POETAL AND ADULT TESTIS OF THE SLENDER LORIS

INTRODUCTION:

Embryogenesis of the gonads and the genital ducts has received some attention. The formation of the genital ridge has been studied in the pig (Allen, 1904); rat (Hargitt, 1926; Huckins, 1962); mouse (Eguchi and Hashimoto, 1961); dog (Al Radhawy, 1958; Geir and Marion, 1969); cow (Krehbiel, 1963; Erickson, 1966); human (Grunwald, 1942; Gillman, 1948; Witschi, 1948; Turner, 1965; Arey, 1965). Postnatal development of the testis and the genital ducts has received considerable attention and the literature dealing with primates and laboratory animals has been reviewed by Albert (1961).

Some recent investigations on the spermatogonial population of rodent testis have evoked renewed interest in the kinetics of spermatogenesis and in the mode of proliferation of germ cells in different species of mammals, (Clermont and Bustos-Obregon, 1968; Huckins, 1971; Clermont, 1972). There have been relatively few such investigations in the sub-human primates.

The purpose of the present study was to investigate the morphology of the sex cords in the male lorises
of various ages, from embryonic life to maturity. In so doing, the morphological characteristics of the testis, its vascular system and the details of the spermatogenic process in the adult testis of the slender loris, *Loris tardigradus lydekkerianus*, emerged.

**OBSERVATIONS**

**DEVELOPMENT OF THE TESTIS IN THE SLENDER LORIS**

*Stage 1: 4.0 mm (Total-length) embryo*

In the earliest stage studied (4.0 mm, T.L.) the differentiation of the gonad has commenced as a mesenchymal thickening, (Fig.1, GR) below and between the differentiating adrenal, (Fig. 2, AD) and mesonephros (MES). This thickening is in close contact with the coelomic epithelium (COE) or the future gorminal epithelium. The coelomic epithelium covering the ridge appears to be proliferating as the cells appear to be migrating inwards from the surface and contributing to the mesenchymal mass forming the ridge. The mesenchymal cells lying in between the differentiating adrenal gland and mesonephric tubules also appear to be converging towards the thickening and contribute to the formation of the gonadal ridge. Although no distinct primordial germ cells are distinguishable in this stage, a few large cells with faintly staining spherical
nuoleii are present in the mass of the ridge which consists mostly of elongated cells with elliptical nuclei. The faintly stained cells might be the primordial germ cells (PNG).

Stage 2: 10.0-13.0 mm (Total-length) embryo

When the embryos have reached a total length of 10.0-13.0 mm the gonadal ridge is well defined (Fig.3, GR) beneath the mesonephric corpuscles (GL). The mesenchymal cells that constitute the bulk of the ridge are spherical and amongst them large cells with spherical vesicular nuclei can clearly be distinguished as the primordial germ cells or the gonocytes (Fig.4, GC). A distinct germinal epithelium (Fig.3, GE) covers the coelomic surface of the gonadal ridge which extends beneath the glomeruli (GL) of the mesonephric tubules.

Some mitotic figures are seen in the gonadal ridge. Neither the rete cords nor the distinct epithelial sex cords are distinguishable in this stage as the entire ridge consists of a mass of rounded epithelial cells.

The mesonephric duct runs on the lateral surface of the Wolffian body and running across in the urino-genital cord opens into the cloaca posterior to the attachment of the allantoic stalk.
Stage 3: 33.0 mm (Total-length) embryo

In the 33.0 mm (T.L.) stage (Figs. 5, 6, 7 and 8), the gonad is distinguishable as a pendulant body (Fig. 5, TES) protruding from the mesial surface of the mesonephros (MES). The gonadal sex can be made out at this stage as the embryonic testis consists of distinct sex cords (Fig. 6, SC). Beneath the coelomic epithelium (Fig. 7, COE) which is still distinct the mesenchymal cells of the cortical region are being transformed into three to four layers of elongated fibroblasts giving rise to the tunica albuginea (Fig. 7, TA). Some gonocytes (GC) are seen lying in the coelomic epithelium and also in the region of the differentiating tunica albuginea and in the mesenchymal tissue between the sex cords which are being laid down by an investment of a PAS positive basement membrane, (Fig. 8, BM). The sex cords show an irregular branching arrangement and are not distinctly delineated. The basement membrane surrounds them only partially.

The tunica albuginea is better formed on the lateral surface of the gonad than on the medial side. Ventrally, the tunica is not yet formed and in this region the epithelial cell mass with a few gonocytes is seen to be continuous with the coelomic epithelium as in the previous stage.
Anteriorly the testis is attached to the mesonephros by a narrow region through which one or two solid mesenchymal strands connect the gonad with the anterior nephric corpuscles (Fig. 6, NC). These strands are the forerunners of the rete testis (RT) and efferent connections between the testis and the epididymis. Posteriorly the testis is fused with its lateral surface to the ventro-mesial surface of the mesonephric body. The mesonephric duct (Fig. 5, 6, MND) runs along the lateral surface of the mesonephric kidney which consists of 25-30 mesonephric corpuscles. Running parallel to it and ventrally is the paramesonephric or the Mullerian duct (PMD). It opens anteriorly into the coelomic cavity by a short ciliated funnel just behind the diaphragm. The anterior end of the mesonephros is attached to the diaphragm by a short strand of mesenchymal tissue, the diaphragmatic ligament. Posteriorly the mesonephric and the paramesonephric ducts open separately into the urinogenital sinus, the latter duct opening medial to the former. The urinogenital sinus behind the opening of the nephric ducts consists of a solid strand of epithelial cells which is continuous with the body surface ectoderm at the tip of a genital protruberance. An anal plate separates the urinogenital sinus and the rectum.
Stage 4: 42.0 mm (Total-length) embryo

In the next stage studied (42.0 mm, T.L.) the development of the testis is more advanced than in the previous stage. Anteriorly the testis is constricted further from the mesonephric body which is attached by a cephalic ligament to the lateral abdominal wall. The mesonephros has disappeared from the anterior region and only its nephric duct is present. The sex cords (Fig. 9, SC) are distinct with a PAS positive limiting membrane completely surrounding the cords. The basement membrane is being invested by the mesenchymal cells which are elongated into fibroblasts (Fig. 10). The seminiferous cords are lined by a regular row of cells with oval nuclei, the presertoli cells. In the centre of the cords enlarged gonocytes (GC) are noticed. The space in between the cords, viz, the interstitial space, is extensive and contains mesenchymal cells which are becoming rounded and differentiating into foetal Leydig cells (Fig. 10, ISC). The vascularity of the testis has increased in the interstitium (Fig. 9). The tunica albuginea is still incomplete as in the previous stage in the ventromedial region due to the persistence of the ventral epithelial ridge.
In the middle region of the mesonephros, the mesenchymal strands of the rete testis are noticed to extend from the nephric corpuscular portion into the testis at the region of its attachment to the ventro-medial surface of the mesonephros. These cords are more distinct than in the previous stage and have developed from the nephric blastoma. From the posterior-lateral edge of the mesonephros a mesenchymatous strand extends across the body cavity and is inserted on the abdominal wall where a small depression has developed. This is the beginning of the formation of the inguinal canal.

The paramesonephric duct shows signs of regression. The coelomic funnel is much smaller than in the previous stage and is undergoing regression. The duct itself has dwindled in its size but is still present and posteriorly it opens medially to the mesonephric ducts into the urinogenital sinus. The proximal extremities of the mesonephric ducts are dilated and wider than in the previous stage and represent the anlage of the seminal vesicles.

Cowper's glands have appeared in the form of paired solid epithelial outgrowths from the urethral plate which still remains solid and connected with the tip of the genital protruberance.
Stage 5: 50.0-57.0 mm (Total-length) embryo

The 50.0-57.0 mm (T.L.) embryos show a marked development of the testis and the ducts. There is an increase in the size of the testis largely due to the increase in the glandular interstitial tissue (Fig. 11, ISC) which pervades the entire gonad. The interstitial cells are large with spherical nuclei and deeply eosinophilic cytoplasm. Large number of these cells are present on the inner surface of the tunica albuginea which is more vascularised than in the previous stage. The ventral epithelial thickening (VET) observed in the previous stages though present has decreased due to the growth in size of the testis. The epithelial nature is still evident although the fibroblasts characteristic of the neighbouring region of the tunica albuginea are appearing and becoming continuous on either side of the ventral ridge.

The seminiferous cords (SC) have increased in length as well as in width. The diameter of the tubule is 48μ. The cords are widely separated by the intervening interstitial mass of cells (Fig. 11). The nuclei of the presertoli cells are slightly bigger with somewhat oval nuclei instead of the elliptical narrow ones of the previous stage. The gonocytes are
of two types; some are large (Fig. 12, LGC) with spherical vesicular nuclei showing masses of chromatin granules irregularly scattered; and the other gonocytes are smaller (SGC) with compact deeply staining nuclei. Some of these gonocytes are found near the basal membrane amongst the presertoli cells. They are fewer when compared to the large vesicular type which are mostly found in the central part of the seminiferous cords. Some of the large gonocytes are in the process of undergoing degeneration. The cords are coiled in the peripheral region and are straight in the central part of the testis. Some of the cords are irregularly branched and interconnected. All the cords are oriented towards the hilar region which is fairly extensive. In this region the rete cords are becoming evident and are continuous through the mesenchymatic strands with the epididymal duct which is highly coiled in the anterior part of the testis.

The mesonephros is almost completely regressed and partly transformed into the epididymis. The convoluted tubules of the epididymis and the vas deferens are becoming quite distinct. The vas deferens (Fig. 11, MND) lies on the dorso-lateral surface of the testis in the genital strand and posterior to
the testis, it stretches across the coelomic cavity. The two deferent ducts run close together between whom the remnants of the posterior part of the paramesonephric ducts could be seen. Distally the vasa deferentia are surrounded by a mesenchymatous tissue in which the seminal vesicles have differentiated as conical sacular outgrowths from the terminal part of the deferent ducts. The short ejaculatory duct opens immediately into the dorsal wall of the urethra.

A gubernacular bulb has differentiated in the posterior wall of the abdomen and is connected with the posterior end of the regressing Wolffian body by means of a short gubernacular ligament which was noticed in the previous stage. At the region of its insertion on the abdominal wall, the shallow depression has deepened to initiate the formation of the inguinal ring.

Posterior to the urinary bladder, the urino-genital sinus is surrounded by a thick mesenchymatous mass in which 8 to 10 pairs of epithelial buds are proliferating from the epithelium of the sinus. These are the beginnings of the prostate gland. The buds are more on the dorsal and lateral surfaces of the urethra than on the ventral surface.
Cowper's glands have grown and acquired a cavity which opens by a short duct into the penial urethra in front of the growing mesenchymatous thickening of the corpus cavernosum of the penis.

**Stage 6: 70.0-72.0 mm (Total-length) embryo**

In this stage the testis lies close to the opening of the inguinal recess which has deepened. In other words, the testis is descending into the inguinal canal. The lower part of the Wolffian body which consists of the coiled epididymal duct (Fig.13, CDE) and the mesonephric duct already lie inside the recess.

The globular testis is about 1.1 mm long and has nearly assumed the morphology of the adult testis. It is attached to the regressing Wolffian body by a thin mesenchymatous septum on its dorsal surface. A thick tunica albuginea has developed uniformly and the ventral thickening seen in the earlier stages is absent.

Unlike in the previous stage, in which the seminiferous cords were not close to each other, in this stage, they are closely packed with the interstitial tissue (Fig.14). The diameter of the cord is 66μ and
the length of the cords has also increased. The degeneration of some of the gonocytes which had set in the previous stage is more evident and the degenerating gonocytes (DGC) are more in number and are more centrally placed in the cords, (Fig.15). The nuclear apparatus of these degenerating gonocytes, consisting of condensed chromatin material shows irregular fragmentation and clumps of chromatin. In some of these gonocytes, the large vesicular nucleus and the cytoplasm appear to have constricted into two or three, giving the appearance of a group of two or three cells adhering close together. The cytoplasm of these degenerating cells is highly vacuolated. The normal gonocytes are smaller in size and are seen at the periphery of the cords (Fig.15,16, NGC) and show granular chromatin material with one or two nucleoli.

The interstitial tissue consists of dense mixture of differentiated Leydig cells (Fig.16, LC) and elongated differentiating cells. The former have large spherical nuclei and eosinophilic cytoplasm, while the latter are provided with darkly staining elongated nuclei.

The Wolffian body is almost transformed into the epididymis showing greatly coiled duct. The mesonephric corpuscles have completely degenerated.
Anteriodorsally to the testis, the epididymal duct is highly coiled giving rise to the head epididymis. In front of the middle region of the testis, a network of small canals connecting the converged narrow solid terminal ends of the seminiforous cords or the tubuli recti have become differentiated into the rete testis (Fig.17, RT). They are in contact with the epididymal ducts by means of mesenchymatous mass passing through the tunica at the region of its attachment with the Wolffian body.

The vas deferens has shifted its position from its lateral position to a dorsomedial position due to the change in position of the testis brought about by its growth and descent. Posteriorly from the tail part of the epididymis, the vas deferens (Fig.13, VD) emerges and forms a loop and runs posteriomedially to open into the terminal part of the seminal vesicle. The seminal vesicles have grown bigger in size and the epithelium has assumed a pseudostratified appearance. More posteriorly the epithelium shows a few outpushings into the thick fibromuscular coat that is differentiating surrounding the seminal vesicle. The vesicular duct and the vas deferens open together into the neck of the urinary bladder. The remnants of the posterior
ends of the Mullerian ducts are seen medial to the terminal parts of the vesicular ducts.

The prostatic buds (Fig.18, PRB) have grown much larger than in the previous stage and are arranged in pairs on the dorsal and lateral regions extending into the mesenchymatous mass surrounding the urinogenital canal.

Cowper's glands (Fig.19, CG) show branching tubes with cavities leading to a duct which runs parallel to the urethra before opening into it.

Stage 7: 102.0 mm(Total-length) embryo

The testis has completely descended into the inguinal canal and an inguinal ring is distinct in the posterolateral wall of the abdominal cavity. The spermatic cord and the vas deferens pass through the ring. The entire testis when dissected and taken out of the embryo (Fig.20) shows the pattern of adult morphology of the testis and epididymis. But the epididymis is more extensive than the testis which forms a small spherical structure of about 1.3 mm diameter and of the same length lying on the ventral surface of the epididymis. The epididymis measures
about 6.0 mm in length including a thick fibrous gubernaculum which is closely applied to the cauda epididymis.

The globular testis is surrounded by a compact tunica albuginea. At its anterior end, the testis has a rete testis network (Fig. 21, RT) just beneath the tunic. The rete network was much deeper in the previous stage resembling a mediastinum. But such a mediastinum does not exist in this stage as the rete network is peripherally situated and traverses the tunica albuginea (TA). The seminiferous cords when compared with the previous stage lack the degenerating gonocytes and on the other hand show increased number of the normal smaller gonocytes (Fig. 22) occurring both in the centre and the periphery of the seminiferous cords. A few mitotic figures are also seen in some cords. The diameter of the cords (52μ) has decreased from the previous stage. Probably this is due to lengthening of the cords. Some gonocytes could be recognised as the spermatagonial cells as their nuclei are more compact and take a deep stain. Regression has set in the Leydig cells. The interstitial cells are still found in dense masses all round the seminiferous cords, but they are undergoing transformation into elongated cells (ISC) from the spherical ones of the previous
stage. They are thus losing their secretory function and undergoing dedifferentiation.

The epididymis consists of highly convoluted epididymal ducts showing the differentiation of the different zones (Fig. 23) by the development of connective tissue partitions. The differentiation has set in the epithelial cells of the different regions. The caput epididymis consists of more coils of the duct than in the corpus or the cauda epididymis. The vas deferens emerges from the tail epididymis and runs along the ventromedial surface of the testis and caput epididymis into the abdominal cavity through the inguinal ring.

In the anterior region of the caput epididymis the spermatic artery and the vein show a number of coils forming the beginning of the pampiniform plexus formation (Fig. 23, PPP).

The accessory glands have grown further in size.

**Stage 8: Newly born infant (18 hours old; 110.0-117.0 mm, Total-length)**

Infants were born in the laboratory and one was aborted at full term. The weight of the infants ranged from 14.0 gm to 18.0 gm and the total length varied from 110.0 mm to 117.0 mm.
At birth, the testes are seen in the posterior wall of the abdomen as small swellings being lodged in the inguinal region, the swelling being visible only in a dissectional view of the abdominal cavity. The inguinal ring transmits the spermatic cord, the ductus deferens, blood vessels and nerves to the testis. The testis (Fig. 24) is oval in appearance with a length of about 1.6 mm and greatest width in the middle being about 1.3 mm. The two testes together weigh about 14.2 mg. The gubernaculum is reduced in size and is attached to the posterior end of the testis and the cauda epididymis.

The testis has a compact tunica albuginea and the blood vessels running over its surface are clearly recognisable and have the same pattern as that of the adult (vide infra). The pampiniform plexus (Fig. 25, PPP) also can be recognised distinctly and it lies close to the caput epididymis. The seminiferous cords are disposed in the longitudinal axis (Fig. 24) and their terminal ends converge in the region of the rete testes. The tubuli recti are connected with the rete network. The coils of the seminiferous cords are more closely situated in the peripheral region of the testis than in the central region where the inter-cordal space is
much more than in the peripheral region and is filled with interstitial tissue. The seminiferous cords are lesser in diameter than in the previous stage. The germ cells are less distinct and are of two types. The first type has large vesicular nuclei with chromatin granules distributed over a chromatin network. These have one or two nucleoli as well. These cells are in some places grouped together in the centre of the cord or in the peripheral region. The second type, less numerous than the first type has smaller compact nucleus with deeply staining chromatin. Some of the germ cells range between the two types and are probably transitional stages. Two types of spermatogonial cells are thus being differentiated. Some mitotic figures are also evident.

The interstitial cells have decreased in number and shrunk in size. The large cells with spherical nuclei characteristic of the prenatal stages are absent. Most of the cells are in the form of fibroblasts with compressed elongated nuclei and with very little cytoplasm.

The duct system is also well differentiated (Fig. 26) with the tubuli recti (TR) being lumenated and connected with the rete testis (RT) which form a
flattened network in the anterior region of the testis. It is partly enclosed in the tunica albuginea. As the rete network emerges out of the tunica, it opens into the efferent ductules of the caput epididymis (EFD). Connective tissue partitions have grown thicker in the mass of the epididymis as seen in Fig. 25.

The vas deferens has acquired a muscular coat and its terminal end is crescentric in cross section. Along the vesicular duct it opens into the prostatic urethra on a thick muscular projection (Fig. 27). The prostatic gland (PG) consists of dichotomously branching epithelial buds lying dorsal to the bases of the vesicular and deferent ducts. Cowper’s glands (Fig. 28) have grown towards the base of the prostate gland. From the central cavity of the gland highly branching tubular extensions project into the mass of the gland.

**THE POSTNATAL TESTIS:**

Juvenile and immature lorisises occur in all months of the year along with the mature adults. During the weaning period which lasts for about 3 to 4 months, there is a gradual increase in the body weight from about 15 g. to 75-100 g. The body weight of the pre-pubertal animals range from 175 g. to 200 g.
and an adult animal weighs from 250 g to 300 g. With an increase in body weight there is an increase in testicular weight as shown in Table 1, and Fig. 29. This increase is a gradual one till the body weight reaches about 180 g. Thereafter there is a sudden spurt of growth which coincides with the onset of spermatogenesis. Table 2, enumerates the changes that take place in the germ cells, Sertoli cells and the interstitial cells in the different testicular weight range.

In a 11-day old infant, weighing 18.0 g, the weight of the testes is about 15.2 mg. The testis is more compact with seminiferous cords than in the newborn, resulting in a diminution of interstitial tissue. The interstitial cells are not only reduced in number but also in size and activity. They look more like un-differentiated mesenchymal cells. The large Leydig cells noticed in the foetuses before birth are totally absent.

The seminiferous cords contain more number of gonocytes than seen at the time of birth, the diameter of the cords being 35μ. There are several mitotic figures, indicating the multiplication of gonocytes as well as presertoli cells. It is also seen that
some of the gonocytes are enlarged with vacuolated cytoplasm and large vesicular nucleus with clumps of chromatin material. These resemble the degenerating gonocytes as seen in stages 5 and 6 described earlier. The normal gonocytes are of two types; one with compact deeply staining nucleus and the other with larger nucleus showing fine chromatin granules. The latter are the pre-spermatogonia and are intermediate between gonocytes and type A spermatogonia.

The pre-sertoli cells are also more numerous than in the new born testes. They have elongated or elliptical nuclei giving a palisade appearance along the basement membrane.

When the testes-weight reaches a range of 20 mg to 40 mg, the body weight shows an increase ranging between 70 g and 130 g. There is a considerable change in the structure of the testis. The seminiferous cords are no longer compactly situated; instead, they are separated by interstitial space which is large but sparsely filled with interstitial tissue. The diameter of the cord is about 48μ. The gonocytes and the pre-sertoli cells are reduced in size. The cords are covered with prominent fibroblasts or connective tissue cells (Fig. 30). The basement membrane is less
conspicuous. The testes in general appears to be inactive, however, the gonocytes with compact nuclei appear to be more in number when compared with the previous stage. The tunica albuginea is thicker than before, (Fig.31).

In the propuberal animals ranging from 120 gm to 160 g body weight, the testes show an increase in weight ranging between 50 mg to 100 mg. The intercudal space seen in the previous stage no longer exists as the seminiferous cords have increased both in length and width, the diameter being 80μ. In the narrow triangular spaces bound by the adjacent cords faintly staining rounded cells have differentiated from the mesenchymal cells seen earlier. These cells are the differentiating Leydig cells which are coming into functional state before the onset of pubertal condition (Fig.32, LC). The undifferentiated mesenchymal and connective tissue cells of the interstitial tissue are distinct.

The lamina propria of the seminiferous cords is thick. The presertoli cells have grown in size; their nuclei being more prominent and some what oval in shape. The spermatogonial cells appear fewer as they are distributed. There are darkly staining and pale spermatogonia, the former being more in number than the latter. An occasional primary spermatocyte in the
proleptotene stage is also noticed in some cords. The tunica-albuginea is thicker with a compact inner layer of fibroblasts and an outer layer made of loose bundles of collageneous connective tissue and fibroblasts which are fewer in this region.

As the testes grow further, the weight ranges over 100 mg and body-weight over 175 gm. The seminiferous cords have the spermatocytes in addition to the spermatogonial cells. The nuclear chromatin of the spermatocyte appears crust-like. The spermatocytes appear to be in the proleptotene and leptotene stages. Besides these, there are several mitotic figures in the spermatagonial cells. The Sertoli cell nuclei assume an elliptical shape tending to become irregular and are increased in number and arranged along the basement membrane. The cords are greatly coiled and compactly arranged. The inter-tubular tissue consists of polygonal cells with small spherical nuclei and mesenchymal cells with spindle shaped nuclei. The tunica-albuginea has become thin with the inner fibrous layer being more compact and the outer layer seen prominently in the previous stage is undistinguishable.

In the next stage, when the body weight ranges from 175 g to 230 g, there is a sudden increase in the
testicular weight to about 400 mg, and above. The tubules become highly coiled and closely packed together. They have an average diameter of 92\(\mu\). Large number of multinucleate bodies and blebs of cytoplasmic mass are seen in the centre of the cord gradually loosening up to from the lumen which occurs at the next stage. The spermatogonia of A and B type have made their appearance. These spermatogonia appear as darkly staining cells with a granular chromatin in the A-type spermatogonia, and a crust like chromatin in the B-type spermatogonia. The primary spermatocytes are also evident in different stages of meiotic division, namely, preleptotene, leptotene, zygotene and pachytene. An occasional diplotene is also seen. In addition there are the secondary spermatocytes which are smaller than the primary spermatocytes. They are found towards the centre of the cord. The process of spermiogenesis has not yet commenced. The nuclei of the Sertoli cells have undergone a thorough change both in shape, volume and position. They can be identified with difficulty as they are fewer and the germinal cells out number them. They are irregular in outline with faintly staining granular chromatin. In the testes weighing about 550 mg the lumen is being formed in the centre of the cord some time showing cellular debris in the lumen (Fig. 33, 34).
As in the previous stage there occur within the tubule the A and B type spermatogonia, the spermatocytes—primary and secondary, and in addition spermatids are also present. The most common type of primary spermatocyte stage is the leptotene stage with a typical nuclear configuration where the chromatin threads are seen to be loosely arranged (Fig. 35). Spermatids and spermatogonia are seen in a few tubules indicating the initiation of spermiogenesis. Hence this stage could be considered as the prepubertal stage. There is a sudden spurt of activity and growth with the onset of spermatogenesis. The diameter of the tubules is about 102μ and the lumen diameter is about 45μ.

Leydig cells are now localised within the inter-tubular space in a compact organised mass of a few large cells. They form clumps of 5 to 8 cells, (Figs. 33, 36).

The climax in development of this stage is reached when the testicular weight reaches about 700 mg and the body weight about 250 g. The tubule diameter is about 125μ. The first set of mature sperms are to be present towards the lumen. All the stages of spermiogenesis are seen to exist although a regular cycle has not been established. The fully mature
Sperms are seen only in few tubules of the section as a definite wave of spermatogenesis is not yet established. The cell-associations giving rise to the cycle of the seminiferous epithelium is also not evident although they could be identified here and there. The definite cell associations are described with reference to the adult testis.

**ADULT TESTIS**

The fully developed testes of an adult slender loris are large, ellipsoid glands measuring 18 mm. long, 12 mm. broad and 10 mm. in thickness. In the breeding season which extends from September to December, the weight of the testis reaches a maximum of 2655 mg. and the body weight varies from 250 g. to 330 g. When the testis reaches a state when sperms are being produced for the first time, the weight of the testis will be about 700 mg. The minimum weight of the testis is noticed during the months of May, June and July when it would be 1280 mg. The variations in the testicular weight during different months of the year have been shown in Fig. 37 and Table 3. The testis weight/body weight ratio in the immature animals is about 0.17% and in the mature animals it reaches about 1.01%.
The testes in the brooding season lie in the posterior wall of the abdomen, a little in front of and on either side of the base of the penis (Fig. 38). The testis is lodged in an area which shows an external swelling and which is distinguishable by a patch of skin which is deeply pigmented. The surrounding area remains whitish or pale grey in colour while the scrotal area is brownish. The pigmentation appears at the time of maturity and fluctuates slightly with the changes in the season. The swollen area is referred to as the 'scrotal sac'. Internally the sac lies between two layers of the abdominal wall and is lined internally with the tunica vaginalis parietalis. The cavity of the sac communicates in front with a passage, the inguinal canal, (Fig. 39, IC), which opens into the peritoneal cavity by a narrow circular opening of about 3 to 4 mm in diameter. This opening is the inguinal ring (IC) through which the spermatic cord (SC) and the ductus deferens (DD) pass. The testes move forwards and backwards in the inguinal passage and may be found anywhere between the scrotal sac at the base of the penis and the inguinal ring in the ventrolateral wall of the abdomen. The movement of the testes in the inguinal canal is controlled by the gubernaculum which
is a thin elastic strand extending from the caudal end of the testis to the region of the pubic symphysis.

**TESTICULAR CAPSULE:**

The testis is encapsulated with a white fibrous tissue covering known as the testicular capsule which is mainly made up of the tunica albuginea consisting of collagenous tissue and fibroblasts. The capsule in the adult is thinner than what it was in the postnatal and puberal conditions. The fibrous layer, made up of closely situated fibroblasts, forms a distinct inner layer of the tunica albuginea. There are less of fibroblasts and more of collagenous fibres in the superficial part of the tunica albuginea. The tunica does not extend into the parenchyma of the testis in the form of either septa or trabeculae. A tunica vasculosa is not distinct as the seminiferous tubules are closely pressed to the inner surface of the testicular capsule. The tunica vaginalis visceralis is an extremely thin layer made up of flattened layer of mesothelial cells whose existence could be made out by the nuclei which protrude slightly on the surface of the capsule. The testicular capsule is thicker in the region where it encloses the testicular artery and at the region of the passage of the rete testis.
**MEDIASTINUM:**

There is very little mediastinum in the slender loris. In a small area at the cranial end of the testis, the tubulae recti of the seminiferous tubules converge a little beneath the testicular capsule and open into a network of short straight tubules, the rete testis (Fig. 41). These pass through the slightly thickened fibrous capsular wall. There is no parenchyma or fibrous tissue extensions in the region of the tubulae recti or rete testis.

**RETE TESTIS:**

A very small part of the network of these branching channels (Figs. 40, 41) lies beneath the testicular capsule. Most of the network is embedded in the thick fibrous tissue of the testicular capsule. The channels are wider and lined with a simple cuboidal epithelium (Fig. 42) in the beginning and become narrower and thinner as they reach the outer wall of the capsule where they communicate with the efferent ductules.

**SEMINIFEROUS TUBULES:**

The seminiferous tubules are highly convoluted in a complex pattern. Peripherally beneath the
testicular capsule, they are compact and in close contact with the inner surface of the tunica albuginea. Their coils are somewhat loose towards the central region of the testis with large intertubular spaces.

A seminiferous tubule is surrounded by a basement or limiting membrane which is slightly PAS positive. The seminiferous epithelium rests on this membrane. It is covered on its outer surface by elongated fibroblast like cells of two types; one has an attenuated darkly staining nucleus while the other has an elongated spindle shaped nucleus.

The seminiferous tubules of the adult are wider than in the propuberal stage having a diameter of about 135-140μ. However, the two terminal portions forming the tubulae recti are small, straight and short tubes.

Spermatogenesis initiated in the propuberal stage is well established and shows fixed cellular associations. As a result, a given cross section of a seminiferous tubule of the adult slendor loris is lined with a regularly layered developing germ cells of a particular stage of spermatogenesis. Typical stages can be identified in different sections of the tubules. Cellular group of known composition
constitute the stages. The cellular compositions consist of the combinations of one or more different types of spermatagonia, the primary spermatocytes in a particular meiotic stage, the secondary spermatocytes, the spermatids, the particular steps of spermatid transformations into spermatozoa and the mature spermatozoa.

SPERMATOGONIA

The spermatogonia of the slender loris could be classified into the A-type spermatogonia and the B-type spermatogonia. Based upon their cytological differences, the A-type could be further classified into the A1 and A2 types.

A1-TYPE SPERMATOGONIA: (Fig.43):

They are relatively small cells with a spherical to slightly ovoid and uniformly stained nucleus. The chromatin is finely granulated with two nucleoli. These spermatogonia are present at all stages of the seminiferous cycle. They are seen to undergo mitosis.

A2-TYPE SPERMATOGONIA: (Fig.44):

These cells have a large oval or slightly elongated nucleus containing granular chromatin which appears coarser than that of type A1 nuclei. The single large
nucleolus is round or ovoid and appears to lie free in the nucleoplasm. The A2-type spermatogonia are found in larger numbers and lie in a row along the basal membrane of the seminiferous tubule.

**B-TYPE SPERMATOGONIA:** *(Fig. 45):*

They are slightly smaller than A2-type and their nuclei are spherical and contain deeply staining chromatin granules adhering closely together and hence appear as crust-like chromatin, also attached to the nuclear membrane. A deeply staining nucleolus is also present.

**SPERMATOCYTES**

**THE PRIMARY SPERMATOCYTES:**

These are formed as a result of the last mitotic division of the B-type spermatogonia. They are easily distinguishable by their characteristic meiotic prophase. The meiotic division prolongs over a long period. In the very early stage, the premeiotic interphase spermatocyte resembles B-type spermatogonium differing only in its nucleus being slightly larger than that of its progenitor. The preleptotene stage (Fig. 43, 45, PL) shows a granulo-filamentous type of chromatin. The
chromatin granules resolve themselves into finely beaded filaments and take the morphological configuration of the leptotene stage (Fig. 44, L). The leptotene stage gives rise to the zygotene stage after a short duration. The coming together of the homologous chromosomes occurs and the nucleus appears clear on one side and densely stained at the opposite pole, giving rise to the characteristic "bouquet" configuration (Fig. 45, Z). The nuclear volume progressively increases and the chromosomes begin to condense and grow shorter and thicker in the pachytene stage (Fig. 43, P). This stage continues for a long period and enters the next stages of diplotene and diakinesis which are of short duration. Very little morphological differences were observed between the late pachytene and diakinetic spermatocytes.

THE SECONDARY SPERMATOCYTES:

The secondary spermatocytes are derived at the end of the reduction division of the primary spermatocytes. They are recognised by their smaller size when compared with the primary spermatocyte. They are slightly larger than the spermatids which result from the second meiotic division. The nucleus of the secondary spermatocytes are slightly spherical and deeply stained and possess coarse chromatin granules, some of which clump together.
THE SPERMATIDS:

Arising from the second maturation division, the spermatids are the haploid cells which do not divide further. They undergo an extraordinary complex series of changes leading to the production of the highly differentiated gametes, the spermatozoa. Newly formed spermatids are characterised by a small spherical nucleus and a well demarcated Golgi zone which undergoes elaborate transformation. These changes are vivid in PAS-Haematoxylin stained preparations and form the basis for the description of the different steps of spermiogenesis. These steps form the basis of recognition of cell associations.

In the slender loris, fourteen steps have been identified based on the PAS staining of the acrosome system as described by Clermont and Leblond (1955). The fourteen steps can be grouped broadly into four phases, the golgi phase, the cap phase, the acrosomal phase and the maturation phase.

The golgi phase extends from step I to step 3 during which time the cytoplasm of the newly formed spermatid exhibits an irregularly spherical zone, the golgi zone, which starts to elaborate small granules,
the proacrosomic granules. These coalesce to form a single large granule, the acrosomic granule which becomes closely attached to the surface of the nucleus. The next phase, that is the cap phase, extends from steps 4 - 7, during which the acrosomic granule increases in size and flattens slightly at the surface of the nucleus. The acrosomic granules and head cap, both well stained by PAS technique, together constitute the acrosomic system. During these steps of spermiogenesis the head cap enlarges progressively and covers initially a third and finally a half of the nuclear surface. The acrosomal phase includes steps 8 - 12 when the acrosomic granule and the head cap of the spermatid orient themselves towards the basement membrane of the seminiferous tubule. The nucleus becomes flattened and elongated gradually and the head cap fits tightly over the nuclear apex. In the last two steps making up the maturation phase, during which period the spermatid completes its transformation into a spermatozoon. During this phase the nucleus completes its condensation and takes its definite shape becoming flattened. The anterior two thirds of the nucleus is covered by the delicate acrosomic system, now rather staining pale with PAS. Much of the cytoplasm shifts towards
the caudal pole of the nucleus. At the end of the process, a small quantity of cytoplasm separates from the transforming spermatid to become the residual body. All the fourteen steps of spermiogenesis are illustrated in Fig. 46.

The steps of the spermatid development are used as a key to understand the developmental relationship of the spermatogonic cells. The seminiferous epithelium of an adult sexually mature animal is composed of the germinal cells described above and Sertoli cells. One or two generations of spermatogonia are seen along the basement membrane along with one or two generations of spermatocytes and one or two generations of spermatids which border the lumen of the tubulo. The various generations of the germinal cells are not associated at random but form definite cellular associations of fixed composition. The typical cell associations are referred to as stages of the cycle. Such stages represent artificial sub-divisions through a continuous process and therefore the demarcation between the end of a stage and the beginning of the next is often imprecise. The method of Clermont and Leblond (1955) which makes use of the steps in the development of spermatids as seen in the PAS-Haematoxylin stained sections can be utilised
to identify the cell associations. Both A1 and A2 type spermatogonia are present in all stages of spermatogenesis. This is succeeded by the B-type spermatogonia which is present in stages VII through stage III. As a result of one cycle of spermatogonial multiplication and differentiation, a new generation of primary spermatocytes appears in stage VI. Therefore tubules of stages IV through XII contain two sets of primary spermatocytes, the newly formed one being nearer to the basement membrane. The first set is the prelooptotene spermatocyte at stage IV which enters leptotene at stage VI and VII. Zygotene is seen at stage VIII and IX. The pachytene spermatocyte commences from stage X to XII and is continued further from stage I to IX. These spermatocytes in the pachytene stage constitute the older group. Diplotene and diakinesis occur at stage X. The secondary spermatocytes persist for a short time in stage XI and partly in XII and immediately divide to form a new group of spermatids. The first twelve stages of spermiogenesis form the basis for identification of tubules; the remaining steps of spermiogenesis require more than one cycle for completion. Steps 1 to 4 of spermatid development overlap with steps 13 and 14, these being the older spermatids, assume the general appearance of the mature
spermatozoa which at the end of stage IV are released. This leaves stage V to XII with only one generation of spermatids. These above said cell associations are depicted in Fig.47.

**CYCLE OF SEMINIFEROUS EPITHELIUM:**

The typical cellular association that form the cycle are those that are identified and frequently observed in sections of seminiferous tubules. These are ascertained by careful examination of the tubular histology in serial sections. Each typical cellular association is considered as a stage of the cycle of the seminiferous epithelium (Clermont 1963). In the slender loris 12 stages have been identified and the photomicrographs of each stage are shown in Figs.48 to 59.

**STAGE I:** This stage is characterised by the presence of two generations of spermatids. The first generation is composed of newly formed spermatids with a spherical nucleus and a small acrosomic structure. Between these young spermatids towards the lumen are the older spermatids with an elongated tail and the acrosome covering the major portion of the nucleus. Associated with the spermatids are the primary spermatocytes in
the pachytene stage. Along the limiting membrane of the tubules are the type Al, A2 and B-type spermatogonia (Fig. 48).

**STAGE II:** This stage shows the next step of spermatid formation of the younger generation with the acrosome forming a slightly deeper depression on the nucleus. This is closely associated with the mature spermatids whose condition is similar to that seen in the previous stage. The spermatocytes associated with this stage are the pachytene of the meiotic prophase. The Al, A2 and B-type spermatogonia are also visible, (Fig. 49).

**STAGE III:** (Fig. 50): The spermatids of the younger generation are seen with the acrosome being characteristic of the golgi phase. The spermatid of the older generation has an elongated nucleus with a closely adhering acrosome which forms a hook-like structure. This is the last step of spermiogenesis, just prior to the release of spermatozoa into the lumen of the tubule. Large number of Al and A2 spermatogonia and B-type spermatogonia are also visible with spermatocytes in the pachytene stage.

**STAGE IV:** (Fig. 51): In this stage we find the fully-formed spermatozoa being released into the lumen.
These have a long tail and are seen to cast off the residual cytoplasm. The spermatids of the younger generation which are closely associated with the fully mature sperms have slightly oval nuclei with the acrosome forming a cap. Primary spermatocytes are seen in the pachytene stage and a few younger generation of spermatocytes are in the preleptotene stage. Both A1 and A2 spermatogonia are distinct. There is a complete absence of B-type spermatogonia.

**STAGE V: (Fig.52):** This stage is characterised by the younger generation only. The older generation of spermatids have left the seminiferous epithelium as fully mature sperms. The spermatids have slightly elongated nuclei and thick acrosomes. Spermatocytes are in the pachytene and preleptotene stages of meiosis. Spermatogonia A1 and A2 are present.

**STAGE VI: (Fig.53):** This stage is seen to be made up of spermatids with nuclei showing the initial signs of elongation. The spermatocytes of the younger generation are the leptotene and those of the older generation remain to be the pachytene spermatocytes. Type A1 and A2 spermatogonia are very prominent.
STAGE VII: (Fig.54): The spermatids appear typical of the cap phase with the acrosome slightly advanced than the previous one forming a clear cap on the nucleus. In addition to the spermatocytes and spermatogonia which are similar to the previous stage, the B-type spermatogonia are present in this stage.

STAGE VIII: (Fig.55): The spermatid of this stage has the nucleus which is elongated in shape. The spermatocytes are in the pachytene stage and in addition there are the spermatocytes in the sygotene stage with their chromatin in a typical bouquet arrangement. Type A1, A2 and B-type spermatogonia are also present.

STAGE IX: (Fig.56): This is similar to the previous stage but with an elongated acrosome attached to the nucleus.

STAGE X: (Fig.57): These cellular associations seen in this stage show a single generation of maturing spermatids. They have typical pointed and deeply stained nuclei directed towards the limiting membrane. The younger generation of spermatocytes are in the pachytene stage of meiotic prophase, while the spermatocytes of the older generation are undergoing the maturation division. Both A1, A2 and B-spermatogonia are also clear.
STAGE XI: (Fig. 58): Due to the completion of the division of the primary spermatocytes in the earlier stage, this stage is characterised by a large number of secondary spermatocytes. The secondary spermatocytes show homogeneous chromatin within the spherical nuclei which are much smaller than those of the primary spermatocytes. The primary spermatocytes of younger generation are in the pachytene stage. The spermatids undergoing spermiogenesis possess elongated nuclei which are slightly curved at the tip and covered by acrosome. Type A1, A2 and B-spermatogonia are present.

STAGE XII: (Fig. 59): This is the final stage and is characterised by a large number of secondary spermatocytes almost similar to the previous stage which would give rise to spermatids. The primary spermatocytes continue to be present in the pachytene stage. The spermatids have an elongated nuclei and a flagellum is developing. The spermatogonia are seen in their characteristic location towards the limiting membrane. Following this stage is stage I characterised by a new set of spermatids with the acrosome in the Golgi phase and the older generation of spermatids continue in their maturation phase.
Thus the pattern of the cycle of the seminiferous epithelium is determined by the way in which new generation of germ cells begin their differentiation at definite intervals while older generations are in the process of advanced development. Thus typical cross section of a seminiferous tubule shows a combination of four or more generations of germ cells which develop in rigid co-relation.

**SEPTOLI CELLS:**

The sex cords of the foetal testis of loris is made up of two types of cells, the gonocyte and the indifferent cell or sustentacular cell. The indifferent cells are the future Sertoli cells. They are cytologically distinct from gonocytes being elliptical in shape, darkly stained and arranged at the periphery. Little change takes place in these cells until after the onset of spermatogenesis when they gradually increase in size and become Sertoli cells. They are mononucleate. In adults the Sertoli cell nuclei are irregular in shape and are situated near the basal membrane, a location characteristic of many mammals. Although a Sertoli cell (Fig. 45, S), with its characteristic large nucleolus is readily identified, the cytoplasm has proven
particularly elusive. It is true that many of the ordinary histological stains will visualise the cytoplasm which lies near the nucleus but it fails however to depict the finer branches and it is by means of these, that contact with the spermatid is established. The Sertoli cells and the basal layer of spermatogonia are the only two enduring elements of the seminiferous epithelium and are consequently the basic elements upon which its permanent structure depends.

LEYDIG CELLS:

Leydig cells are seen in the interstitial space between the seminiferous tubules (Fig. 60). They undergo two distinct periods of development. The first occurring in the foetus and the second taking place at puberty. The interstitial cells are abundant in foetal life and decrease in postnatal life where they appear to contain only undifferentiated cells (mesenchymal cells). From these cells later, Leydig cells develop in great number at the time of puberty. The interstitial cells of Leydig in the adult loris are relatively large polyhedral epithelial cells. The nucleus is distinctly vesicular and is ovoid with a single nucleolus (Fig. 61). These cells are believed to be the source of androgen.
It was difficult to determine the absolute number of Leydig cells as it includes connective tissue of various types and blood vessels. The number of Leydig cells in the normal mature animal is surprisingly small.

**Vascular System:**

The testis receives its blood supply from two sources, the internal spermatic artery and the vasal or deferential artery originating from the hypogastric artery. The spermatic artery follows a long tortuous course and in the epididymal region is enveloped by the venous return channels forming the pampiniform plexus. The convolutions begin as the artery passes through the inguinal canal. Fairly high in the vascular cone, branches are given off to the head of the epididymis, the superior epididymal branches. These branches also are convoluted in their course in the plexus and are surrounded by veins. The arterial supply to the testis is illustrated in Fig.62. The inferior epididymal artery sends some branches to the distal end of the caput epididymis. It then descends to the corpus where it forms a well defined anastomatic loop with the
second source of blood supply, the vasal artery, which originates from the hypogastric artery. The vasal artery runs along the vas deferens, the cauda and corpus epididymis. The distal caput and corpus receive double supply of blood from the inferior epididymal and collateral supply from the branches of the vasal blood vessel. The internal spermatic artery in loris, is moderately coiled in the spermatic cord having about 8-10 coils. On reaching the plexus, the artery continues on the surface of the testis, and is called as the testicular artery. The main artery encircles the testis three times before entering the parenchyma of the testis at its anterior end. After penetrating into the testis, the testicular artery divides into radiate arteries and an intricate system of intertubular capillaries. The veins arise within the substance of the testis (Fig.63) and pursue a rather straight course under the tunica albuginea, towards the cranial pole of the testis. They drain into the base of the pampiniform plexus. The pampiniform plexus consists of many fine veins which lie closely applied to the coils of the internal spermatic artery. The plexus leads into a single vein the spermatic vein, which empties into the posterior venacava or renal vein.
The veins from the head of the epididymis also drain into the pampiniform plexus while those from the tail of the epididymis join the deferential vein which accompanies the deferential artery and vas deferens through the inguinal ring.

DISCUSSION

ORGANISATION OF THE TESTIS:

Several variations exist between mammals in the processes and stages of testicular development. The processes involved, being differentiation of the testis, descent of the testis into the scrotum, foetal growth and development, and finally pre- and post-puberal differentiation and maturation. The formation of the genital ridge has been studied in the pig (Allen, 1904); rat (Hargitt, 1926 and Huckins, 1962); mouse (Eguchi and Hashimoto, 1961); dog (Al Radhawy, 1958); human (Grunwald, 1942; Gillman, 1948; Witschi 1948; Turner, 1965; Arey, 1965). Extensive reviews on the comparative aspects of testicular development have been put forward by Roosen-Rungc, (1969) and Gier and Marion (1969). The gonad develops from three distinct sources. The somatic elements originate from a thickening of the peritoneal epithelium; the cortex and the
modulla are formed from the condensation of the mesonephric blastema (Witschi, 1956) and the primoidal cells arise extragonadally (Fuss, 1912; Felix, 1912). Differentiation of the sex glands begins with the formation of primordial germ cells in the yolk sac lateral to the base of the vitellino artery with subsequent movement of these primordial germ cells into the embryo proper. It is held that these primordial germ cells are responsible for initiating the processes that lead to the formation of the gonadal ridge and its subsequent differentiation into testis or ovary. The genital ridge which gives rise to the gonad and the genital ducts develops beneath the differentiating mesonephros and is referred to as the urogenital ridge. Waldeyer (1870) introduced the term germinal epithelium to describe the specialised portion of the coelomic epithelium which serves as the gonadal ridge. His observation led him to believe that germ cells proliferated from this somatic tissue. As seen in human, the origin of primordial germ cells in the region of the yolk sac endoderm and their migration by ameboid movement into the genital folds has been confirmed by several independent investigations, (Witschi, 1948; Sheldon and Nelson, 1959).
In slender loris, the differentiation of the gonad commences as a mesenchymal thickening, below and between the differentiating adrenal and mesonephros, and in close contact with the coelomic epithelium. There is a rapid proliferation of cells from the coelomic epithelium, migrating inwards from the surface, as well as from the mesenchymal cells lying in between the differentiating adrenal and mesonephric tubules. These cells converge towards the thickening, contributing to the formation of the gonadal ridge. Although no distinct primordial germ cells are distinguishable in this stage, a few large cells with faintly staining spherical nucleus are present in the mass of the ridge, and these might be the primordial germ cells. This was seen in the loris embryo of 4.0 mm (T.L.). As growth proceeds the gonadal ridge becomes well defined. The large cells with spherical vesicular nuclei become clearly distinguishable as the primordial germ cells or the gonocytes. A distinct germinal epithelium covers the coelomic surface of the gonadal ridge which extends beneath the glomeruli of the mesonephric tubules. This condition is noticeable in an embryo of 10-13 mm (T.L.) Gier and Marion (1969) have also reported that large granulated cells comparable to the primordial germ cells were found in the mesenchyme between coelomic
epithelium and mesonephric tubules in the region of the future genital ridge of 20-21 day dog embryo. The first distinct germinal epithelium was found by them in a bovine embryo late in day 28, and in dog embryo in day 22. The genital ridge of cow, horse, pig and sheep develop at comparable stages and occupy similar positions except that in the pig it is much closer to the dorsal mesentery than in the other species (Gier and Marion, 1969). Presence of these primordial germ cells and their movements have also been shown in human (Witschi, 1948); mouse (Chiquoine, 1954; Mintz, 1957) and rabbit (Chretien, 1966).

In slender loris the foetal gonad becomes distinguishable as testis in an embryo of 33.0 mm (T.L.). The gonadal ridge condenses further and protrudes as a pendulant body from the mesial surface of the mesonephros. Beneath the coelomic epithelium which remains still distinct, the mesenchymal cells of the cortical region get transformed into three to four layers of elongated fibroblasts giving rise to the tunica albuginea. Some gonocytes are seen lying in the coelomic epithelium and also in the region of the differentiating tunica albuginea and in the mesenchymal tissue between the sex cords which are being laid down by an
investment of basement membrane. The sex cords show an irregular branching arrangement and are not distinctly delineated. Hence it could be presumed that the germ cells migrate from the epithelial region through the underlying tunica albuginea into the sex cords. Sheldon and Nelson (1959) have also reported that the majority of the gonia are originally located in the embryonic cortex which along with nurse cells aggregate as cortical cords and cross the primitive albuginea to become continuous with the medullary cords. Condensation of these cords can be recognised as early as 6-7 weeks of age, a week later the testicular morphology becomes distinct when all the germ cells have moved from the coelomic epithelium and crossing the tunica albuginea get incorporated into the medulla. At 30 days in the dog and at 40 days in the cow, the indifferent stage of gonadal development ends and sex differentiation begins (Gier and Marion, 1969).

In slender loris, the rete testes are established in the 33 mm (T.L.) embryo. Anteriorly the testis becomes attached to the mesonephros by a narrow region through which one or two solid mesenchymal strands connect the gonad with the anterior nephric corpuscles. Those strands are the forerunners of the rete testis
and efferent connections between the testis and the epididymis. As development proceeds, the rete cords become evident. They maintain connection with the mesonephric tubules. At the time of birth, the rete testes are seen as a network of small canals in front of the middle region of the testis, connecting the converged narrow solid terminal ends of the seminiferous cords. Similar observations were made by Wilson, (1926) and Gillman, (1948) in the human and in the cow and dog by Gier and Marion, (1969). The number of mesonephric corpuscles involved varies in different mammals: dog, 9-11; cow and horse, 9-12; rodents 2-3(Gier and Marion, 1969). In slender loris, 8-9 mesonephric corpuscles are involved. The distal end of the rete become intimately connected with the seminiferous cords while the proximal ends fuse with the mesonephric corpuscles. Rete attachments are made to the mesonephric corpuscles and maintained throughout the period of mesonephric functioning. As the mesonephros degenerates, the tubules to which the rete are attached are maintained even though their terminal corpuscles degenerate completely.

Continued rapid expansion of the genital ridge without comparable increase in length, results in
ballooning effect with a relatively narrower connection to the mesonephros as the ridge expands. This connection to the mesogonad is continuous between the gonadal ridge and mesonephros, but the mesonephros lengthens more rapidly than does the gonadal ridge. Thus the mesogonad is stretched anteriorly as the cephalic ligament of the gonad and posteriorly as the posterior gonadal ligament which is continuous with the gubernaculum. In slender loris this occurs in a 42.0 mm (T.L.) embryo.

In all animals studied, elongation of the processes vaginalis was accompanied by the movement of the testis across the remaining span of peritoneal cavity so that by the time the tip of the vaginalis reaches the base of the scrotum, the testis was pulled firmly against the inguinal ring where it remains for sometime. In the slender loris, in an embryo of 40-42 mm (T.L.) from the postero-lateral edge of the mesonephros, a mesenchymatous strand extends across the body cavity and is inserted on the abdominal wall where a small depression has developed. This is the beginning of the formation of the inguinal canal. As growth proceeds, the gubernaculal bulb differentiates in the posterior, abdominal wall and is attached to the end of the regressing Wolffian body by means of a short gubernaculal ligament. At the region of its
insertion on the abdominal wall, the shallow depression deepens to form the inguinal ring. In a 102.0 mm(T.Li) foetus, the testis has completely descended into the inguinal canal and inguinal ring is distinct in the posterolateral wall of the abdominal cavity. The spermatic cord and the vas deferens pass through the ring. The inguinal passage of the testis normally occurs in the bovine foetus at 100-105 days, in the human after seven months, (Netter, 1961; Soorer, 1964), in the pig at 100-110 days and in the horse during the month before birth, (Gier and Marion, 1969). As the testis approaches the inguinal ring, the tail epididymis and remnants of the posterior gonadal ligament are pulled into the canal, serving as a wedge for opening the canal. The inguinal ring becomes expanded sufficiently due to the continuous tension that is being exerted on the testis by the gubernaculum thus pulling the testis through the inguinal ring. Tension on the gubernaculum is effected by the more rapid elongation of the processes vaginalis into which the gubernaculum is inextricably bound. Early elongation of the processes vaginalis results in distinct elongation and thinning of the gubernacular cord but as the mesonephros degenerates releasing its hold on the testis, there occurs a shortening and thickening of the cord.
As soon as the testis passes through the inguinal canal, the gubernaculum becomes compressed below the testis rather than contracted. In the inguinal passage, the testis lies within the processus vaginalis. In that position the testis is encased by the original tunica albuginea with its coelomic epithelium surrounded by peritoneal cavity, the recesses vaginalis. The original processus vaginalis completely surrounds the testis, continually separated from the testis by the mesorchium dorsally and the gubernaculum posteriorly. The tunica albuginea continues as the sole sheath of the testis proper, and the processus vaginalis becomes totally the tunica vaginalis. Pressure from the expanding visceral organs undoubtedly assist in moving the testis through the ring.

Development of the germ cell line:

The sex cords of the foetal loris as seen in most other mammalian testis, are made up of two types of cells, the gonocytes and the indifferent cells or supporting cells. The latter are the precursors of the Sertoli cells. These cells are first seen in an embryo of 42.0 mm(T.L.) wherein the seminiferous cords are lined by oval shaped presertoli cells and in the
contre the gonocytes are large and spherical. Gonocytes are derived by the differentiation of the previously similar appearing cells of the primary epithelial cords which in turn come from the germinal epithelium. Gonocytes are larger than Sertoli cells, have regular round nuclei and prominent nucleoli. Both cell types are engaged in active mitotic activity during foetal life. This continues right up till the time of birth. Even after birth, the sex cords continue to have only the gonocytes and the presertoli cells. As growth proceeds, after birth, the gonocytes are seen to be of two types; one with compact deeply staining nucleus and the other with larger nucleus showing fine chromatin. The latter are the prespermatogonia and are intermediate between the gonocytes and A spermatogonia. This arrangement of cells in the prenatal testis is similar to what is seen in rat and mouse, (Roosen-Runge, 1969; Sapsford, 1962 b); rhesus monkey, (Van Wangenen and Simpson, 1954) and in marmoset, (Hampton and Taylor, 1970). The controversy over whether gonocytes are precursors of definitive germ cells in adult testis is still not entirely settled despite the fact that it originated as far back as the turn of the century. Clermont and Perey, (1957); Steinberger and Steinberger, (1975) have given support to the viewpoint that the
definite germ cells do arise from gonocytes and the supporting cells are the precursors of Sertoli cells. Similar conclusions were reached by other investigators, (Sapsford, 1962 b; Roosen-Runge, 1962 b; Beaumont and Mandler, 1963; Huckins, 1963; Roosen-Runge, 1968). A number of reports dealing with the human testis also support the thesis that gonocytes are the precursors of the germinal cell line in the adult testis, (Charney et al, 1952; Albert et al, 1953 a; Mancini et al, 1960 a). The data on the slender loris allows for the same conclusion to be drawn.

In slender loris, histological observations made on the supporting cells led to the conclusion that these cells persist after birth. They do not change during the early developmental stages, but transform at puberty into mature Sertoli cells which are always cytologically distinct from gonocytes and the spermatogonia exist as mononucleate forms. The pattern of change of these cells during the development of the testis is different from that of the germ cells. Little change takes place in these cells until after the onset of spermatogenesis when they gradually increase in size and become Sertoli cells. In monkey, (Van Wangonen and Simpson, 1954) Sertoli cells have been described
as individual cells though it is realised that the boundary of these individual Sertoli cells is difficult to distinguish either in immature or mature testis. In marmoset, (Hampton and Taylor, 1970) the nuclei of the sustentacular cells which line the seminiferous tubule recede towards the basement membrane well before birth as in macaque. In human, sustentacular cell nuclei remain dispersed in the centre of the cord during development and do not attain a basal position until puberty, (Hampton and Taylor, 1970). In loris, they remain mostly in the peripheral region though occasionally they are found also in the central region.

In the foetal loris, in addition to the presertoli cells and the normal gonocytes, degenerating gonocytes are seen. They are large in size with a spherical vesicular nuclei showing masses of chromatin granules irregularly scattered and found towards the centre of the cord. These degenerating gonocytes are first seen in the embryo of 50-57 mm (T.L.). They are found in increased numbers in the embryos of 70-72 mm (T.L.). Their nuclei consist of condensed chromatin material showing irregular fragmentation. In some of the degenerating gonocytes, the large vesicular nucleus and the cytoplasm appear to have constricted
into two or three fragments giving the appearance of a group of two or three cells adhering close together. The cytoplasm of these degenerating cells is highly vacuolated. Just prior to birth, there is a decrease in number of these degenerating gonocytes and an increase in the normal smaller gonocytes which give rise to the type A spermatogonia. The degenerating gonocytes are also seen again after birth although in decreased numbers. Many workers have suggested that gonocytes degenerate in the neonatal testes and the definitive germinal cell line is formed from undifferentiated epithelial like supporting cells, (Regaud, 1901; Kirkham, 1915; Allen, 1918, 1949; Firket, 1920; Hargitt, 1926; Bookhout, 1937; Bryson, 1944). Allen (1949) suggested that in the rat, primordial germ cells degenerate after birth and Niomi and Ikonon (1965) concluded that in the human testis there is probably no continuous germ cell track because the primordial germ cells differentiate prior to the development of permanent spermatogonia.

Allen (1949), studied the degenerating cells in great detail and concluded that all primordial germ cells degenerated by the postnatal age of nine days. Clermont and Perey (1957), for the first time
quantitatively the cell population in the postnatal seminiferous tubules and demonstrated that in the Sherman albino rats some gonocytes start dividing at four days of age and give rise to spermatogonia, but many gonocytes failed to divide and degenerated. Sapsford (1962 b), in a non-quantitative study reached similar conclusion but challenged the view that nuclear swelling in gonocytes is indicative of degeneration. Roosen-Runge (1968), for the first time attempted to determine the absolute number of gonocytes during the postnatal period. He assumed that the decrease was due to the diminution of degenerating cells and the transformation of gonocytes into definite spermatogonia. Huckins (1963, 1965), has often described the phenomenon of degeneration... of gonocytes. Quantitative analysis has led to the conclusion that approximately 75% of the primordial cells populated at the time of birth is doomed to degenerate. The gonocytes produce the first spermatogonia in the second half of the first week after birth (Roosen-Rungo, 1962 b). Furthermore, all investigators agree that at least some gonocytes degenerate and disappear during the first week. Roosen-Rungo, (1962 b), and Beaumont and Mandl, (1963), showed that the evidence for degeneration was derived
entirely from microscopic observation of gonocyte morphology. All major histological accounts are however in agreement that at least some germ cells die before they transform into spermatogonia. Charney et al (1952): in human hold that spermatogonial cells present at birth remain scarce until the individual reaches about ten years of age and then increase in number abruptly, at the same time evolving into mature sperma-
togonia. Clermont and Perey (1957), noted in rat, that large number of germ cells undergo degeneration during the first day after birth and disappear. Quantitative study of degenerating cells in rat has been made by Beaumont, (1968), and Huckins (1965). Since the degenerating cells are not immediately compensated by mitotic activity of normal cells it would appear likely that the total population of germ cells temporarily decrease until such time as it is augmented again by the formation of A-type spermatogonia. Degeneration of the gonocytes no longer implies the complete extinction of a whole generation of germ cells. The litterature remains contradictory however, on the quantity and morphology of degenerating gonocytes and on their cause of death.
Extensive reviews by Philips and Andrews (1936), Moore (1939), Schonfield (1943), Albert et al (1953 a,b) Albert (1961), Blum, (1968) deal partly or entirely with the postnatal development of the mammalian testis. Several mammalian species have been the target of impressive studies such as cat (Scott and Scott, 1957); goat, (Yao and Eaton, 1954); rhesus monkey (Van Wangenon and Simpson, 1954); the human (Sniffen, 1952; Charnoy et al, 1952; Albert et al, 1953 a,b; de la Balzo et al, 1954; Roosen-Runge, 1956). Clermont and Huckins (1961), re-evaluated the details of the seminiferous tubule development in the rat. Utilising techniques of reconstruction from serial sections, they investigated the morphologic characteristic and topographic arrangement of germinal cells during the development of seminiferous tubules from the 17th day of embryo life to adult-hood. Their findings confirmed those of Roosen-Runge in the rat (1956), Bremer (1911) and Grunwald (1934) in the human and de Burlet (1921) in the marsupial. Many investigators proceeded to study the initiation of the spermatogenic process during puberty on the basis that gonocytes are the precursors of the germ cell line, (Regaud, 1901; Kirkham, 1915; Allen, 1918, 1949; Firket, 1920;
Hargitt, 1926; Bookhout, 1937; Bryson, 1944). In slender loris soon after birth, gonocytes of two types are seen; one with compact deeply staining nucleus and the other with large nucleus showing fine chromatin granules. The latter are the prespermatogonia and are intermediate between the gonocytes and A-type spermatogonia. These continue till the prepubertal stage.

Manicini et al, (1960 a) observed that in the human the gonocytes form type A-spermatogonia some of which degenerate while others form several additional types of spermatogonia. Most of these spermatogonia also degenerate and only a small number enter the process of spermatogenesis at the time of puberty. Sapsford (1962 b) was the first to observe in ram that the progeny of the postnatal gonocyte divisions resembled adult type A-spermatogonia, but they were distinctly large and stained light. He also described an intermediate germinal cell in the rat and mouse, the immature type A spermatogonia, which form from the gonocytes. This cell was morphologically distinct and served as a precursor of the type A spermatogonia. In tissue culture of newborn rat testis, Steinberger et al (1964) observed the cells with morphologic characteristics which were intermediate between the gonocytes and type A-spermatogonia. They called those cells as
the primitive type-A spermatogonia. A similar cell type was also described in the testis of developing rats by Beaumont and Mandl, (1963) and Huckins, (1963). Under certain culture conditions, the primitive type-A spermatogonia continue to divide without differentiating into type-A spermatogonia. Under more favourable conditions these cells are capable of entering the process of spermatogonosis and forming type A spermatogonia (Steinburger and Steinburger, 1967). Studies concerned with initiation of spermatogonosis in the bovine testis has been conducted by Attal and Courot, (1963) and in the lamb by Courot, (1962 b).

In the slender loris, the propubertal testis, shows type A-spermatogonia, type B-spermatogonia and young spermatocytes in small groups, but never in the same tubular cross section. Those observations indicated that even at that time the spermatogonia did not divide at random but as in the adult, proliferated rhythmically in an almost synchronous fashion thus giving rise to groups of cells at the same stage of development. This condition lasts till the testis weighs 550 mg, after which the lumen gets formed in the semminiferous cord and the process of spermiogenesis commences with the formation of the spermatids.
The climax in development is reached when the testis weighs about 700 mg. and the tubulo diameter is about 125μ, when spermatogenesis is in full swing and with the spermatogenic cycle fully established. Gamete production does not begin uniformly in all the semminiferous tubules. Even within a single tubule only patches of gametogenic activity may be observed during the initial stages of sexual maturation. The adult condition is reached when the testis weighs about 1280 mg and when the tubule diameter is about 135-140μ, when all the stages of the spermatogonic cycle are clear. The study of the transformation of the spermatogonial cell into spermatozoa which was initiated by Von Ebner, (1902), Von La Vallette, (1876), Von Kolliker, (1841), lead further to the understanding of the kinetics of the spermatogenic epithelium. Studies on these aspects by Curtis, (1918); Beylot and Baudrimont, (1926); Moore, (1947); and Roosen-Runge, (1950); have established the facts of the entire process.

Because of their complexity and functional importance the cytological and histological processes taking place within the semminiferous tubule have attracted the attention of numerous biologists. The various types of evolving germ cells, that is, the
spermatogonia, spermatocytes and the spermatids at various steps of their respective development are not arranged at random but form well defined cellular associations. It became evident on careful analysis that such cell associations must succeed one another in time in any given area of the semminiferous tubule. Since such a sequence must repeat itself indefinitely, the notion of the cycle of the semminiferous epithelium emerged. Leblond and Clermont, (1952 a) with the aid of special staining technique, carefully defined the characteristic changes taking place in the acrosome of the spermatid during its development (spermiogenesis) and correlated these changes with each of the specific cellular associations. Thus it became possible to define the kinetics of the spermatogenic process with great precision.

Roosen-Runge and Giesil, (1950), working on rats, came to the conclusion that type-A spermatogonia divide at several definite stages and finally after two or three divisions change into cells of type B which are still mitotic. These after another two divisions give rise to the postmitotic spermatocytes. Spermatogonia in the mouse show the same general appearance as in the rat, and type A, intermediate
and type B cells can be distinguished, (Oakberg 1956 a). There are five spermatogonial divisions in mouse. Cloland (1951), found three divisions in the spermatogonia of the guinea-pig. He did not describe the cell types in detail. Ortavant (1959) investigated the whole spermatogonic cycle in ram. He determined that like the spermatogonia of rat and hamster, those of ram divide five times. An intermediate type was also be distinguished. Clermont and Leblond, (1959), Clermont (1959) after an intensive study in rhesus monkey characterised at least five types of cells mainly by their nuclei which fell into two broad classes A and B. Further type A spermatogonia has been divided into type A1 being identified by a relatively small nearly spherical nucleus with dense chromatin and one or two nucleoli while the type A2 spermatogonia have a relatively large ovoid nucleus in which chromatin appears more coarsely granular than in type A1 as seen in slender loris. Type B spermatogonia undergoes three divisions. The nuclei of type B cells, are also large and ovoid but contain clumps of chromatin and a large polymorphous nucleolus not connected to the nuclear membrane. In type B cells the nucleus is smaller and more spherical and contains more chromatin flakes. The B type is
still more spherical and appears very dense with accumulation of chromatin. They concluded that in the monkey, spermatogonia undergo at least five divisions. In *Macaca arctoides* (Clermont and Antar, 1973) designated these spermatogonial cells as dark staining (Ad) and pale staining (Ap) spermatogonia. In baboon, *Papio anubis*, Chowdhury and Steinberger (1976), showed that the spermatogonia are of two types, Ap and Ad, similar to the human. In slender loris, it was seen that as in the rhesus monkey, the spermatogonia are of two types, type A and B. Type A is further divided into A1 having a small spherical nucleus with dense chromatin and type A2 with a large ovoid nucleus with granular chromatin very much similar to the A1 and A2 spermatogonia of the rhesus monkey. The B type spermatogonia are also large and ovoid with clumps of organells of heavily stained chromatin distributed along the nuclear membrane. This does not divide further and there is also the complete absence of intermediate type spermatogonia similar to that seen in the human. In the case of human, Clermont (1966) has classified the large majority of spermatogonia into three categories referred to as dark type A, pale type-A, and type-B spermatogonia. The dark type spermatogonia have an ovoid nucleus containing a deeply staining dust like
chromatin. In the central part of the nucleus a cavity containing a pale stained material is usually present. One or two nucleoli are closely applied to the nuclear membrane. The pale type A spermatogonia have a discoid or ovoid nucleus containing a pale stained granulated chromatin and show one or two nucleoli attached to the nuclear envelope. The type-B spermatogonia show a spherical nucleus characterised by clumps of organelles of heavily stained chromatin distributed along the nuclear membrane attached to a centrally located nucleolus found free in the nuclear sap. The type-B spermatogonia do not divide further and there is also the absence of the intermediate type spermatogonia. This is similar to what is seen in loris with Al, A2 and B type spermatogonia and with no intermediate type spermatogonia.

In general the morphology of the spermatocyte nuclei of the slender loris is remarkably similar to other mammalian species. However, in slender loris as seen in the baboon, (Chowdhury and Steinberger, 1976), very little morphological difference was observed between the late pachytene and diakinetic spermatocyte in contrast to that observed in the testis of other animals.
The typical cell associations are referred to as the stages of the cycle. Such stages represent artificial subdivisions through a continuous process and therefore the demarcation between the end of a stage and the beginning of the next is often imprecise. For a given animal species, association or stages of the cycle may vary depending upon the criteria used to characterise or to identify them. Such criteria chosen to be useful in the study of the seminiferous epithelium are arbitrary and vary considerably from one investigator to the other.

In various recent studies on the seminiferous tubules of mammals two distinct trends have emerged in the choice of criteria for the identification of the stages. Curtis (1918), Roosen-Runge and Giesel, (1950), and Ortavant (1954) used the nuclear morphology of the spermatids simultaneously with the position of the more mature spermatids within the seminiferous epithelium. Such a classification is composed of eight stages in rat, ram, bull, rabbit, boar, mink and monkey. With this approach a classification of six stages has been prepared for the human. The second method employed by Leblond and Clermont, (1952 a,b; 1955) makes use of the steps in the development of spermatids as seen in
PAS/Haematoxylin stained sections. Based on the development of the acrosomic system of spermatids, Leblond and Clermont (1952) classified the semminiferous epithelial cycle into various stages in most mammals especially in the rat, hamster, guinea-pig, mouse, ram, bull, monkey and man. On this basis there are 19 steps in the spermiogenesis of rat, 16 steps in the mouse, (Oakberg, 1956); 14 steps in the monkey (Clermont, 1952). This technique provides a classification which is composed of larger number of stages. Thus for example 14 stages were described in the rat, 13 stages in the hamster and guinea pig and 12 stages in the mouse and monkey. In this technique the transforming acrosome system of the spermatids stain deep purple. The steps of formation and evolution of these organelles are used to characterise the steps in development of the spermatids. These in turn can be utilised as a set of criteria to identify the cell association to which these spermatids belong. The method used in the case of the slender loris was the latter one where the stages were identified according to the configuration and stainability of the acrosomic system. Based on the above technique, the spermatogenic cycle in the slender loris is seen to be divided into 12 stages. The spermiogenic process is completed with 14 steps. This is similar to that
seen in the case of rhesus monkey, Clermont, (1952) and also to that of baboon, (Chowdhury and Steinberger, 1976). The spermatogenic cycle was also defined for the hamster, (Clermont, 1954) the ram (Ortavant, 1954); the bull (Kramer, 1960); the rabbit (Swiestra and Foote, 1963) and the guinea pig (Clermont, 1960). Defining the cycle of the semminiferous epithelium in man was quite difficult since histological examination of the semminiferous tubules fail to reveal well defined cellular associations. A detailed re-evaluation of this problem led Clermont, (1963) to describe the cycle of the semminiferous epithelium on a similar principle to that described for other mammalian species. He proposed that in man the entire cycle consists of 6 stages. Although the basic concept appears to be borne out by the available information, the detailed composition of the various cellular associations, as well as the numerical relationship among the various germinal epithelial cells remain poorly defined. Work done by Barr (1973) on 4 sub-human primates viz., the squirrel monkey, rhesus monkey, baboon and African green monkey demonstrated that the stages of the cycle of the semminiferous epithelium are identical in all. Full spermatogenic activity was proven by biopsy in
all the monkeys in his study. He described 12 stages and 14 steps in all the four non-human primates. The kinetics of spermatogenesis for the true simians (Orangutang, gorilla and chimpanzee) have not been studied. It is possible that the duration of spermatogenesis in any one of these species is more closely approximated than in man.

**SERTOLI CELLS:**

Sertoli cells have the distinction of being the only non-germinal cells within the walls of the seminiferous tubule. Since their description by Sertoli in 1865, the cells in the seminiferous tubule which bear his name has attracted continued attention. Particular interest is attached to them, because of the intimate relationship which they establish with the maturing spermatids. Inference concerning their function has led to their designation as sustentacular cells and nurse cells. More descriptive in character are the term foot cells due to their adherance to the periphery of the tubule.

Histological studies of the testis of the slender lories show that Sertoli cells are first seen in an embryo of 33.0 mm (T.L.). These Sertoli cells
are easily recognised as growth progresses since they are arranged in a palisado-like manner along the distinct basement membrane. This pattern continues until birth and in the early postnatal period till the pubertal stage. The pattern of arrangement of Sertoli cells is also seen in the immature human testis, (Chaney, Conston and Moranze, 1952; Sniffen, 1952) and in the chimp (Graham and Bradly, 1972). Thus these Sertoli cells do not change during the early developmental stages but transform into mature Sertoli cells without giving rise to any other cell type. These indifferent cells or Sertoli cells exist as mononucleate forms and not as a syncytium. In monkey (Van Wagener and Simpson, 1954) Sertoli cells have been described as individual cells though it is realised that the boundary of these individual Sertoli cells is difficult to distinguish either in the immature or mature testis. The controversy as to whether Sertoli cells exist in the form of syncytium (Rogaud, 1901; Coulombre and Russel, 1954) or individual units have recently been settled in favour of the latter, (Elftman, 1965; Fawcett and Burgos, 1956; Nicander et al 1961; Vilar et al, 1962; Sapsford, 1963).
Ever since their discovery Sertoli cells were considered to be nurse cells for the germinal elements. A functional relationship between Sertoli cells and neighbouring germinal elements has been suggested by Von Ebner, (1902) and Rolshoven, (1945) and Elftman, (1963). Vilar et al (1962) provided considerable evidence supporting the nursing function of Sertoli cells. In loris as in other species, the Sertoli cells are rather morphologically obscure in histological preparations as their cell limits are often difficult to follow, although their distinctive nuclei are easily seen. The close relationship between the differentiating spermatids and Sertoli cells in the slender loris shows apparently that Sertoli cells have a nutritive or supporting function. The complicated structural interaction of Sertoli cells and germinal epithelium is probably facilitated by the generally accepted idea that Sertoli cells do not divide in the mature testis. This belief has been primarily on casual observation of lack of Sertoli cell mitosis in histological sections of mature testis. But in the immature testis, these Sertoli cells divide to produce a large number of elliptical cells which are seen to be arranged towards the basement membrane. More systematic study of this question was conducted by Clermont and
Pcorey (1957) who surveyed histological preparations of testis of foetal and immature rats for Sertoli cell mitotic figures. Those authors observed the greatest mitotic activity in Sertoli cells of 15 to 21 day old foetuses and in the new born animals. No mitotic activity was observed in animals older than 15 to 18 days. Sertoli cell population in the adult testis is stable. This conclusion has been assumed by many investigators in the past who used Sertoli cell as a reference point or correction factor in counting germinal cells (Clormont and Mongentaler, 1955). Recently Buston Obregon, (1970) using the technique of microscopic visualisation of whole mounts of semminiferous tubules conducted a quantitative study of the topographic distribution and numerical relationship of Sertoli cell in the testis of the adult rat. As a result of this study, they concluded that Sertoli cells are distributed randomly and their number is constant along the basement membrane of the seminiferous tubule in all stages of the cycle of the seminiferous epithelium. However in the case of human testis, Steinborger and Tijoe (1968) reported a lack of uniformity of distribution of Sertoli cells in the seminiferous tubules of human testis. They also found marked variation
in the absolute numbers of these cells in the testis of different individuals. In the case of slender loris, also Sertoli cells are not uniformly distributed.

By their particular position, their structure and their intense metabolic activity, Sertoli cells play an important role in the metabolic exchange with the germ cells and in the co-ordination of spermatogenesis. They are also credited with an endocrine role, (Cuorot et al, 1970).

**LEYDIG CELLS:**

Leydig cells, also called as the interstitial cells of the vertebrate testis, secrete androgens that regulate the development and function of the male reproductive tract and external sex characteristics. They also appear to promote spermatogenesis. Clusters of these prominent cells usually occur in the interstitial space between the seminiferous tubules. The Leydig cells reside in the interstitial tissue, and form an irregular meshwork of loose connective tissue, filling the space between the seminiferous tubules. In most mammalian testis as in loris, the interstitial tissue contains blood vessels of various sizes, lymphatics, clusters of Leydig cells, and various
cellular elements especially fibroblasts and macrophages. These components lie in the connective tissue stroma consisting of ground substances interlaced with collagen fibres and some elastic fibres. The clusters of Leydig cells fibres occur primarily along blood vessels (Fornecr, 1957) which are very precisely arranged in relation to the seminiferous tubule, (Muller, 1957; Kormono, 1967).

The origin of Leydig cell is unclear. Some embryologists (Gillman, 1948; Aroy, 1965) believe that they are formed by a process of specialisation of the mesenchymal cells. Others favour the theory that they originate from the coelomic epithelium or mesonephric blastoma, (Witschi, 1956). In the slender loris during the differentiation and development of the male gonad, (33.0 mm (T.L.) embryo) a prominent epithelial ridge or thickening is noticed on the ventral surface of the testis, where the tunica albuginea is interrupted and not continuous. From this region it is seen that the mesenchymal cells are being proliferated into the interstitium of the testis and these cells appear to get transformed into Leydig cells. This ridge however disappears at a later stage. Hence it is possible that the Leydig cells originate
partially as a result of the proliferation from the epithelial lining of the developing gonad. In the slender loris at a time when the sex-cords are being formed the mesenchymal cells surrounding the cords become rounded and are seen differentiating into foetal Leydig cells in an 42.0 mm(T.L.) embryo. These cells become glandular, large and deeply eosinpholic. At this time it is also noted that the Wolffian duct is differentiating and the Mullerian duct is regressing. Studies in several mammalian species have indicated a close correlation between the appearance of Leydig cells in the male foetus and the establishment of sexual differentiation of the reproductive ducts and the appearance of androgenic activity in the foetal testis. Foetal differentiation of Leydig cells is correlated closely with acquisition of the capacity to synthesize testosterone, and with important androgen-dependent changes occurring during early development, (Jost, 1970).

In the slender loris, the number of interstitial cells increase rapidly until near term. Just prior to birth in an embryo of 102 mm(T.L.), it is seen that these interstitial cells are still found in dense masses all round the seminiferous cords, but they are undergoing transformation into elongate cells. They
are thus seen to be losing their secretory function and reverting to an undifferentiated stage. In the neonatal testis, the interstitial cells are seen to have decreased in number and shrunk in size. The large cells with spherical nuclei characteristic of the prenatal stages are absent. Most of the cells are in the form of fibroblasts with compressed elongated nuclei and very little cytoplasm.

The extent to which foetal Leydig cells decline in number and regress and the age at which regression is maximal, seem to vary in species. Testicular differentiation in the hamster foetus occurs at 11.5 days, (Price and Origit, 1965). Leydig cells make their appearance between day 12-13 and are present as groups of large cells concentrated around interstitial blood vessels. This pattern is similar to that of the rabbit in which testicular differentiation begins in the foetus on day 16, (Gondos and Conner, 1972). Leydig cells appear on day 18 and regression of Leydig cells occurs during the first week after birth, (Gondos and Conner, 1972). In the human foetus, testicular differentiation begins at 6 weeks (Van Wagenon and Simpson, 1965), Leydig cells appear at 8 weeks (Jirasek, 1967) and regression of Leydig cells begins at 18 weeks.
of gestation, (Polliniemi and Niemi, 1969). In all cases Leydig cells appear shortly after testicular differentiation and remain for a fixed period of time before undergoing regression. This general pattern is also true in the slender loris. The control mechanism responsible for early Leydig cell development and regression are not known, although it has been speculated that gonadotrophins from the placenta (Niemi et al., 1965) or from the foetal pituitary (Jost, 1961) may be involved.

In an extensive cytological and cytochemical study Manicini et al. (1963) clearly demonstrated in the developing human testis two phases of Leydig cell development, the first occurring during foetal life, reaching a peak during the sixth month of gestation and followed by degeneration and disappearance of the formed elements shortly after birth and several weeks after birth. The second phase was observed with the onset of puberty when new Leydig cells differentiated in the interstitial tissue from specialised fibroblasts. These results are in agreement with those of Sniffen (1952) on human testis. He stated that the interstitial cells which are abundant in foetal life decrease in postnatal life. Here they appear to be made up of only undifferentiated cells (mesenchymal cells) and then later
from these cells, Leydig cells develop in great number at the time of puberty. This is in accordance with the work of Bascom (1923) on bull testis; Hooker (1944) and Baillie (1964 b) on mouse testis, and Black and Christensen (1969) on guinea-pig testis. In the rhesus monkey, Leydig cells disappear shortly after birth (Van Wagenen and Simpson, 1954). Postnatal regression period has also been observed in the rabbit (Allen, 1904), cattle (Bascom, 1923; Hooker, 1944, 1948) and mouse (Hitzeman, 1962; Baillie, 1964 a,b,c).

In the slender loris, there is a diminution of interstitial tissue in the postnatal testis. The interstitial cells are not only reduced in number but also in size and activity. They look more like undifferentiated mesenchymal cells. The large Leydig cells noticed in the foetuses before birth are totally absent. This condition of the interstitial cells continues until the prepubertal stage when the testis weighs about 100 mg. The narrow triangular spaces in cross sections, bound by the adjacent cords contain faintly staining rounded cells which have differentiated from the mesenchymal cells seen earlier. These cells are the differentiating Leydig cells which are coming into a functional state before the onset of
pubertal condition. The undifferentiated mesenchymal and connective tissue cells of the interstitial tissue are distinct. Just prior to puberty, when the testis weighs about 400 mg. Leydig cells are seen to be localised within the intertubular space in a compact organised mass of few large cells. They form clumps of 5-8 cells. In the adult testis they appear as large polyhedral epithelial cells with the nucleus being distinctly vesicular and ovoid with a single nucleolus. The pattern and significance of Leydig cells differentiation in the postnatal period are not as clearly defined as they are in the foetus. In mouse, bull and man differentiation of new Leydig cells begins at about the age of puberty and continues throughout life. Postnatal Leydig cells develop from mesenchymal or fibroblast cells (Hooker, 1948; Sniffen, 1950; Albert et al, 1953; Mancini et al, 1963). Metamorphosis of precursor cells into Leydig cells must be presumed to be the chief if not the sole means of forming new Leydig cells and of increasing their number in as much as mitotic figures have rarely been seen, although Roosen-Runge and Anderson (1959) report frequent mitosis in Leydig cells in the foetal rat. The development of a postnatal generation of Leydig cell has been reported in
the horse, (Bouin and Ancel, 1905); bull, (Hooker, 1944), mouse (Hooker, 1948), monkey, (Van Wagenon and Simpson, 1954) and man (Sniffen, 1950; Albert et al., 1953; Mancini et al., 1963).

In bull (Hooker, 1944) the intertubular tissue in the postnatal-prepubertal testis is said to exhibit little evidence of differentiation and it consists of mesenchymal cells. Many of these cells however contain typical Leydig cell nuclei, (Hooker, 1948). When studied, using routine haematoxylin/eosin staining, though Leydig cells are prominent at birth, they are difficult to discern in the next few months and become prominent again at the onset of sexual maturity. These observations in slender loris support Hooker's (1948) statement that the postnatal, prepubertal testis shows little differentiation. The use of PAS technique however renders Leydig cells not visible but they are prominent during the entire postnatal, prepubertal period indicating continuity of the supposed foetal and pubertal generations. Van Wagenon and Simpson (1954) reported similar postnatal changes in the monkey. Theoretically, one might except that at puberty, differentiation or even hypertrophy of Leydig cell would precede differentiation of the tubules, judged
from the ability of testosterone to stimulate spermatogenesis and the supposed production of male hormone by Leydig cells. In this study on the slender loris, Leydig cells were found to be distinguishable from indifferent inter-tubular cells at about the same period as the earliest differentiation occurred in the tubules. The appearance of the fully functional cells on the basis of the size, rounded cell body and granulated or vacuolated cytoplasm was not seen however until spermatogenesis was far advanced. This condition noticed in slender loris, is similar to that seen in the rhesus monkey, (Van Wangenen and Simpson, 1954). Albert et al (1953) in a review of the developmental stages in the human testis have stressed the fact that changes leading to the maturity at puberty occur in the tubules before they do so in the Leydig cells. Sniffen (1952) also describes the appearance of the first spermatocytes in the human testis before differentiation of the Leydig cells has occurred. Hooker (1944) also reports that in the bull the differentiation of the tubule occurs earlier than that of Leydig cells. In rabbit testis (Gondos et al, 1976) spermatogonial mitosis first appear at seven to eight weeks of age. The findings indicate that Leydig cell differentiation proceeds the onset of spermatogenesis. According to
Gondos et al (1977) in the rabbit, proliferation of the Leydig cell is a result of both multiplication and differentiation, but principally the latter. Partially differentiated cells are comprised of a significant and relatively constant proportion of the interstitial cell population throughout the postnatal period, as is seen during the foetal Leydig cell development. This indicates similarity in the pattern of differentiation of the two Leydig cell generations. Since the increase in Leydig cells is associated with a decrease in the mesenchymal cells, the change in distribution of cells apparently reflects a maturational process. This is in agreement with the generally accepted notion that Leydig cells are derived from mesenchymal cells in the testicular interstitium (Christensen and Gillim, 1969; Hookor, 1970; Gondos, 1974). The pattern and significance of the Leydig cell differentiation in the postnatal period are not as clearly defined as they are in the foetus. In mouse, bull and man differentiation of new Leydig cells begins at about the age of puberty and continues throughout life. Postnatal Leydig cells develop from mesenchymal or fibroblastic cells (Hookor, 1948; Sniffen, 1950; Albert et al, 1953; Mancini et al, 1963). Metamorphosis of precursor cells into
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It is generally presumed that once full sexual maturity is reached a stable condition of relative equilibrium persists in the intertubular tissue until the approach of old age and this is so in loris as it occurs in the other groups of mammals.

**VASCULAR SUPPLY:**

The anatomic patterns of the vasculature of the testis of different species depend on the position of the testis, whether abdominal, inguinal or scrotal (Setchell, 1970). With the evolution of the scrotum, the sensitivity of the testis to heat is governed by the singular anatomic arrangement of its vasculature. In all species the blood vessels originate near the
kidneys, but with the evolution of scrotal testis (Cowlos, 1965) came a further specialisation of vasculature. The internal spermatic artery became elongated, convoluted and closely invested with network of venous channels, constituting the pampiniform plexus.

A marked variation in the pattern of testicular blood supply among various species was noted by de Graaf, (1677) who suggested that these variations may reflect species-differences in the control of the scrotal temperature. The most striking feature of the vascular anatomy of scrotal testis of eutherian mammals are the convolutions of the internal spermatic artery. The convolutions begin as the artery passes through the inguinal canal. Fairly high in the vascular cone, branches are given off to the head of the epididymis and these branches are also convoluted in their course in the cone and are surrounded by veins. On leaving the vascular cone the artery continues on the surface of the testis with wide variation between species in its course after it has run under the epididymis to the distal pole.

Among the Prosimii, there are examples of two vascular arrangements. In the ring tail lemur, the arrangement is similar to that in the carnivora with
moderate coiling in the cord and a fairly simple course up the free border of the testis while giving branches to the interior. Bosman's potto (*Perodicticus potto*) and the bush baby (*Galago crassicaudatus*) resemble rabbits and squirrels in having arteries which, after convoluting in the cord, either themselves or their branches encircle the testis twice or thrice before entering the testis. Of the Anthropoidea, the representatives of the Platyrrhini examined, the squirrel and red handed tamarind monkeys resemble the lemur and carnivore but the Catarrhine monkeys (rhesus monkey and Olive baboon) have much more complicated coiling on the free surface of the testis, (Harrison, 1949). In the chimpanzee and gorilla (Setchell, 1968) the artery is convoluted in the cord and run down the epididymal margin of the testis; it then curves round the caudal pole of the testis and runs up the anterior border with further convolutions before supplying the testis. The gibbon (Harrison, 1949) has a simpler arrangement similar to that in man (Harrison and Barclay, 1948) with minimal coiling in the cord. It runs a fairly direct course down the epididymal border and gives rise to branches which pass up the anterior surface while dividing further into intratesticular arteries.
The human spermatic artery shows no convolutions during its passage through the pampiniform plexus (Harrison and Barclay, 1948). During its intraabdominal course it gives off branches to the cord and epididymis. Upon reaching the posterior border of the testis, it forms two branches which pierce the tunica albuginea and break up into numerous small branches underlying the tunica albuginea to form the tunica vasculosa. From this superficial vascular network, numerous terminal branches are given off which enter the testicular parenchyma. In slender loris the internal spermatic artery is moderately coiled in the spermatic cord and encircles the surface of the testis thrice before entering the parenchyma of the testis. Once penetrating within the testis, the testicular artery divides into radiate arteries, inter-tubular arterioles and intricate pattern of intertubular capillaries. Harrison and Weiner, (1949) suggested that the intimate relationship of arteries and veins in the spermatic cord, coupled with the slow non pulsatile blood flow followed by the tortuosity of the artery, provide a mechanism for precooling arterial blood before it reaches the testis. It has been confirmed in several species that the blood within the internal spermatic artery cools as it approaches the
Table to show the changes in the average body weight (gm), testicular weight (mg) and diameter of the seminiferous tubules (μ) in the different body-weight range. MEAN ± S.E.

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<tr>
<th>Range of Body weight (gm)</th>
<th>No.</th>
<th>Ave. Body weight (gm)</th>
<th>Ave. Testis weight (mg)</th>
<th>Ave. diameter of tubule (μ)</th>
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<tr>
<td>10 - 50</td>
<td>3</td>
<td>47 ± 9</td>
<td>15.2 ± 2.7</td>
<td>45</td>
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<tr>
<td>50 - 100</td>
<td>9</td>
<td>77 ± 10</td>
<td>21.6 ± 4.8</td>
<td>30</td>
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<tr>
<td>100 - 150</td>
<td>4</td>
<td>126 ± 21</td>
<td>40.8 ± 10.3</td>
<td>51</td>
</tr>
<tr>
<td>150 - 200</td>
<td>5</td>
<td>179 ± 28</td>
<td>70.8 ± 6.7</td>
<td>66</td>
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<tr>
<td>200 - 250</td>
<td>3</td>
<td>220 ± 16</td>
<td>556.3 ± 84.2</td>
<td>112</td>
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(microns), germ cell, Sertoli cell and Interstitial cell in

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<th>OLII CELLS</th>
<th>INTERSTITIAL CELLS</th>
<th>REMARKS</th>
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<tr>
<td>1 cells, 1</td>
<td>Highly differentiated.</td>
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<td>ow of cells</td>
<td>The space occupied is</td>
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<td></td>
<td>twice that of the semi-</td>
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<tr>
<td></td>
<td>niferous cords</td>
<td></td>
</tr>
<tr>
<td>1 cells,</td>
<td>Equal amount of inter-</td>
<td></td>
</tr>
<tr>
<td>ow of cells</td>
<td>stitial cells and cord</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cells</td>
<td></td>
</tr>
<tr>
<td>1 cells to-</td>
<td>Leydig cells showing</td>
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<td>e basement</td>
<td>a decrease in amount.</td>
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<td></td>
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<td></td>
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<tr>
<td>1 cells have</td>
<td>Faintly staining round-</td>
<td></td>
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<td>size, their</td>
<td>ded cells are seen</td>
<td></td>
</tr>
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<td>being more</td>
<td>coming into a functional</td>
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<tr>
<td>it and some</td>
<td>state.</td>
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<tr>
<td>size in shape.</td>
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<td>cells tend to</td>
<td>Intertubular space is</td>
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<td>irregular in</td>
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</tr>
<tr>
<td>and arranged</td>
<td>cells small and</td>
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<td></td>
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<tr>
<td>Lipid cells,</td>
<td>Leydig cells are now</td>
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<tr>
<td>stained seen</td>
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<td>intertubular space in</td>
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<td>a compact organised</td>
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<td>Lipid cells</td>
<td>Initially lumen</td>
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<td>only shaped</td>
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<td>staining</td>
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<td>cells</td>
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<td>Lipid cells</td>
<td>Adult testis</td>
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Changes in the weight of the testis (in mg) both absolute and relative, in the different months of the year.

(MEAN ± S.E.)

<table>
<thead>
<tr>
<th>MONTH</th>
<th>NO. OF ANI.</th>
<th>BODY WT. (gm)</th>
<th>TESTIS WEIGHT (mg)</th>
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<tr>
<td></td>
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<td>ABSOLUTE</td>
</tr>
<tr>
<td>Jan.</td>
<td>5</td>
<td>302.0 ± 38.8</td>
<td>2158.0 ± 160</td>
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<tr>
<td>Feb.</td>
<td>4</td>
<td>280.0 ± 7.6</td>
<td>1640.0 ± 124</td>
</tr>
<tr>
<td>Mar.</td>
<td>3</td>
<td>270.0 ± 15.8</td>
<td>1707.0 ± 173</td>
</tr>
<tr>
<td>Apr.</td>
<td>5</td>
<td>283.3 ± 22.0</td>
<td>1719.0 ± 206</td>
</tr>
<tr>
<td>May.</td>
<td>5</td>
<td>275.0 ± 17.5</td>
<td>1430.5 ± 218</td>
</tr>
<tr>
<td>Jun.</td>
<td>5</td>
<td>269.9 ± 29.0</td>
<td>1281.1 ± 209</td>
</tr>
<tr>
<td>Jul.</td>
<td>13</td>
<td>273.9 ± 37.1</td>
<td>1823.3 ± 220</td>
</tr>
<tr>
<td>Aug.</td>
<td>11</td>
<td>291.0 ± 61.2</td>
<td>2148.0 ± 222</td>
</tr>
<tr>
<td>Sept.</td>
<td>8</td>
<td>275.4 ± 20.8</td>
<td>2625.0 ± 284</td>
</tr>
<tr>
<td>Oct.</td>
<td>5</td>
<td>307.5 ± 25.4</td>
<td>2655.5 ± 238</td>
</tr>
<tr>
<td>Nov.</td>
<td>8</td>
<td>296.0 ± 42.1</td>
<td>2583.0 ± 294</td>
</tr>
<tr>
<td>Dec.</td>
<td>12</td>
<td>307.0 ± 40.8</td>
<td>2476.0 ± 294</td>
</tr>
</tbody>
</table>
Fig. 1: Low power photomicrograph of the transverse section of a 4.0 mm. embryo passing through the left mesonephros. X 125.

Fig. 2: Photomicrograph of the transverse section of a 4.0 mm. embryo at the region of the genital ridge formation from the coelomic (germinal) epithelium. X 540. (AD—adrenal, COE—coelomic epithelium, DA—dorsal aorta, GR—genital ridge epithelium, MES—mesonephros, NC—notochord, NT—nerve tube, PMG—primordial germ cell)
**Fig. 3:** Low power photomicrograph of a 10.0-13.0 mm. (TL) embryo showing a longitudinal section through the mesonephros and the genital ridge. X 125.

**Fig. 4:** High power photomicrograph of the above in the part of the genital ridge showing a few gonocytes. X 630.

(GC-gonocytes, GE-germinal epithelium, GL-gomerules, GE-genital ridge, MES-mesonephros).
**Fig. 5:** Photomicrograph of the 33.0 mm.(TL) embryo, in a transverse section passing through the foetal testis. X 36.

**Fig. 6:** Photomicrograph of the 33.0 mm.(TL) embryo, in a transverse section of the upper part of the testis under high magnification. X 125.

(AD—adrenal, MES—mesonephros, MND—mesonephric duct, NC—nephric corpuscles, PMD—paramesonephric duct, RT—rete testis, SC—sex cord, TA—tunica albuginea, TES—testis).
Fig. 7: 33.0 mm. (TL) embryo: Photomicrograph of the transverse section of the foetal gonad showing a gonocyte being found in the coelomic epithelium beneath which the tunica albuginea is being formed. X 540.

Fig. 8: 33.0 mm. (TL) embryo: Photomicrograph of the transverse section of the male foetal gonad showing the gonocytes and the sex cords being covered by a PAS + basement membrane. X 540.

(BM—basement membrane, COE—coelomic epithelium, GC—gonocytes, SC—sex cords, TA—tunica albuginea).
Fig. 9: 42.0 mm. (TL) embryo: Photomicrograph of the transverse section of the testis showing the seminiferous cords in the interstitial mass of the cells.
X 125.

Fig. 10: Higher magnification of the above.
X 630.
(GC—gonocytes, ISC—interstitial cells,
SC—sex cords, TA—tunica albuginea)
Fig. 11: 57.0 mm.(TL) embryo: Photomicrograph of the transverse section of the testis showing the enormous increase in the interstitial tissue and the persistence of the ventral epithelial thickening. X 125.

Fig. 12: 57.0 mm.(TL) embryo: High power magnification of a section of the seminiferous cords showing the two types of gonocytes, the large and the small gonocyte, X 630. (ISC-interstitial tissue, LGC-large gonocyte, MND-mesonephric duct, PMD-regressed paramesonephric duct, SC-sex cords, SGC-small gonocyte, TA-tunica albuginea, VET-ventral epithelial thickening).
Fig. 13: 72.0 mm. (TL) embryo: Photomicrograph of the transverse section of the left testis and the cauda epididymis. X 35.

Fig. 14: 72.0 mm. (TL) embryo: Photomicrograph of the transverse section of the testis showing the densely packed seminiferous cords and the interstitial tissue. X 125.

(CA—cauda epididymis, IT—interstitial tissue, SC—seminiferous cords, TES—testis, TA—tunica albuginea, UB—urinary bladder, UR—ureter, VD—vas deferens).
Fig. 15: 71.0 mm. (TL) embryo: Photomicrograph of the transverse section of the seminiferous cords showing degenerating gonocyte (shown by arrow) and the normal gonocyte. X 540.

Fig. 16: 71.0 mm. (TL) embryo: High magnification of the seminiferous cords and interstitial tissue showing the normal gonocyte. X 630.

(DGC—degenerating gonocyte, NGC—normal gonocyte, LC—leydig cell).
Fig. 17: 71.0 mm.(TL) embryo: Photomicrograph of the transverse section of the testis at the region of the rete testis (RT). X 125.

Fig. 18: 71.0 mm.(TL) embryo: Photomicrograph of the section at the prostatic region of the urethra showing the prostatic buds (PRB) in the thick mesenchymatous anlage of the prostate gland. X 35.
Fig. 19: 70.0 mm. (TL) embryo: Photomicrograph of the cross section of the Cowper's gland (CG). X 35.
Fig. 20: Camera lucida drawing of the entire testis dissected out from the 102.0 mm. (TL) embryo. X 20.
(caput epididymis, CÈ-cauda epididymis, GUB-gubernaculum, MLÈ-mullerian duct remnant, SC-spermatie cord, TÈ-testis, VD-vas deferens.)
Fig. 21: 102.0 mm.(TL) embryo: Photomicrograph of the cross section at the anterior region of the testis showing the rete network passing through the tunica albuginea. X 125.

Fig. 22: 102.0 mm.(TL) embryo: Photomicrograph of the section of the seminiferous cords showing the gonocytes (arrows) and the interstitial tissue being dense. X 540.

(CPE-caput epididymis, ISC-interstitial tissue, RT-rete testis, SC-seminiferous cords, TA-tunica albuginea).
Fig. 23: 102.0 mm. (TL) embryo: Transverse section of the caput epididymis and vas deferens with the pampiniform plexus. X 35.

Fig. 24: 117.0 mm. (TL) newborn infant: Photomicrograph of the vertical section of the testis, caput epididymis and the corpus epididymis showing the connection between them. X 35.
(CPE-caput epididymis, CRE-corpus epididymis, PP-pampiniform plexus, TES-testis, VD-vas deferens).
FIG. 23

FIG. 24
Fig. 25: 117.0 mm.(TL) new born infant: Vertical section more lateral to the one shown in Fig. 24, showing the pampiniform plexus and the efferent connections. X 35.

Fig. 26: 117.0 mm.(TL) new born infant: Enlarged photograph of the vertical section of the tubuli recti, rete network and efferent ductules. X 125.

(CPE-caput epididymis, T2S-testis
EFD-efferent ductules, RT-rete
testis, PPP-pampiniform plexus, TR-tubuli
recti, VD-vas deferens).
Fig. 27: 117.0 mm. (TL) new born infant: Photomicrograph of the cross section of the prostate gland at the level of the prostatic urethra showing the prostatic buds, vesicular duct and the terminal part of the vas deferens. X 35.

Fig. 28: 117.0 mm. (TL) new born infant: Photomicrograph of the cross section of the urethra and the Cowper's gland. X 35.

Fig. 29: Changes in the testicular weight (in mgs.) and the diameter of the seminiferous tubules (in microns) in the different body weight range.
FIG. 29

Testicular weight

Diameter of tubules

Body weight range in gms.

Testicular weight in mgs

Diameter of tubules in microns.
Fig. 30: High power magnification of the section of the seminiferous cords showing the gonocytes (GC) with compact nuclei and pre-Sertoli cell (PSE). X 540.

Fig. 31: Photomicrograph of a section of the testis of a juvenile slender loris showing the intratesticular and intracapsular portion of the rete testis. X 35.

Fig. 32: Photomicrograph of the transverse section of the testis (50–100 mg. weight group) showing the compact but wider tubules with darkly staining cells (DGO) and pale staining spermatogonia (PGO), Sertoli cells (SE) and Leydig cell (LC). X 540.
Fig. 33: Photomicrograph of the section of the testis weighing 415 mg.; a prepubertal stage, where the tubules are closely packed together and with a clear lumen in the centre. X 125.

Fig. 34: High power magnification of the above showing the A and B type spermatogonia and the spermatocytes in the tubule. X 540.

(ASG-A type spermatogonia, BSG-B type spermatogonia, LO-leydig cell, LU-lumen, SPC-spermatocyte).
Fig. 35: High power magnification of the testis tubule section showing the A and B type spermatogonia, spermatocyte and secondary spermatocyte. X 900.

(ASG-A type spermatogonia, BSG-B type spermatogonia, PSP-primary spermatocyte, SSP-secondary spermatocyte, SE-Sertoli cell).

Fig. 36: High power magnification of the section of the prepubertal testis showing the (isc) interstitial cells in groups of 5-8 in the intertubular space. X 900.
Fig. 37: Graph to illustrate the changes in the absolute and relative weights (Mean ± S.E.) of the testis (in mgs.) during the different months of the year.
FIG. 37
Fig. 38: Photograph of the ventral aspect of the external genitalia of an adult slender loris to show the pigmentation of the scrotal sac.
Fig. 39: Photograph of the dissectional view of the reproductive organs in the slender loris, showing the inguinal ring through which the spermatic cord and the ductus deferens pass from the inguinal passage into the peritoneal cavity.

Fig. 40: Photomicrograph of the section of the juvenile testis showing the intra-capsular section of the rete testis. X 35.

Fig. 41: Photomicrograph of the juvenile testis section at the rete testis region. X 125.
(TB-tubuli recti, TA-tunica albuginea, RT-rete testis).
Fig. 42: Photomicrograph of the section of the testis showing the cuboidal epithelial lining of the rete testis (RT) X 540.

Fig. 43: Photomicrograph of the section of the seminiferous epithelium of the adult slender loris, to show the A1 spermatogonia (A1) preleptotene (PL) and pachytene (P) spermatocytes along with the step 5 (S5) of spermatid development. X 900.
Fig. 44: Photomicrograph of the section of the seminiferous epithelium to show a series of A2 spermatogonia, the leptotene (L) and pachytene (P) stages of primary spermatocytes. X 900.

Fig. 45: Photomicrograph of the section of the seminiferous epithelium to show the B type spermatogonia (B), pre-leptotene (PL) and myotene (Z) spermatocytes and the Sertoli cells (SE). X 900.
Fig. 46: Spermatogenesis in the slender loris.

A1, A2, B - spermatogonia,
PL, L, Z, P, - primary spermatocytes.
II - secondary spermatocytes.
I - 14 - stages in spermiogenesis.
SPERMATOGENESIS IN LORIS.

FIG. 46
Fig. 47: Typical cell association in the twelve stages (Roman numerals) of spermatogenesis. Spermatid development occurs through 14 steps of spermiogenesis (numbers I-14). Spermatosoa are released in the lumen during stage IV. (A1, A2, B - spermatogonia, PL-preleptotene, L - leptotene, Z-zygotene, P-pachytene, Div-meiotic division, II - secondary spermatocytes).
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**CELL ASSOCIATIONS IN DIFFERENT STAGES OF SPERMATOGENESIS IN SLENDER LORIS, LORIS TARDIGRADUS LYDEKKERIANUS.**

**FIG. 47**
Fig. 48: Photomicrograph of the section of the seminiferous tubule to show the stage I of the seminiferous epithelial cycle. There appears two generations of spermaticid, the younger generation in the golgi phase and the older generation in the maturation phase. \( \times 900 \).

Fig. 49: Photomicrograph of stage II of the seminiferous epithelial cycle showing the two stages of spermaticid but in a slightly advanced state. \( \times 900 \).
Fig. 50: Photomicrograph of stage III of the cycle showing the older generation of spermatids in the form of fully mature sperms and the younger spermatids in the golgi phase. × 900.

Fig. 51: Stage IV of the cycle where the spermatozoa are being released into the lumen. The younger generation of spermatids are also seen. × 900.
**Fig. 52:** Stage V of the cycle showing only one generation of spermatids in the cap phase. x 900.

**Fig. 53:** Stage VI of the seminiferous epithelial cycle with spermatids having the acrosome as a clear cap on the nucleus. x 900.
Fig. 54: Stage VII showing the spermatid nuclei very clear with the acrosomal cap facing the basement membrane. × 900.

Fig. 55: Stage VIII showing the spermatids in steps 8 of development. × 900.
**Fig. 56:** Stage IX of the epithelial cycle showing the spermatids in the acrosomal phase of spermiogenesis. $\times 900$.

**Fig. 57:** Stage $\lambda$ of the epithelial cycle showing spermatids in the acrosomal phase and in addition are the dividing spermatocyte characteristic of this stage. $\times 900$. 
**Fig. 58:** Stage XI of the cycle showing sperms in the maturation phase and a large number of secondary spermatocytes. X 900.

**Fig. 59:** Stage XII of the seminiferous epithelial cycle showing the spermatids considerably elongated and also several secondary spermatocyte. X 900.
Fig. 60: Photomicrograph of the adult testis to show the Leydig cells occupying the intra tubular space. X 540.

Fig. 61: Photomicrograph of the adult testis to show the Leydig cells under higher magnification. X 900.
Fig. 02: Arterial supply to the testis in the adult male loris.

(CEP = caput epididymis, CDE = cauda epididymis, EPI. ART. = epididymal artery, TES = testis, TEST. ART. = testicular artery, V. ART. = vasal artery, VL = vas deferens).
Arterial supply to the testis

FIG. 62
Fig. 05: Venous supply to the testis in the adult male loris.
Venous supply to the testis

FIG. 63