medulla.**

In the hedgehog, according to Sheehy, the medulla consists of plexiform cords, processes from which extend into the cortical substance, as may be seen in almost any section.

These cords are surrounded by a delicate connective tissue in which are a few connective tissue corpuscles. Processes of this tissue fan towards into the cords, further splitting them up into loculi of variable size, so that the whole cord comes to have a fine reticular structure, consisting of anastomosing connective tissue fibres in which may be seen a
few clusters of cells. A cell is situated in each locusus if small, if large it may contain several, which appear somewhat irregularly columnar in shape, with granular protoplasm, staining pink in eosine, and usually shrunken in hardened preparations, around the nucleus which is large, pimple, rounded in outline and contains a nuclear network, but no nucleoli. During life the cells no doubt fill the spaces in which they lie.

Among the cells a few blue-staining, colloidal masses may be seen, similar to those of the glomerular zone, but no pigment granules are present in the cords or in any other part of the medulla. The cords are placed round numerous large venous pouches, of which the largest occupies the centre of the organ.

Changes occurring in the organ during winter sleep.

During hibernation the cells of the zona glomerulosa appear very cloudy and
their nuclei stain with difficulty; here and there immediately under the capsule masses of yellowish material may be seen which appear to consist mainly of debris, suggesting cell destruction.

The zona fasciculata seems to be diminished in extent, the zona reticularis often reaching up almost to the zona glomerulosa, which gives a wavy, mottled appearance, to well stained preparations, under a low magnifying power. The cells with large nuclei already alluded to are seen in increased numbers.

In the lymphatic spaces between the cells of the zona reticularis, the masses of yellow pigment granules, of which there are always a few in summer, are much increased in size and number; (pág. 34 Pl. xx11) so doubtless this organ plays an important part in the elimination, alteration or storage of the pigment during hibernation.

The blue-staining colloid material has entirely disappeared from the medullary stripes, though now some
yellow granules are occasionally present.

The changes in this organ as in the spleen are therefore very slight.
The Bone Marrow.

During the summer months the marrow of the long bones is red in colour and very fluid; during autumn, and the beginning of hibernation, it is more solid and contains some fat, and in spring, towards the end of winter sleep, it is very solid, fatty, and can be withdrawn from the shaft of the bone as a cylindrical mass almost entirely yellow in colour, the result of fatty degeneration having occurred in many of the cells.

If the marrow be minutely examined, it will be found to consist of numerous cell elements varying in size and character, and at different times of the year in numbers also.

During summer one may recognize, amongst others, the following kinds of cells:

1. Ordinary small marrow cells.
   These cells do not stain deeply with ordinary basic anilin dyes, and are
present in extraordinary numbers; they vary much in size and in the number of nuclei present in each, and may be seen dividing by karyon-mitoses. Few only of the nuclear figures produced are perfect, most are irregular and a few exhibit club-shaped thickenings of the ends of the chromatin threads. (a, figs. 40, 41, 42 Pl. xxi.)

(2) Scarcely less abundant than the foregoing, are the ordinary white blood corpuscles, which may be distinguished from them by the intensity with which their nuclei stain with basic aniline dyes. They exhibit the usual characters presented by such cells in other parts of the body, and are seen to possess from one to six nuclei, varying in shape and arrangements in the cell. (b, figs. 40, 41, 42 Pl. xxi.)

(3) Cells which become very deeply and homogeneously stained with basic dyes, and have the appearance of isolated nuclei; they vary greatly in size, but are usually rounded
in shape, and are present in family large numbers. (5., Figs. 40, 41 & 42 Pl. xxxi.)

Some of these cells may be uninucleated white blood corpuscles, but others are far too large to be accounted for in this way.

(4). Cells often of considerable size which have a washed out appearance when stained with basic fuchsin, and present a homogenous pale pink colour, slightly intensified at their margins, they seem to contain no nuclei and may possibly be degenerating large marrow cells. They are never very common except towards the end of hibernation. (5., Figs. 40, 41 & 42 Pl. xxxi.)

(5). Large marrow cells.

These cells are very numerous, and present a faintly staining, finely granular protoplasm surrounded by a thin envelope. In the protoplasm is a granular nucleus which stains more deeply, and which varies in size and shape, being now spherical, now horseshoe-shaped, now biped, and now
even divided into two. The cells often exhibit a form of mitosis in which the figures are composed of a multitude of rods of irregular shape; Arnold says that they divide by indirect fragmentation, exhibiting no distinct monastric figure, but the chromatin, which stains slightly, becomes diffused through the nucleus; after a time differentiation occurs, daughter nuclei appear, and the cell then divides up, some protoplasm going to each nucleus, either suddenly or more slowly.

(d. figs. 40, 41 & 42, Pl. xxiii)

(6). Giant Cells of Sartor.

These cells which vary much in size and are not very numerous in summer, consist of a faintly granular protoplasm, which stains with difficulty, and in which there may be a single large somewhat evanescent granular nucleus, or a lobulated mass, which is granular and stains like the nucleus. This lobulated body may sometimes be very large occupying...
the greater part of the cell, or may be very small and nearly homogeneous in appearance. Demay (65) looks upon these cells as macroplasts for the ordinary small marrow cells, and believes the lobulated mass to be filled with a number of small marrow cells derived either from the nucleus or the protoplasm of the cell, or perhaps from both, and that after a time they rupture the parent cell and escape into the marrow. He gives many elaborate figures to uphold his theory. Though the lobulation is evident enough, yet I have failed after diligent search to find any appearances confirming his views, and think that much further proof is necessary before they be fully accepted.

I have drawn a few of these cells in various stages in, (b. fig. 41. Pl. xxiv), and fig. 43. Pl. xxiv and also in fig. 44. (Pl. xxiv)

(f) Nucleated red blood corpuscles.

They are of about the same size as
ordinary red blood corpuscles, but stain very deeply with acid fuchsin; in each is a large rounded nucleus, homogeneous in appearance, which stains intensely with basic dyes; they may be seen dividing by the mid-metaphase method, but are by no means numerous when compared with the other elements of the marrow.

(8) Ordinary red blood corpuscles, which are present in very large numbers. (e.g. figs. 40, 41 & 42, Pl. xxi.)

(9) Plasma cells.

Coarsely granular basophilous cells are not very abundant, but exhibit their usual characters, and may sometimes possess two nuclei, suggestive of cell division; but owing to the quantity of deeply staining granules with which the cell protoplasm is filled, I have been unable to make out any homogeneous figures in them. (f. figs. 40, 41 & 42 Pl. xxi., and fig. 43 Pl. xxiv)

(10) Eosinophilous cells.

Similar to the basophilous cells
in appearance but often of larger size, the granules with which their protoplasm is crowded, stain only with acid anilin dyes, especially acid fuchsins, and the nucleus which may be single or multiple hardly stains at all. These cells do not appear to be identical with the eosinophilous cells of Ehrlich. During summer they are not more numerous than the plasma cells. (J. Roy. 42. Pl. xxv)

(11) Fat cells of the ordinary type, which vary in numbers at different times of the year.

At the end of autumn, a period at which the animal is about to hibernate, or has only just begun to do so, all the cells of the marrow appear increased in numbers.

Granulocytes and basophilous cells are very conspicuous by their relative frequency and the eosinophilous cells especially so: the deeply staining homogenous cells and the nucleated red blood corpuscles are relatively only slightly increas-
ed; the red and white blood corpuscles, the large and small marrow cells are present in relatively the same numbers, but the washed out cells appear to have considerably decreased.

In spring, towards the end of hibernation, there is a great diminution in the numbers of all the cells, with the exception of fat cells, of which the greater part of the marrow is then composed. Red and white blood corpuscles, and small marrow cells are still the most numerous, closely followed by the washed out cells, which may be seen of various shapes and sizes, their margins very deeply stained, they are, no doubt, some form of degenerated marrow cell. A few large marrow cells may be seen still undergoing division; basophils cells are present in diminished numbers and seem to be degenerating as their granules are not crowded and look few in number; some giant cells and one or two nucleated red blood corpuscles may be met with, as well as
homogeneous deeply staining cells which are fairly numerous and eosinophilic, cell in great quantity.

There are no granules of pigment free in the marrow of the long bones.

The sternal marrow during hibernation resembles that of the long bones, but is less fatty and more liquid, it appears not to contain granules holding granules, though such granules were found by Dietzsch [2:3] in the sternal marrow of hibernating marmots.
The Blood.

Samples of blood taken from animals at frequent intervals were examined, both fresh and after preservation in films, which were stained and mounted in various ways.

The blood elements vary in numbers rather than in appearance at different times of the year. In a former chapter I have given the numbers of both red and white corpuscles at different seasons, and therefore need only allude to their characters.

Red blood corpuscles.

They are of the usual shape but of very small size, only measuring some 3 μ in diameter. (e.g., figs. 45 & 46, Pl. XXV). 

White blood corpuscles.

Never very numerous as compared with the red, but are of relatively large size, measuring usually 6 μ or 6.5 μ in diameter. They contain
the usual one to pix nuclei which vary much in shape and arrangement, often giving rather grotesque appearances to some of the cells (b, Fig. 45 pl. xxv).

**Blood Plates.**

The blood plates which are numerous may be isolated or collected into groups (c & d, Figs. 45 & 46 pl. xxv). They are rounded or oval in form, from 1.5 to 2.5 μ in diameter, and stain a pale tint with basic dyes; possibly they may be identical with the albocytes of Edington (67).

**Other Elements.**

Some corpuscles a little larger than the red, and which stain somewhat irregularly with basic dyes, but with about the same intensity as blood plates, may occasionally be seen (f, Fig. 46 pl. xxv). They appear to be red blood corpuscles in process of disintegration; why they should stain and have the appearance presented in the figure would be difficult to say; but if
blood plates are truly converted into red blood corpuscles as many believe, the red cells exhibit the same reaction to dyes both before the production and after the removal of haemoglobin from them.

Lastly, an occasional plasma cell, similar to those found in the red marrow may be found circulating freely in the blood stream, they are never very numerous, appear only in summer and present their usual characters. (cf. fig. 45 Pl. xxv)

In October the number of blood plates seems further increased as one would expect, as they are no doubt developed for the formation of the red corpuscles which, as elsewhere shown, are rapidly becoming more numerous at this time of the year. White blood corpuscles appear however in slightly diminished numbers.

In March, that is well on in hibernation, the red corpuscles diminish in number, and many small
ones varying from 1.5 to 2 μ in diameter may be found among these of normal size so that the blood seems full of them; blood platelets also are fairly numerous and vary considerably in size; white blood corpuscles are present in fair numbers, many being uninnucleated, but the majority exhibit four resting nuclei; and plasma cells are entirely absent.
The so-called Hibernating Gland.

The hibernating gland, which is a bilateral structure, consists of a lobula\-ted orange-brown mass of tissue, situated chiefly in the axilla which it completely fills, but also extends into the neck and along the spinal column posteriorly.

The axillary portion is roughly triangular in shape, with the apex directed upwards and forwards to become continuous over the sternal end of the clavicle with another similar mass lying on the surface of the sterno-mastoid muscle, and in the septa between it and neighbouring muscles. This portion also invests the external jugular vein.

On cutting through the sternal attachment of the sterno-mastoid, a prolongation of the gland is seen beneath it, extending downwards behind the scapula to the middle line of the back where it reaches
to the spinal column and passes down it for a little distance.

The axillary portion of the gland has a well-marked ganglionic mass in connection with it, and is supplied by large nerve trunks, which are the cutaneous branches of the third, fourth, and fifth intercostal nerves. The remainder of the gland is supplied by twigs from the cutaneous branches of the cervical nerves.

The blood vessels of the gland are derived from the corresponding intercostal and cervical vessels and from the inferior thyrocervical artery.

The hibernating gland which has nothing whatever to do with the thymus, varies much in size at different times of the year; it is largest at the commencement of winter-sleep, being equal to about 3.04% of the total body weight, and diminishes rapidly during the early part of hibernation; by January, that is three months after its onset,
I found it had decreased to about 1% of the total weight of the animal, and by the end of March to about 0.9%.

These figures represent average percentages only. The gland is never totally absent but during June and July is reduced to a small reddish mass situated in the apex of the axilla.

The Capsule.

Each division of the gland is surrounded by a fibrous capsule of varying thickness which pends in peripar, dividing the organ into lobes and lobules.

The capsule and peripar consist of ordinary connective tissue, containing some elastic fibres, connective tissue corpuscles, and fat cells in varying quantity; where thick it produces considerable thickening of the capsule. Blood vessels and nerves ramify in it, though not abundantly, and it is reflected in as a fibrous sheath to the blood vessels which pass into the gland.
The Lobules.

The lobules are composed of somewhat polyhedral or rounded nucleated cells with a distinct envelope, (e., fig. 47 Pl. xxvi) surrounding a granular protoplasm which exhibits a delicate loose-meshed network, (p., fig. 47 Pl. xxvi) in the meshes of which various sized droplets of fat may be seen. (f. fig. 47 Pl. xxvi)

There may be many small droplets, rounded or elongated in shape, in which case their long axes are often disposed transversely in the cell, or there may be several larger rounded masses of fat, or only one big drop occupying nearly the whole cell, in which a little protoplasm however remains.

The protoplasmic network which is at first close and perfectly regular, gradually becomes less regular, and more and more open, and if the fat be dissolved out with ether, a vacuole is produced in which there is no network, showing that the fat has entirely replaced the cell protoplasm.
There is a single nucleus in each cell which is rounded or oval, possesses an envelope, is structureless and stainless homogeneously (n, fig. 47 Pl. XXVI).

**Origin of the cells.**

The cells arise, as may be seen at the margin of the lobules, from small round, nucleated, very granular connective tissue cells, not bigger than red blood corpuscles. (n, fig. 48 Pl. XXVI).

These small cells gradually enlarge, the nucleus as well as the protoplasm participating in the growth, the network gradually becomes apparent, and the cells begin to stain of a dark-brown with osmic acid, indicating either the presence of fat diffused throughout, or some antecedent of fat; presently, tiny droplets of fat make their appearance, which increase in size, or by coalescing produce several large droplets. (c, d, e, f, g, h, i, j fig. 48 Pl. XXVI) or they may even run together into one big drop which occupies the whole cell.
a little protoplasm only remaining under the capsule in which is the flattened nucleus. This latter appearance is rare one, and the protoplasm is never so reduced as in ordinary fat cells, a hollow sphere of some thickness, always being present.

The cells vary in size from 30 μ when quite young to 35 μ in their long and 30 μ in their short diameter when fully grown; owing to this great increase in size the cells become united together into a compact mass, and the cells present a polyhedral outline in hardened sections.

The figures given above only apply to cells taken out of the gland; I have therefore measured many cells in hardened preparations, with Breslunski's eyepiece micrometer.

The following table gives the measurements of ten such cells which show an average of 32.67 μ for their long diameter and 32.45 μ for their short diameter; the average of both
<table>
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<th>Long Diameter in Micro-millimetres</th>
<th>Short Diameter in Micro-millimetres</th>
<th>Average in micro-millimetres of the two diameters</th>
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The nuclei vary in size from 4.95 μ to 6.6 μ with an average of 5.77 μ.

The Blood vessels.

The arteries which ramify in the pelta of connective tissue, break up into large branches for the lobules, which penetrate into their interior; these inter-lobular arteries divide into a number of smaller branches ending in arterioles, which in their
From give rise to a very fine plexus of capillary vessels, which closely surround the individual cells of the gland.

This plexus is very fine and close, and arranged in such a way that each cell is surrounded by a capillary loop, as is the case in ordinary fatty tissue. (Fig. 49 Pl. xxvii).

The blood is returned by veins which accompany the arteries and ramify in a corresponding manner. There is only one main artery and vein for each lobule.

Owing to the complicated way in which the close capillary network is arranged and the numerous anastomoses which it exhibits, the tissue, in paraffin cut sections, has an appearance like that of worm-eaten wood (Fig. 50 Pl. xxvii).

Both the capillaries and veins exhibit in their interior a colloid, somewhat finely granular, homogenous looking mass, in which individual red blood corpuscles may be in-
bedded (fig. 51 Pl. xxviii). This would suggest that a nutritive material of some kind may be produced by the gland, upon which the animal could subsist during the intermissions which occur in its winter sleep, for as is well known, fat alone is insufficient to nourish a mammal. This homogenous material is absent from the arteries, where the blood corpuscles may be seen closely packed together. Daring to the loose structure of the gland the arteries exhibit very thick walls.

Sympathetic nerves accompany the blood vessels and may be seen in the connective tissue of the gland generally, but are not very abundant or of large size.

Ganglion:

The ganglion consists of a multitude of very small, unipolar cells closely packed together (fig. 52 Pl. xxviii).

A single nerve fibre (m. fig. 53 Pl. xxviii) passes to each cell, the axis cylinder
describing one or two curves in the envelope before finally entering the protoplasm, the envelope that is seen surrounding the cell is merely a part of the grey sheath of the nerve, especially enlarged; there is no lymph space between it and the cell and no endothelial lining, such as is seen in the cells of the gasserian ganglion. (2, fig. 53 Pl. xxviii)

The protoplasm of the cell is granular and encloses a single, round, vesicular nucleus in which is a minute nucleolus. (2, fig. 53 Pl. xxviii). The ganglion is richly supplied with large nerve trunks that ramify among the cells, and which either start from or end in them.

I have stated that the cells are unipolar, though they may possibly be bipolar, but I have only been able to trace a single nerve to each; there may nevertheless be a very fine recurrent twig, which, owing to the small size of the cells, has escaped notice. The single, visible
nerve fibers does not appear to divide into two as in the gasserian ganglion.

The ganglion is richly supplied with blood vessels, and is no doubt trophic in function.

Many nerves end in the walls of the blood vessels, and are vasomotors, but some no doubt pass directly into the gland cells, but at present I am unable to say how they terminate, though I have examined many gold stained preparations made with the hope of determining that point.

From what has been said it will be evident that Jackson and Marshall Hall were much nearer the truth than Prunelle, Marchi, and others, when they said that the hibernating gland was a mere mass of fat and not a part of the thymus gland; in fact there is no vestige of lymph follicular tissue in the organ, with the exception of a few aggregations of lymph corpuscles.
near some of the larger vessels and nerves. It is then not a blood gland proper, as it neither destroys nor produces any of the elements of the blood, but seems rather to be concerned in the production of nutritive material its cells being used up in the process.

In October at the beginning of hibernation the gland has attained its maximum development, is very voluminous and contains many cells holding a single droplet of oil nearly filling them, and the capsule is crowded with ordinary fat cells. Occasionally masses of lymph follicles occur in it as also in the larger peptone surrounding some of the large nerve trunks and larger blood vessels; they contain however no corpuscles of Hassel, which distinguishes them at once from the thymus gland.

Changes occurring in this organ during hibernation.
By the end of March the gland has again become reduced in size, and sections prepared from it exhibit peculiarities which distinguish them at once from those obtained from the same organ in summer.

Many gland cells appear to have lost their envelopes and become fused together at their margins, (fig. 54 Pl. xxix) and to have had their protoplasmic network replaced by somewhat coarse granules, irregularly disposed, giving the cells a wasted appearance. (a, figs. 54 & 55 Pl. xxix).

Among these granules are many fat globules and also vacuoles with irregular outlines which contain a hyaline colloid material, (f, fig. 55 Pl. xxix) with which the capillaries in their immediate neighborhood are also filled. (g, fig. 55 Pl. xxix); thus showing that this material is produced by the cells, probably at the expense of their protoplasm. This material is not found in all the cells but
only in those which are somewhat profoundly altered.

The nuclei of the fused cells have also undergone considerable change, instead of staining of a uniform tint, they appear much paler, exhibit a thick envelope, surrounding a clear vesicular space in which shreds of network may be seen, especially near the margin, and in the centre one or more distinct, rounded, deeply staining nuclei, which stand out conspicuously. (C, fig. 54 and D, fig. 55, Pl. XXI.)

As already seen in the liver, this swelling of the nucleus appears to precede the destruction of the cell. That the cells of this gland do disappear during hibernation cannot be doubted, as the organ diminishes in size, whereas the cells in it seem if anything, rather larger, therefore their number must have diminished, the cells having been used up not so much in the production as storage of fat, which is
probably complete before the writer
pleat begins, but rather to supply
the colloid nutritive material with
which the vessels are filled.
Why this destruction should be
preceded by a swelling of the nu-
cles and the revelation in it of
a nucleolus is obscure; possibly
this altered nucleus may have
some function in the production of
colloid matter by the cell. No doubt
the nucleus also is ultimately re-
moved, as no supernumerary ones
are visible in the gland; how this
is accomplished, I have not at pre-
sent the faintest conception.
Many cells seem to have under-
gone no change whatever; possibly
only such cells as are required for
the immediate nutrition of the
animal are used up, the others
remaining untouched, as it were,
until required. There seem to
be fewer capillaries among the un-
touched cells than among them.
in which active changes are going on, this is more apparent, however, than real, the capillaries of the active portion being more distended, and as rendered more conspicuous than in the remainder of the gland.

Wedges in among the unchanged cells, some which appear to stain of a citron yellow color, as if containing a pigment, are seen, but they are only few in number and possibility of no great importance. In the lymphatics, also, in this part of the gland, some large yellow pigment granules may be seen, but not in any quantity.

The fibrous tissue, both of the capsule and trabeculae, especially round the vessels and nerves, appears to contain, in some places, considerable masses of lymph follicular tissue, in which small cells containing granules of yellow pigment, may be seen, similar to those already noted in the spleen,
lymph glands, etc.; they are probably adventitious, and have nothing to do with the function of the organ, which would seem entirely nutritive in character.

A few plasma cells are occasionally met with in the connective tissue.
The Heart and Blood Vessels.

The Heart.

The heart of the hedgehog which is of considerable size, weighs \( \frac{1}{47} \) of the total body weight, and is remarkable for the great thickness of its left ventricular wall, which measures four millimeters from pericardium to endocardium; the right ventricle is much thinner only measuring a little over one millimeter, whilst that of the auricles is only about three quarters of a millimeter in thickness.

Histologically, it does not differ from the hearts of other small mammals, except in being slightly more vascular, and in containing a little more connective tissue between the muscle fibers, which offer no peculiarities.

In autumn the heart is enclosed in a coating of fat which also extends some little distance upon the large vessels; it disappears during winter.
sleep and is quite absent in pregnancy. The weight of the heart also decreases owing to the loss of fat, but the muscle fibre itself suffers hardly any loss.

The Blood Vessels.

Otto [69] noticed the larger size of the blood vessels in the hog and when accurately measured them, was able to make a comparison between them and similar vessels in the rabbit; he found the vessels of the head, especially, to be nearly three times as big as in the former animal.

The blood vessels of the hog are remarkable for the great thickness of their various coats and especially of the adventitia; the middle coat consists of non-striped muscular fibres, transversely placed, and varies in thickness with the size of the vessel; the intima which is rarely thick, is lined internally by endothelial cells which are remarkable for their very great length, as compared with their breadth, (fig. 59, Pl. xxxi). Corresponding to which the m-
clei of the cells are very long and spindle-shaped, causing them to be readily mistaken for non-striped muscle fibres, especially in the arterioles, where their nuclei are as long, or even longer than those of the muscle fibres (§ 64 Pl. XXX).

The innervation of the arteries is especially interesting, as they exhibit a very beautiful plexus of non-medullated nerve fibres.

In teasing out some portions of the ganglion of the hibernating gland, which had been prepared by Ramon's modification of Löven's gold method, some of the arteries of the thorax were torn, when a beautiful fine internal nerve-plexus was revealed, (figs. 56 & 57 Pl. XXX) the fibres of which anastomose very frequently, to produce a wide meshed reticulum, situated immediately beneath the muscle fibres, in the connective tissue of the intima.

Whether or no there are any ganglion cells in it I have been unable to determine definitely.
but as seen in the figure some of the nodal points are thickened and appear to contain one or perhaps two contained nuclei. This plexus which I believe has not been hitherto described, is continuous with the nerve plexus figured by Beale (69), which, as is well known, is situated outside the muscular coat of all blood vessels, and the fibres of which only cease to run at wide intervals. (Pl. fig. 58 Pl. xxx)

The fibres of communication between these two plexuses are not very numerous and pierce the middle coat, passing between the muscle fibres. (Pl. fig. 58 Pl. xxx)

Beale's plexus is found in all blood vessels, arteries, capillaries, and veins, but up to the present I have only seen the internal plexus in the small arteries of this one locality, though I have no doubt that it exists in all the arteries of the hedgehog and possibly also in those of other mammals.
In connexion it is no doubt identical with that of Baker, but whether any trunks pass from it to the muscle fibres or to the times of the intima I have as yet been quite unable to determine, as it is very difficult to rupture the outer and middle coats without also tearing through the intima, and the vessel stain so deeply with the gold, that unless such a rupture be produced, noplexus at all is visible.

It might be said that what I have described as a nerveplexus is nothing but a view of the intima of the endothelial cells of the intima, stained with gold, and that the nodular thickenings are little masses of cement substance filling up spaces between neighbouring cells, as gold sometimes produces a positive and sometimes a negative picture; to make sure that such was not the case I injected a similar vessel with silver nitrate, and after exposing it to light for a few days in
glycerine examined the endothelial outlines. Figure 59 was drawn with a camera lucida from the preparation, and a glance at it will convince anyone that the gold preparation was not a negative picture of these outlines.

The gold reaction of itself is not quite sufficient to determine the nervous nature of the network, but when we take into consideration with it, that the fibres are often headed in appearance and that they communicate directly with an undoubted plexus, I think there can be no further doubt upon the subject.

It is a nerve plexus, and a very fine one, situated in an unexpected locality.
Dermic System.

Skin of Dorsal Region.

The back of the hedgehog is covered over with short, sharp, thickly peduncled spines, which must be removed before a view of the skin itself can be obtained. When the spines have been clipped off, the skin is seen to be almost black in colour and very rugose, the spines springing from the depressions between the rugosities.

If a section be made at right angles to the surface, the skin is seen to consist of a thick layer of dense fibrous tissue thrown into irregular elevations, over which a very thin epithelium is arranged evenly, and also passes down to form sheaths for the spines; beneath the fibrous tissue is a skin muscle of some thickness the panniculus car...
mos; there are no sweat glands present nor any sebaceous glands in connection with the glands, but a good deal of fat is sometimes accumulated in its deeper layers.

The Epithelium.

The epithelium covering the true skin (e.g., fig. 61 Pl. XXXI) consists of two layers; the outermost of which, the stratum corneum, is composed of several layers of keratinized, flattened epithelial cells, that have lost their nuclei and which have a macerated appearance; this layer is thickest in the depressions between the rugae. (E.g., fig. 61 Pl. XXXI); the innermost, the stratum Malpighii, consists of one or at most of two layers of small germinating cells which are often vacuolated and contain flattened oval nuclei; some pigment, melanin, in granular form may sometimes be seen in the cells. (E.g., fig. 61 Pl. XXXI).

This layer gives rise directly to the stratum corneum, there being neither stratum lucidum nor stratum granu-
between them.

**The Mucosa.**

The true skin, which is very thick, is torn into large and sometimes slightly con-
formed papillae, which do not indent the stratum Malpighii, but are raised up like little hills over which the
epidermis paves in an even layer.

The tissue consists of course, thick
wavy fibres of connective tissue which
cross and recross in all directions, and
among them some elastic fibres may
be seen, as well as, connective tissue
corpuscles, and large somewhat branched
pigment cells, containing granules of
melanin, scattered irregularly. This
fibrous tissue is almost devoid of blood
vessels, there being only a few small
ones at its inner surface, so that the
tissue must depend for nourishment
entirely upon the percolation of lymph
through the spaces that exist here and
there between the fibres; this arrange-
ment permits the lymph to bathe the
inner surface of the epithelial coat.
also, and nourish it.

The densest part of the minora is situated immediately under the epithelium, it gradually opens out towards the fasciculus carnosus.

**Spine follicles.**

The prines, (5 fig. 64 Pl.xxxii) the structure of which will be discussed later, spring from the cutis vera in follicles, similar to those which envelope the roots of the hairs.

The body of the spine narrows down into a thin neck, which presently widens out in the true spine, to form a hemispherical root, the flat surface of which is directed outwards; in this way a very firm attachment is obtained, the root acting much in the same way as the well-known cup-shaped yacht anchors; the convex surface is indented in the middle by a small papilla of connective tissue, from the blood vessels of which the spine obtains its nourishment. (p. fig. 64 Pl.xxxii)

The spine follicle is set in the cutis,
seen at no very great depth, which in account of its size appears less than it really is, one would have expected a much deeper attachment for the spine, seeing that, the ordinary hairs penetrate upwards for some considerable distance.

Both layers of the epidermis are prolonged upwards to form the epidermic coverings of the spine ridges, which may be divided into two parts; the upper and larger portion being separated from the spine by a small space, corresponding to the space into which the pelagic material is poured in the case of ordinary beings, and at the bottom of which some epithelial debris is usually found (c, fig. 61 Pl. xxx x 1); a lower and shorter portion which becomes fused with the spine itself at the spot where it widens out to form the rib.

Two layers can be distinguished in both these regions, the inner and
inter root sheath; the inner root sheath is merely a layer of the stratum corneum continuous with that on the surface of the skin, and homogeneous in appearance though really composed of cells produced by those of the inner root sheath, which consists of a stratum Malpighii rather thicker than that covering the skin generally.

In the lower part of the follicle the cells of the stratum Malpighii can be seen giving origin to those of the spine; a layer in which the cells are in a state of transition, recognized by its different staining, interwoven between the two. (L. fig. 61, Pl. xxi) and which replaces the inner root sheath in this region.

The papillae of the true skin which projects up into the spine follicle is small compared with the spine of the spine, vascular in character and covered with somewhat larger epithelial cells which give rise to the large, somewhat flattened cells that are...
ultimately converted into the part of the spine (Leand p. 61 Pl. XXXII).

The inner root-sheath does not appear to be differentiated into several layers as in the human hair follicle, and though I have diligently searched for it, I have been unable to recognise any special enticle to the root-sheath, though such a layer in all probability does exist.

The follicle has also a dermic covering of very dense connective tissue, the fibres of which are disposed in a circular manner round the follicle; this layer is best seen just above the root of the spine and probably serves to fix it more firmly in the skin.

There is no vestige of any sebaceous gland in connection with the spines nor is there any other gland which could replace it in function, which is peculiar, for as we shall see, the spines are only modified hairs. Attached to the dermic coverings
of the follicle, especially round the root, are large numbers of small non-striped muscle fibres, arranged in long separate bands, which seem to radiate from the follicle and become attached, some to the epithelium covering the skin, but the greater portion run some distance and become firmly fixed to the fibres of the deeper part of the corium. (c.f. fig. 61 Pl.xxxvii) When they contract they powerfully ereth the skin, making this somewhat formidable protective weapon stand up in a very menacing manner.

These muscle fibres constitute a very much enlarged arrector pili muscle.

The deeper layers of the corium are composed of much finer bundles of connective tissue, and are much more cellular than those immediately below the epithelium, and in this looser tissue are the arterio-venous and nerves. (c.f. ii. fig. 61 Pl.xxxvii)
destined for the supply of the whole skin; they are most numerous near the spine. Follicles where a true rete mirabile, composed of capillary blood vessels, exists. (R.m. fig. 61 Pl. xxxi.)

Now the nerve fibres end I have not been able to discover; there being apparently no end organs in this part of the skin. Some fat cell may be found here occasionally.

**The Panniculus Carneus.**

The panniculus carneus (R. fig. 67 Pl. xxxi.) is strike, and consists of striated muscle fibres which differ in nothing from those of the skeletal muscles of this animal.

Occasionally a hair of the ordinary type may be found among the spines.
Skin of Ventral Region.

The skin of the under surface of the body is thickly covered with rather stiff hairs of the ordinary type which gradually pass into the furr at the sides of the body; it is much thinner and less rugose than that of the dorsum, and contains both sweat and sebaceous glands.

The cutis vera which is only about half the thickness of that of the back, is thrown up into numerous little papillae, over which the very thin epidermis is spread in an even layer; it is very vascular and full of fat in its inner part, in which the sweat glands are also situated.

Beneath this is a paracutaneous carnosus of some thickness and of peculiar structure, beneath which again there is some loose cellular tissue full of fat, nerves and blood vessels.
Epithelium.

The epidermis consists of two layers of epithelial cells, like that of the dermis from which it differs in no essential particular

Cortex Vasa.

The connective tissue is arranged in fine wavy bundles, among which are clasping cells and many elastic fibres, and between them lymph spaces and pigment cells; it is densest just under the epithelium but very open in its deeper layers, and full of fat cells, blood vessels and nerves. Occasionally small masses of lymph follicular tissue may be found close to the epidermis

Sweat glands.

These glands, which are pimple coiled tubes occur in the deeper layers of the cortex vasa, and resemble closely those of other animals. the secreting portion has a central lumen surounded by a single layer of clear columnar cells, situated
on a homogeneous basement mem-
brane, but the non-striped muscle
fibres found between it and the
cells in man seem to be wanting
here; outside the basement mem-
brane there is a connective tissue
sheath.

The duct runs outwards to open
on the surface of the skin, and
has a wavy course in the dermis,
but has not the usual cohoes-
arrangement in the epidermis, owing
to the slight thickness of the latter
coat. The duct is lined by a single
layer of clear cubical cells with
very large spherical nuclei surround-
ing a central lumen and placed
on a basement membrane of vary-
ing thickness, outside which there
is a fibrous sheath. The internal
circular lining of the duct is of
extreme tenacity.

Hair Follicles.

The hair follicles are long and
narrow and peculiar in structure.
to those of the species, from which they differ in shape, approximating more closely to those of the cat, dog, etc.

The inner root sheath does not appear to be differentiated into various layers in its lower part as in man.

The dermic coverings which are well developed are arranged longitudinally, as well as circularly around the follicle.

The arrector pilis muscle of non-striped fibres is rather large for the size of the hair, is attached to its sheath, and radiates outwards as many fine strands, which become attached to the connective tissue fibres of the corium. These strands are not closely packed, but spread out into a sort of network enclosing the acini of numerous large sebaceous glands, which have a structure identical with those of man and other animals, and pour their secretion, by short ducts, into the
cavity between the hair and the upper part of its follicle.

The skin is abundantly supplied with blood vessels and nerves which run up quite close to the epithelium and surround the hair follicles and sweat glands; the nerves supply the vessels, do not appear to terminate in any special end organs, but become lost near the epithelium.

**Panniculus Carnosus.**

The panniculus carnosus of this part of the skin, consists of striated muscle fibres, separated from one another by a little loose connective tissue. The fibres vary considerably in size and length, and consist of very fine fibrils, but are peculiar in possessing large number of nuclei under the paracolemma; these nuclei which are clear, oval flattened bodies containing a network and a nucleolus, are often arranged close together in rows, which for the most part run a straight
course of, but which sometimes
wouldspirally wound the fibre; there
may be four or five such rounds
in one fibre (A, fig. 62 Pl. xxxiii).
In some fibres a tubular space runs
up the centre, which is filled with
nuclei, similar in every respect to
those under the parcolemma, and
closely packed together. What this
may indicate I do not know, but
it suggests very rapid proliferation
(C, d, fig. 63 Pl. xxxiii). In transverse
section these fibres are very peculiar,
showing as they do a round hole in
the centre in which may be one
or more oval nuclei (C, d, fig. 64 Pl. xxxiv).
Fibres which do not possess this
tubular arrangement may exhibit
several isolated nuclei each sur-
rrounded by a little undifferentiated
protoplasm among the fibris, where-
by the fibre comes to look like a
non mammalian muscle fibre
(A, fig. 64 Pl. xxxiv) so that we have
here a kind of muscle fibre which
is generally believed to be found only in amphiblia, but which occurs in various localities in the hedgehog as already pointed out.

The paracolurumna is by no means tightly attached to the fibres, and only at long intervals, in an annular manner. This partial separation of the paracolurumna might be produced by maceration of the tissues, but I think this scarcely likely as they were fixed half an hour after the death of the animal, that is, long before they were dead or had lost their irritability.

For comparison I prepared sections of the human platysma muscle, which is morphologically speaking, a paracolurumnaeous, but found nothing similar in it, its being in every respect exactly similar to other human muscle fibres.

The skeletal muscles of the hedgehog do not differ markedly from those
of other small mammals, though they have certainly more nuclei under the pericellulae, but they are neither arranged in rows nor very closely packed together, and no fibres exist in their possessing nuclei among the fibres.

(\textit{fig. 65} Pl. xxxiv)

It is also strange that the \textit{pars-}

nucleus carnosus of the dorsum should not differ from the ordinary skeletal muscles, whilst that of the ventral plane shows such remarkable varieties.

In examining the skeletal mus-

cles I incidentally obtained pre-

parations showing the motor nerve

terminations in the pecti muscles of the eye, and in the mylohyoid.

These terminations have the usual C-shaped arrangement characteristic of motor terminations, that of the \textit{nutcracker oculi} is simple (\textit{fig. 65} Pl. xxxiv) whilst that of the mylohyoid presents a much more complex and branching figure, much obscuring the fundamental
type, which can nevertheless be distinctly enough made out. (Fig. 67 P.lxxxv)

Changes which occur in the skin during hibernation.

The changes which occur are not great, the quantity of fat varies considerably and is always diminished after the long winter sleep; the glands also exhibit sluggish changes dependent on their want of activity.

The thickness of the skin of the back and its want of blood vessels, as compared with that of the under surface of the animal's body, may be of service to it during winter sleep, preventing loss of heat by radiation for, owing to the circulatory motion suspended, the back and sides are much exposed, and would lose much heat, if full of vessels, whilst the under surface being rolled up would necessarily lose much less, and therefore need not be deprived of the usual blood supply.
Hairs and Spines.

The Hairs.
The hairs are fibrous or fibro cellular and consist of a cuticle, a cortex and a medulla.

The Cuticle.
This consists of a single layer of uniciliated epithelial scales as in the hairs of other mammals.

The Cortex.
This part of the hair is of considerable thickness, is composed of compressed epithelial cells, which yet exhibit here and there some traces of a nucleus.

The Medulla.
The pith or medulla consists of vacuolated cells or spaces separated from one another by peptata, which are mostly transverse in direction, some few being obliquely, and some vertically placed. The pith is small in amount when compared with the cortical part of the hair; it is largest at the root.
and entirely wanting at the tip. The root of the hair is slender and implanted upon a papilla of the true skin as already mentioned.

These fine hairs are confined to the abdominal and thoracic regions; at the sides where they gradually merge into the pubes, some larger ones may be seen which by their size might be called small pubes, though in softness they rather resemble hairs.

The tips of these exactly resemble the abdominal hairs in structure (Fig. 68 Pl. xxxvi); lower down in the shaft the medulla widens out and becomes many times thicker than the cortex. The spaces in it are wider, and the transverse septa compound, being composed of numerous strands which stretch across the medulla to end in many branches at the inner surface of the cortex, with which they fuse, giving, in longitudinal sections, an appearance as of tree trunks laid across and attached by their roots.
and branches to the sides. On a surface view each septum and each branch of it is seen to be, not a thin cord but a plate-like structure of fibrous appearance, but simplified like the cortex of compressed, elongated epithelial cells, which stain however differently from it with anilin dyes. The spaces between the septae are filled with air (see fig. 69 Pl. xxxvi).

The thickness of the cortex appears to be the same as in the tip and seems to contain here and there some vestige of a nucleus (fig. 69 Pl. xxxvi).

The Spines.

The true spines which cover the back of the animal are sharp, about an inch in length, and of peculiar shape, their attached ends being curved at almost a right angle by which means any pressure exerted on the point of the spine is not directly communicated to the root, but extended in farther bending it. The animals take
full advantage of this, throwing themselves down from considerable heights or to their spines without sustaining any injury [Wood].

I have often watched hedgehogs when placed upon a table run about and investigate every part of it, then throw themselves bodily to the ground, alight on their backs with a considerable thud, and at once get up and begin to investigate the new locality thus reached; were it not for their peculiar shape the spines would be driven into the animals by such a fall. The spines is coloured black and white in transverse bands, the black being produced by granules of melanin in the cortex, the white by absence of this pigment; it is also ribbed longitudinally, by twenty-two or twenty-four longitudinal grooves of little depth, which correspond to inward prolongations of the cortex as afterwards to be explained.

The shape of the spines is that of a cun
elongated spindle, tapering at both ends, at the tip, to a sharp, very-hard point; and towards the root into a thin, soft, flexible neck in which the curve already alluded to is situated. This softness no doubt of a free play of the tissues in bending; internally, the spine ends in an expanded sort placed upon a papilla, and surrounded by a sheath, as already fully explained.

The whole spine can readily be cut with a knife or razor when freshly pulled out of the skin, but when kept for a short time they become very hard indeed.

A spine may be divided into three portions: a cuticle, a cortex, and a medulla.

The Cuticle.

The cuticle consists of a single layer of imbricated, keratinised, epithelial scales, which are large, irregular, plate-like, structures devoid of even a trace of nucleus, and which do not stain at all readily with
either basic or acid anilin dyes. It extends from the bulb to the tip of the spine, clumping in at the longitudinal furrows to form a continuous outer coat. (Fig. 70 Pl. XXXVII).

**The Cortex.**

The cortex is very narrow being reduced in the centre of the shaft to a mere shell, it gets thicker towards the hard tip of the spine, of which it is the main constituent, and thins off considerably at the bulb.

It is composed, as in the hair, of compressed epithelial scales which are elongated in the long axis of the spine and correspondingly narrow transversely, giving a fibrous appearance to the tissue, in some cases a few nuclei or their remains can be detected in it. These cells and the cement substance between them, for they are held together by a small amount of cement, contain pigment of a dark colour, probably melanin, similar to that found in other
mammalian hairs. (figs. 72 and 75 Pl. xxxviii
and 95, fig. 76 Pl. xxxix).
In transverse section, the cortex is
seen to project inwards towards the
centre of the spine at regular intervals,
forming 22 to 24 longitudinal ridges
or septa, extending the whole length
of its body and tip, and which cor-
respond to the furrows or depressions
already noticed on its external surface.
(figs. 72, 73, 74 and 75—Pl. xxxviii).
These septa project inwards for about
a quarter of the distance from the
centre of the spine to the inner
surface of the cortex; they are internal
broadnesses, so to speak, which
must give great additional strength
to the structure, enabling it to sus-
pend a much greater weight, applied
vertically to the tip, than a simple
cylindrical sheath of cortical substance
would be able to; they must also
add greatly to the elasticity of the
spine, preventing undue bending of it
from lateral strain, and enabling it
easily to regain its normal shape when no distorted.

The internal edges of the butresses are not sharp but nicely rounded, often exhibiting a slight thickening, so that in transverse sections each butress seems to end in a slightly thickened knout. (c. fig. 76 Pl. xxxix.)

The cortex as a whole stains differently with different anilin dyes, having a decided preference for the acid anilins, such as, acid fuchsin, eosine and acid orange; only staining very slightly with basic anilins, showing thereby its keratinised condition. (Plate xxxix.)

At the root, the cortex becomes continuous with a layer of large columnar cells belonging to the stratum Malpighi of the skin, and exhibits in this region a marked cellular structure, the nuclei of its cells being plainly visible when suitably stained (fig. 51 Pl. xxxii).

The Medulla.

The medulla is very large, occupying
by far the greater part of the spine, it is thickest in the middle of the
shaft, becomes gradually thinner and thinner towards the tip, from which
it is almost absent, but widens out considerably in the bush. (Fig. 61.
Pl. xxxii)

The pith is divided into narrow, somewhat lenticular, chambers, the
primary loculi, (61, Fig. 71 Pl. xxxvii) by
horizontal partitions of delicate tissue,
the primary septa, (61, Fig. 71 Pl. xxxvii)
which may be simple or compound, ex-
tended quite across the spine and appear
to be complete, that is there is no
communication from one chamber to
another (m, Fig. 72, 73 & 75, Pl. xxxviii).

The primary septa split in to se-
veral leaflets when they reach the
inner limits of the cortical buttresses,
and these secondary septa (62, Fig. 71
Pl. xxxvii, & Fig. 77 Pl. xxxix) penetrate into
the spaces between the buttresses to
become attached to the cartil as well
as to the lateral walls of the buttresses.
In this way a very strong attachment is obtained and the space enclosed between neighboring buttresses is divided into a large number of secondary horizontal chambers, of triangular shape; the secondary loculi (l.2, figs. 71 Pl. xxxvii & 77 Pl. xxxix), much smaller than the primary loculi of the middle of the pulp.

A very instructive view of the secondary chambers may be obtained by making a surface section of a stone (fig. 77 Pl. xxxix) in which it will be seen that the secondary septa are again often split into smaller leaflets, the tertiary septa (l.2 figs. 71 Pl. xxxvii & fig. 77 Pl. xxxix) producing a third set of minute chambers along the sides of the buttresses, the tertiary loculi (l.2, figs. 71 Pl. xxxvii & 77 Pl. xxxix).

No doubt these strata by their number, bind the buttresses very firmly together, so as to prevent their being suddenly separated by any violent and sudden strain therein.
in the spine in a vertical direction.

These septa stain deeply with basic
acridine dyes, but only feebly with acid
ones. (Pl. XXXVIII) The thicker central
septa stain more deeply than the thin-
ner marginal ones, no doubt owing
to their greater thickness (m., figs. 72, 73
& 75—Pl. XXXVIII); they stain irregularly
however, showing a blotchy appearance.

The secondary lamellae exhibit near
the buttresses small deeply stained
spots, (m., figs. 74 & 75—Pl. XXXVIII & m., fig. 76
Pl. XXXIX) I believe these to be the
remains of the nuclei which were
present in the cells that formerly
composed the septa, but of which every
other trace has disappeared. These
blotches are most conspicuously
brought out by methyl blue and
methylene blue. All the loculi seem
filled with air.

In transverse section the centre of
the spine appears either as an empty
space, (m., fig. 74 Pl. XXXVIII) or to be filled
with a delicate membrane. (m., figs. 72, 73

388.
85. (Pl. XXXVIII) depending on whether the section has passed through a chamber or at the level of one of the primary septa. The secondary loculi appear always filled with membrane owing to the closeness with which the secondary septa are packed, and on the fact that it is almost impossible to obtain thin sections. (pp. 72, 73, 74, 75-Pl. XXXVIII)

Morphological nature of spines.

From the foregoing it will be seen that the spines of the hedgehog are simply modified hairs, and not more of ordinary hairs agglutinated together, as the horn of the rhinoceros is said to be. Each spine is a true hair springing from a simple papilla, forming a sheath and modified to meet the needs of the animal, its mechanical structure exhibiting great strength combined with lightness, forming a very efficient defensive weapon. Were the spines compound structures one would expect them to
Arising from a compound papilla which is not the case; besides a gradual transition can readily be traced between the softest hairs of the abdomen and the strongest spines, transition which is accomplished by easy stages.
Résumé and Conclusion.

Physiology of hibernation.

The body weight gradually diminishes during hibernation, as stated by Valentin. The blood, the colour of which varies a little, is never devoid of oxygen, clot readily, and becomes very concentrated towards the end of winter sleep, owing to abstraction of fluid from it, to produce the liquid part of the urine; its percentage of haemoglobin is about 85% at all times of the year.

The blood perfused when analysed during hibernation shows an abundance of both pererin albumen and of pererin globulin, though one would have expected the former to be much diminished in quantity.

The alkalinity of the blood as shown by Raycraft’s test papers diminished gradually during lethargy, all the alkali possible, being withdrawn from it, to combine with the phosphoric
acid for the production of acid phosphates excreted in the urine.

The red blood corpuscles increase in number from June to October, then steadily decrease, owing to rapid concentration of the blood; however, they seem to increase considerably during the first half of hibernation; the white corpuscles diminish suddenly at the end of October, but gradually increase in number towards the end of winter sleep.

The bile is always alkaline in reaction, green in colour, and during hibernation differs little from that produced in summer, being only somewhat different in phosphates.

The feces which are passed at short intervals by the animal during hibernation, are green in colour, and consist entirely of mucus stained with bile, and contain certain salts.

During summer the urine is slightly acid and quickly deposits crystals on cooling; during hibernation the animal wakes at short intervals to pass a clear
acid urine, which does not deposit any crystalline matter, and which, on analysis, shows a great diminution of urea and of chlorides; whilst sulphates are fairly and phosphates very abundant in it. The urine poisons in the bladder for some little time; no doubt absorption must take place through the walls especially of such substances as are known as the convulsive principals, unless the epithelium has selective power, as would seem to be the case, otherwise the crystalline phosphates which are very diffuseable ought to pass back again into the blood, and lie like the chlorides absent from the secretion, this, as has been shown, is however not the case.

During hibernation the vitality of all the tissues is very great, the heart may be seen to beat regularly for several hours after the death of the animal, and movements of the diaphragm occur two hours after muscular irritability lasting for a much longer time.
The probable cause of hibernation is not cold, but rather the scarcity of food produced by the cold. The condition probably started towards the end of the Tertiary epoch when the climate of Europe changed slowly from one of subs-tropical warmth and plenitude, to one of arctic cold and absence of vegetable and insect life, for the great part of the year. Such animals as depended upon tender plants and insect life for food must either have perished or become modified to their changed surroundings. Birds flew away and started the phenomenon known as migration; hibernating animals slept, and learned to do without food suddenly but very gradually by slow stages. In tropical climates many animals aestivate, not from heat or cold but from want of food caused by these conditions of temperature.

The conclusion which we must come to is that the various physiological phenomena presented by these animals have been
developed by slight variations in a constant direction through many ages, to fit them for their prolonged past, and thus spare them from that death which would otherwise surely overtake them.

Histology.

In the tongue I have shown that the conical or fungous papillae are not homogeneous, but very heterogeneous in structure; the circumvallate papillae which are three in number contain acini of parous glands as well as ganglion cells. The mucosa varies in thickness in different parts of the organ. Plasma cells are very numerous indeed in the connective tissue of the tongue except near parous and mucous glands, they spring from small round connective tissue corpuscles, and after a certain time lose their characteristic granules and either disappear altogether, or come to resemble ordinary
connective tissue cells so closely as to be indistinguishable from them.
Nerves terminate in the cells of the mucous membrane by minute more or
less cupshaped extremities, situated at
one side of the vacuolated nucleus of
some of the epithelial cells of the preatun
Malpighii. The mucous glands of the
tongue are very large especially in its
posterior parts.
During hibernation all the tissues
reach less readily to pains, plasma
cells diminish in number, and the
various glands cease to secrete.
A very peculiar kind of muscle fibre
found in the superficial lingual muscle
is described, as also other peculiar fibres
situated more deeply in the organ,
which resemble closely those of the
paranuclear corpuscles of the ventral
skin.

The esophagus presents few peculiarities;
it is however devoid of glands and
lymph follicular tissue, except at either
end where a few nuclei of mucous glands
and one or two posterior glands may be found in the mucous membrane, the deep layers of which are conspicuous all through the tube, for the great thickness of the muscularis mucosae. The fibres of the muscular coat are striped quite to the stomach, a peculiar fibre with micros among the fibrils is described. Plasma cells which are common in summer are wanting almost entirely in winter.

At its junction with the stomach several pars flaccida glands may be found in the sub-mucous coat, the ducts of which pierce the mucous membrane; immediately upon these, follow a few glands resembling those of the pyloric snail stomach, but from ordinary cardiac glands make their appearance and fill almost the whole mucous membrane of the stomach, the pyloric glands being confined to a relatively very small area.

The ducts of these glands are lined by mucigen containing cells, from which mucus is discharged without sup
true, i.e., they are not true chalice cells.

The columnar cells that line the free
surface of the stomach are not mucous
forming, but true columnar cells like
those covering the vili, and are absor-
tive in function. The connective tissue
of the submucous coat contains six types
of connective tissue corpuscles; that
between the muscularis mucosae and
the closed ends of the glands is not
adrenalin, but mucoid in structure.

The muscularis coat both enter into
the formation of a big pyloric sphincter
which is united above with the mus-
cularis mucosae.

During hibernation all the glands of
the stomach are inactive, and do not
stand readily; but the most conspicu-
ous change in the organ, is the infil-
tration of its connective tissue with
wandering cells, which are white blood
corpuscles, they give Ehrlich's eosin
reaction but are not degenerating as
maintained by Herzenhain, for they
are found in all stages of division.
they are arranged among the fibres in little clusters or in rows; plasma cells are entirely absent.

The small intestine is peculiar in having no rugae, and the villi which are long and leaf-like contain numerous chalice cells of peculiar shape. The lacteal which varies in calibre, contains no valves, but proceeds the muscularis mucosae obliquely to open directly into a big lymphatic vessel in the sub-mucosa, there being no valve at its opening, the obliquity with which the lacteal passes through the single layer of the muscularis mucosae being no doubt sufficient to prevent re-gurgitation. The cells of Lieberkühn's follicles differ in size and structure, as well as in reaction and function, from those covering the villi. The fibrous tissue between their closed ends and the muscularis mucosae is not adenoid but mucoid in character and arranged in a thick layer.

The changes that occur during Herbert-
tion are similar to those of the stomach.
the great infiltration of the connective
tissue from which plasma cells are absent
with wandering cells being most cons-
picuous.
the duodenum is peculiar only in ha-
vying Brunner's glands all heaped together
into a hollow cone, near the stomach.
the cells of these glands exactly resemble
those of the pyloric glands, and remain
inactive during winter sleep.
the duodenum expands, and the small in-
teestine gradually fades into the large,
in which juice occurs, it presents no
great peculiarity.
the liver seems constructed on the
type of compound tubular glands, but
its lobules are very indistinctly mark-
ed off; the intermediate bile ducts are
long and conspicuous. Each liver cell
has a capsule of its own, and those bor-
dering on the large veins and capsule
exhibit blunt processes. A few smaller
cells with vacuolated nuclei may be
seen here and there, they are breaking.
down and soon disappear. Towards the end of hibernation the liver cells which are shrunk somewhat contain multitudes of small golden yellow pigment granules containing no pigment. The blood capillaries contain loose rosy holding pigment granules, and cells like phagocytes which contain a pigment without rosy; no doubt these various pigments ultimately become converted into bile pigment by the liver cells.

The pancreas does not differ markedly from that of other animals; the cells, either islet or centro-acinar, exhibit two zones; during winter the connective tissue of the organ becomes infiltrated with wandering cells. The parotid and submaxillary glands offer no peculiarities which require special attention.

With regard to the lymphatic glands, their stroma consists of fine fibres of connective tissue clasped by connective tissue capsule. The central nodules present distinct germinal centres surrounding by condensed zones. The lymphatic
nerves contain some pip different kinds of cells, of which the plasma cells appear, up to the present time, to have been overlooked. Phagocytes are numerous and of large pip. In winter the germinal centres become less active, phagocytes increase greatly in number and contain debris of various kinds, as well as pigment granules, which contain no iron; some multinucleated granul cells make their appearance and contain pigment; the pneumes contain many free granules of pigment, and plasma cells in increased numbers.

The Malpighian corpuscles of the spleen possess germinal centres and are surrounded by perforated capsules of unstriped muscle fibres. The pulp, which is composed of branching cells, contains ten varieties of cell elements. The greatest destruction of blood elements seems to occur just under the capsule where the stream is slowest; granul and spleenic cells are most numerous here. During hibernation the germinal centres become almost inactive, and plasma
cells entirely disappear, but the corneophlebic cells, and especially phagocytes and giant cells, filled with pigment and debris, become much more abundant. In the suprarenal bodies nothing peculiar is seen in the cortex; the medulla appears to consist of phlebic cords, containing large cells in loculi, the walls of which are composed of firm connective tissue; among these cords are the venous plexuses. Some colloid material may be found in them as also between the cells of the outer cortical zone. The cells of the cortex contain no pigment, though some golden yellow granules may be seen between the cells of the zona reticularis, but is entirely absent from the medulla. Occasionally a large cell may be seen with in the cortex.

The cells change somewhat in appearance during hibernation, and the zona reticularis seems to increase in size; the colloid material disappears from the organ, and the pigment between the cells of the inner cortical zone is much in-
creased, and some may even be seen in the medullary cords.

There are eleven or more varieties of cells recognizable in the red marrow of the long bones, which vary in quantity at different seasons, the tissue is lean in spring and summer, but very fat during winter, when all the cells appear decreased in number, especially the nucleated red blood corpuscles and plasma cells; these cells which are granular like plasma cells but stain with acid anilins increase considerably. There are no free pigment granules at any time in the marrow.

In the blood the white corpuscles are of large size and very conspicuous, blood platelets are numerous, and a few plasma cells may be found; in winter these disappear, the platelets become fewer, the red corpuscles become smaller and all the elements diminish in number.

The hibernating gland which is situated in the axilla, neck and back, has nothing whatever to do with the thyress
though some lymph follicular tissue may sometimes be found in it. The organ is surrounded by a capsule of connective tissue which divides it into lobes and lobules; it consists of connective tissue corporcles which enlarge and gradually accumulate fat at the expense of their protoplasm, they spring from small round connective tissue cells, 50 in diameter, possessing an envelope and a single nucleus, and reach when full grown, a size of from 30 to 33 μ in diameter. The fat which increases in quantity never quite fills the cells, which therefore differ in appearance from ordinary fat cells. The organ is abundantly supplied with nerves and blood vessels, its venules being often filled with a colloid material, probably secreted by the cells, and which may serve as food; a fine ganglion of the unipolar type is situated in connection with the gland, in the axilla.

Towards the end of October the submaxillary gland increases rapidly in size,
but soon again diminishes as quick
sleep proceeds, the cells being used up
in the process. The cells lose their en-
velopes, fuse together, become granular,
their nuclei swell, exhibit nucleoli, and
vacuoles filled with colloid material
make their appearance in the protoplasm.
The fat disappears and the capillaries
become distended with colloid matter.

All the cells of the organ do not change
at once, but only such are needed
for immediate use, the others are
stored up and remain unchanged till
required. A few plasma cells, which
are absent in primates may be seen
in the septa during hibernation.

The walls of the heart are very thick,
beyond which nothing need be paid
about it. The blood vessels also have
厚皮 coats, the inner one of which is
peculiar, owing to the elongated shape
of the nuclei of its endothelial cells,
which appear like those of non-striped
muscle fibres. Some arteries contain a
nerve plexus, as yet undescribed, which
is very fine indeed and situated in the
connective tissue of the integuments, immediately beneath the muscular coat; it is
directly continuous with Beale's plexus
outside the muscle.

The skin of the back is thick and
pallid of surface covered by an extremely
thick epithelium, composed of two
layers only, and is full of bristles, strong
spines, set in pockets like ordinary hairs.
The spines are anchored in the skin in a very firm manner, and the follicle which
surrounds their inner end, is epithelial in character; each spine springing from a little vascular papilla
of fibrous tissue, has a very large
rector pili muscle attached to it, but
is without sebaceous glands; near it is
a very minute of capillary blood ves-
sets. The panniculus carnosus is com-
posed of ordinary striped muscle fibres
and in somewhat thick, there are
no sweat glands in this locality.

The skin of the ventral aspect is
much thinner and full of soft hairs.
it contains sweat glands, is very vascular and covered by a thin epidermis. The connective tissue is fine and full of elastic fibres, it also contains masses of lymph follicular tissue; the hair follicles resemble those of the paws but are smaller, and have many pelvic glands opening into them; sweat glands and fat cells are also present in the skin. The muscular carneous is very peculiar, the nuclei of its striped fibres run in chains under the paracolemma, and some fibres present a tube, running up their centres, filled with nuclei, and some exhibit nuclei scattered among the fibrils like amphlblain muscle.
The human platysma which is morphologically a skin muscle does not possess any pile fibre, the skeletal muscles contain rather more nuclei under the paracolemma than those of most animals; and motor nerves terminate in them in various ways, some terminations are simple, others
elaborate in design, though we can be reduced to the usual C-shaped type.
The hairs are either fibrous or fibro-cellular, and the spines which are just enlarged
hairs and into agglomerations of hairs,
are very light, yet mechanically strong
and penetrable weapons; they contain
a cuticle, a cortex and a medulla.
The cuticle isimple, the cortex which
is thin is strengthened by internal
butteness, and the medulla which
is very broad, helps, by its numerous
and complicated septa, to strengthen
the structure.

In conclusion it would appear that
the plasma cells are in reality only
weld connective tissue corpuscles, which
exist in large numbers in almost every
organ during that period of the year, in
which the animals are ravenously feeding
and storing up internal food for winter
use; and that when the fast begins,
they diminish in number in every
manner, except in the hibernating gland,
where they increase, which is not as
vanishing, seeing that, that organ is a
source of food for the whole body; and
in the lymph glands where their presence
does not seem very explicable.
The hibernating gland and the fat of
the body act as internal nourishment
for the animals, but are efficiently used,
and without waste.
All the tissues seem more or less passive
with the exception of the liver, kidneys
and blood glands, which provide over
the organism, eliminating poorly such
products of metabolism as would be
hurtful, and storing others for future
use.

The army of phagocytes, store scavengers
of the body, appears to be fully occupied
in collecting and rendering harmless
all offsite material, which without
their aid might be dangerous to life,
and for this purpose their numbers
have been greatly increased. What
because of all the pigments, to which
I have alluded so often, is not certainly
some may be stored to be used again,
but the greater part is, I believe, excreted by the liver.

With regard to the skin, the exposed parts are well protected, both against attack from without and from less from within, while the more covered parts only perform the functions which are usually performed by the whole skin of other animals.
Methods.

Bibliography.

List of Specimens.
Methods.

All the methods used by me in this research are well known; I shall therefore merely mention the special method adopted in the case of each tissue without going into details.

Fixing and Hardening.

Corrosive sublimate.

Portions of all the tissues were rapidly cut from the animals as soon as dead, and fixed in a saturated watery solution of corrosive sublimate, in which they were allowed to remain from half an hour to an hour; after that they were placed in a stream of running water for several hours, to wash all the corrosive out of them; this does the tissues no harm, as their elements are completely fixed, and do not swell in water. If the tissues be very delicate, it is better to wash out the corrosive by soaking in spirit for several days, changing the fluid at short intervals.

When all the sublimate is removed...
The tissues should be carefully brought up the alcohol scale, stained in alcoholic hematoxylin, decolorized in acid alcohol (75% alcohol with 6 drops of HCl to the 100 cc.), dehydrated, cleared in toluol, and embedded in paraffin, in the usual way.

Sections having been made with the Cambridge, Rema, or other paraffin-cutting microtome, are fixed to the slide with either Schälbrein's, colchicine, Mayer's albumin, or papily with absolute alcohol, the paraffin dissolved out in turpentine, xylol or toluol, and either mounted in balsam at once or taken down the alcohol scale into water after which they may be stained in almost any water-soluble dye, like ordinary gum-copal sections, dehydrated, and mounted in balsam, or simply in Farrant's solution or glycerine according to the refrangibility of the tissue.

The results obtained by this method were controlled by various other methods.

Sections were prepared to cut in gum in the following ways.
Source.

Cut in small pieces, place in a mixture of chronic acid and spirit for about ten days, taking care to change the fluid two or three times, and preserve in methylated spirit for at least seven days before using.

Asophages.

Cut into short lengths and place in Müller and spirit for about three weeks, then in spirit for four weeks, after which time the tissue is ready to be sectioned.

Stomach & Intestines.

Open carefully, clean off any particles of food or mucus, suspend in chronic acid and spirit for 10 days, change the fluid once or twice, and complete the hardening in methylated spirit.

Livers & Hibernating Gland & Lymph Glands.

Place small pieces of the tissue in Müller and spirit for 30 days, change the fluid to ensure hardening, and place in methylated spirit for several weeks before cutting. The hibernating gland owing to its lobulated structure does not
cut well in gum, and should therefore always be embedded in paraffin.

Pancreas, Salivary glands & Suprarenal bodies.

Place in chronic acid & spirit for one week, after which, for another week in methylated spirit. Do not cut well in gum owing to lobulated structure.

Spleen.

Place in spirit for 2 or 3 hours, then in Müller & spirit for 20 days, occasionally changing the fluid, and then in methylated spirit for about 6 weeks.

Skin.

Place pieces in chronic acid & spirit for 2 or 3 days, then in spirit for several weeks. The pinnia must however be cut off before hardening, otherwise they will chip the knife, and prevent their sections being obtained.

Bone marrow.

This is best prepared by cutting the bone into two, placing the marrow on a pledge, picking out any broken pieces of osseous matter with needles, and reducing the tissue to a pulp by gently
sticking it with the thick end of a needle. Some of this already partially separated tissue is placed on a cover, another is placed over it, and the two being separated by pledging them one on the other, an even film is produced, which is allowed to dry spontaneously.

Blood.

As it comes out of a poch in the skin the blood is collected on a cover and filtered as just described for the masses; the separated covers should be moved in the air to ensure rapid fixing.

**Staining Agents.**

**Gold Chloride.**

This solution which fixes as the same time as it stains, is a very convenient agent, especially for nerve terminations. I used two methods, as described by Ranvier.


(see, Vade Mecum, 2nd Edition § 208.)
Both are uncertain in their action, now one favor the other, giving the desired results. The latter method is advantageous as the tissues can be embedded in paraffin, in the usual way, without deteriorating the stain, and thin sections obtained. If the lemon juice method be used, the tissues should be mounted in glycerine.

**Osmic Acid.**

Tissue sections, when placed in osmic acid, are quickly fixed by it, and remain colorless if not exposed to light during the process, if placed in the light, however, all fatty material becomes blackened, which allows of its ready recognition under the microscope. Flemming's chromo-osmocetic acid mixture (see. Vade mecum. 2. Edition. § 36) gives similar results and fixes better. Tissues stained in this way can be embedded in paraffin, by the usual method without the blackened fat being dissolved out of them by it.
Haemalum. Etc.

Green or paraffin cut sections will stain well in a 1-20 solution of this dye, in from 5 to 15 minutes, according to the time, they may then be washed in distilled water and mounted in balsam, in the usual way. This dye may be
combined with eosin in water solution (1-1200 or 1-2000) which gives a good double stain. A few drops of a saturated alcoholic solution of picric acid may
be placed in the alcohol with which sections stained doubly, as above stated, are dehydrated; this produces a beau-
tiful multiple stain, of service in the
study of the tongue and pleuris generally.

Or haemalum alone with picric acid
used as just described gives fairly good
results with some tissues (e.g. spleen).

Ehrlich's Acid Haemalum & Benzo-pyperumine B.

Stain in the acid haemalum for 15-
minutes; wash in ordinary tap water for
20 minutes; then stain in a 1-2000 water
solution of benzo-pyperumine B3 (soluble in water)
for 40 minutes; de-colorize,
in acid alcohol (6 drops HCl to 100 cc. of 70% methylated spirit) till the sections assume a reddish yellow tinge, dehydrate, clear in oil of cloves, and mount in balsam.

This is a very good multiple plan for the elementary touch generally.

I have given a modified at full length as it is new.

Prussian carmine & Alum-carmine

are excellent dyes for most tissues, and being so well known require no further comment. Sections stained with the latter dye, being dehydrated in alcohol containing prussic acid are sometimes very beautiful.

Anaesthetic Dyes

Sulphur green

A 1-1200 waxy gum solution in combination with carmine 1-1200, sometimes gives marvelous results, and the length of time which the tissue is left in each dye, varies with the effect desired.

For Sholl's eosin in phosphin, cells, a very short sojourn in eosin alone is necessary, if the baso-philous cells are sought for,
stain first in caine for 20 minutes or so, then in the green dye for a somewhat longer period. Sections stained with this combination must always be mounted in balsam.


drude's fluid.

(see, Vade mureum, 2 edition, § 252.)

This dye gives also very good results; the stain should be obtained direct from Grobler, as home made samples are very apt to fail.

methyl blue.

In watery solution this dye is very good for basophilic cells.


dafroaxis.

In concentrated solution useful for staining

methyl orange.

In watery solution may be used with advantage in the study of the nerves.


dtian violet.

A 1% - 2% watery solution is excellent for blood pleats, and white blood corpuscles.

Alcoholic solutions of these dyes are sometimes indispensable.

Saturated alcoholic methyl-blue.
Excellent for both blood and marrow, and can for the latter tissue be combined with acid fuchsin with advantage.

Saturated alcoholic basic fuchsin.

Of great service in the study of marrow.

All sections stained in anilin dyes should be mounted in balsam.

To determine the presence of iron, two methods may be used.

(1) Place sections of the tissue in Ammonium Sulphide for 12 hours; any iron will become blackened. Mount in Flemings solution or glycerine.

(2) Barrett's method. Stain for 15 minutes in Potassium ferrocyanide, and mount in acid glycerine (6 drops HCL to 100cc of glycerine). The stain only gradually develops, all iron becoming blue in colour.

Nitrate of Silver.

Invaluable for demonstrating cell outlines.

Of this old and well-known method nothing need be said.
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Tongue.

Shows spinous and fungiform papillae in transverse section.

Tg. 3. V.T.S. Tongue of hibernating hedgehog (middle third). Alum-carmine. Balsam.
Shows the cylindrical longitudinal muscle and median raphe.

Tg. 5. V.T.S. Tongue of hibernating hedgehog (middle third). Alum carmine and Iodine Green. Balsam.
Shows the distribution of Plasma cells, the granules of which are stained with the green stain.

Tg. 10. V.T.S. Tongue of hibernating hedgehog. (fig)
Haematoxylin. Balsam.
Shows muscle fibres entering a fungiform papilla and also plasma cells.

Tg. 11. V.T.S. Tongue of hibernating hedgehog. (fig)
Haematoxylin. Balsam.
Shows a nerve ending in a fungiform papilla.

For comparison.


Shows peculiar muscle fibres.


Shows peculiar muscle fibres.

Tq. 23. V.T.S. Edge of tongue of hibernating hedgehog (posterior third). Essine & haematoxylin. Balsam.

Shows peculiar muscle fibres.


Shows peculiar muscle fibres.

Tq. 27. V.T.S. Edge of tongue of hibernating hedgehog (posterior third). Picro-carmine. Tarran.

Shows peculiar muscle fibres.


Tq. 34. V.T.S. Tongue of hibernating hedgehog (posterior third).
Tg. 35. V. T. S. Tongue of hibernating hedgehog (post. third)
Eosin & haematoxylin. Balsam.
Shows ceruminous papilla, etc.

Tg. 38. V.T.S Tongue of hibernating hedgehog (post. third) Ehrlich’s acid haematoxylin & benzo-purpurine B. Balsam.
Shows ceruminous papilla with glands in it; also mucous and perous glands, and dilated duct of mucous gland in the mucosa.
Compare with Tg. 56.

Tg. 39. V. T. S. Tongue of hibernating hedgehog (post. third) Picro-carmine. Stained.
For glands, compare with Tg. 33.

Tg. 51. L. V. S Tongue of hibernating hedgehog (ante. third) Ehrlich’s acid haematoxylin & benzo-purpurine B. Balsam.
Shows phalins & fungiform papilla, and plasma cells.

Tg. 52. L. V. S Tongue of hibernating hedgehog (ante. third) Ehrlich’s acid haematoxylin & benzo-purpurine B. Balsam.
Shows papillae etc.

Tg. 56 V. T. S. Tongue of hibernating hedgehog (post. third)
Ehrlich's acid haematoxylin & benz-purpurin. Balsam.

Shows circumvallate papillae, glands, etc. Compare with T.S. 36.

T.S. 57. V.T.S. Tongue of hibernating hedgehog. (Post-mort)
Ehrlich's acid haematoxylin & benz-purpurin. Balsam.

Shows mucus glands, and muscle fibres like those of mammal's cardiac and ganglion for mucus glands.

**Oesophagus**


Shows general structure.


Shows muscularis mucosae.


Shows a muscle fibre with nuclei among the fibres.


Eosine & Iodine green. Balsam.

Shows a mucous acinus in the connective tissue of the mucosa and plasma cells.

30. L.S. Oesophagus of summer hedgehog.

Propocollin and Acrilin blue. Balsam.

Shows plasma cells to be numerous.

32. L.S. Oesophagus of summer hedgehog.

Eosine & Iodine green. Balsam.

Shows plasma cells. Compare with 12.

33. L.S. Oesophagus of summer hedgehog.

Haematoxylin. Balsam.

For general structure.

34. L.S. Oesophagus of summer hedgehog.

Picro-carmine. Tannin.

Shows the muscularis mucosae.

Stomach.

20. V.S. Oesophagal portion of Stomach, summer.

Ehrlich’s and haematoxylin & leuco-purpurine B.

Balsam.

Shows circular arrangement of muscle fibres round the necks of the cardiac glands.

21. V.S. Oesophagal portion of Stomach of summer hedgehog.
St. 22. V.S. Cardiac end of stomach of summer hedgehog.

Ehrlich's acid haematoxylin & benzo-purpurine B.
Balsam.

Shows the various forms of connective tissue corpuscles mentioned in the text.

St. 31.

V.S. Cardiac end of stomach of summer hedgehog.

Eosin. Balsam.

To compare with similar sections stained by other methods.

St. 32. V.S. Cardiac end of stomach of summer hedgehog.

Ehrlich's acid haematoxylin & benzo-purpurine B.
Balsam.

Shows various conditions of the cells lining the ducts of the glands, etc.

St. 34. V.S. Cardiac end of stomach of summer hedgehog.

Eosin & iodine-green. Balsam.

Shows how the parietal cells stain with this combination.

St. 36. V.S. Cardiac end of stomach of summer hedgehog.
St. 37. V.S. Cardiac end of stomach of hibernating hedgehog.

Haematoxylin. Balsam.

For general structure.

St. 3. V.S. Cardiac end of stomach of hibernating hedgehog.

Eosine. Balsam.

Shows wandering cells of connective tissue.

Compare with St. 31.

St. 6. V.S. Cardiac end of stomach of hibernating hedgehog.

Eosine & haematoxylin. Balsam.

For wandering cells.

Compare with St. 36.

St. 9. V.S. Cardiac end of stomach of hibernating hedgehog.

Sholich's and haematoxylin & benz-o-purpurine B.

Shows a mass of wandering cells resembling a politory gland.

Compare with St. 32.

St. 10. V.S. Cardiac end of stomach of hibernating hedgehog.

Sholich's acid haematoxylin & benz-o-purpurine B.

Shows politory glands.

Compare with St. 9, 36, St. 32.

St. 14. V.S. Cardiac end of stomach of hibernating hedgehog.

Eosine & iodine green. Balsam.

For wandering cells. Compare. St. 34.
Pyloro-Duodenal Junction.

P.D. 20. V.L.S. Pyloro-duodenal junction of rumen of herring, 
Ehrlich's and haematoxylin & benzopurpurine B. 
Balsam.

Shows the general structure.

P.D. 21. V.L.S. Pyloro-duodenal junction of rumen of herring, 
Ehrlich's and haematoxylin & benzopurpurine 13. 
Balsam.

Compare with P.D. 8.

P.D. 23. V.L.S. Pyloro-duodenal junction of rumen of herring, 
Ehrlich's & iodine green. Balsam.

For wandering cells, etc. Compare. St. 34.

P.D. 26. V.L.S. Pyloro-duodenal junction of rumen of herring, 
Ehrlich's & haematoxylin. Balsam.

For general structure.

P.D. 2. V.L.S. Pyloro-duodenal junction of hibernating herring, 
Ehrlich's & haematoxylin. Balsam.

Compare with P.D. 26.

P.D. 6. V.L.S. Pyloro-duodenal junction of hibernating herring, 
Haematoxylin. Balsam.

P.D. 7. V.L.S. Pyloro-duodenal junction of hibernating herring, 

Compare with P.D. 21.

P.D. 10. V.L.S. Pyloro-duodenal junction of hibernating herring, 
Picro-carmine. Ferrum.

So compare with those mounted in balsam.
Small Intestine

I. 5. V.S. Small intestine of hibernating hedgehog.
Shows the villi in transverse section and the shape of the chalicie cells.

I. 20 V.S. Small intestine of hibernating hedgehog.
Haematoxylin & Balsam.
For general structure.

I. 24 V.S. Small intestine of hibernating hedgehog.
Haematoxylin & Eosine. Balsam.
Shows the mucous connective tissue between Lieberkühn's glandes and the muscularis mucosae.

I. 26 V.S. Small intestine of hibernating hedgehog.
Picro-carmine. Farrow.
To compare with other & to show the same as I. 24.

I. 28 V.S. Small intestine of hibernating hedgehog.
Shohl's acid haematoxylin & benz-purpurine.
Balsam.
For the epithelium, muscularis mucosae, etc.

I. 31 V.S. Small intestine of summer hedgehog.
Haematoxylin & Eosine. Balsam.
For cells of adenoid tissue of villus, etc.
I. 32. V.S. Small intestine of pinnamer hedgehog.
Ehrlich's acid haematoxylin & benzopurpurine B.
Balsam.
Compare with I. 28.

I. 33. V.S. Small intestine of pinnamer hedgehog.
Ehrlich's acid haematoxylin & benzopurpurine B.
Balsam.

For lacteal vessel.

I. 35. V.S. Small intestine of pinnamer hedgehog.
Picro-carmine. Farrand.
Compare with I. 26.

Large Intestine

II. 40. V.S. Function of small & large intestines of
pinnamer hedgehog.
Ehrlich's acid haematoxylin & benzopurpurine B.
Balsam.
For general structure.

II. 2. V.S. Large intestine of hibernating hedgehog.
Haematoxylin. Balsam.
For general structure.

II. 4. V.S. Large intestine of hibernating hedgehog.
Picro-carmine. Farrand.

II. 8. V.S. Large intestine of hibernating hedgehog.
Esrine & haematoxylin. Balsam.
For epithelium, wandering cells, etc.

L. I 11. V.S. Large intestine of hibernating hedgehog.
Ehrlich's acid haematoxylin & benz-o-purpurine B.
Balsam.
For epithelium, wandering cells, muscular
muscae, etc.

L. I 12. V.S. Large intestine of hibernating hedgehog.
Eosine & iodine green. Balsam.
For wandering and chalice cells.

L. I 20. V.S. Large intestine of nummer hedgehog.
Haematoxylin. Balsam.
Compare with L. I 2.

L. I 21. V.S. Large intestine of nummer hedgehog.
Eosine & haematoxylin. Balsam.

L. I 22. V.S. Large intestine of nummer hedgehog.
Ehrlich's acid haematoxylin & benz-o-purpurine B.
Balsam.
Compare with L. I 11.

L. I 23. V.S. Large intestine of nummer hedgehog.
Picro-carmine. Tannin.
Compare with L. I 4.
Liver.

L. 1. Liver of hibernating hedgehog.

Shows pigment in liver cells.

L. 3. Liver of hibernating hedgehog.

Shows the pigment granules running as a dark band through the middle of the cell columns.

L. 4. Liver of hibernating hedgehog.

Shows some containing pigment in the capillaries.

L. 15. Liver of hibernating hedgehog.

Haematoxylin & eosine. Balsam.

Intermediate bile duct.

L. 16. Liver of hibernating hedgehog.

Shows yellow pigment near sinus of liver acinus, also pigment carrying cells in the capillaries and portal lobules, venous structure.

L. 17. Liver of hibernating hedgehog.

Shows acid haematoxylin & eosin. Balsam.

Bile ducts and general structure.
L. 20. Liver of summer hedgehog.
   Haematoxylin & orcein. Balsam.
   Shows 2 mucous acini in the bile ducts.
   Orcein & haematoxylin. Balsam.
   For general structure, etc.
L. 22. Liver of summer hedgehog.
   Shorle's acid haematoxylin & benz-o-phosphorin.
   Balsam.
   To compare with L. 17.
L. 25. Liver of summer hedgehog.
   Unstained. \textit{Farrand.}
   To compare with L. 3.

Pancreas.

P. 3. Pancreas of hibernating hedgehog.
   Borax-carmine & haematoxylin. Balsam.
   Shows intra-lobular ducts.
P. 4. Pancreas of hibernating hedgehog.
   Borax-carmine, haematoxylin & orcein. Balsam
   Shows intermediate ducts.
P. 5. Pancreas of hibernating hedgehog.
   Borax-carmine, haematoxylin & orcein. Balsam.
   Shows ganglia near the ducts.
Haematoxylin Farrant.
The cells show two different zones.

P. 13. Pancreas of hibernating hedgehog.
Eosine, haematoxylin. Balsam.
Shows mucous glands, in walls of big ducts.

P. 20. Pancreas of summer hedgehog.
Borax-carmine. Balsam.
The cells exhibit two zones.

P. 24. Pancreas of summer hedgehog.
Haematoxylin. Farrant.
The cells show two zones, the inner of which is very granular.

Parotid Gland.

P. 4. Parotid of hibernating hedgehog.
Haematoxylin & eosine. Balsam.
Shows a large duct the epithelium of which has replacement cells.

Haematoxylin. Farrant.
Shows the cell network in the cells of the ducts, and the granularity of those of the gland.

Borax-carmine, haematoxylin & eosine. Balsam.
Shows stroma of gland, several acini having fallen out of the section.
Paraist of hibernating hedgehog.
Borax-carmine, haematoxylin & eosine. Balsam.
Shows the inter-lobular ducts.

Sub-Maxillary gland.

Sm. 1. Sub-maxillary of hibernating hedgehog.
Borax-carmine. Balsam.
Shows the effect of paralytic secretion.

Sm. 3. Sub-maxillary of hibernating hedgehog.
Borax-carmine, haematoxylin & eosine. Balsam.
Shows intermediate ducts.

Sm. 9. Sub-maxillary of hibernating hedgehog.
Alum-carmine. Fastatin.
Shows the granularity of the cells.

Sm. 12. Sub-maxillary of hibernating hedgehog.
Picro-carmine. Fastatin.
Compare with others.

Sm. 20. Sub-maxillary of pinnate hedgehog.
Borax-carmine. Balsam.
Compare with Sm. 1.

Sm. 21. Sub-maxillary of pinnate hedgehog.
Borax-carmine. Balsam.
Shows perine as well as zymosan acid.
Lymphatic Gland.

Ly. 8. Lymph gland of neck of hibernating hedgehog.
       Eosine & iodine green. Balsam.
       Shows plasma cells.

Ly. 10. Lymph gland of neck of hibernating hedgehog.
        Haematoxylin. Balsam.
        For the general structure.

Ly. 11. Lymph gland of neck of hibernating hedgehog.
        Haematoxylin & eosin. Balsam.
        Shows the germinal centres.

Ly. 18. Lymph gland of neck of hibernating hedgehog.
        Ehrlich's acid haematoxylin & benzopurpurine. Balsam.
        Shows giant cells.

        Haematoxylin & eosin. Balsam.
        Shows giant cells.

Ly. 22. Lymph gland of neck of hibernating hedgehog.
        Beray carmine, cut in paraffin. Balsam.
        Shows Kaposi mitosis in germinal centres.

Ly. 23. Lymph gland of neck of hibernating hedgehog.
        Paraffin. Beray carmine, haematoxylin & eosin.
        Balsam.
        Shows giant cells.


Shows granul cells.

Ly. 25. Lymph gland of neck of hibernating hedgehog.

Shows phagocytes.

Ly. 27. Lymph gland of neck of hibernating hedgehog.
Paraaffin. Borax-carmine, haematoxylin & eosine.

Balsam.

Shows phagocytes.

Ly. 30. Lymph gland of neck of summer hedgehog.
Paraaffin. Borax-carmine, haematoxylin & eosine.

Balsam.

For the general structure.

Ly. 32. Lymph gland of neck of summer hedgehog.
Paraaffin. Borax-carmine, haematoxylin & eosine.

Balsam.

For general structure.

Spleen.

Sp. 2. T.S. Spleen of hibernating hedgehog.
Alum-carmine & picric acid. Balsam.

Shows granul cells, muscle fibres, subcapsular pinn, etc.

Sp. 3. T.S. Spleen of hibernating hedgehog.
Haematoxylin & picric acid. Balsam.
Sp. 7. T.S. Spleen of hibernating hedgehog.

Haematoxylin & eosine. Balsam.

Shows the muscular capsule of the Malpighian bodies.


Sapronin. Balsam.

For pigment, etc.

Sp. 15. T.S. Spleen of hibernating hedgehog.

Alum-carmine. Balsam.

For pigment, etc.

Sp. 20. T.S. Spleen of hibernating hedgehog.

Ehrlich's acid haematoxylin & benzoyl-pyronine 1%. Balsam.

For granul cells and splenic cells.

Sp. 22. T.S. Spleen of hibernating hedgehog.

Ehrlich's acid haematoxylin washed out, water and alcohol. Balsam.

For pigment, etc.

Sp. 23. T.S. Spleen of hibernating hedgehog.

Eosine & violine green. Balsam.

Shows eosinophilous cells & plasma cells.


For granul cells, etc.

Sp. 51. T.S. Spleen of summer hedgehog.
Sp. 53. T.S. Spleen of summer hedgehog.

Iodine & iodine green. Balsam.

Compare with Sp. 23.

Sp. 57. T.S. Spleen of summer hedgehog.

Schloët's acid haematoyxlin & benzopurpurine Balsam. Paraffin.

Compare with Sp. 20.

Sp. 58. T.S. Spleen of summer hedgehog.


For various cells.

Sp. 59. T.S. Spleen of summer hedgehog.


Compare with Sp. 7 & Sp. 30.

Supra-Renal. Body.


Haematoyxlin & eosine. Balsam.

For the general structure, pigment in cells and problem cells.

Sp. 4. Supra-renal of hibernating hedgehog.

Haematoyxlin & eosine. Balsam.

For general structure, etc.

Hæmatop吖lin . Balsam.
For general structure, etc.

For plasma cells.

Unstained . Farrant.
To prove the absence of pigment from
the gland cells.

Hæmatop吖lin & Iodine . Balsam.
Compare with S.R. 3 & 4.

Hæmatop吖lin . Balsam.
Compare with S.R. 9.

Sulphuric acid hæmatop吖lin & benco-permanor.
Balsam.

Unstained . Farrant.
Compare with S.R. 15.

Red Marrow of the Long Bones.

M. 1. Thinwalled marrow of femur of hibernating hedgehog.
Basic fuchsin . Balsam.
Shows the cells of which the marrow is composed.


Shows various kinds of marrow cells.


The preparation is deeply stained.


Shows granul cells.


Shows eosinophil cells.


Shows all the marrow cells.


Compare with M. 2 & M. 10.


Compare with M. 1 & M. 16.

M. 32.

Filmed marrow of sternum of hibernating hedgehog.

Basic fuchsin. Balsam.

Shows absence of iron holding granules.

Blood.

Bl. 10. Filmed blood of summer hedgehog 3.7.90.

Gentian violet. Balsam.

Shows blood-plate & white corpuscles.

Bl. 11. Filmed blood of summer hedgehog

Methyl-blue. Balsam.

Shows plasma cells.

Bl. 15. Filmed blood of September hedgehog 9.7.90.

Methyl-blue. Balsam.

Shows degenerating red corpuscles.

Bl. 16. Filmed blood of summer hedgehog

Methyl-blue. Balsam.

Shows general structure.

Bl. 24. Filmed blood of October hedgehog 30.10.90.

Methyl blue. Balsam.

Compare with Bl. 11.

Bl. 30. Filmed blood of November hedgehog 19.11.90

Methyl-blue. Balsam.
Bl. 52. Filmed blood of March hedgehog, 5-3-91.
  Methyl-blue. Balsam.
  Compare with Bl. 11 & 24 & 30.

Bl. 53. Filmed blood of March hedgehog.
  Methyl-blue. Balsam.
  Compare with others.

Hibernating Gland.

Fig. 1. Hibernating gland of hibernating hedgehog.
  Paraffin. Borax-carmine, haematoxylin, & eosine.
  Balsam.
  Shows colloid material in capillary.

Fig. 2. Hibernating gland of hibernating hedgehog.
  Borax-carmine, haematoxylin, Balsam, Paraffin.
  Shows plasma cells.

Fig. 3. Hibernating gland of hibernating hedgehog.
  Paraffin. Borax-carmine, haematoxylin & eosine.
  Balsam.
  For general structure.

Fig. 4. Hibernating gland of hibernating hedgehog.
  Shows cell of gland that have undergone no change.

Fig. 5. Hibernating gland of hibernating hedgehog.
  Shows yellow material in capillary.
Hg. 6. Hibernating gland of hibernating hedgehog.
Benzin, borax-carmine, haematoxylin & esin. Balsam.
Shows colloid material in capillary.

Hg. 7. Hibernating gland of hibernating hedgehog.
Benzin, borax-carmine, haematoxylin & esin. Balsam.
Shows colloid matter in capillary.

Hg. 8. Hibernating gland of hibernating hedgehog.
Benzin, borax-carmine, haematoxylin & esin. Balsam.
Shows the nests eaten appearance.

Hg. 9. Hibernating gland of hibernating hedgehog.
Benzin, borax-carmine, haematoxylin & esin. Balsam.
Shows a patch almost destitute of capillaries.

Hg. 10. Hibernating gland of hibernating hedgehog.
Benzin, borax-carmine, haematoxylin & esin. Balsam.
Shows yellow pigment in the lymphatics.

Hg. 11. Hibernating gland of hibernating hedgehog.
Haematoxylin & esin. Balsam.
Shows lymph follicular tissue around vessel and nerve.

Hg. 12. Hibernating gland of hibernating hedgehog.
Gin-carmine. Tincture.
Shows lymph follicular tissue around vessel & nerve.

Hg. 13. Hibernating gland of hibernating hedgehog.
Injected. Balsam.
Shows capillary network.


Fig. 58. Hibernating gland of summer hedgehog.

Safranin. Balsam.

Shows general structure.

Fig. 40. Hibernating gland of summer hedgehog.


Shows cell isolated and developing.

Fig. 41. Hibernating gland of summer hedgehog.

Gomme acid, Magenta. Seared. Tannic.

Shows isolated cells, etc.


Shows nucleolus of cells.


Shows isolated cells into which nerves enter.


Shows arterial inner nerve plexus.


Shows plexus muscular arterial nerve plexus.
Skin.

Sh. 1. V.S. Skin of Abdomen of hedgehog.
Haematoxylin. Balsam.
Shows sweat glands, etc.

Sh. 2. V.S. Skin of Abdomen of hedgehog.
Haematoxylin. Balsam.
Shows panniculus carnosus.

Sh. 3. V.S. Skin of Abdomen of hedgehog.
Haematoxylin. Balsam.

Sh. 6. V.S. Skin of Abdomen of hedgehog.
Haematoxylin & eosine. Balsam.
Shows panniculus carnosus & general structure.

Sh. 10. V.S. Skin of back of hedgehog.
Haematoxylin & eosine. Balsam.
For general structure.

Sh. 11. V.S. Skin of back of hedgehog.
Haematoxylin & eosine. Balsam.
Shows back of spine.

Sh. 12. V.S. Skin of back of hedgehog.
Eschweiler's acid haematoxylin & benzoyl peroxide 15.
Balsam.
Shows the vertebræ.

Sh. 14. V.S. Skin of back of hedgehog.
Haematotyphlin, eosine, & Prusi acid. Balsam.
Shows fibrous covering of the spine.

Mu. 1.
L.S. & J.S. Skeletal muscles of hedgehog.
Alum-carmine. Balsam.

Mu. 5.
L.S. Human platysma.
 toluidine blue haematoxylin & benzopurpurine B.
Balsam.
Compare with panniculus carnosus.

Mu. 10.
Rectus oculi of hedgehog.
Shows termination of motor nerve.

Mu. 12.
Mylo-hyoid of hedgehog.
Shows termination of motor nerve.

S. 1.
L.S. Spine of hedgehog.
Methyl orange. Balsam.
Shows centre of spine.

S. 3.
L.S. Spine of hedgehog.
Methyl orange. Balsam.

S. 5.
L.S. Spine of hedgehog.
Methyl blue. Balsam.

S. 6.
L.S. Spine of hedgehog.
Gentian violet. Balsam.
S. 8.
L.S. Spine of hedgehog.
Acid fuchsin. Balsam.

S. 11.
L.S. Spine of hedgehog.
Safranin. Balsam.
Shows the root.

S. 12.
L.S. Spine of hedgehog.
Methyl blue & acid fuchsin. Balsam.
Shows the cuticle and sutures in surface section.

S. 17.
L.S. Spine of hedgehog.
Unstained. Balsam.

S. 20.
T.S. Spine of hedgehog.
Methyl orange. Balsam.
Shows sutures & central peptic.

S. 21.
T.S. Spine of hedgehog.
Methyl blue. Balsam.
Shows a difference of stain between cortex and medullary pept., & the remains of nuclei?

S. 22.
T.S. Spine of hedgehog.
Methyl blue. Balsam.

S. 23.
T.S. Spine of hedgehog.
Safranin. Balsam.
Shows pigment in the cortex.

S. 24.
T.S. Spine of hedgehog.
S. 31.  
and pickin.  Balsam.

L. S. Small hair-spine of hedgehog.  
Metalipl blue.  Balsam.  
Shows median transverse repta, loculi, & cortex.

S. 34.  
L. S. Tip of thick hair of hedgehog.  
Saffronin.  Balsam.  
Shows how the cortex predominates over the medulla.

S. 30.  
Ordinary soft hair of hedgehog.  
Unstained.  Balsam.  
Shows that it is a fibrous hair.
Plates.
Fig. 1. Plate I.

Vertical section of a Conical or Spinous Papilla of Tongue—stained with Ehrlich’s acid haematoxylin and benzo-purpurin, and mounted in balsam.

x 300 (Ob. N.7 and Ob. N.6 Hartung); drawn with Hachet’s camera lucida.

- b. Capillary blood-vessel.
- c. Stratification cornueum of the epithelium.
- d. Cells of spine which contain eelide granules.
- e. Cells of spine which stain uniformly orange, but which do not contain eelide in a granular form.
- f. Growing part of the stratum Malpighii of the epithelium which stains more deeply than the remaining portion of the same stratum.
- g. Subcutaneous connective tissue which is prolonged upwards under the spine to form a fibrous papilla.
- h. Cells forming the tip and posterior aspect of the spine, and which have been fully transformed into keratin.
- i. Stratum Malpighii of the epithelium.
- j. Downward projection of the deep layers of the stratum Malpighii, forming an epithelial papilla from which the greater part of the cells entering into the formation of the spine spring.
3. Keratinised material which separates the cells of the spine from neighbouring epithelial cells.
Fig. 2. Plate II.

Longitudinal section of anterior portion of Tongue—showing a fungiform Papilla with several conical papillae near it. Stained with Ehrlich's acid haematoxylin and benz-o-purpurin, and mounted in balsam. x 54 (Ob. №3 and Oc. №1 Leitz); drawn with Nachet's Camera lucida.

b. Blood vessels.

c. Stratum corneum of the epithelium.

d. Cells containing elcidin.

e. Sub epithelial connective tissue projected upwards as fibrous papillae.

f. Bundle of nerve fibres passing up the centre of the fungiform papilla and reaching to the epithelium.

Fig. 3. Plate II.

Vertical transverse section of a Circumvallate Papilla of the Tongue. Stained with Ehrlich's acid haematoxylin and benz-o-purpurin, and mounted in balsam. x 50 (Ob. №3 and Oc. №3 Hartnick); drawn with Nachet's camera lucida.

a. Acini of von Ebner's glands situated in sub-epithelial connective tissue but outside the papilla.
b. Blood vessel.
c. Stratum corneum of the epithelium.
e. von Ebner's glands.
f. Sub-epithelial connective tissue.
g. Stratum Malpighii of the epithelium.
h. Taste bulbs.
i. Secondary papilla of fibrous tissue.
j. Position in which the epithelial covering is thinnest.
k. Valley around the papilla.
Fig. 4. Plate III.

Coarsely granular Cells of Connective tissue of Tongue. Stained with Zielhies' acid haematoxylin and benzopurpurin; and mounted in balsam.

(Ob. 100x; immersion Beck and H.3 Hartnack's Oc.). Enlarged from drawings made with Hachet's camera lucida.

a. Smallest cells of this kind observed. They are round, medullated and full of granules.

b. Similar cells slightly larger and of irregular shape.

c. Still larger cells.

d.) Full grown cells of various shapes.

e.)

f. An old cell with few granules only round the nucleus, apparently breaking down. This cell is taken from the Mesentery of the same animal.

r. Red blood corpuscles drawn to scale.

Fig. 5. Plate III.

Nuclei of Epithelial cells of Tongue in which Merck fibrils are seen to end. The cell outlines are not visible owing to treatment of the tissue with formic acid.

Stained with Gold chloride and mounted in glycerine.

A semi-diagrammatic figure.

(Ob. 100x; water immersion Beck and 0.5% Hartnack). Enlarged from
Plate III.

Fig. 4.

Fig. 5.
Camões. Arautoiro.
Fig. 6. Plate IV.

Transverse section of Striped Muscle Fibres of Tongue.
Stained with Eosine and Haematoxylin and mounted in balsam.

×700 (Ob. M.3 and Oc. M.3 Leitz, tube elongated); drawn
with Hachets Camera lucida.

a. Fibre composed of fine fibrils.
b. Curvus muscle fibre described in text.
c. Central core of b. composed of longitudinally
placed fibrils.
d. Circularly disposed fibrils.
e. Undifferentiated protoplasm.
f. Nuclei.
g. Sarcolemma.
h. Ordinary connective tissue.

Fig. 7. Plate IV.

Transverse section of Striped Muscle Fibres of Tongue.
Stained with Eosine, Haematoxylin and Peric Acid, and
mounted in balsam.

×700 (Ob. M.3 and Oc. M.3 Leitz, tube elongated); drawn
with Hachets Camera lucida.

a. Fibre composed of coarse fibrils.

Other letters same as in fig. 6.
Fig. 8. Plate V.
Transverse section of the Oesophagus.
Stained with picric-carmine and mounted in ferrate solution. x 50 (Ob. N.3 and Ob. N.3 Hartnack); drawn with Zeiss camera lucida.
A. Mucous Membrane.
B. Sub-mucous coat.
C. Muscular coat.
D. Lumen of Oesophagus.
E. Blood vessel.
F. Stratum cornueum of the epithelium.
G. Connective tissue of the mucous membrane.
H. Epithelium living the tube.
I. Inner layer of the muscular coat.
J. Stratum Malpighii of the epithelium.
K. M. Bundles of non-stripped muscle of the muscularis mucosae.
L. Outer layer of the muscular coat.

Fig. 9. Plate V.
Transverse section of a striped muscle fibre of the Oesophagus, showing three nuclei, each surrounded by a little undifferentiated protoplasm, imbedded within the fibre; other nuclei occur in the same fibre in the usual position under the paraluminal.
Stained in haematoxylin and mounted in balsam. x 400 (Ob. No. 7 and Oc. No. 2 Leitz, treti elongated), drawn with Hackett's camera lucida.

H. Nucleus.
O. Nucleolus.
\( p \). Undifferentiated protoplasm.
S. Sarcolemma.
\( f \). Connective tissue surrounding the fibre.
Fig. 10. Plate VI.

Vertical Longitudinal section of the junction of the Oesophagus with the Stomach.

Stained with Shulz's acid haematoyxlin and benzopurpurin, and mounted in balsam.

× 20 (Ob. with Ross and H.3 O. Hartreeck), drawn with Zeiss' camera lucida.

C. Oesophagus.
D. Stomach.
A. Mucous coat.
B. Sub-mucous coat.
C. Muscular coat.
G. Blood vessels.
E. Epithelium.
G. Gastric glands of the ordinary type.
L. Solitary glands.
M. Mucous gland in oesophagus.
M.M. Muscularis mucosae.
P. Glands resembling those usually found at pyloric end of stomach.
S. Serous glands.
Fig. 11. Plate VII.

Various appearances presented by Columnar Cells of the Mucous Membrane of the Stomach.
Stained with Ehrlich's acid haematoxylin and benzopurpurine, and mounted in balsam.

(Ob. forater immersion Beck, Oc. No. 3 Hartnack); drawn with Handy's camera lucida.

a. Columnar cells lining the ducts of the cardiac glands in the resting stage. Taken from a hibernating animal.

b. Similar cells from the ducts of the pyloric glands during hibernation.

c. Cells lining the ducts of the cardiac glands after active secretion.

d. Cells lining the ducts of the cardiac glands after a temporary resting condition, the animal being in a state of activity.

e. Similar cells after a more prolonged state of rest; animal active.

f. Columnar cells of the ordinary type which line the general surface of the stomach.

g. A chalice cell from the mucous membrane of the duodenum. The cell
is full of nuclides and presents a plug of mucin projecting from its open mouth.
Fig. 12. Plate VIII.

Connective Tissue Corpuscles of the Sub-mucous Coat of the Stomach.
Stained with Heidenhain’s acid haematoxylin and bengz purpurin, and mounted in balsam.

(Ob Shake water immersion slide and Ob H3 Hartnack),
drawn with Hachet’s camera lucida.

a. Ordinary connective tissue corpuscle.
b. Connective tissue corpuscle the prototisomes of which stains orange with bengz purpurin.
c. Connective tissue corpuscle the prototisomes of which stains violet with the acid haematoxylin.
d. Coarsely granular corpuscle.
e. Wandering cell.

Fig. 13. Plate VIII.

Vertical section of the Stomach of a Hedzleag in the hematoxylin condition showing the part of the Mucous Membrane nearest the Muscularis Mucosa.
Stained with Iodine and Iodine Green, and mounted in balsam.

x 200 (Ob H3 and Ob H3 Hartnack) drawn with Hacht’s camera lucida.

b. Arteriole.
c. Ordinary connective tissue corpuscles.
Fig. 14. Plate IX.

Wandering Cells of the Connective Tissue of the Stomach of a Hibernating Hedgehog.

Stained with Eliechi's acid haematoxylin and benzoo-purpureae, and mounted in balsam.

(Ob. from parer immersion Beck and Dr. K.3 Hartmack); drawn with Hackel's camera lucida.

a. Small wandering cell with a single nucleus containing a nucleolus.

b. Wandering cells each exhibiting a bi- or tri-lobed nucleus with two nucleoli.

c. Wandering cells each exhibiting a bi- or tri-lobed nucleus with two nucleoli.

d. Cell with a dumb-bell shaped nucleus and two nucleoli.

e. Cells each exhibiting two distinct and separate nuclei in each of which is a nucleolus.

f. Cell showing a slight constriction of the protoplasm between the two widely separated nuclei.

h. Cell recently divided into two cells of the type (c)
n. Lymph corpuscles drawn to scale.
Fig. 15. Plate V.

Vertical Section of the Junction of the Stomach with the Duodenum, giving a view of the whole extent of Brunner's glands.

Stained with Ehrlich's acid haematoxylin and benz-purpurine, and mounted in balsam.

x 5 (Ob. 2 inch Ross and Ob. H. 2 zess); drawn with Zeiss' camera lucida.

D. Duodenum.

5. Stomach.

b. Brunner's glands in the subsmucous coat of the duodenum.

b0. Circular blood vessels.

c.m. Circular muscle coat of the duodenum, which sends prolongations upwards between the lobules of Brunner's glands. It is continuous with the pyloric sphincter.

d. Ducts of Brunner's glands piercing the muscularis mucosae.

im. Internal muscle coat of the stomach

j. Junction of the mucous membrane of the stomach with that of the duode-

mum.

l. Lieberkühn's glands.
l.m. Longitudinal muscle coat of the duodenum
which is continuous with the outer muscle coat of the stomach.

m.m. Muscularis mucosae.

m. Portions of the muscularis mucosae which
pass between the lobules of Brunner's glands to become continuous with that
of the duodenum.

o.m. External muscular coat of the stomach.

p. Pyloric glands of the stomach.

p.s. Pyloric sphincter, into the formation of
which both inner and outer muscle coats
of the stomach enter. It is continuous
at intervals with the muscularis mucosa
of the stomach.

p.m. Sub-mucous coat.

v. Villi.
Fig. 16. Plate XI.
Epithelium covering a villus in active condition, showing the transition between the absorbing cells, and the cells which secrete the intestinal juice.
Stained with Ehrlich's acid haematoxylin and benzopurpure and mounted in balsam.
\(\times 300\) (Ob. H.2 and Oc. H.3 Hartnack), drawn with Zeiss' camera lucida.

a. Absorbing cells.
b. Secreting cells.

Fig. 17. Plate XI.
Columnar Epithelial Cells of the Intestine of a hibernating Hedgehog.
Stained with Ehrlich's acid haematoxylin and benzopurpure and mounted in balsam.
(Ob. 10 with water immersion Berch and Oc. H.3 Hartnack), drawn with Zeiss' camera lucida.

a. Cells which cover the villi.
b. Cells which line Lieberkühn's glands.
c. Small replacement cell.
Fig. 18. Plate XII.

Vertical Transverse Section of the Small Intestine
Stained with Ehrlich's acid haematoxylin and bengo-
purpurin and mounted in balsam.

x 300 (Obj. N°7 and O.C. N°3 Hartshock); drawn with
Hachet's camera lucida.

a. Arteriole
b. Basement membrane of Lieberkühn's glands.
f. Epithelium of the closed ends of Lieberkühn's
glands.
g. Connective tissue of a somewhat gelatinous

nature of the mucous membrane.

l. Lymph space in the Sub-mucosa.
la. Lacteal vessel opening into (/).
lm. Lumen of Lieberkühn's gland.
m. Internal muscular coat of the intestine.
m.m. Muscularis mucosae.
s. Sub-mucous coat.

Fig. 19. Plate XII.

Epithelium of Villus of a tubular crypt, viewed
from a section cut in paraffin and stained with
borax-carmine, eosine and haematoxylin and
mounted in balsam.

x 300 (Obj. N°7 and O.C. N°3 Hartshock); drawn with Hachet's
Camera lucida.

a. Ordinary columnar cell.

c. Chalice cell filled with mucogen.

d. Nucleus of chalice cell, deeply placed and
   retaining the borax carmine stain.

x. Nucleus of columnar cell which has
   taken on a violet stain with haematoxylin.
**Fig. 20. Plate XIII.**

An Intermediate Duct of the Liver with its accompanying acini.
Stained with eosine and haematoxylin and mounted in balsam.

\[x \times 300\] (Ob. H.27 and Oc. H.3 Hartnack), drawn with Hachets' camera lucida.

b. Bile capillary = lumen of tubule.
c. Capillary blood vessel.
i. Intermediate duct.
l. Liver cells.
u. Nuclei of blood capillary wall.

**Fig. 21. Plate XIII.**

Transverse section of a tubule of the liver.
Stained with eosine and haematoxylin and mounted in balsam.

(Ob. 50x: 100x immersion. Oc. H.2 Hartnack), drawn with Hachets' camera lucida.

b. Bile capillary.
c. Blood capillary.
e. Capsule of liver cell.
f. Nucleus of liver cell.
h. Nucleus of liver cell.
l. A liver cell with phorochrom protoplasm.
Fig. 20.

Fig. 21.
Fig. 22. Plate xiv

Wall of a Sub-lobeular Vein of the Liver, partly surrounded by Liver Cells with blunt processes. Stained with cosine and haematoxylin and mounted in balsam. x600 (Ob. N.5 and Oc. N.3 Leitz), drawn with Hachets Camera lucida.

1. Lumen of Vein.
2. Capillary blood vessel.
3. Connective tissue of vein.
4. Endothelial cell of vein.
5. Liver cells of ordinary type.
6. Nuclei of connective tissue capillaries.
7. Liver cells with processes projecting into the connective tissue of vein.
Fig. 23. Plate XV.
A group of Acini from the liver of a hibernating hedgehog, showing a band of Pigment Granules running down the centre of each acinus and surrounding the lumen.
Stained in Heidenhain's acid haematoxylin and mounted in Farrant's solution.
(Ob. 40 micrometer immersion Beck and Oc. No.3 Hartnack's)
drawn with Hachet's Camera lucida.

b. Lumen of tubule or bile capillary.
c. Blood capillary.

Fig. 24. Plate XV.
Cells of the liver of a hibernating hedgehog, showing the accumulation of Pigment Granules in that part of the cell which lies nearest to the bile capillary and its absence from that part which is turned towards the blood capillary.
Stained in eosine and haematoxylin and mounted in balsam.

Enlarged from a drawing made with (Ob. 40 micrometer immersion Beck and Oc. No.3 Hartnack's) and Zeiss Camera lucida.

b. Bile capillary.
c. Blood capillary.
2. Nucleus of endothelial cell of blood capillary.
1. Liver cell.
1. Pigment granules.
2. Red blood corpuscles.

Fig. 25. Plate XV.
Three Cells of the Liver.
Stained with eosine and haematoxylin and mounted in balsam.
(Ob. Hb. X 400 in water immersion, Beck and O. H. 5 for trach). Enlarged
from a drawing made with NICOLET'S camera lucida.
a. Normal liver cell.
b. Swollen liver cell, the nucleus of which has become much enlarged.
c. A cell the nucleus of which has become vacuolated, the nucleolus lost, but the nuclear envelope of which persists. The cell is about to break down and disappear.
e. Nucleolus.
m. Nuclear membrane.
n. Nucleus.
v. Vacuolated nucleus.
Fig. 26. Plate XVI.
Liver of hibernating hedgehog.
Showing the large pigment-holding cells in the blood capillaries.
Stained with eosine and haematoxylin and mounted in balsam.
(Ob. 100 mch water immersion Beck and Oc.M3 Hartnack)
drawn with Zeiss' camera lucida.
On the right side of the figure one of these cells is shown on a larger scale, and beside it a white and three red blood corpuscles drawn to the same scale.

a. Pigment holding cell.
b. Nucleus of pigment holding cell.
c. Capillary blood vessel.
d. Bile capillary.
e. Liver cell.
f. Nucleus of liver cell.
g. Nucleus of endothelial cell of blood capillary.
h. Pigment in liver cells.
i. Red blood corpuscles.
j. White blood corpuscles.
Fig. 27. Plate XVII.
Transverse section of an acinus of the pancreas; showing the inner and outer parts of the cells and the tortuous lumen.

a. Basement membrane.
c. Inner zone of cell.
d. Outer zone of cell.
e. Nucleus of cell.
f. Nucleolus of cell.
g. Lumen of acinus.
h. Fibrous stroma of stroma of the pancreas.

Fig. 28. Plate XVII.
Stroma of the Parotid Gland.
(The general structure of the gland has been omitted, it being represented only by a general purple tint.)
Stained in haematoxylin, eosine and haematoxylin after embedding in paraffin, and mounted in balsam.

a. Holes from which sections of the acini have
been removed.

c. Blood capillaries.

e. Endothelial nuclei of capillary wall.

f. Nuclei of cells of the acini of the gland.

h. Nuclei of connective tissue corpuscles.

i. Stroma of fibrous tissue.

l. A thicker fibrous trabecula.
Fig. 29. Plate XVIII.

Two kinds of Cells found in the Sinuses of the Lymph Glands.
Stained with Eosine and Haematoxylin and mounted in Balsam. (Ob. 1:1000; water immersion Beck and Oc. No.3 Hartnack); drawn with Zeiss' camera lucida.

a. Lymph corpuscles proper.

b. Somewhat larger corpuscles similar to the lymph corpuscles except in size and amount of surrounding protoplasm. They closely resemble the cells of the germinal areas.

Fig. 30. Plate XVIII.

Four Phagocytes and one coarsely granular corpuscle from a lymph gland of a hibernating hedgehog.
Stained in haematoxylin and eosine, and mounted in balsam. (Ob. 1:1000; water immersion Beck and Oc. No.3 Hartnack); drawn with Zeiss' camera lucida.

a. A uninucleated phagocyte, containing a red blood corpuscle and some brown pigment-granules.

b. Phagocyte containing in addition some golden yellow pigment in a vacuole.

c. Phagocyte containing besides these some small vacuoles.

d. Phagocyte with vacuoles and brown pigment-granules.
2. Basophilous, coarsely granular corpuscle
Fig 31. Plate XIX.

Group of Phagocytes, from a section of Lymph gland, cut in paraffin, stained in Haematoxylin and Eosin and mounted in balsam. (Ob. 1/10 with water immersion Beck and Oc. II No. 3 Hartnack), drawn with Zeiss camera lucida.

a. Phagocytes.
b. Section of blood vessel.
c. Capillary.
d. Fibrous tissue.

Fig 32. Plate XIX.

Sectinial view of a Giant Cell or Multinucleated Phagocyte, showing the large number of nuclei which it contains, and pigment granules of various sizes in its protoplasm.

From a section of Lymph gland of a hibernating animal, cut in paraffin, stained with boxcar carmine, and mounted in balsam. (Ob. 1/10 with water immersion Beck and Oc. II No. 3 Hartnack), drawn with Zeiss camera lucida.

Each nucleus contains a nucleolus.

Fig 33. Plate XIX.

Surface view of a similar cell, in which the nuclei
are all grouped to one side.

From a pectini of lymph gland of a hibernating animal cut in gum, stained in haematoxylin and erine and mounted in balsam. (Ob. 7 µich, water immersion Peck, and Ob. 1073 Hartnack); drawn with Zeiss camera lucida.
Fig 34. Plate XX.

Some cells of the Splenic Pulp. From a section of Spleen stained in haematoyxlin and eosine, and mounted in balsam. (Ob. 10 em. under immersion Berl and Oc. No. 3 Hartnack), drawn with Zeiss' camera lucida.

A. Ordinary lymph corpuscles.
B. Cells similar to but rather larger than ordinary lymph corpuscles, which stain deeply and resemble those found in the Germinal Centers of the Malphigian Corpuscles.
C. Cells which stain very deeply with eosin, found occasionally at the periphery of the Germinal Centers of the Malphigian Corpuscles.
D. Multinucleated Giant Cells.
E. Basophilous coarsely granular corpuscles.
F. Splenic Cells containing pigment and other effete matter.
G. A so-called Eosinophilous Cell of Ehrlich.

Fig 35. Plate XX.

Giant cells of Spleen seen in section. From a paraffin cut section of the spleen of a hibernating animal, stained in haematoyxlin and eosine, and mounted in balsam. (Ob. No. 7 and Oc. No. 3 Hartnack) drawn with Zeiss' camera lucida.
Most of the nuclei are arranged in an irregular ring around one or more centrally placed ones.

Fig 36. Plate XX

A similar cell, from a paraffin cut section, stained with Schleicher’s acid haematoyxlin and benz-o-purpurin, and mounted in balsam (Ob. No. 2 and Ob. No. 3 Hartnack); drawn with Zeiss’ camera lucida.

The protoplasm is seen to be vacuolated and to contain bodies which stain a certain yellow colour, highly suggestive of red blood corpuscles; also bodies which stain pale blue like degenerating nuclei. Probably these cells are a species of phagocyte.
Supra-rennal Capsule, showing the arrangement and appearance of the cells in the three cortical zones. All the cells are drawn on the same scale.

Stained with eosine and haematoxylin, and mounted in balsam. (Obj. 30" rich water immersion, Beck and Oc. 40" Hartnack); drawn with Zeiss camera lucida.

G. Zona Glomerula.
F. Zona Fasciculata.
R. Zona Reticularis.

On the left side of the drawing R there are a few cells of the zona fasciculata which have been prolonged down into this zone, they are smaller than those figured at F which are taken from the upper part of the zona fasciculata.

The cells of the zona reticularis are smaller, clearer, and more closely packed together than the cells of the other zones.
Fig. 38. Plate XXII.

Three cells of the zona fasciculata of the supra renal capsule, showing the enlargement which sometimes takes place.

Stained in haematoxylin and eosine, and mounted in balsam. (Ob. 1/2 inch water immersion Parks and Oc. W.3 Hartnack); drawn with Zeiss camera lucida.

a. Ordinary cell.

b. Cell the protoplasm of which has increased in size.

c. Cell in which the nucleus has also become enlarged, presenting a coarsely granular appearance, and two large nucleoli, united by some material, possibly nucleolar in origin.

Fig. 39. Plate XXII.

Sections of the supra-renal capsule of a hibernating hedgehog, showing a lymph space surrounded by cells of the zona reticularis, and containing a mass of yellow pigment granules.

From a paraffin cut sections stained in haematoxylin and eosine and mounted in balsam. (Ob. 1/10 inch water immersion Back and Oc. W.3 Hartnack); drawn with Zeiss camera lucida.
In the blood capillaries, one or two red blood corpuscles and some debris may repen.
Fig 40. Plate XXIII.
Bone Marrow from the femur of a Hedzelaug, killed in July, frozen and dried.
Stained with alcoholic basic fuchsin and mounted in balsam. (Ob. 10 inch water immersion, Beck and Oc. No. 3 Hartnack); drawn with Zeiss camera lucida.

a. Small marrow cell.
b. White blood corpuscles.
c. Cell which stain very deeply and uniformly.
d. Large marrow cells in various stages of division.
e. Large cells which stain uniformly but of a pale pink colour.
f. Basophilus coarsely granular corpuscles.
g. Red blood corpuscles
h. Granul marrow cell.

Fig 41. Plate XXIII.
Bone Marrow from the femur of an animal killed in October treated as above. (Ob. 10 inch water immersion, Beck and Oc. No. 3 Hartnack); drawn with Zeiss camera lucida.
Letters same as in Fig. 40.
Fig 42. Plate XXIII.
Bone Marrow from the femur of an animal killed in March; treated as above. (Ob. from
water immersion Beck and Oc. No. 3. Hartnack) drawn
with Zeiss camera lucida.

Letters same as in fig. 40.
Fig. 43. Plate XXIV.

Three kinds of cells of the marrow of the femur of an animal killed in October, filmed, dried and stained in saturated alcoholic Methyl blue and acid fuchsin. (Obj. 1/10 inch water immersion, Beck, and H. 3. O. Hartnack), drawn with Zeiss camera lucida. Specimen mounted in balsam.

f. Basophilic, evenly granular corpuscles.
h. Giant marrow cell.
j. Eosinophilic cells, one of which presents two nuclei.

Fig. 44. Plate XXIV.

A group of marrow cells from the femur of an animal killed in October; treated as above. (Obj. 1/10 inch water immersion, Beck, and O. H. 3. Hartnack); drawn with Zeiss camera lucida.

The cells exhibit various appearances suggestive of the production of many daughter cells in them as described by Denys.
Fig. 45. Plate XXXV.

Blood of Hedergberg fiilmed and dried.
Stained in gentian violet and mounted in balsam.

(Ob. 10 inch water immersion, Beck, and Oc. II.5 Hertweck)
Drawn with Zeiss’ camera lucida.

a. Red blood corpuscles.

b. White blood corpuscles, the nuclei of which are either single or multiple, and arranged in various ways in the cell.

c. Blood platelets which are of large size and may possibly correspond to the Alloecytes of Edington.

d. Clusters of these blood platelets.

e. Basophilic cell.

Fig. 46. Plate XXXVI.

Blood of Hedergberg filmed, dried, and stained with alcoholic Methyl blue; mounted in balsam.

f. Breaking down red blood corpuscles.
Fig 47. Plate XXVI.

Four cells of the Hibernating Gland.
from a section cut in paraffin, stained with
osmic acid and paraflavin and mounted in balsam.
(Ob. No. 1 Leitz and Oc. No. 3 Leitz); drawn with Hachets
camera lucida.

8. Envelope of cell.
f. Fat droplets, blackened with osmic
acid.

II. Nucleus.

p. Protoplasmic network.

Fig 48. Plate XXVI.

Isolated cells of the Hibernating Gland.
from a preparation fixed with osmic acid,
treated in micro-carmine and mounted in
tarrant's solution.
(Ob. No. 1 and Oc. No. 3 Leitz); drawn with Hachets' camera lucida.

a. Small round granular connective

b. Tissue corpuscles, from which the gland cell

spring.

Cells in various stages of growth and con-
taining fat; blackened with osmic acid, in
variable amount.
i. Adult cells.

h. Ordinary clumping connective tissue corpuscles.

r. Red blood corpuscles blackened by osmic acid.
Fig. 49. Plate XXVII
An injected lobule of the Hibernating gland, showing the rich capillary plexus which it contains.
(OB. N° 3 and Oe N° 4 Hartnack); drawn with Zeiss' camera lucida.

Fig. 50 Plate XXVII
Section of the Hibernating gland, stained in osmic acid and safranine, cut in paraffin and mounted in balsam; showing the worm-eaten appearance which the tissue presents, owing to the large number of capillary blood vessels which ramify in it.
(OB. N° 7 and Oe N° 3 Hartnack); drawn with Zeiss camera lucida.

C. Capillary blood vessels.
E. Nucleus of capillary wall.
F. Fat blackened by osmic acid.
H. Nuclei of the cells of the gland; the outlines of which have been omitted.
Fig. 51. Plate XXVIII.

A large vein of the hibernating gland full of a colloid material, in which some red blood corpuscles stained black with osmic acid may be seen.

From a paraffin cut section fixed in osmic acid, stained in pararosanilin and mounted in balsam.

(Ob. No. 2 Zeiss and Oc No. 2 Hartnack); drawn with Zeiss' camera lucida.

Fig. 52. Plate XXVIII.

Group of unipolar cells from the ganglion of the hibernating gland, stained with Ramvier's Lovib's gold method, teased and mounted in glycerine.

(Ob. No. 7 and Oc No. 3 Hartnack); drawn with Zeiss' camera.

Fig. 53. Plate XXVIII.

Two cells with nerve fibres going to them from the same ganglion, stained as above (Ob. pH 10% in water immersion blank and Oc No. 3 Hartnack); drawn with Zeiss' camera lucida.

E. Cell envelope.
m. Medullated nerve fibres
n. Nucleus of ganglion cell.
p. Protoplasm of ganglion cell.
Fig. 54. Plate XXIX.

Section of the Hibernating Gland of a hedgehog killed in March towards the end of hibernation, showing the process of the cells, the alteration of the nuclei and of the cell network.

Tissue fixated with corrosive sublimate, cut in paraffin, stained with cosine and haematoxylin and mounted in balsam.

(Ob. 1/10 inch water immersion, Beck, OC H23 Hartnick.) drawn with Zeiss' camera lucida.

a. Cell protoplasm which is granular.
b. Spaces from which the fat has been dissolved out.
c. Vesicular nucleus of the cell.
d. Nucleolus.
e. A nucleus that has undergone no change.
f. Capillary blood vessel.
g. Nucleus of capillary wall.

Fig. 55. Plate XXIX.

Capillary of Hibernating Gland containing colloid material, some of which may also be seen in spaces in the cells; from
a hedgehog killed in March.
Cut in paraffin stained in rosein and hæ-
matopxylin and mounted in balsam.
(Oh. 40 μm water immersion Beck and 0.8%3
Hartnack; tube fully elongated).
a. Cells.
b. Nucleus of cell.
c. Capillary
d. Nuclei of endothelial wall.
e. Colloid matter in capillary
f. Colloid matter in spaces in the
cells.
g. Spaces in the cells from which
fat has been dissolved out.
Fig. 56. Plate xxx.

A small Artery of the hibernating gland from which the outer and middle coats have been torn with needles, showing a rich Plexus of Nerve Fibres between the endothelial lining and the muscular coat.

Stained by Ranvier's modification of Löwits gold chloride method and mounted in glycerine.

(Ob. H.β. and Oc H.β. Hartnack; tube fully elongated);
drawn with Zeiss camera lucida.

M. Fibres of muscular coat.

P. Plexus of nerve fibres.

Fig. 57. Plate xxx.

A portion of the Artery shown in fig 56 more highly magnified.

(Ob. 1/10 with water immersion Beck. and Oc H.β. Hartnack);
drawn with Zeiss camera lucida.

Fig. 58. Plate xxx.

A small Artery partially dissected with needles, showing the Nerve plexus described by Scale outside the muscular fibres, continuous with the plexus beneath the muscular coat, by fibres that pass between the muscle fibres.
Plate xxx

Fig. 56

Fig. 57

Fig. 58
The fibres of the deeper plexus are represented as slightly out of focus.

Stained by Raivier's modification of Lüttgau's gold chloride method and mounted in glycerine. (Ob. No. 7 and Ob. No. 3 Hartnack, tube fully elongated); drawn with Zeiss' camera lucida.

b. Nerve plexus of Beale.
c. Communicating fibrils.
f. Plexus beneath the muscular coat.
a. Outer coat.
m. Middle coat, \{ of the Artery.
c. Inner coat.
Fig. 59. Plate XXXI

Endothelial lining of an artery injected with silver nitrate; the cells, the outlines of which are blackened, are of a very elongated shape.

Mounted in glycerine.

(Obs. N° 7 and Oc. N° 3 Hartnack; tube fully elongated.)

drawn with Hackel's camera lucida.

Fig. 60. Plate XXXI.

An Arteriolae.

Stained in eosine and haematoxylin and mounted in balsam.

(Obs. N° 7 and Oc. N° 3 Leitz); drawn with Hackel's camera lucida.

a. Adventitious coat.

b. Nuclei of connective tissue corpuscles in it.

c. Middle coat.

d. Nuclei of its muscle fibres.

e. Inner coat.

f. Elongated spindle shaped nuclei of its endothelial cells.
Fig. 61. Plate xxxv.
Vertical section of Spine Follicle.
Stained in haematoxylin and eosine and mounted in balsam. (Ob. N. No. 3 and Ob. N. No. 3 Hartnack); drawn with Zeiss camera Lucida.

C. Cutis vera.
E. Epidermis.
P. Panniculus carnosus.
S. Spine.
a. Artery.
c. Stratum corneum.
d. Epithelial debris.
i. Epithelial layer intermediate between the cells of the spine and those of the follicle.
m. Stratum Malpighi.
u. Nerve.
p. Papilla of spine.
p.i. Pith of spine.
r.m. Rete mirabile.
s. Space between spine and follicle.
v. Vein.
Fig. 62. Plate XXXIII.

Muscle fibres of the Panniculus Carnosus of the ventral part of the Skir, showing the arrangement of the nuclei in longitudinally disposed chains under the Sarcolemma.

Stained with haematoxylin and eosine and mounted in balsam. (Ob. N°7 and Oc N°3 Leitz); drawn with Nachet's camera lucida.

a. Nuclei in rows
b. Sarcolemma.
c. Connective tissue fibres between the muscle fibres.
d. Bundle of nerve fibres.

Fig. 63. Plate XXXIII.

A single fibre from the same region, showing a tubular space in its centre, filled with nuclei.

Stained with haematoxylin and eosine and mounted in balsam. (Ob. N°7 and Oc N°3 Leitz); drawn with Nachet's camera lucida.

a. Nuclei under the sarcolemma
b. Sarcolemma.
c. Tubular space in the centre.
of the fibre.

d. Nuclei in the tube.
Fig. 64. Plate xxxix

Fibres of the Paramuculus Carnoun of the same region, in transverse section, showing two fibres with tubular spaces in their centres, one with nuclei among the fibrils, similar to an amphibian muscle fibre, one, similar to the skeletal muscles in character and one in oblique section.

Stained with haematoxylin and eosine, and mounted in balsam. (Ob. H.O. 1/2 and Oc. H.O. 3 Leitz); drawn with Hackel's camera lucida.

a. Nuclei under the sarcolemma.
b. Sarcolemma.
c. Tubular space in the centre of a fibre.
d. Nuclei in the tube.
e. Nuclei in centre of fibre among the fibrils.
f. Connective tissue between the fibres.

Fig. 65. Plate xxxiv

Transverse Section of Skeletal Muscle Fibres. Stained with alum-carmine, and mounted in balsam. (Ob. H.O. 1/2 and Oc. H.O. 3 Leitz); drawn with...
Hachect's camera lucida.

a. Nuclei under the sarcolema.
b. Sarcolema.
c. Connective tissue around the bundle.
Fig. 68. Plate XXXVI

The tip of a somewhat thick ordinary hair, showing that it consists of a cuticle, cortex and pith, and that it resembles the soft abdominal hairs in structure.

Stained with paraffin and mounted in balsam. (Ob. No. 7 and Ob. No. 1 Leitz), drawn with Hackett camera lucida.

C. Cuticle of imbricated scales.

f. Fibrous looking cortex.

M. Medulla full of spaces containing air.

Fig. 69. Plate XXXVI

Body of a pinular hair, showing the wide medulla split into irregular compartments by thick branching septa. The cortex and cuticle are of about the same absolute size as in the tip, the medulla alone having been widened out.

Stained in methylene blue and mounted in balsam. (Ob. No. 7 and Ob. No. 1 Leitz), drawn with Hackett camera lucida.

C. Cuticle.

f. Cortex.
M. Medulla

S. Fibrous locking septa that stretch across the medulla.
Fig. 70. Plate xxxvii.

Surface view of the cuticle of a spine
from a balsam preparation.
(Ob. No. 7 and Oc. No. 3 Leitz); drawn with Hachets
camera lucida.

Fig. 71. Plate xxxvii.

Longitudinal section of a spine showing
the pepta which divide the Medulla or Pith
into various larger or smaller loculi.
Stained with orange and mounted in balsam.
(Ob. No. 3 and Oc. No. 1. Leitz); drawn with Hachets'
camera lucida.

b. Buttress seen out of focus.
c. Cuticle.
f. Cortex.
l1. Primary, lenticular loculi.
l2. Secondary loculi.
m. Medulla.
s1. Primary pepta.
s2. Secondary pepta.
s3. Sertorial pepta.
Fig. 72. Plate xxxviii.
A semi-diagrammatic transverse section of the body of a pine, showing the arrangement of the cortex into internal buttresses. Stained with acid fuchsin and mounted in balsam. ( Obj. No. 3 and Obj. No. 1 Leitz);

b. Buttress of cortex.
c. Cuticle
f. Cortex full of pigment
m. Medulla
s. Primary peptuin.

Fig. 73. Plate xxxviii.
A semi-diagrammatic transverse section of the body of a pine.
Stained with acid orange and mounted in balsam. (Obj. No. 3 and Obj. No. 1 Leitz).
b. Buttress
c. Cuticle
f. Cortex without pigment
m. Medulla
s. Primary peptuin.
Fig. 74. Plate XXXVIII

A semi-diagrammatic transverse section of the body of a pipe.

Stained in methyl blue and mounted in balsam. (Ob. No. 3 and Oc No. 1. Leitz).

b. Buttresses.

c. Cuticle.

d. Cortex.

m. Medulla.

n. Blotches of pigment, possibly indicating old nuclei.

s, Secondary peptum.

Fig. 75. Plate XXXVIII

A semi-diagrammatic transverse section of the body of a pipe.

Stained with osmic acid and mounted in balsam. (Ob. No. 3 and Oc No. 1. Leitz).

b. Buttresses.

c. Cuticle.

d. Cortex.

m. Medulla.

n. Blotches, perhaps old nuclei.

s, Primary peptum.

S2 Secondary peptum.
Fig. 76. Plate XXXIX.

Transverse section of the body of a spine showing the thick, rounded edges of the buttresses, and the circular staining of the secondary septa.

Stained with Methyl Blue and mounted in balsam. (Ob. No. 7 and Oc No. 1 Leitz); drawn with Hachat's camera lucida.

b. Buttress.
c. Cuticle.
f. Cortex.

n. Blotches of colour, probably old nuclei.
p. Pigment granules.
s. Secondary septa.

Fig. 77. Plate XXXIX.

A surface section of a spine showing the spaces between the buttresses bridged across by the secondary septa, producing secondary and tertiary loculi.

Stained with methyl blue and acid fuchsin and mounted in balsam. (Ob. No. 3 and Oc No. 3 Leitz) drawn with Hachets' camera lucida.
b. Buttresses.
e. Cuticle.
f. Cortex.
l2. Secondary loculi.
l3. Serticary loculi.
m. Medulla.
s2. Secondary pecta.
s3. Serticary pecta.
Fig. 78. Plate XL.
Crystals from a sample of Hedgehog urine
passed on July 7th, 1890.
The various appearances presented by the
crystals are shown as viewed from various
directions; in the centre of the figure are
two yellow bodies which are probably del-
tered vegetable matter that had fallen
into the urine from the cage.
(OB. No. 7 and OB. No. 3 Hartnack), drawn with
Hachet’s camera lucida.

Fig. 79. Plate XL.
Cells varying in shape and appearance
mixed with granular matter, found in
the urine of a hibernating hedgehog
(OB. No. 7 and OB. No. 3 Hartnack); drawn with
Hachet’s camera lucida.
Uranis of Hellespont 2. 7790

from above

from below

a little out of focus

Fig. 78.

Fig. 79.