The insects are primarily dioecious, in that only one sex is represented in one individual. There is a close parallelism between the part of the male and female systems and most organs of the reproductive systems are of interest to the physiologists, morphologists and taxonomists. The taxonomists and morphologists deal with the structural peculiarities for the classification of the species and attempt to enlighten the structures in terms of ontogenetic and phylogenetic origins. But the duties of the physiologists is to understand the functions fully with a knowledge of anatomy.

The egg cell liberated by the female will develop only after fusion with the spermatozoa, set free by the male. The physiology of reproduction deals with the arrangements for the separation and ripening of these male and female gametes and the mechanism by which they come in contact with each other. It looks to the next generation and maintains the continuity of the races (species).

The reproductive system consists of paired gonads, the testes of the male and the ovaries of the female, paired gonoducts of mesodermal origin into which the sexual
products are liberated and a median duct, lined with cuticle, derived by invagination from the ventral body wall, forming the vagina in the female and the ejaculatory duct in the male.

The testis of the male is made up of a series of tubular follicles of varying number and arrangement. Histologically each follicle contains a succession of zones in which the sex cells are found to be present in different stages of development. Each 'spermatogonium' arising in the 'germarium' at the apex of the follicle, divides repeatedly to form a cyst, filled with 'spermatocytes' covered with a mantle of somatic cells. The spermatocytes divide to form 'prespermatids' and then 'spermatids' which, finally, in the lower extremity of the follicle, become transformed into the elongated and flagellated spermatozoa. It is the task of reproductive system of male insect to produce and deliver to the female sufficient spermatozoa to fertilize the eggs. The spermatozoa are usually liberated to the exterior through the vasa efferentia, vasa deferentia and an intromittent organ known as 'penis' or 'aedeagus'. Sometimes the spermatozoa are found in adherent bundles or in packets mixed with the secretion of accessory glands.
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The ovary of the female is likewise composed of a series of tubular follicles or 'Ovarioles'. In these the oocytes arising in the germarium do not multiply repeatedly as do the germ cells in the male but each becomes enormously enlarged to form the egg cell or ovum. The oocytes remain enclosed by 'follicular cells', they are nourished, at first by special 'nurse cells'. The paired ovaries connect with a pair of lateral oviducts which in turn join to form a median oviduct and opens posteriorly into a genital chamber which is sometimes closed to form a tube like structure, the vagina and this often develop to form a bursa copulatrix. The spermatheca and accessory glands are found to be present in association with the genital chamber or vagina.

From early part of the present century many attempts have been made to elucidate the morphology, histology and histochemistry of the reproductive organs of the different groups of insects by various investigators.

The specific work as presented below is an attempt to bring together some of the major contributions so far made, from the different parts of the World on morpho-histology, histochemistry, of male and female reproductive system of insects especially in Hemipterans and Lepidopterans.
Review of literature:

(A) **Hemiptera**:

Kerkis (1926) reported that in most of the aquatic heteroptera the number of follicles comprising the testis is constant and it varies from species to species and the ovarian tubules are same as that of the number of the testicular follicles.

Payne (1934) observed the testis, ducts and accessory glands in the adult bug *Leptocoris trivittatus* and described that the male reproductive systems consisted of two fan-shaped testis; each composed of seven short plump like follicles.

Rakshpal (1941) studied on the post-embryonic development of the male genital organs in Aleurodidae (Homoptera).

Carson (1945) made a comparative study of the testicular apical cells in the Homopteran insects. *Philaenae* sp. and *Enchenopa curvata*. Besides, he also described that in *Philaenae* sp. the testis is paired and each consists of a large number of bluntly oval follicles which are separated from one another and resemble a small bunch of
grapes; in *Enchenopa* sp., the testis is quite similar to *Philaenasa* sp. except that the follicles are more pointed at the distal end.

Bonhag and Wick (1953) presented anatomical, histological and certain cytological aspects of the genital organs of both male and female milkweed bug, *Oncopeltus fasciatus* Dallas and interpreted the structure of these organs in terms of their functions. They reported the presence of 7 testicular and ovarian follicles in the said specimens. They also observed the presence of the erection fluid reservoir in the ejaculatory duct of the male specimen.

Davis (1956) reported that the reproductive system of *Cimex lectularius* consists of two large fan-shaped testes and each composed of 7 testicular follicles.

Moriber (1956) while studying the histochemistry of spermatogenesis in Hemipteran insects identified spermatocytes and spermatid zones over and above the mature sperms and cysts occupied PAS reactive substances.

Gupta et al. (1960 a, b) made histochemical studies during spermatogenesis of *Dysdercus cingulatus* (Heteroptera)
and that of *Laccotrephes maculata* Fabr. (Heteroptera : Nepidae).

Tulsyan *et al.* (1961) proved deeply into structural peculiarities of the male reproductive organs of *Diplonichus annulatum* Fabr. (Heteroptera).

Sinha (1961) visualized the male reproductive organs of post-embryonic development of *Centrocells insolitus* Green (Hemiptera).

Joseph (1965) worked on the male and female reproductive organs of *Liburnia pallescens* (Distant) and *Delphacodes propinqua* (Fieber) (Homoptera, Fulgoroidea, Araeopidae). He stated that each testis is composed of two small sperm tubes, which are bundled up together by peritoneal sheath, and the number of ovarian follicles ranges between 12 to 16.

Merle (1969) observed the anatomical, histological and cytological structures of the male and female reproductive organs in *Pyrrhocoris apterus* L.

Sareen *et al.* (1972) observed the mitochondria in the spermatogonia and spermatocytes of *Cimex* sp. and reported
that they were filamentous and lipoproteinous in nature and completely devoid of the nucleic acids and carbohydrate materials.

Trandaburu (1973) elucidated the ultrastructure of the axial filament and modifications of the nucleus during spermiogenesis in *Eurydema ventralis* Kol. (Heteroptera: Pentatomidae).

Itaya et al. (1980) described the stages of spermiogenesis and structure of spermatozoon in *Leptocoris* sp.

Banerjee and Banerjee (1984) observed the male reproductive organs of *Blasmomia granulipes* Westwood and reported that the paired testes are fan-shaped, yellow in colour and each consists of 7 testicular follicles. Moreover they described the presence of erection fluid pump, associated with the ejaculatory duct.

Mandal (1985) made a comprehensive study on *Lethocerus indicus* under family Belostomatidae and reported that in said species the testes were paired, white and globular. Each testis was composed of a tangle of 5 elongated testicular follicles enclosed within a common globular sac-like structure and he described this sac-like structure as
scrotum. Moreover, he described the presence of acid mucopolysaccharides in the tunica and cyst cell membrane by using PAS technique and alcian blue method.

(B) Lepidoptera:

Norris (1932) from histological studies in *Ephestia kühniella* stated that the primary simplex is composed of 4 secretory areas and also described the process of transfer of spermatozoa from the spermatophore to the spermatheca.

Omura (1936) described the male reproductive system of *Bombyx mori* and gave emphasis to study the intratesticular behaviour of the spermatozoa.

Musgrave (1937) made histological observation on the male and female reproductive organ of *E. kühniella* and described the muscular lining of the seminal duct.

Rakshpal (1944) studied the structure and development of the male reproductive organs in some Lepidopteran insects and found that ejaculatory duct originated as a groove on the floor of the aedeagus.
Carson (1945) made a comparative study of the testicular apical cell in the Lepidopteran insect, *Papillo turnus*. He stated that the testis was composed of eight follicles, and red in colour.

Khalifa (1950) studied the spermatophore formation in *Galleria mellonella* and considered the accessory glands to their source. He described 7 spermatophores, the formation of which depend on the copulation time.

Callahan (1958) reported that the common ejaculatory duct of *Heliothis zea* had two distinct segments, one - ductus ejaculatorius simplex and the other - cuticular segment.

Shrivastava (1960) reported on the morphological study of the male reproductive organs of *Leneinodes orbonalis* Green (Lepidoptera : Pyraustidae) in which the widely separated vasa deferentia originated from the ventrolateral margin and the follicular epithelium was without any trachae. He divided the ejaculatory ducts into upper glandular and terminal cuticular part.

Callahan and Cascio (1963) observed histological nature of the genital tract and described the mode of transmission of sperm in the corn worm, *Heliothis zea*. 
Sado (1963) while studying the spermatogenesis in irradiated sterile silkworm, *Bombyx mori* L., identified two types of spermatozoa viz. apyrene and eupyrene.

Chaudhury and Raun (1966) recorded a progressive increase of testis size till early pupal life followed by decline in *Ostrinia nubilalis* (Lepidoptera : Pyraustidae) and termination of spermatogenesis after adult emergence.

Tedders, Jr. and Calcote (1966) worked on male and female reproductive systems of the hickory shuckworm moth, *Laspeyresia caryana* (Fitch) (Lepidoptera : Olethreutidae). They observed that the paired testes were bluish in colour and remain enclosed in a common scrotum. They also reported the characteristic features of bursa copulatrix.

Shen and Berryman (1966) from their studies on male reproductive system and spermatogenesis of the moth, *Rhyacionia buolina* reported all stages of spermatogenesis in adults which indicated the probability of sperm production throughout life.
Drecktrah and Brindley (1967) studied on male and female reproductive systems of Ostrinia nubilalis Hubner. They reported the presence of fused testes and each ovary consisted of 4 polytrophic ovarioles which were devoid of terminal filaments.

Davis (1968) worked on the morphology of the male and female reproductive systems of the south western corn borer, Diatraea grandiosella Dyar. and reported that the testes were yellow in colour, paired and remained enclosed within a common sheath in adpressed condition which gave the appearance of a single organ, in females each ovary consisted of 4 polytrophic ovarioles.

Retnakaran (1970) recorded the male spruce budworm, Choristoneura fumiferana (Lepidoptera: Tortricidae) and recorded some aspects of spermatogenesis and its relation to the life history. Moreover, he described that the pupal and adult testes contained mostly spermatozoa. The coalescence of the paired larval testes occurred during the pharate pupal stage to give rise the unpaired adult testis.
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Tedders and Osburn (1970) studied the morphology of both male and female reproductive systems of the pecan bud moth *Gretchenia bolliana* (Lepidoptera: Olethreutidae). They reported the presence of paired reddish testes, in the form of a single round organ. They stated mainly the arrangement of the seminal duct in pecan bud moth and compared with that of the hickory shuckworm.

Danilova and Vereyakaya (1971) described the ultrastructure of the testis of *Bombyx mori* L. with notes on basilar membrane.

Chase and Gilliland (1972) studied the testicular development in *Heliothis virescens* and detected 4 additional membranes *viz.* tunica externa, membrana communis, tunica interna and capsula lobuli in the testicular sheath.

Chinzei *et al.* (1972) showed the nucleic acid changes in the testis of *B. mori* during metamorphosis. Before the emergence of adult, in the testis the levels of RNA and DNA remain little affected.

Agalykov *et al.* (1972) studied the variations of nucleic acid concentration of the different male tissues of *B. mori* L. as a whole and remarked that the concentration
of the nucleic acids was dependent on both histolysis as well as histogenesis.

Beals and Berberet (1976) gave an account on the male and female reproductive system of *Elasmopalpus lignosellus* (Lepidoptera: Pyralidae). In their observations the fused testes, vasa deferentia with extensive musculature and the ejaculatory duct with joining accessory glands were the characteristic features. The also stated the presence of polytrophic type of egg tube with an alternating succession of oocytes and trophocytes.

Riemann and Thorson (1976) reported the structure of vasa deferentia of adult flour moth, *A. Kühniella* (Zeller) together with some changes that occurred in sperm during their transit through the vasa deferentia.

Katsuno (1977) studied the eupyrene and apyrene spermetozoa in *B. mori* L. (Lepidoptera: Bombycidae) with special reference to intratesticular behaviour of the spermetozoa after emergence.

Drecktrah (1978) worked on the morphology of the internal reproductive system of the adult female army
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cutworm, *Euxoa auxiliaris* (Lepidoptera : Noctuidae). He reported the presence of paired ovaries and each consisted of 4 polytrophic very long and convoluted ovarioles. The convolutions were very well marked at the distal ends where the ovarioles curved back upon themselves several times.

Mondal (1981) studied the histology and histochemistry of the male reproductive system of *Antheraea mylitta* D. (Saturniidae : Lepidoptera). He observed that the testes were paired, more or less ovoid, yellowish white bodies situated on either side of the dorsal vessel between the 5th and 6th abdominal segments. Each testis was made up of 4 testicular follicles which were enclosed by a peritoneal sheath.

It is in this context the present investigation involves the morphological, histological and histochemical studies of both male and female reproductive systems by means of various standard techniques. From the foregoing review of the works hitherto done, it is evident that no comprehensive account concerning different aspects of the male and female reproductive system of *Gerris spinolae* and *Corcyra cephalonica* has yet been published. These two insects have been selected for the purpose of present
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investigation because of their highly characteristic and specialised reproductive organs and also because Corcyra cephalonica is a major pest of vegetable fields; abundantly found in the state of West Bengal, India.