CHAPTER IV

OBSERVATIONS
A. Toxicity assessment, mortality and behaviour

Results of physico-chemical analysis of diluent water used in the present study are given in Table 14.

Toxicity tests are necessary in water pollution evaluations because chemical and physical tests alone are not sufficient to assess potential effects on aquatic biota (Tarzwell, 1971). Different kinds of aquatic organisms are not equally susceptible to the same toxic substances, nor are organisms equally susceptible throughout the life cycle. Even previous exposure to toxicants can alter susceptibility (APHA, 1985).

During the acute toxicity test no mortality of the fishes were observed in the control fish under identical conditions. This indicates that no factor other than the pesticide used was responsible for mortality of treated fishes. The 96 h LC 50 values of carbaryl, malathion, BHC and endosulfan for *Heteropneustes fossilis* were found to be 58 mg/L, 30 mg/L, 3.15 mg/L and 0.0035 mg/L respectively. For *Mystus tengara* the LC 50 values at 96 h for carbaryl was 18 mg/L, for malathion 8 mg/L and 0.95 mg/L for BHC. For *Anabas testudineus* the LC 50 values were 20.5 mg/L for carbaryl, 11.8 mg/L for malathion and 2.02 mg/L for SH C.
Susceptibility of various fish species for different compounds can be determined considering their 96 h LC 50 values. Survival number of *Heteropneustes fossilis*, *Mystus tengara* and *Anabas testudineus* at different concentrations and time intervals with the pesticides used are given in tables 4-13 and Fig. 1-4.

The result shows that test fishes namely *Heteropneustes fossilis*, *Mystus tengara* and *Anabas testudineus* are very sensitive to chlorinated pesticide. Among the four pesticides (carbaryl, malathion, BHC, endosulfan) used for *Heteropneustes fossilis*, endosulfan was found to be most toxic whereas, carbaryl was least toxic. In *Mystus tengara* and *Anabas testudineus* of the three pesticides (carbaryl, malathion, BHC) used, BHC was found to be most toxic followed by malathion and carbaryl. Toxicity of pesticides used in the present work are in the following order: Endosulfan > BHC > malathion > Carbaryl, BHC > malathion carbaryl and BHC > malathion > carbaryl for *Heteropneustes fossilis*, *Mystus tengara* and *Anabas testudineus* respectively.

Fishes exposed to the test solutions, manifested interesting changes in their behaviour. Behaviour response of fish varied in accordance to the test concentrations. As soon as the fish were transferred from fresh water to different
concentrations of pesticides solutions, secretion of mucus from body surface was observed. Fishes became hypersensitive and showed a rapid rate of opercular movements. They frequently came to water surface to gulp atmospheric air directly and an erratic swimming activity was also noticed. Again, extreme signs of restlessness, muscle spasm, body torsion and coughing (coming of air bubbles from the mouth) was observed in higher concentrations of all the pesticides. Body bending of fish was very obvious in case of BHC treated Mystus tengara and malathion exposed Anabas testudineus.

Rapid jerky movement of body and fin was more pronounced in Heteropneustes fossilis than in Mystus tengara and Anabas testudineus, particularly with malathion, BHC and endosulfan. In higher concentrations of malathion, initially the anterior snout region of Mystus tengara became red in colour. Further after 48 h, base of pectoral, pelvic and anal fins also became red and snout region was turned deep red in colour. Dead fishes were completely dark yellow in colour. Generally in all fishes (Heteropneustes fossilis, Mystus tengara and Anabas testudineus) colour of body became pale in all pesticide concentrations. Fishes swam with their bellies up in higher concentrations and it was very prominent in Heteropneustes fossilis and Mystus tengara. The enlargement of belly was observed only in Mystus tengara treated
with malathion. Some fish frequently dashed against the walls of the aquarium and even tried to jump out. This effect was more pronounced in BHC treated *Anabas testudineus*. Prior to the death, the fish lost its equilibrium, became dull and settled down on the bottom showing occasional movements. It ultimately lead respiratory distress and paralysis. The dead fish were covered with a layer of mucus on their body surface. In lower concentrations of all the pesticides, all the above mentioned effects were visible but to a lesser extent.

Table 4. Physico-chemical characteristics of the diluent water.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water temperature</td>
<td>24 - 27°C</td>
</tr>
<tr>
<td>pH</td>
<td>7.5 - 8.2</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>8.1 - 8.9</td>
</tr>
<tr>
<td>Total alkalinity</td>
<td>140 - 170</td>
</tr>
<tr>
<td>Total hardness</td>
<td>140 - 160</td>
</tr>
</tbody>
</table>

All the values except pH and temperature are expressed as mg/l.
Fig. 1 -
Relation between dosage and Lc values for 96 h on exposure to carbaryl, malathion and BHC in Heteropneustes fossilis.
Fig. 2 -
Relation between dosage and Lc values for 96h on exposure to endosulfan in *Heteropneustes fossilis*.
Fig. 3 —
Relation between dosage and Lc values for 96h on exposure to carbaryl, malathion and BHC in Mystus tengara.
Fig. 4

Relation between dosage and Lc values for 96 h on exposure to carbaryl, malathion and BHC in *Anabas testudineus*. 
B. Morphology of reproductive organs of *Heteropneustes fossilis* (Bloch), *Mystus tengara* (Ham) and *Anabas testudineus* (Bloch).

Reproductive organs of fishes in general and of certain species in particular have received greater attention by number of workers. Earlier studies on reproductive organs of fishes were mainly concerned with structural characteristics of testis and ovaries. Some of the workers like - Tampi (1957), Stenger (1959), Kamalaveni (1961) turned their studies towards the morphology of reproductive organs of few teleostean fishes. Before studying histology and histopathology of an organ knowledge of its morphology is a prerequisite. Hence, in the present investigation an attempt has been made to study the morphology of male and female reproductive organs of *Heteropneustes fossilis* (Bloch), *Mystus tengara* (Ham) and *Anabas testudineus* (Bloch).

**Male reproductive organs of *Heteropneustes fossilis* (Bloch)**

It consists of a pair of testis, a pair of spermducts, a common spermduct and a pair of bifid seminal vesicles (Fig. 5).

**Testes** are elongated and flattened structures situated ventral to the kidney on either side in the posterior part
of abdominal cavity. They are creamy in colour and joined posteriorly. Inner margin of testis is smooth, while its outer margin shows small projections. A pair of spermducts runs along the inner margin of the testis and joins posteriorly to form a common spermduct. Bifid seminal vesicles are small glandular structures, situated on each side of common spermduct. They are light yellow in colour, oval in shape and tapers towards the outer margins. Seminal vesicles open at the base of the common spermduct, which in turn opens into the urinogenital papillae.

Female reproductive organs of Heteropneustes fossilis (Bloch)

Female reproductive organs consist of a pair of ovaries, a pair of oviducts and a common oviduct (Fig. 6). The ovaries are reddish brown in colour and of equal in size with a blunt anterior end tapering towards posterior side. They are situated ventral to the kidney on either side in the abdominal cavity. A small oviduct arises from the posterior part of each ovary. These ducts joins together to form a common oviduct, which opens to the exterior by female genital pore.

Male reproductive organs of Mystus tengara (Ham)

It is composed of a pair of testis, spermducts, a common spermduct and a pair of seminal vesicles (Fig. 7).
Testes are elongated and flattened structures, which occupy the posterior two-thirds of the body cavity. They are white in colour, equal in size with a number of finger-like processes on the outer margin. The two testis diverge anteriorly along the ventrolateral aspects of the swim-bladder and joins together posteriorly. From the anterior most end of each testis runs a spermduct and they unite together near the urinary bladder forming the common spermduct. The seminal vesicles are whitish in colour and situated caudal to the testis on either side of the common spermduct. Each seminal vesicle is a comb-like structure, composed of number of finger-like lobes. Each lobe is broad at its base and tapers distally. The common spermduct runs further and opens into the urinogenital papillae.

**Female reproductive organs of Mystus tengara (Ham)**

It consist of a pair of spindle shaped ovaries, occupying the posterior two-third of the body cavity (Fig. 8). They are reddish brown in colour and are of equal in size. Their anterior end is free and diverged along the ventro-lateral side of swimbladder. Posteriorly they join together to form a common oviduct, which opens outside by female genital pore.
Male reproductive organs of Anabas testudineus (Bloch)

They consist of a pair of testis, a pair of spermducts and a common spermduct (Fig. 9).

Testes are elongated structures occupying three-fourth posterior part of the body cavity. They are white in colour and of unequal length. Left lobe is slightly bigger than the right one. There is a groove running along the mid-dorsal axis of each testis. The efferent duct and blood vessels run beneath this groove. From the posterior end of each testis a small spermduct leaves and soon joins its counter part to form a common spermduct. Common spermduct opens out by the urinogenital pore.

Female reproductive organs of Anabas testudineus (Bloch)

In Anabas testudineus female reproductive organs consist of a pair of elongated sac like ovaries lying posteriorly in the abdominal cavity (Fig. 10). They are yellow in colour and equal in size. Anterior end of ovary is blunt, but posteriorly it tapers and joins each other to form the common oviduct. The common oviduct opens outside by female genital pore.
Pesticide induced morphological changes in the reproductive organs of *Heteropneustes fossilis* (Bloch), *Mystus tengara* (Ham) and *Anabas testudineus* (Bloch).

In *Heteropneustes fossilis* shrinkage in the male reproductive organs was noticed after 4 and 15 days of BHC, 4 and 30 days of endosulfan treatment. Whereas there was no noticeable change after treatment with malathion and carbaryl.

After 30 days of BHC, 4 and 15 days of endosulfan treatment the female reproductive organs exhibited a reduction in size and change in colour. They turned light brown with scattered black spots from their normal reddish brown colour. But there was no change with carbaryl and malathion.

In *Mystus tengara* reduction in size of male reproductive organs was prominent after 30 days of carbaryl and BHC treatment. As seen in *Heteropneustes fossilis* there was no change after malathion treatment.

Reduction in size of female reproductive organs was noticed after 30 days of malathion and 15 days of BHC treatment. In addition change in colour from reddish brown to light brown was observed after 10 days of BHC and 30 days of malathion treatment. Carbaryl treatment did not show
any such morphological disturbances.

In *Anabas testudineus* morphological changes in the male reproductive organ was observed after 30 days of carbaryl treatment only. The size of testis was greatly reduced and the same effect could be noticed in the female reproductive organs with carbaryl after 30 days whereas, change in colour was observed from yellow to pale yellow after 30 days of carbaryl and malathion treatment.
Fig. 5. Diagram showing the general morphology of male reproductive organs of *Heteropneustes fossilis*.

Fig. 6. Diagram showing the general morphology of female reproductive organs of *Heteropneustes fossilis*. 
Fig. 7. Diagram showing the general morphology of male reproductive organs of *Mystus tengara*.

Fig. 8. Diagram showing the general morphology of female reproductive organs of *Mystus tengara*.
Fig. 9. Diagram showing the general morphology of male reproductive organs of *Anabas testudineus*.

Fig. 10. Diagram showing the general morphology of female reproductive organs of *Anabas testudineus*. 
C. Histopathological observations on gonads of
Heteropneustes fossilis (Bloch), Mystus tengara (Ham)
and Anabas testudineus (Bloch)

The histopathological effects observed in the testis
of Heteropneustes fossilis, Mystus tengara and Anabas
testudineus with different pesticides after 4, 10, 15 and
30 days of exposure are described below.

I. Histological observations on testis of control
Heteropneustes fossilis (Bloch)

Testis of Heteropneustes fossilis is enclosed in a
thin layer of peritoneum and sheath of connective tissues.
Below this lies number of seminiferous tubules. Seminiferous
tubules are of various size and shape and are situated
inbetween an interlobular connective tissue septa (Fig. 11).
Interlobular spaces are filled with interstitial cells, blood
capillaries and connective tissue (Fig. 11). Interstitial
cells are small, irregular in shape with small nucleus. Each
seminiferous tubule has a cavity in the centre, which is
lined by germinal epithelium. Different stages of spermatoge-
genesis i.e., primary and secondary spermatogonia, primary
and secondary spermatocytes, spermatids and sperms are
observed in all these seminiferous tubules (Fig. 11,12).
Germinal epithelial cells give rise to primary spermatogonia. Primary spermatogonia are large and spherical in shape containing a big centrally placed round nucleus with a distinct nucleolus. Primary spermatogonia are arranged along the wall of the seminiferous tubules (Fig. 11).

After divisions, primary spermatogonia give rise to secondary spermatogonia. Secondary spermatogonia are smaller than primary spermatogonia with clear cell boundaries (Fig. 11).

Primary spermatocytes are smaller than secondary spermatogonia and possess darkly stained nucleus (Fig. 12). Chromatin of primary spermatocytes is visible as a fine reticulum at first and later on gets thickened. In some of these cells, chromatin material gathers on one side of the nucleus, leaving a clear space but no nucleolus is seen (Fig. 12).

Secondary spermatocytes are smaller than primary spermatocytes. They have deeply staining nucleus (Fig. 11) and they give rise to spermatids.

Spermatids are smaller than secondary spermatocytes with a prominent darkly stained nucleus (Fig. 11). Spermatids transform into sperm which are small in size (Fig. 12). They are darkly stained and are situated in the
middle region of seminiferous tubules.

In *Heteropneustes fossilis*, seminal vesicle consist of number of vesicular tubules or locules, which are separated and surrounded by thick partitions of connective tissue sheaths. The locules are of different sizes and the inner surface of the locule is lined by continuous secretory epithelium (Fig. 13). Cells of secretory epithelium are columnar, with basally located nuclei. Secretory epithelium secretes the vesicular fluid. Most of the vesicular tubules are empty, except few in which little vesicular fluid is noticed. The intervening spaces between vesicular tubules contain blood vessels and no sperms in the vesicular tubules could be seen (Fig. 13, 14).

There was no change in the testis and seminal vesicle of simultaneous control fish which were kept in the aquaria during the period of experiments except that they showed the maturation of different stages of spermatogenesis.

**Histopathological changes induced by carbaryl in testis of *Heteropneustes fossilis* (Bloch)**

After 4 days of exposure marked changes were observed in the vesicular tubules such as shrinkage and deformities in their shape. The lumen of vesicular tubule was greatly reduced and normal structure of columnar cells was completely
disturbed (Fig. 15). There was no apparent structural change in the anterior part of the testis, except slight shrinkage of the primary spermatogonia (Fig. 16).

After 10 days of treatment histopathological changes were more prominent than 4 days treated testis. Seminiferous tubules were reduced in size and a partial arrest of spermatogenesis was observed (Fig. 17). Primary and secondary spermatogonia, primary and secondary spermatocytes were also reduced in size. Interlobular septa was completely broken and interlobular spaces increased (Fig. 17). Interstitial cells and blood capillaries were normal in condition. In seminal vesicles, vesicular tubules showed slight recovery. This resulted a little increase in the lumen of vesicular tubules. The connective tissue exhibited fibrosis and it was in degenerating condition (Fig. 18). Columnar cells showed acute necrosis and in some of the vesicular tubules at some places they were seen in degenerated condition (Fig. 18).

After 15 days of exposure, in some seminiferous tubules, primary and secondary spermatogonia showed acute shrinkage and were in degenerating condition. Their cytoplasm was not clearly seen and pyknotic nuclei and nucleolus were observed (Fig. 19). Primary spermatocytes were greatly reduced in number and they showed slight necrosis. Secondary
spermatocytes, spermatids and sperms were clumped to form a mass like structure and the germinal epithelium was in degenerating condition (Fig. 19). Fibrosis and degenerative changes in connective tissue of seminal vesicle were more pronounced after 15 days of exposure. Nucleus of the columnar cells was enlarged (Fig. 20).

After 30 days of exposure seminiferous tubules became enlarged in size and their wall showed wrinkled appearance. Nuclei of primary spermatogonia became oval in shape and in some seminiferous tubules they were seen as cloudy mass. At some places, primary spermatogonia exhibited cytoplasmic vacuolisation as well as degeneration (Fig. 21,22). Number of secondary spermatocytes, spermatids and sperms were greatly reduced. Seminiferous tubules were mostly filled with primary spermatocytes and exhibited hypertrophy. Interstitial cells showed necrosis (Fig. 21,22). Vesicular tubules in seminal vesicles lost their normal architecture and were seen compact with reduced lumen (Fig. 23). Nucleus of columnar cells showed hypertrophy and damage was more than 15 days treated seminal vesicle. In most of the tubules, columnar cells were in degenerating condition (Fig. 23).

**Histopathological changes induced by malathion in testis of Heteropneustes fossilis (Bloch)**

After 4 days of exposure seminiferous tubules showed
shrinkage, deformities in shape and interlobular septa was completely broken and interlobular spaces were increased (Fig. 24). Necrosis was observed in all stages of spermatogenesis and interstitial cells. The spermatocytes, spermatids and sperms were seen clumped in the centre of tubule (Fig. 24). In seminal vesicles, changes observed were the enlargement of columnar cells and a sign of fibrosis at some places in the connective tissue (Fig. 25).

Seminiferous tubules were normal in size and shape after 10 days of exposure. Number of spermatogonia, spermatocytes and spermatids were greatly reduced. There were no sperms in most of the tubules (Fig. 26). At some places, primary spermatogonia were seen with a broken cell wall and completely degenerated nuclear material. Primary and secondary spermatocytes and spermatids exhibited hypertrophy (Fig. 26). Interstitial cells were seen with a big nucleus and little cytoplasm. Walls of seminiferous tubule and interlobular connective tissue septa became thickened (Fig. 26). Vesicular tubules in seminal vesicles were irregular in shape and lumen of the tubules was greatly reduced due to an abnormal enlargement of connective tissue. The columnar cells showed acute necrosis (Fig. 27).

After 15 days of exposure walls of seminiferous tubule
became thin and ruptured at places. Degeneration of primary spermatogonia was more pronounced. Due to an abnormal enlargement, primary spermatocytes were appeared as cloudy swollen mass. Number of secondary spermatocytes and spermatids were further reduced. Interstitial cells were seen with big nucleus and little cytoplasm (Fig. 28). There was progressive recovery in seminal vesicles with slightly increased vesicular lumen and normal condition of connective tissue. But, the necrosis observed in the columnar cells of secretory epithelium was severe (Fig. 29).

After 30 days of exposure seminiferous tubules showed recovery and most of the seminiferous tubules were filled with all stages of spermatogenesis (Fig. 30). Some of the seminiferous tubules were seen with shrunk and damaged spermatogonia, clumped spermatids and sperms with little eosinophilic secretion. Wall of tubules were broken at places. Interstitial cells were severly affected and had only remnant of nucleus and cytoplasm (Fig. 31). In seminal vesicles, connective tissue became very thin and at some places it was in degenerating condition. Vesicular tubules showed deformities in their shape (Fig. 32). Linear arrangement of columnar cells was completely disturbed and were in degenerating condition (Fig. 32).
Histopathological changes induced by BHC in testis of *Heteropneustes fossilis* (Bloch)

After 4 days of exposure, wall of seminiferous tubules were completely broken (Fig. 33). Interlobular space was reduced and secondary spermatogonia, primary and secondary spermatocytes, spermatids and interstitial cells exhibited necrosis (Fig. 33). Severity of damage was more prominent in seminal vesicles. Vesicular tubules showed shrinkage and deformities in their shape. Space between vesicular tubules increased (Fig. 34). Fibrosis was noted in connective tissue sheaths and columnar cells were completely broken and disorganised (Fig. 34).

After 10 days of treatment, seminiferous tubules were normal in size and shape (Fig. 35). Wall of seminiferous tubules became thick and acute necrosis was observed in the interstitial cells and erythrocytes in blood capillaries (Fig. 35). Cytoplasm of primary spermatogonia was reduced and primary spermatocytes showed hypertrophy (Fig. 35). There was no significant change in seminal vesicle (Fig. 36).

Histopathological changes were more prominent after 15 days of exposure. Seminiferous tubules became enlarged in size and process of spermatogenesis was completely arrested (Fig. 37). Few primary and secondary spermatogonia, primary
and secondary spermatocytes and spermatids were observed
in seminiferous tubules (Fig. 37). Spermatogonia and sperma-
tocytes showed shrinkage and deformities in shape (Fig. 37).
Most of the seminiferous tubules were without sperm (Fig. 37).
Spaces between the tubules were greatly increased and inter-
lobular septa was in degenerating condition. Interstitial
cells had a big nucleus and reduced cytoplasm (Fig. 37).
Clumped erythrocytes were noticed in blood capillaries
(Fig. 37). In seminal vesicle, spaces between vesicular
tubules increased and connective tissue became compact
(Fig. 38). Normal arrangement of columnar cells was disturbed
and at some places they showed degeneration (Fig. 38).

After 30 days of exposure seminiferous tubules were
extensively reduced in size and process of spermatogenesis
was completely arrested. Single layer of primary spermatogonia
with an enlarged nucleus was seen in seminiferous tubu-
les (Fig. 39). Interstitial cells were degenerated and inter-
lobular septa was broken. Wall of seminiferous tubule became
very thick (Fig. 39) and vesicular tubules in seminal
vesicles showed acute necrosis (Fig. 40). Lumen of vesicular
tubules was reduced and connective tissue exhibited fibrosis
and columnar cells became enlarged in size (Fig. 40).
Histopathological changes induced by endosulfan in testis of *Heteropneustes fossilis* (Bloch)

After 4 days of exposure wall of seminiferous tubule became thick, ruptured and irregular in shape (Fig. 41). Spermatocytes, spermatids and sperms were seen in clumps (Fig. 41). Interstitial cells showed acute necrosis and primary spermatogonia were seen as a cloudy mass in germinal epithelium (Fig. 41). The toxic effects were more pronounced in seminal vesicle (Fig. 42). Normal histology was completely disturbed and connective tissue exhibited extensive fibrosis. Vesicular tubules were seen with reduced lumen and degenerating columnar cells (Fig. 42).

After 10 days of exposure seminiferous tubules lost their normal size and became irregular in their shape. Process of spermatogenesis was completely arrested and spermatocytes, spermatids and sperms could not be seen in most of the tubules (Fig. 43). Primary and secondary spermatogonia, germinal epithelium and interlobular septa were in degenerating condition. At some places only cell wall of primary spermatogonia was seen (Fig. 43). Lumen of vesicular tubules became elongated due to thickening of connective tissue. Structure of columnar cells was indistinct and they exhibited acute necrosis (Fig. 44).
After 15 days of exposure seminiferous tubules were reduced in size and became compact (Fig. 45). There was slight recovery in the process of spermatogenesis. Primary and secondary spermatogonia, few primary and secondary spermatocytes and spermatids were observed in seminiferous tubules (Fig. 45). Nucleus and nucleolus of primary spermatogonia showed slight enlargement in their size (Fig. 45). Interstitial cells and blood capillaries also showed slight recovery (Fig. 45). Connective tissue of seminal vesicle became more thick and this resulted in reduction of the lumen of vesicular tubules. Columnar cells exhibited necrosis (Fig. 46).

After 30 days of treatment peritoneum and wall of seminiferous tubules were ruptured and identity of some seminiferous tubules was completely lost (Fig. 47, 48). At some places primary spermatogonia became oval in shape and were in degenerating condition (Fig. 48). Lumen of the tubules had eosinophilic secretion with few scattered spermatocytes, spermatids and sperms (Fig. 48). Germinal epithelium was in degenerating condition. Interlobular connective tissue septa showed acute fibrosis and disintegration (Fig. 47). Interstitial cells exhibited necrosis and blood capillaries had clumped erythrocytes (Fig. 47). In seminal vesicles, columnar cells became enlarged and fibrosis was
noticed in connective tissues (Fig. 49).

**Histological observations on testis of control**

*Mystus tengara* (Ham)

In *Mystus tengara* testes are characterised by the presence of number of seminiferous tubules, covered by a thin peritoneum and connective tissue sheath (Fig. 50). Seminiferous tubules are of different size, shape and are separated from one another by a thin connective tissue septa (Fig. 50). Wall of seminiferous tubules are lined internally with germinal epithelium (Fig. 51). Process of spermatogenesis was active in all the seminiferous tubules and they were filled mostly with spermatids and sperms (Fig. 53). Few secondary spermatogonia and primary spermatocytes are also observed in seminiferous tubules (Fig. 53). Structure of these cells are as described earlier in *Heteropneustes fossilis*. In interlobular spaces there are few interstitial cells, blood capillaries and connective tissue (Fig. 51, 52). Interstitial cells are small darkly stained structures and are very few in number (Fig. 51).

Seminal vesicle is composed of a number of vesicular tubules enclosed in a thin peritoneum. Each vesicular tubule is separated from one another by a thick connective tissue sheath and the intervesicular spaces are filled with blood
vessels (Fig. 54). The internal lining of these tubules is lined by a layer of secretory epithelium. Cells of secretory epithelium are columnar and their nucleus is located in the centre. Almost all epithelial cells of one tubule are of same size and most of the tubules are filled with vesicular fluid and few sperms (Fig. 54, 55). In some vesicular tubules, vacuolization in the cytoplasm of secretory epithelial cells is noticed and many of them contain acidophilic droplets of various sizes (Fig. 56, 57).

There was no significant change in the testis and seminal vesicle of simultaneous controlled fish except a slight depletion of vesicular fluid in the vesicular tubules after 30 days.

Histopathological changes induced by carbaryl in testis of Mystus tengara (Ham)

After 4 days of exposure seminiferous tubules showed slight shrinkage and deformity in shape and interlobular spaces were slightly increased (Fig. 58). Process of spermatogenesis was active and seminiferous tubules were filled with primary spermatocytes, spermatids and sperms (Fig. 58). There was no apparent structural change in seminal vesicle except at some places secretory epithelial cells were found
detached from tubular wall (Fig. 59, 60).

Wall of seminiferous tubules became thick and ruptured at several places after 10 days of treatment. Seminiferous tubules were reduced in size and process of spermatogenesis was partially arrested (Fig. 61). Number of spermatids and sperms reduced and seminiferous tubules were seen with a layer of primary spermatogonia and primary spermatocytes. Connective tissue septa exhibited fibrosis (Fig. 61, 62). Interstitial cells and erythrocytes in blood capillaries showed necrosis and at places germinal epithelium was in degenerating condition (Fig. 61, 62). In seminal vesicle, secretory epithelial cells were enlarged in size and connective tissue became thick. Few small acidophilic droplets and vesicular fluid was observed in some vesicular tubules (Fig. 63, 64).

After 15 days of exposure connective tissue septa in the testis became thick and interlobular space was greatly reduced (Fig. 65). Process of spermatogenesis was further arrested and seminiferous tubules were observed with few primary and secondary spermatogonia, secondary spermatocytes, spermatids, sperms and a number of primary spermatocytes (Fig. 65). Primary spermatogonia showed acute necrosis and at places they were in degenerating condition (Fig. 65).
Germinal epithelium also revealed disintegration. Lumen of seminiferous tubules had eosinophilic secretion with a number of primary spermatocytes. Interstitial cells were degenerated (Fig. 65). Secretory epithelial cells in seminal vesicles became reduced in size and connective tissue showed sign of fibrosis (Fig. 66, 67). Vesicular fluid was seen in some vesicular tubules and epithelial cells had a number of small acidophilic droplets (Fig. 66, 67).

After 30 days of exposure seminiferous tubules revealed maximum shrinkage and the process of spermatogenesis was further arrested (Fig. 68). Few shrunk primary spermatogonia, primary spermatocytes and sperms were noticed in these tubules. Interstitial cells were degenerated (Fig. 68). Normal histological structure of seminal vesicle was disturbed and vesicular tubules exhibited shrinkage and deformities in shape (Fig. 69). Connective tissue and secretory epithelial cells were ruptured and little vesicular fluid, a few sperms and acidophilic droplets were noticed in some of the vesicular tubules (Fig. 69, 70).

Histopathological changes induced by malathion in testis of Mystus tengara (Ham).

After 4 days of treatment wall of seminiferous tubule and connective tissue septa became thick. Seminiferous tubules
were reduced in size and spermatogenesis was partially arrested (Fig. 71). Number of primary spermatocytes were more than spermatids and sperms (Fig. 71). There was no remarkable structural change in seminal vesicles, except a slight reduction in size of vesicular tubules. Vesicular fluid and acidophilic droplets were noticed in most of the tubules (Fig. 72).

After 10 days of treatment seminiferous tubules retained their normal shape whereas, partial arrest of spermatogenesis observed after 4 days of treatment became more pronounced and few damaged primary spermatogonia was also seen in seminiferous tubules (Fig. 73). At some places, primary spermatogonia were in degenerating condition. Wall of seminiferous tubule and connective tissue septa exhibited fibrosis. Interstitial cells showed acute necrosis (Fig. 73). There was no change in seminal vesicle. Connective tissue and epithelial cells were normal and vesicular fluid was noticed in most of the tubules. Acidophilic droplets of various size was also observed (Fig. 74, 75).

After 15 days of exposure there was no significant change except fibrosis of connective tissue septa and wall of seminiferous tubule (Fig. 76). Seminiferous tubules were filled with sperms, spermatids, primary spermatocytes and secondary spermatogonia (Fig. 76). Secretory function of
epithelial cells in seminal vesicle was inhibited. In some vesicular tubule little vesicular fluid and few sperms were noticed (Fig. 77). Connective tissue showed extensive fibrosis and acidophilic droplets were not observed (Fig. 77). Normal architecture of epithelial cells was not much effected (Fig. 77).

After 30 days of treatment testis showed recovery. Process of spermatogenesis was active and seminiferous tubules were filled with spermatids and sperms (Fig. 78). Connective tissue septa seems to be inactive (Fig. 78). In seminal vesicle, vesicular tubules became reduced in size and secretory function of epithelial cells was inhibited. Little vesicular fluid and few acidophilic droplets were observed in some vesicular tubules (Fig. 79).

Histopathological changes induced by BHC in testis of Mystus tengara (Narm)

Normal histological structure of testis was completely disturbed after 4 days of BHC treatment. Seminiferous tubules showed shrinkage and deformities in their shape (Fig. 80). Interlobular space was increased. Wall of seminiferous tubules and connective tissue septa became thick. In most of the tubules clumped spermatocytes, spermatids and sperms were
noticed (Fig. 80). Shrinkage and deformities in shape was observed in seminal vesicles as in seminiferous tubules. Secretory epithelial cells showed necrosis and at some places they were seen detached from vesicular wall (Fig. 81). Connective tissue showed fibrosis and at places it was completely broken and vesicular tubules were seen separating from each other (Fig. 81, 82). Little vesicular fluid and few acidophilic droplets were observed in some vesicular tubules (Fig. 81).

After 10 days of exposure seminiferous tubules were further reduced in size. Process of spermatogenesis was partially arrested and seminiferous tubules were seen with some clumped primary spermatocytes and spermatids (Fig. 83). Connective tissue septa becomes inactive and showed extensive fibrosis and interstitial cells atrophied (Fig. 83). In seminal vesicle there was a slight recovery, whereas vesicular tubules were greatly reduced in size and connective tissue exhibited extensive fibrosis (Fig. 84,85). Secretory epithelial cells were somewhat in normal condition and vesicular tubules were seen with little secretion and acidophilic droplets were noticed in most of the epithelial cells (Fig. 84,85).

After 15 days of exposure wall of seminiferous tubule
was broken at some places, but seminiferous tubules retained their normal size and shape and seen filled with primary spermatocytes, spermatids and sperms (Fig. 86). Primary spermatocytes were more in number and spermatogenesis was partially arrested at spermatid stage (Fig. 86). Connective tissue septa became thick and interstitial cells got degenerated (Fig. 86). In seminal vesicle, vesicular tubules regained their normal size and shape. Connective tissue and secretory epithelial cells were in normal condition (Fig. 87). Vesicular fluid was not observed in most of the tubules and acidophilic droplets were noticed in epithelial cells (Fig. 87).

Seminiferous tubules were reduced in size and spermatogenesis was further arrested after 30 days of exposure (Fig. 88). Only few primary spermatocytes in seminiferous tubules could be seen. Connective tissue septa showed acute fibrosis and seems to be inactive (Fig. 88). Interstitial cells were degenerated. Normal histology of seminal vesicle was completely disturbed (Fig. 89). Vesicular tubules exhibited acute shrinkage and deformity in shape. There was little vesicular fluid in some of the tubules (Fig. 89). Connective tissue exhibited extensive fibrosis and secretory epithelial cells were in degenerating condition (Fig. 89).
Histological observations on testis of control

*Anabas testudineus* (Bloch)

Testis of *Anabas testudineus* is composed of large number of seminiferous tubules, which are closely bound together by a thin layer of peritoneum and connective tissue sheath (Fig. 90). Seminiferous tubules are of different size, shape and are separated from each other by thin layer of connective tissue septa (Fig. 90). Wall of tubules are lined internally with germinal epithelium. Seminiferous tubules are completely packed with sperms, spermatids, primary and secondary spermatocytes and few primary and secondary spermatogonia (Fig. 91, 92). Structure of these cells are as described earlier for *Heteropneustes fossilis* and *Mystus tengara*. Intertubular spaces are filled with few interstitial cells, blood capillaries and connective tissue. Interstitial cells are small rounded structures, very few in number having prominent nuclei. Lumen of seminiferous tubule is partitioned into distinct cysts. Each of these contains germ cells of different stages of spermatogenesis (Fig. 91).

The testis of control fish after 4, 10, 15 and 30 days did not show any significant variation from the normal structure.
Histopathological changes induced by carbaryl in testis of Anabas testudineus (Bloch)

Normal histological architecture of testis got disturbed after 4 days of treatment. Wall of seminiferous tubules became thin and ruptured at several places. Clumping of sperm and shrinkage of primary spermatocytes were also observed (Fig. 93).

After 10 days of exposure wall of seminiferous tubules and connective tissue septa were completely ruptured (Fig. 94). Germinal epithelium was in degenerating condition and few shrunk and damaged primary spermatogonia and clumped spermatocytes, spermatids and sperms were seen in the seminiferous tubules. Structure of different stages of spermatogenesis and interstitial cells was indistinct (Fig. 94, 95).

After 15 days of exposure testis showed some recovery (Fig. 96). Wall of seminiferous tubules, connective tissue septa and interstitial cells became somewhat normal whereas the number of different stages of spermatogenesis was reduced (Fig. 96). Primary spermatogonia and primary spermatocyte were also reduced in size (Fig. 96).

After 30 days of exposure there were significant
changes in the testis. Wall of seminiferous tubules, connective tissue septa, germinal epithelium and primary spermatogonia were in degenerating condition (Fig. 97). At several places connective tissue septa was degenerated, resulting in the formation of spaces in between the seminiferous tubules (Fig. 97). Seminiferous tubules were reduced in size and spermatogenesis was greatly arrested (Fig. 97, 98). Only damaged primary spermatogonia and few sperms were observed in these tubules (Fig. 97). At some places primary spermatogonia was seen with an enlarged nucleus (Fig. 97). Few shrunk interstitial cells were noticed in interlobular spaces and blood capillaries had clumped erythrocytes (Fig. 97).

Histopathological changes induced by malathion in testis of *Anabas testudineus* (Bloch)

After 4 days of exposure seminiferous tubules showed slight shrinkage and deformity (Fig. 99). Interstitial cells exhibited necrosis. Process of spermatogenesis was active and seminiferous tubules were filled with spermatocytes, spermatids and sperms (Fig. 99).

After 10 days of exposure seminiferous tubules had retained their normal shape and size (Fig. 100). Nucleus
of primary spermatogonia became oval in shape. At some places, outer wall of primary spermatogonia was broken and showed sign of degeneration (Fig. 100). Secondary spermatogonia, primary and secondary spermatocytes, spermatids and sperms were normal in condition (Fig. 100).

After 15 days of treatment there was no apparent structural change except, thickening of wall of seminiferous tubules and slight enlargement of the cytoplasm of primary spermatogonia (Fig. 101). Seminiferous tubules were normal in their size, shape and all the stages of spermatogenesis were observed (Fig. 101).

After 30 days of exposure seminiferous tubules were reduced in size and their walls were ruptured at several places (Fig. 102). Degenerative changes were observed in germinal epithelium and interstitial cells. At some places, wall of seminiferous tubules and germinal epithelium was completely degenerated (Fig. 103). Number of spermatocytes, spermatids and sperms were reduced and were seen in clumps (Fig. 102, 103). Primary spermatogonia exhibited hypertrophy and deformities in shape (Fig. 102, 103).
Histopathological changes induced by BHC in testis of Anabas testudineus (Bloch)

There was no remarkable change in testis after 4 days of exposure (Fig. 104). Process of spermatogenesis was active and seminiferous tubules were filled with spermatogonia, primary and secondary spermatocytes, spermatids and sperms (Fig. 104). Primary spermatocytes were more in number than secondary spermatocytes, spermatids and sperms (Fig. 104). Interstitial cells, germinal epithelium and connective tissue were normal in condition (Fig. 104).

After 10 days of treatment there was no remarkable change in testis (Fig. 105). Seminiferous tubules were filled with primary and secondary spermatocytes, spermatids and sperms (Fig. 105).

Seminiferous tubules were reduced slightly in size and their wall became thick after 15 days of exposure (Fig. 106). Interstitial cells exhibited necrosis (Fig. 106). Process of spermatogenesis was active and seminiferous tubules were filled with primary and secondary spermatocytes, spermatids and sperms (Fig. 106).

After 30 days of exposure primary spermatogonia and primary spermatocytes became reduced in size and interstitial
cells showed acute necrosis (Fig. 107). Spermatogenesis was partially arrested at secondary spermatocyte stage. Primary and secondary spermatocytes were more in number than other stages of spermatogenesis (Fig 107).

The histopathological changes observed in the ovary of *Heteropneustes fossilis*, *Mystus tengara* and *Anabas testudineus* with different pesticides after 4, 10, 15 and 30 days of treatment are described below.

**Histological observations on ovary of control *Heteropneustes fossilis* (Bloch).**

Ovary of *Heteropneustes fossilis* (Bloch) consist of ovarian wall and ovarian lumen containing large number of ova enclosed by outer thin peritoneal membrane (Fig. 108). Ovarian wall is thick and is differentiated into an outer tunica albuginea layer and an inner germinal epithelium (Fig. 109). Tunica albuginea is made up of connective tissue, muscle fibres and blood vessels. Germinal epithelium and tunica albuginea are compactly placed but at many places germinal epithelium along with some tissue of tunica albuginea projects into the ovarian lumen to form finger like folds known as ovigerous lamellae (Fig. 110). These ovigerous lamellae are responsible for development of oocytes,
which can be seen in various stages of development in an ovary (Fig. 110). In the ovarian lumen there are bunches of chromaffin tissue, which are found scattered among the oocytes, near the tunica albuginea and attached along the ovigerous lamellae (Fig. 110). The chromaffin cells are small, polygonal in shape with a small nucleus placed centrally (Fig. 111). They are collected together and covered over by a thin membrane.

Oogonia are found in nest or clusters in lamellae and are characterised by their small size, a large nucleus and a single centrally situated nucleolus (Fig. 112). Their cytoplasm is clear and lightly stained. In the ovary of Heteropneustes fossilis different stages of maturation have been distinguished on the basis of changes noticed in the nucleus and cytoplasm as described below.

Stage - I oocyte

They are bigger in size than oogonia and are characterised by the presence of thick deeply stained cytoplasm around the nucleus (Fig. 110). Nucleus of these cells contains darkly stained scattered chromatin granules and 2-3 nucleoli of almost of the same size.
Stage - II oocyte

The oocyte - I develops to form stage - II oocyte (Fig. 110, 111). They are characterised by the presence of deeply stained homogenous cytoplasm and a big nucleus containing chromatin material in the form of fine granules dispersed throughout the nucleoplasm. 7-19 small nucleoli are either found scattered in the nucleoplasm or arranged along the periphery of the nucleus (Fig. 110, 111). Formation of follicular epithelium begins at this stage but is not complete.

Stage - III oocyte

Further development of oocyte is marked by the formation of single layer of follicular epithelium around cytoplasm (Fig. 110, 111). The nucleus contains 18-25 nucleoli and few of them pass out of the nuclear membrane and are seen in the ooplasm. The ooplasm takes a comparatively lighter stain (Fig. 113).

Stage - IV oocyte

Oocyte of IV stage is characterised by its big size (Fig. 114, 115, 116). Clear vacuoles of small size are seen along the periphery just below the follicular epithelium (Fig. 115). In early stage of their formation, vacuoles are
seen scattered in the cytoplasm. Later on they rapidly increase in size and get arranged along the periphery in the form of a ring (Fig. 115). Nuclear extrusion is very common at this stage (Fig. 114). Large number of oocytes show highly undulated nuclear membrane, although few still possess a smooth nuclear membrane. Nucleus contains 20–26 nucleoli which enter into the pockets of nuclear membrane and pass out to the ooplasm (Fig. 115, 116). Cytoplasm takes light stain and some oocytes at this stage have a yolk nucleus seen in the ooplasm (Fig. 114).

The ovaries of 4, 10 and 15 days control fish did not show any variation from the normal structure. Whereas, after 30 days size of stage I, II and III oocyte was reduced and oocyte IV became enlarged (Fig. 117, 118, 119).

**Histopathological changes induced by carbaryl in ovary of Heteropneustes fossilis (Bloch)**

After 4 days of exposure peritoneum was broken at places, tunica albuginea became compact and blood vessels were enlarged in size (Fig. 120). Deformities in shape was observed in stage III and IV oocyte (Fig. 121). Margin of oocyte III presented wrinkled appearance and the follicular layer was ruptured (Fig. 122). Oogonia and chromaffin tissue
exhibited acute shrinkage and ovigerous lamellae were seen broken at places (Fig. 122). Whereas, there was no structural change in oocyte I and II (Fig. 122).

After 10 days of treatment tunica albuginea became thick, resulting in an elongated appearance of blood vessels (Fig. 126). Cytoplasmic deformities was noticed in stage II, III and IV oocytes (Fig. 123, 124). In oocyte III and IV nuclear material was in degenerating condition and cytoplasm was seen withdrawn from the follicular layer (Fig. 123, 124, 125). Nucleus of oocyte III and IV became enlarged in size (Fig. 123). In some II and III stage oocytes, the nucleus migrated to the periphery and cytoplasm was seen projected as a hood (Fig. 123, 124). There was no change in oogonia, oocyte - I, ovigerous lamellae and chromaffin tissue.

After 15 days treatment fibrous part of tunica albuginea increased in thickness and was found detached from germinal epithelium (Fig. 127). Blood vessels became reduced and few clumped erythrocytes were observed (Fig. 127). Ovigerous lamellae were broken at places and oocytes II were seen irregular in shape with big nucleus and reduced cytoplasm (Fig. 128). In stage III oocyte there was no change in nuclear material whereas, the nucleus migrated to the periphery (Fig. 128). Stage IV oocyte exhibited shrinkage
and the cytoplasm and follicular layer were in degenerating condition (Fig. 129). Chromaffin tissue, oogonia, and oocytes were in normal conditions.

The ovarian wall after 30 days of exposure exhibited fibrosis (Fig. 130). Blood vessels became swollen and number of erythrocytes increased greatly (Fig. 130). Germinal epithelium was broken at places and ovigerous lamellae were in degenerating condition (Fig. 130, 131). Oogonia were completely degenerated and chromaffin tissue exhibited shrinkage (Fig. 132). Cytoplasmic and nuclear deformities were observed in most of the oocytes. Stage II oocyte became irregular in shape and cytoplasm was greatly reduced. In stage III and IV oocytes cytoplasm was badly damaged and nuclear material was seen disintegrated (Fig. 131). In addition, follicular layer was ruptured and found detached from the cytoplasm (Fig. 133).

**Histopathological changes induced by malathion in ovary of Heteropneustes fossilis (Bloch)**

After 4 days of treatment ovarian wall became compact and blood vessel exhibited hypertrophy (Fig. 134). In some stage - II oocyte, the cytoplasm was greatly reduced (Fig. 135). Migration of nucleus to the periphery and
disintegration of nuclear material was observed in stage III oocyte (Fig. 135). Ovigerous lamellae, oogonia, oocyte of stage I, IV, chromaffin tissue and follicular layer of stage III and IV oocytes were not effected.

After 10 days of exposure peritoneum was seen ruptured at places (Fig. 136). Blood vessels became shrunk and erythrocytes became clumped (Fig. 136). Number of stage I, III and IV oocytes were greatly reduced and stage III oocytes became elongated in shape (Fig. 137, 138). Cytoplasm of stage II oocyte exhibited vacuolization (Fig. 137). Ovigerous lamellae and chromaffin tissue were in normal condition. Whereas, oogonia were mostly disintegrated (Fig. 137, 138). Nucleus of stage IV oocyte showed reduction in size and follicular epithelium was in degenerating condition (Fig. 139).

Tunica albuginea became compact and blood vessel were greatly reduced in size after 15 days of exposure (Fig. 140). Germinal epithelium and ovigerous lamellae were seen ruptured at several places (Fig. 140, 141). Deformities in shape and migration of nucleus to the periphery was noticed in stage II and III oocytes (Fig. 141, 142). In some stage II oocyte, nuclear material was completely degenerated (Fig. 142) and cytoplasm exhibited vacuolization (Fig. 141). Oocytes
of stage IV became irregular in shape and nucleus was greatly reduced. Follicular epithelium was also ruptured at places (Fig. 142). Stage I oocyte revealed reduction in size (Fig. 142) and oogonia, chromaffin tissue were normal in condition.

After 30 days of treatment no cellular disturbance was noticed except formation of atretic oocytes (Fig. 143). Ovarian wall became thick and blood vessels were reduced in size (Fig. 144). Ovigerous lamellae and chromaffin tissue were not affected (Fig. 143, 145).

**Histopathological changes induced by BHC in ovary of Heteropneustes fossilis (Bloch)**

After 4 days of treatment ovarian wall became thick and blood vessels were reduced in size (Fig. 146). Inter-follicular spaces increased due to shrinkage of all the stages of oocytes (Fig. 147). Ovigerous lamellae were seen broken at places (Fig. 147). Migration of nucleus to the periphery was observed in some of stage II oocytes. Follicular epithelium of stage III oocyte was in degenerating condition, whereas in stage IV oocyte it became thin (Fig. 148). Few bunches of chromaffin tissue and a slight reduction in size of oogonia and stage I oocyte was also noticed (Fig. 147, 149).
After 10 days of exposure ovarian wall became thick and blood vessel showed an abnormal swelling and became thick walled (Fig. 150). Number of stage I oocyte was greatly reduced (Fig. 151). Degeneration of nuclear material was observed in stage II, III and IV oocytes (Fig. 151). Ovigerous lamellae, chromaffin tissue and follicular layer in stage III and IV oocytes were normal whereas, oogonia were in degenerating condition (Fig. 151,152).

Toxic effects were more severe after 15 days of exposure. Ovarian wall became more compact and peritoneum was seen broken at places (Fig. 153). Abnormal swelling of blood vessels observed after 10 days of exposure became more prominent (Fig. 153). Erythrocytes in blood vessels exhibited hypertrophy and became clumped (Fig. 153). Germinial epithelium and ovigerous lamellae were in degenerating condition (Fig. 153,154). Oogonia were mostly degenerated and stage I oocyte showed considerable shrinkage of their size (Fig. 155). Vacuolization and clumping of cytoplasm was observed in some oocytes of stage II and III (Fig. 154). Interfollicular spaces became more prominent and there was remarkable decrease in number of stage III and IV oocytes. Follicular layer of stage III and IV oocytes was in degenerating condition (Fig. 156,157). Few shrunk bunches of chromaffin tissue was also noticed (Fig. 157).
After 30 days of exposure ovarian wall became more compact (Fig. 158). Oogonia were almost degenerated and number of stage I and II oocytes was significantly reduced (Fig. 159). Oocytes of IV stage were completely absent and the lumen of ovary was seen mostly with oocytes of III stage (Fig. 159). They showed reduction in their size. Chromaffin tissue was mostly degenerated and follicular layer of stage III oocyte was in degenerating condition. (Fig. 160). Degenerative changes were observed in the ovigerous lamellae also (Fig. 159).

Histopathological changes induced by endosulfan in ovary of Heteropneustes fossilis (Bloch)

Remarkable changes were observed in ovarian wall after 4 days of exposure. Peritoneum was broken and tunica albuginea became thick (Fig. 161). Blood vessels exhibited an abnormal enlargement and thickening with few clumped erythrocytes (Fig. 161). Germinal epithelium was detached from tunica albuginea (Fig. 161) and ovigerous lamellae were broken at several places (Fig. 162). Shrinkage and deformities in shape of oogonia and almost all the stages of oocytes was quite evident. Cytoplasm of stage I,II,III and IV oocytes showed clumping (Fig. 162). Follicular layer of stage III, IV oocytes showed wrinkled appearance and
chromaffin tissue was badly damaged (Fig. 163).

After 10 days of exposure fibrous part of tunica albuginea became more thick and germinal epithelium was ruptured at places (Fig. 164). Blood vessels showed an enlargement in their size (Fig. 164). Interfollicular spaces increased due to reduction in number of stage II oocyte and size of stage I oocyte (Fig. 165). Deformities in shape was observed in some stage III oocyte. Oogonia, ovigerous lamellae, chromaffin tissue and follicular layer of stage III and IV oocyte were not effected (Fig. 165).

The ovarian wall after 15 days of treatment became thick and blood vessels revealed an enlargement and thickening (Fig. 166). All stages of oocytes became compactly arranged and exhibited an elongated appearance (Fig. 167). Interfollicular space was reduced due to an overall shrinkage of the ovary (Fig. 167). Ovigerous lamellae were seen broken at several places (Fig. 167) and oogonia exhibited acute shrinkage (Fig. 168). In stage III oocytes, nucleus was much reduced in size and nuclear material was in degenerating condition (Fig. 167). Follicular layer of stage III and IV oocyte showed degeneration (Fig. 168), whereas the chromaffin tissue was not effected (Fig. 167,168).

There was no change in ovarian wall after 30 days of
treatment (Fig. 169). Oogonia revealed shrinkage and number of stage I and II oocyte was more than the other stages of oocytes (Fig. 170, 171). Enlargement of nucleus was observed in stage II oocyte (Fig. 172) and cytoplasm of some stage III oocytes was in degenerating condition (Fig. 172). In some of the stage IV oocytes cytoplasm as well as their nuclei were in degenerating condition (Fig. 173). Follicular layer of both stage III and IV oocytes also exhibited degeneration (Fig. 173, 174). Ovigerous lamellae and chromaffin tissue were not effected (Fig. 174).

Histological observations on ovary of control
*Mystus tengara* (Ham.)

In basic features, histology of the ovary of *Mystus tengara* is identical to that of *Heteropneustes fossilis* (Bloch). Each ovary remained covered with a thin peritoneal covering under which lies a thick tunica albuginea consisting of connective tissue, muscle fibres and blood vessels (Fig. 175,176). The inner most layer is germinal epithelium, which is not distinct in *Mystus tengara* as in *Heteropneustes fossilis* (Fig. 176). Germinal epithelium and tunica albuginea projects into the ovarian lumen to form the ovigerous lamellae, which encloses numerous ova in different stages of development and growth (Fig. 177,178). In ovary of
Mystus tengara there were two stages of oocytes i.e., oocyte I and oocyte II (Fig. 177). Like Heteropneustes fossilis in Mystus tengara there were bunches of chromaffin tissues found near the tunica albuginea, along the ovigerous lamellae and near the oocytes. The chromaffin tissue is covered by a membrane at some places such as near the oocytes and inside the ovarian folds, but near the tunica albuginea they do not have a membrane and are freely associated with the connective tissue of the ovary. The chromaffin cells are polygonal in shape with a small centrally situated nucleus (Fig. 175, 178).

Oogonia, the first stage of the germ cell remains arranged in the form of clusters being surrounded by stromal elements (Fig. 179). They are characterised by their small size, a large nucleus and centrally situated single nucleolus. The cytoplasm is clear and is lightly stained (Fig. 179).

Oogonia matures to transform in stage I oocyte. They are characterised by the thick and deeply stained cytoplasm around the nucleus (Fig. 177). Nucleus contains darkly stained chromatin granules and 2-3 identical nucleoli.

Further development of oocyte results in the formation of stage II oocytes. They are characterised by presence of darkly stained homogenous cytoplasm around a big nucleus.
Nucleus of these oocytes contain chromatin material in the form of fine granules, dispersed throughout the nucleoplasm. 5-9 nucleoli are either arranged along the periphery of the nuclear membrane or scattered in the nucleoplasm (Fig. 177). Besides this corpora atretica and unovulated mature yolky eggs in the process of resorption called residual egg were also seen in the ovary of Mystus tengara (Fig. 175).

There was not much remarkable change in the ovary of control fish after keeping them for 4, 10, 15 and 30 days under similar conditions in the aquaria.

**Histopathological changes induced by carbaryl in ovary of Mystus tengara (Ham)**

Enlargement of blood vessels and fibrosis in tunica albuginea were the most significant changes observed after 4 days of exposure (Fig. 180). There was no remarkable change in different stages of oocytes, oogonia, ovigerous lamellae, residual eggs, corpora atretica and chromaffin tissues (Fig. 181).

After 10 days of treatment peritoneum was broken at places and tunica albuginea showed degeneration (Fig. 182). Blood vessels were reduced in size having few erythrocytes (Fig. 182). Ovigerous lamellae were ruptured at places and stage I and II oocytes were less in number (Fig. 183).
Cytoplasmic clumping and migration of nucleus to the periphery was observed in stage II oocytes (Fig. 183). Corpora atretica and residual eggs were not effected. There was an increase in number of chromaffin tissue (Fig. 183) and oogonia were mostly degenerated.

After 15 days of exposure ovarian wall showed fibrosis (Fig. 184). Blood vessels became reduced in size and few erythrocytes were noticed (Fig. 184). Ovigerous lamellae were in degenerating condition and stage II oocytes were further reduced in number (Fig. 185). Most of the oogonia, stage I oocytes and residual eggs became disintegrated but few corpora atretica were observed. The chromaffin tissue was not effected (Fig. 185).

After 30 days of treatment tunica albuginea exhibited fibrosis and blood vessels were slightly reduced in size (Fig. 186). Most of the oogonia, corpora atretica and residual eggs got degenerated. Stage I oocytes were reduced in number and some stage II oocytes underwent atresia which resulted in an increase in the interfollicular space (Fig. 187). Chromaffin tissues increased in number and they were mostly found near the germinal epithelium (Fig. 186).
Histopathological changes induced by malathion in ovary of Mystus tengara (Ham).

Significant change observed after 4 days of treatment was an abnormal swelling of blood vessel of the ovarian wall (Fig. 188). Cytoplasm of stage I and II oocyte exhibited poor staining and their nuclear material was not very active (Fig. 189). There was no change in ovigerous lamellae, oogonia, corpora atretica, residual egg and chromaffin tissue (Fig. 189).

After 10 days of exposure ovarian wall became thick and broken at some places (Fig. 190). Toxic effects observed on the blood vessel after 4 days of treatment was more prominent with a slight reduction in their size (Fig. 190). An increase in erythrocytes number was also seen (Fig. 190). Number and size of stage I and II oocyte was reduced (Fig. 191). Ovigerous lamellae and oogonia were somewhat normal in condition (Fig. 191). Corpora atretica were few and residual eggs could not be seen in the ovary whereas, there was an increase of chromaffin tissue, which was not effected (Fig. 191).

Enlargement of blood vessels became more prominent after 15 days of exposure (Fig. 192). Number of erythrocyte was considerably increased and fibrous part of tunica albuginea showed fibrosis (Fig. 192). Most of the stage II oocytes underwent atresia resulting in more corpora atretica (Fig. 193).
Cytoplasmic clumping was seen in stage II oocyte (Fig. 193). Stage I and II oocyte were greatly reduced in number (Fig. 193). Ovigerous lamellae, oogonia and chromaffin tissue were not affected.

After 30 days of exposure peritoneum was broken at places and tunica albuginea showed fibrosis. Blood vessel exhibited dilation with less number of erythrocytes (Fig. 194). Ovigerous lamellae and oogonia were seen degenerating at different places (Fig. 195, 196). Stage I and II oocyte exhibited necrosis and stage II oocyte was greatly reduced in number. Reduction in the size of nucleus of stage II oocyte was also noticed (Fig. 195). Corpora atretica was not observed and chromaffin tissue got degenerated. Few residual eggs were seen at this stage (Fig. 195).

Histopathological changes induced by BHC in ovary of Mystus tengara (Ham)

Ovarian wall became compact and blood vessels were greatly reduced in size after 4 days of treatment (Fig. 197). Ovigerous lamellae were completely ruptured and oogonia, stage I, II oocytes, corpora atretica, residual eggs and chromaffin tissues were seen diffused or scattered in the ovocoel (Fig. 198,199).

Changes after 10 days of exposure were more prominent
than 4 days treatment. In addition to the compact appearance of ovarian wall and reduction in size of blood vessel, peritoneum was broken at several places (Fig. 200). Ovigerous lamellae, oogonia and chromaffin tissue were in degenerating condition whereas, corpora atretica and residual eggs were not observed (Fig. 201, 202). Acute shrinkage and deformity in shape and size was observed in stage I and II oocyte (Fig. 202). Reduction in size of nucleus was quite apparent in stage II oocyte (Fig. 202).

After 15 days of treatment ovarian wall became thick and blood vessels were reduced in size (Fig. 203). Stage II oocytes were much decreased in number and there was much reduction in their cytoplasm and size of nucleus (Fig. 204). Most of the ovigerous lamellae and oogonia got degenerated. Corpora atretica and residual eggs were not observed (Fig. 204). The chromaffin tissue was not effected (Fig. 204).

After 30 days of treatment ovary showed slight recovery with appearance of ovigerous lamellae, few oogonia and oocytes stage I and II (Fig. 205, 206). There was no disturbance in the histoarchitecture of oogonia, stage I and II oocytes. Corpora atretica and residual eggs could not be observed (Fig. 205). Ovigerous lamellae were broken at places and chromaffin tissue was much degenerated (Fig. 205). In the ovarian wall, peritoneum was ruptured at places, tunica
albuginea revealed fibrosis and blood vessels gets enlarged having hypertrophied erythrocytes in them (Fig. 207).

**Histological observations on ovary of control**
Anabas testudineus (Bloch).

Ovary of Anabas testudineus (Bloch) consist of a thin and highly vascularised ovarian wall, an ovarian lumen with three stages of oocytes viz. immature, maturing and mature oocytes and few atretic oocytes (Fig. 208, 210).

The ovarian wall consist of an outer thin peritoneum, a middle thick tunica albuginea and an innermost germinal epithelium (Fig. 209). Germinal epithelium and tunica albuginea projects into the ovocoel in the form of lamellae, which becomes indistinct as mature oocytes become densely packed in the ovarian lumen. Since the process of oogenesis was active, oogonia could not be observed. The oocytes were packed compactly and interfollicular spaces were rarely observed. The description of different stages of oocytes is as follows:

**Immature oocytes**

Immature oocytes were comparatively less in number and mainly situated along the inner margin of ovarian wall (Fig. 208). They are characterised by deeply stained homogenous cytoplasm with a large nucleus and 5-18 nucleoli.
**Maturing oocytes**

Maturing oocytes were characterised by the presence of yolk vacuoles along their periphery (Fig. 209). As the maturation advances, yolk vacuole gets enlarged and multiply, filling almost the whole of the ooplasm (Fig. 210). The oocyte nucleus gets enlarged having 11-28 nucleoli and their nuclear membrane becomes irregular (Fig. 210). Ooplasm takes a comparatively lighter stain with Azan and darkly stained yolk granules were seen distributed in the ooplasm (Fig. 210). Maturing oocytes were surrounded by a thin layer of zona radiata and follicular epithelium (Fig. 210).

**Mature oocytes**

Mature oocytes were big in size having large amount of yolk droplets and yolk vacuoles spread throughout the ooplasm (Fig. 211). Nuclear membrane becomes inconspicuous and the pyknotic nuclei were seen with few nucleoli. These oocytes were surrounded by an external layer or theca followed by zona granulosa and the innermost zona radiata. With Azan stain yolk droplets were stained orange and the nucleus take blue colour (Fig. 211).

The ovary of 4, 10, 15 and 30 days control *Anabas testudineus* fish did not show any change from those of normal structure.
when kept in the aquaria simultaneously with the experimental fishes.

**Histopathological changes induced by carbaryl in ovary of Anabas testudineus** (Bloch)

After 4 days of exposure ovarian wall became compact and peritoneum was ruptured at several places (Fig. 212). Interfollicular spaces were observed due to the shrinkage of oocytes (Fig. 213). Outer margin of mature oocytes showed a wrinkled appearance (Fig. 214). Theca, zona granulosa and zona radiata layer of mature oocytes were found detached from the cytoplasm (Fig. 214) whereas, immature and maturing oocytes were not much affected (Fig. 213).

Fibrous part of tunica albuginea become thick and blood vessels were ruptured after 10 days of treatment indicating haemorrhage (Fig. 215). Interfollicular spaces became prominent due to shrinkage of immature and mature oocytes (Fig. 216). Deformity of immature oocyte was noticed and the thecal wall of mature oocyte was broken at some places (Fig. 216). Maturing oocytes were not much affected.

After 15 days of exposure tunica albuginea became thick and at places germinal epithelium was found detached (Fig. 217). Reduction in size of mature oocytes resulted in the formation of interfollicular space (Fig. 218). Theca, zona granulosa
and zona radiata of mature oocyte were ruptured and in some oocytes they were in degenerating condition at some places (Fig. 218). Whereas immature and maturing oocytes were not much effected.

Toxic effects of pesticide was more severe after 30 days of exposure. Ovarian wall showed much thickening and blood vessels became turgid (Fig. 219). Process of oogenesis was severely effected and ovaries were seen with large number of immature oocytes (Fig. 220). Maturing oocytes were completely absent and mature oocytes became necrotic and reduced in size with damage and rupture of their outer thecal wall (Fig. 220). Broken and degenerating ovigerous lamellae were also observed (Fig. 220).

Histopathological changes induced by malathion in ovary of Anabas testudineus (Bloch).

After 4 days of exposure changes observed in histology of ovary were fibrosis of the ovarian wall and occurrence of interfollicular spaces due to shrinkage of mature oocytes (Fig. 221, 222). In some mature oocytes theca, zona granulosa and zona radiata were seen detached from the cytoplasm (Fig. 222, 223). There was no apparent structural change in immature, maturing and atretic oocytes (Fig. 223).

After 10 days of exposure tunica albuginea exhibited
acute fibrosis and germinal epithelium was somewhat degenerated (Fig. 224). Interfollicular spaces were observed due to shrinkage and deformities in shape of mature oocytes (Fig. 225, 226). In some mature oocytes at some places the zona granulosa was found detached from zona radiata and theca (Fig. 225). Immature and maturing oocytes were mostly not effected (Fig. 226).

After 15 days of treatment ovarian wall exhibited acute fibrosis and at places degenerative changes were observed in tunica albuginea and germinal epithelium (Fig. 227, 228). Mature oocytes became shrunk, deformed in shape and thecal wall was detached from the zona granulosa (Fig. 228). There was no remarkable change in immature and maturing oocytes whereas, degenerative change was noticed in ovigerous lamellae (Fig. 228).

Remarkable histopathological changes observed after 30 days of exposure. Ovarian wall became considerably thick and peritoneum got detached from tunica albuginea at some places (Fig. 229). Blood vessels became swollen with some erythrocytes (Fig. 229). Most of the immature, maturing and mature oocytes were in the process of atresia (Fig. 230, 231). Some atretic oocytes were at their final stage and interfollicular spaces were also noticed (Fig. 230, 231). In some mature oocytes theca, zona granulosa and zona radiata were
broken at places (Fig. 231).

**Histopathological changes induced by BHC in ovary of Anabas testudineus** (Bloch).

After 4 days of exposure there was no apparent structural change in the ovary. Ovarian wall, immature, maturing, mature oocytes and atretic oocytes were almost in normal condition (Fig. 232).

After 10 days of exposure peritoneum was broken at places and tunica albuginea exhibited slight fibrosis (Fig. 233). Number of immature oocytes were more than maturing oocytes (Fig. 234). Outer margin of mature oocytes exhibited an irregular appearance and theca and zona granulosa got detached from zona radiata (Fig. 234,235).

Changes observed after 15 days of exposure were more severe than that of 10 days. Ovarian wall became more thick and peritoneum alongwith part of connective tissue and muscle fibres became separated from tunica albuginea (Fig. 236). Blood vessels became elongated and ovigerous lamellae got ruptured at some places (Fig. 236,237). Number of immature oocytes increased and only few maturing oocytes were noticed (Fig. 237). Interfollicular spaces were observed due to shrinkage and deformities in shape of mature oocytes.
(Fig. 237, 238). Theca, zona granulosa and zona radiata of some mature oocytes became thin and got detached (Fig. 237).

After 30 days of exposure there was no significant change in ovary, except shrinkage and deformity in shape of some mature oocytes (Fig. 239). Ruptured theca, zona granulosa and zona radiata was evident in shrunk mature oocytes (Fig. 239). Ovarian wall was normal in condition and process of oogenesis was also normal. Ovaries were seen with few immature oocytes, maturing oocytes, atretic oocytes and number of mature oocytes (Fig. 239, 240).
Fig. 11. Photomicrograph of T.S. of testis of control *H. fossilis* showing arrangement of seminiferous tubules, interstitial cells, blood capillaries and different stages of spermatogenesis. AZAN. X 600.

Fig. 12. Photomicrograph of T.S. of testis of control *H. fossilis* showing germinal epithelium, sperms and primary spermatocytes. AZAN. X 600.

Fig. 13. Photomicrograph of T.S. of seminal vesicle of control *H. fossilis* showing secretory epithelial cells, connective tissue sheath and little vesicular fluid. AZAN. X 400.

Fig. 14. Photomicrograph of T.S. of seminal vesicle of control *H. fossilis* showing blood vessels and arrangement of vesicular tubules. AZAN. X 400.
Fig. 15. Photomicrograph of T.S. of 4 days carbaryl treated seminal vesicle of H. fossilis. AZAN. X 400.
Arrow shows reduced lumen of vesicular tubules.
Arrow with spot shows disturbed normal structure of columnar cells.

Fig. 16. Photomicrograph of T.S. of 4 days carbaryl treated testis of H. fossilis. AZAN. X 600.
Arrow shows shrunk primary spermatogonia.
Arrow with spot shows normal secondary spermatocytes.
Arrow with two spot shows normal spermatid.
Arrow with into shows normal secondary spermatogonia.
Arrow with cross shows normal primary spermatocytes.

Fig. 17. Photomicrograph of T.S. of 10 days carbaryl treated testis of H. fossilis showing reduction in size of seminiferous tubules and partial arrest of spermatogenesis. AZAN. X 600.
Arrow shows increased interlobular spaces.
Arrow with spot shows reduction in size of secondary spermatogonia.
Arrow with into shows reduction in size of primary spermatogonia.
Arrow with cross shows reduction in size of secondary spermatocytes.
Arrow with dash shows reduction in size of primary spermatocytes.

Fig. 18. Photomicrograph of T.S. of 10 days carbaryl treated seminal vesicle of H. fossilis. AZAN. x 400.
Arrow with spot shows slightly increased lumen of vesicular tubules.
Arrow shows fibrosis and degeneration of connective tissue sheath.
Arrow with into shows degenerated columnar cells.
Arrow with cross shows acute necrosis of columnar cells.
Fig. 19. Photomicrograph of T.S. of 15 days carbaryl treated testis of *H. fossilis*. AZAN. X 600.

Arrow shows shrunk and degenerating secondary spermatogonia with pyknotic nuclei and nucleolus.

Arrow with spot shows slight necrosis in primary spermatocytes.

Arrow with into shows clumped secondary spermatocytes, spermatids, and sperms.

Arrows with cross show shrunk and degenerating primary spermatogonia with pyknotic nuclei and nucleolus.

Arrow with two dash shows degenerating germinal epithelium.

Fig. 20. Photomicrograph of T.S. of 15 days carbaryl treated seminal vesicle of *H. fossilis*. AZAN. X 400.

Arrows show fibrosis and degeneration in connective tissue sheath.

Arrows with spot show enlarged nucleus of columnar cells.

Fig. 21. Photomicrograph of T.S. of 30 days carbaryl treated testis of *H. fossilis* showing enlargement in size of seminiferous tubules. AZAN. X 600.

Arrow shows cloudy appearance of nucleus of primary spermatogonia.

Arrow with into shows degenerating primary spermatogonia.

Fig. 22. Photomicrograph of T.S. of 30 days carbaryl treated testis of *H. fossilis* showing wrinkled appearance of wall of seminiferous tubules. AZAN. X 600.

Arrow shows oval shaped nucleus of primary spermatogonia.

Arrow with spot shows necrosis in interstitial cells.

Arrow with into shows degenerating primary spermatogonia.

Arrows with cross shows hypertrophied primary spermatocytes.

Arrow with dash shows cytoplasmic vacuolization in primary spermatogonia.
Fig. 23. Photomicrograph of T.S. of 30 days carbaryl treated seminal vesicle of *H. fossilis* showing compact nature of vesicular tubules. AZAN. X 400.

Arrow shows degenerating columnar cells.

Arrow with spot shows hypertrophied nucleus of columnar cells.

Fig. 24. Photomicrograph of T.S. of 4 days malathion treated testis of *H. fossilis* showing shrinkage and deformities in shapes of seminiferous tubules. AZAN. X 600.

Arrow shows clumped spermatocytes, spermatids and sperms.

Arrow with spot shows increased interlobular space.

Arrow with into shows necrosis in primary spermatogonia.

Arrow with cross shows necrosis in secondary spermatogonia.

Arrow with dash shows necrosis in interstitial cells.

Fig. 25. Photomicrograph of T.S. of 4 days malathion treated seminal vesicle of *H. fossilis*. AZAN. X 400.

Arrow shows fibrosis in the connective tissue sheath.

Arrows with spot show enlargement of columnar cells.

Fig. 26. Photomicrograph of T.S. of 10 days malathion treated testis of *H. fossilis* showing absence of sperms in the seminiferous tubules. AZAN. X 600.

Arrow shows thick wall of seminiferous tubule and connective tissue septa.

Arrows with spot show broken cell wall and degenerated nuclear material of primary spermatogonia.

Arrows with two spots show big nucleus and little cytoplasm of interstitial cells.

Arrow with into shows hypertrophied spermatid.

Arrow with cross shows hypertrophied primary spermatocyte.

Arrow with dash shows hypertrophied secondary spermatocyte.
Fig. 27. Photomicrograph of T.S. of 10 days malathion treated seminal vesicle of *H. fossilis* showing irregular shaped vesicular tubules. AZAN. X 400.

Arrow shows abnormal enlargement of connective tissue.

Arrows with spot show reduced lumen of vesicular tubules.

Arrow with dash shows acute necrosis in columnar cells.

Fig. 28. Photomicrograph of T.S. of 15 days malathion treated testis of *H. fossilis*. AZAN. X 600.

Arrow shows big nucleus and little cytoplasm of interstitial cells.

Arrow with into shows cloudy appearance of primary spermatocyte.

Arrows with cross show degenerating primary spermatogonia.

Arrow with dash shows thin and ruptured wall of seminiferous tubule.

Fig. 29. Photomicrograph of T.S. of 15 days malathion treated seminal vesicle of *H. fossilis* showing progressive recovery and normal connective tissue. AZAN. X 400.

Arrows show slightly increased lumen of vesicular tubules.

Arrows with spot show acute necrosis in columnar cells.

Fig. 30. Photomicrograph of T.S. of 30 days malathion treated testis of *H. fossilis* showing seminiferous tubules filled with all stages of spermatogenesis. AZAN. X 600.

Arrow shows normal primary spermatocytes.

Arrow with spot shows normal secondary spermatogonia.

Arrow with into shows secondary spermatocyte.

Arrow with cross shows normal primary spermatogonia.

Arrow with dash shows normal spermatids and sperms.
Fig. 31. Photomicrograph of T.S. of 30 days malathion treated testis of *H. fossilis*. AZAN. X 600.
Arrow shows reminicence of nucleus and cytoplasm of interstitial cells.
Arrow with spot shows ruptured wall of seminiferous tubule.
Arrow with into shows clumped spermatids and sperms with eosinophilic secretion.
Arrow with cross shows shrunk and damaged primary spermatogonia.

Fig. 32. Photomicrograph of T.S. of 30 days malathion treated seminal vesicle of *H. fossilis*. AZAN. X 400.
Arrow shows degenerating columnar cells.
Arrows with spot show thin and degenerating connective tissue.

Fig. 33. Photomicrograph of T.S. of 4 days BHC treated testis of *H. fossilis*. AZAN. X 600.
Arrow shows broken wall of seminiferous tubule.
Arrow with spot shows reduced interlobular space and necrosis in interstitial cells.
Arrow with two spots shows necrosis in secondary spermatocyte.
Arrow with into shows necrosis in secondary spermatogonia.
Arrow with cross shows necrosis in spermatid.
Arrow with dash shows necrosis in primary spermatocyte.

Fig. 34. Photomicrograph of T.S. of 4 days BHC treated seminal vesicle of *H. fossilis* showing shrinkage and deformities in shape of vesicular tubules. AZAN. X 400.
Arrow shows increased intervesicular space.
Arrows with spot show broken and disorganised columnar cells.
Arrows with cross show fibrosis in connective tissue sheath.
Fig. 35. Photomicrograph of T.S. of 10 days BHC treated testis of *H. fossilis*. AZAN. X 600.
Arrow shows thick wall of seminiferous tubule.
Arrow with spot shows hypertrophied primary spermatocyte.
Arrow with two spots shows reduced cytoplasm of primary spermatagonia.
Arrow with into shows acute necrosis in interstitial cells.
Arrow with dash shows acute necrosis in erythrocytes.

Fig. 36. Photomicrograph of T.S. of 10 days BHC treated unaffected seminal vesicle of *H. fossilis*. AZAN. X 400
Arrow shows normal connective tissue sheath.
Arrow with spot shows normal columnar cells.
Arrow with cross shows normal vesicular lumen.

Fig. 37. Photomicrograph of T.S. of 15 days BHC treated testis of *H. fossilis* showing enlarged seminiferous tubules. AZAN. X 600.
Arrow shows shrunk and deformed primary spermatogonia.
Arrow with spot shows clumped erythrocytes.
Arrow with two spots show shrunk and deformed secondary spermatocytes.
Arrow with three spots shows shrunk and deformed secondary spermatagonia.
Arrow with into shows increased interlobular space.
Arrow with cross shows big nucleus and reduced cytoplasm of interstitial cell.
Arrow with dash shows shrunk and deformed primary spermatocytes.

Fig. 38. Photomicrograph of T.S. of 15 days BHC treated seminal vesicle of *H. fossilis*. AZAN. X 400.
Arrow shows degeneration of columnar cells.
Arrow with spot shows compact connective tissue.
Arrow with dash shows increased intervesicular space.
Fig. 39. Photomicrograph of T.S. of 30 days BHC treated testis of \textit{H. fossilis} showing single layer of primary spermatogonia in reduced seminiferous tubules. AZAN. X 600.

Arrows show enlarged nucleus of primary spermatogonia.

Arrow with spot shows broken interlobular connective tissue septa.

Arrow with into shows thick wall of seminiferous tubule.

Fig. 40. Photomicrograph of T.S. of 30 days BHC treated seminal vesicle of \textit{H. fossilis} showing necrosis of vesicular tubules. AZAN. X 400.

Arrows show fibrosis in connective tissue.

Arrows with into show enlarged columnar cells.

Arrow with cross shows reduced lumen of vesicular tubules.

Fig. 41. Photomicrograph of T.S of 4 days endosulfan treated testis of \textit{H. fossilis} showing irregular shaped wall of seminiferous tubules. AZAN. X 600.

Arrow shows thick and ruptured wall of seminiferous tubule.

Arrow with into shows clumped spermatocytes, spermatids and sperms.

Arrow with spot shows cloudy appearance of primary spermatogonia.

Arrow with cross shows acute necrosis in interstitial cell.

Fig. 42. Photomicrograph of T.S of 4 days endosulfan treated seminal vesicle of \textit{H. fossilis}. AZAN. X 400.

Arrow shows reduced lumen of vesicular tubules.

Arrows with spot show degenerating columnar cells.

Arrow with cross shows extensive fibrosis in connective tissue.
Fig. 43. Photomicrograph of T.S. of 10 days endosulfan treated testis of *H. fossilis* showing irregular shaped seminiferous tubules. AZAN. X 600.
Arrows show degenerating primary spermatogonia.
Arrow with spot shows degenerating secondary spermatogonia.
Arrow with into shows only cell wall of primary spermatogonia.
Arrow with cross shows degenerating germinal epithelium.
Arrow with dash shows degenerating interlobular septa.

Fig. 44. Photomicrograph of T.S. of 10 days endosulfan treated seminal vesicle of *H. fossilis* showing elongated lumen of vesicular tubules. AZAN. X 400.
Arrow shows thickened connective tissue.
Arrows with spot show acute necrosis in columnar cells.

Fig. 45. Photomicrograph of T.S. of 15 days endosulfan treated testis of *H. fossilis* showing compactly arranged seminiferous tubules. AZAN. X 600.
Arrow shows slight recovery in interstitial cells.
Arrow with two spots show normal secondary spermatogonia.
Arrow with three spots shows normal secondary spermatocyte.
Arrow with into shows normal spermatid.
Arrow with cross shows slight recovery in blood capillaries.
Arrows with dash show enlarged nucleus and nucleolus of primary spermatogonia.
Arrow with two dash shows normal primary spermatocyte.

Fig. 46. Photomicrograph of T.S. of 15 days endosulfan treated seminal vesicle of *H. fossilis* showing reduced lumen of vesicular tubules. AZAN. X 400.
Arrows show necrosis in columnar cells.
Arrow with cross shows thickened connective tissue.
Fig. 47. Photomicrograph of T.S. of 30 days endosulfan treated testis of *H. fossilis*. AZAN. X 600.
Arrows show oval shaped and degenerating primary spermatogonia.
Arrow with spot shows necrosis in interstitial cells.
Arrow with two spots shows degenerating germinal epithelium.
Arrow with into shows acute fibrosis and disintegration of interlobular connective tissue septa.
Arrow with cross shows clumped erythrocytes.
Arrow with dash and spot shows ruptured wall of seminiferous tubules.

Fig. 48. Photomicrograph of T.S. of 30 days endosulfan treated testis of *H. fossilis*. AZAN. X 600.
Arrows show oval shaped and degenerating primary spermatogonia.
Arrow with spot shows ruptured peritoneum.
Arrow with into shows scattered spermatocytes, spermatids and sperms with eosinophilic secretion.

Fig. 49. Photomicrograph of T.S. of 30 days endosulfan treated seminal vesicle of *H. fossilis*. AZAN. X 400.
Arrow shows enlarged columnar cells.
Arrow with spot shows fibrosis in connective tissue.

Fig. 50. Photomicrograph of T.S. of control testis of *M. tenagra* showing peritoneum, arrangement of seminiferous tubules and connective tissue septa. AZAN. X 100.
Fig. 51. Photomicrograph of T.S. of control testis of *M. tengara* showing interlobular space, secondary spermatogonia, germinal epithelium and interstitial cells. **AZAN. X 600.**

Fig. 52. Photomicrograph of T.S. of control testis of *M. tengara* showing interstitial cell and blood capillaries. **AZAN. X 600.**

Fig. 53. Photomicrograph of T.S. of control testis of *M. tengara* showing primary spermatocytes, spermatids, sperms and secondary spermatogonia. **AZAN. X 600.**

Fig. 54. Photomicrograph of T.S. of control seminal vesicle of *M. tengara* showing vesicular tubules filled with vesicular fluid and few sperms, secretory epithelial cells, connective tissue septa and blood vessels. **AZAN. X 400.**
Fig. 55. Photomicrograph of T.S. of control seminal vesicle of *M. tengara* showing vesicular tubules filled with vesicular fluid. AZAN. X 400.

Fig. 56. Photomicrograph of T.S. of control seminal vesicle of *M. tengara* showing acidophilic droplets in the cytoplasm of secretory epithelial cells. AZAN. X 400.

Fig. 57. Photomicrograph of T.S. of control seminal vesicle of *M. tengara* showing acidophilic droplets in the cytoplasm of secretory epithelial cells. AZAN. X 400.

Fig. 58. Photomicrograph of T.S. of 4 days carbaryl treated testis of *M. tengara* showing shrunk and deformed seminiferous tubules filled with primary spermatocytes, spermatids and sperms. AZAN. X 600. Arrow shows increased interlobular space.
Fig. 59. Photomicrograph of T.S. of 4 days carbaryl treated seminal vesicle of *M. tengara*. AZAN. X 400.
Arrow shows vesicular fluid.
Arrow with into shows detachment of secretory epithelial cells from tubular wall.

Fig. 60. Photomicrograph of T.S. of 4 days carbaryl treated unaffected seminal vesicle of *M. tengara*. AZAN. X 400.
Arrow shows normal acidophilic droplets.

Fig. 61. Photomicrograph of T.S. of 10 days carbaryl treated testis of *M. tengara*. AZAN. X 600.
Arrow shows fibrosis in connective tissue septa.
Arrow with spot shows thick wall of seminiferous tubule.
Arrow with into shows ruptured wall of seminiferous tubule.

Fig. 62. Photomicrograph of T.S. of 10 days carbaryl treated testis of *M. tengara*. AZAN. X 600.
Arrow shows necrosis in erythrocytes.
Arrow with spot shows degenerating germinal epithelium.
Arrow with two spots shows primary spermatogonia.
Arrow with into shows primary spermatocytes.
Arrow with cross shows necrosis in interstitial cell.
Fig. 63. Photomicrograph of T.S of 10 days carbaryl treated seminal vesicle of M. tengara. AZAN. X 400.
Arrow shows thick connective tissue sheath.
Arrow with into shows small acidophilic droplets.
Arrow with cross shows enlarged secretory epithelial cells.

Fig. 64. Photomicrograph of T.S of 10 days carbaryl treated seminal vesicle of M. tengara. AZAN. X 400.
Arrow shows vesicular fluid in vesicular tubule.

Fig. 65. Photomicrograph of T.S of 15 days carbaryl treated testis of M. tengara. AZAN. X 600.
Arrow shows secondary spermatogonia.
Arrow with spot shows degenerating germinal epithelium.
Arrow with two spots shows thick connective tissue septa.
Arrow with into shows degenerating primary spermatogonia.
Arrow with cross shows primary spermatocytes and eosinophilic secretion in seminiferous tubule.

Fig. 66. Photomicrograph of T.S of 15 days carbaryl treated seminal vesicle of M. tengara. AZAN. X 400.
Arrow shows vesicular fluid in vesicular tubules.
Arrow with spot shows reduction in size of secretory epithelial cells.
Fig. 67. Photomicrograph of T.S. of 15 days carbaryl treated seminal vesicle of *M. tengara*. AZAN. X 400.
Arrow shows fibrosis in connective tissue sheath.
Arrow with cross shows small acidophilic droplets in secretory epithelial cells.

Fig. 68. Photomicrograph of T.S. of 30 days carbaryl treated testis of *M. tengara* showing shrunk seminiferous tubules. AZAN. X 600.
Arrow shows shrunk primary spermatogonia.
Arrow with spot shows sperms.
Arrow with cross shows primary spermatocytes.

Fig. 69. Photomicrograph of T.S. of 30 days carbaryl treated seminal vesicle of *M. tengara* showing shrunk and deformed vesicular tubules. AZAN. X 400.
Arrows show ruptured connective tissue sheath.
Arrow with spot shows ruptured secretory epithelial cells.

Fig. 70. Photomicrograph of T.S. of 30 days carbaryl treated seminal vesicle of *M. tengara*. AZAN. X 400.
Arrows show acidophilic droplets in secretory epithelial cells.
Arrow with into shows vesicular fluid with few sperms.
Fig. 71. Photomicrograph of T.S. of 4 days malathion treated testis of M. tengara. AZAN. X 600.

Arrow shows thick connective tissue septa and wall of seminiferous tubule.

Arrows with spot show primary spermatocytes.

Fig. 72. Photomicrograph of T.S. of 4 days malathion treated seminal vesicle of M. tengara. AZAN. X 400.

Arrow shows vesicular fluid in vesicular tubules.

Arrow with spot shows acidophilic droplets in secretory epithelial cell.

Arrow with into shows normal connective tissue sheath.

Arrow with cross shows normal secretory epithelial cell.

Fig. 73. Photomicrograph of T.S. of 10 days malathion treated testis of M. tengara. AZAN. X 600.

Arrow shows damaged primary spermatogonia.

Arrow with spot shows acute necrosis in interstitial cells.

Arrows with into show fibrosis in wall of seminiferous tubule and connective tissue septa.

Arrow with cross shows degenerating primary spermatogonia.

Fig. 74. Photomicrograph of T.S. of 10 days malathion treated unaffected seminal vesicle of M. tengara. AZAN. X 400.

Arrow shows normal connective tissue sheath.

Arrow with into shows normal secretory epithelial cells.

Arrow with dash shows vesicular fluid in vesicular tubules.
Fig. 75. Photomicrograph of T.S. of 10 days malathion treated unaffected seminal vesicle of M. tengara. AZAN. X 400.
Arrow shows acidophilic droplets of various size in secretory epithelial cells.

Fig. 76. Photomicrograph of T.S. of 15 days malathion treated testis of M. tengara showing seminiferous tubules filled with sperms, spermatids, primary spermatocytes and secondary spermatogonia. AZAN. X 600.
Arrow shows fibrosis in connective tissue septa and wall of seminiferous tubule.
Arrow with spot shows normal spermatid.
Arrow with two spots shows normal secondary spermatogonia.
Arrow with into shows normal primary spermatocyte.
Arrow with cross shows sperms.

Fig. 77. Photomicrograph of T.S. of 15 days malathion treated seminal vesicle of M. tengara. AZAN. X 400.
Arrow shows secretory epithelial cells.
Arrow with spot shows extensive fibrosis in connective tissue sheath.
Arrow with dash shows little vesicular fluid and few sperms in vesicular tubules.

Fig. 78. Photomicrograph of T.S. of 30 days malathion treated testis of M. tengara showing seminiferous tubule filled with spermatids and sperms. AZAN. X 600.
Arrow shows sperm.
Arrow with into shows spermatid.
Arrow with cross shows inactive connective tissue septa.
Fig. 79. Photomicrograph of T.S of 30 days malathion treated seminal vesicle of *M. tengara* showing reduced vesicular tubules. **AZAN. X 400.**

Arrow shows little vesicular fluid.
Arrow with into shows few small acidophilic droplets in the epithelial cells.
Arrows with cross show secretory epithelial cells.

Fig. 80 Photomicrograph of T.S of 4 days BHC treated testis of *M. tengara* showing shrunk seminiferous tubules. **AZAN. X 600.**

Arrow shows clumped spermatocytes, spermatids and sperms.
Arrows with into show increased interlobular space.
Arrow with cross shows thick wall of seminiferous tubules and connective tissue septa.

Fig. 81. Photomicrograph of T.S of 4 days BHC treated seminal vesicle of *M. tengara* showing shrunk vesicular tubules. **AZAN. X 400.**

Arrow shows little vesicular fluid in the vesicular tubule.
Arrow with spot shows fibrosis in connective tissue septa.
Arrow with into shows detachment of secretory epithelial cells from vesicular wall.
Arrow with cross shows necrosis of secretory epithelial cells.
Arrow with dash shows few acidophilic droplets in epithelial cells.

Fig. 82. Photomicrograph of T.S of 4 days BHC treated seminal vesicle of *M. tengara* showing separation of vesicular tubules from each other. **AZAN. X 400.**

Arrow shows broken connective tissue septa.
Fig. 83. Photomicrograph of T.S. of 10 days BHC treated testis of *M. tengara* showing reduced seminiferous tubules. AZAN. X 600.

Arrows show inactive nature and fibrosis of connective tissue septa.

Arrow with spot shows atrophied interstitial cell.

Arrows with into show clumped primary spermatocytes and spermatids.

Fig. 84. Photomicrograph of T.S. of 10 days BHC treated seminal vesicle of *M. tengara*. AZAN. X 400.

Arrow shows normal secretory epithelial cell.

Arrow with spot shows extensive fibrosis in connective tissue septa.

Arrow with into shows vesicular fluid in the vesicular tubules.

Fig. 85. Photomicrograph of T.S. of 10 days BHC treated seminal vesicle of *M. tengara*. AZAN. X 400.

Arrows show acidophilic droplets in secretory epithelial cell.

Arrow with spot shows extensive fibrosis in connective tissue septa.

Fig. 86. Photomicrograph of T.S. of 15 days BHC treated testis of *M. tengara* showing seminiferous tubules filled with primary spermatocytes, spermatids and sperms. AZAN. X 600.

Arrow shows broken wall of seminiferous tubule.

Arrow with spot shows thick connective tissue septa.

Arrow with into shows primary spermatocyte.
Fig. 87. Photomicrograph of T.S. of 15 days BHC treated seminal vesicle of *M. tengara*. AZAN. X 400.
Arrow shows acidophilic droplets in secretory epithelial cells.
Arrow with spot shows normal connective tissue septa.
Arrow with into shows normal secretory epithelial cell.

Fig. 88. Photomicrograph of T.S. of 30 days BHC treated testis of *M. tengara* showing reduction in size of seminiferous tubules. AZAN. X 600.
Arrows show primary spermatocytes in seminiferous tubule.
Arrow with into shows inactive and acute fibrosis condition of connective tissue septa.

Fig. 89. Photomicrograph of T.S. of 30 days BHC treated seminal vesicle of *M. tengara* showing shrunken and deformed vesicular tubules. AZAN. X 400.
Arrow shows degenerating secretory epithelial cell.
Arrow with spot shows extensive fibrosis in connective tissue septa.
Arrow with into shows little vesicular fluid in vesicular tubule.

Fig. 90. Photomicrograph of T.S. of control testis of *A. testudineus* showing peritoneum arrangement of seminiferous tubules and connective tissue septa. AZAN. X 100.
Fig. 91. Photomicrograph of T.S. of control testis of *A. testudineus* showing cysts containing primary and secondary spermatocytes. AZAN. X 600.

Fig. 92. Photomicrograph of T.S. of control testis of *A. testudineus* showing germinal epithelium, primary and secondary spermatogonia, primary spermatocyte, spermatids, sperms, interlobular space, interstitial cells and blood capillaries. AZAN. X 600.

Fig. 93. Photomicrograph of T.S. of 4 days carbaryl treated testis of *A. testudineus*. AZAN. X 600.

Arrows show thin and ruptured wall of seminiferous tubule.

Arrows with spot show shrunk primary spermatocytes.

Arrow with into shows clumped sperm.

Fig. 94. Photomicrograph of T.S. of 10 days carbaryl treated testis of *A. testudineus*. AZAN. X 600.

Arrows show shrunk and damaged primary spermatogonia.

Arrow with spot shows completely ruptured connective tissue septa and wall of seminiferous tubule.

Arrow with into shows degenerating germinal epithelium.
Fig. 95. Photomicrograph of T.S. of 10 days carbaryl treated testis of *A. testudineus*. AZAN. X 600.

Arrow shows clumped spermatocytes, spermatids and sperms.

Fig. 96. Photomicrograph of T.S. of 15 days carbaryl treated testis of *A. testudineus*. AZAN. X 600.

Arrow shows normal seminiferous tubule wall and connective tissue septa.

Arrow with spot shows reduction in size of primary spermatocyte.

Arrow with into shows normal interstitial cell.

Arrow with dash shows reduction in size of primary spermatogonia.

Fig. 97. Photomicrograph of T.S. of 30 days carbaryl treated testis of *A. testudineus*. AZAN. X 600.

Arrows show degenerating germinal epithelium and wall of seminiferous tubules.

Arrow with spot shows sperms.

Arrow with two spots shows formation of spaces in between the seminiferous tubules.

Arrow with into shows clumped erythrocytes.

Arrow with cross shows enlarged nucleus of primary spermatogonia.

Arrow with dash shows shrunk interstitial cell.

Arrow with dash and spot shows degenerating primary spermatogonia.

Fig. 98. Photomicrograph of T.S. of 30 days carbaryl treated testis of *A. testudineus* showing reduction in size of seminiferous tubules. AZAN. X 100.
Fig. 099. Photomicrograph of T.S. of 4 days malathion treated testis of *A. testudineus*. AZAN. X 600.
Arrow shows necrosis in interstitial cell.
Arrow with into shows spermatocytes, spermatids and sperms in seminiferous tubule.

Fig. 100. Photomicrograph of T.S. of 10 days malathion treated testis of *A. testudineus*. AZAN. X 600.
Arrow shows oval shaped nucleus of primary spermatogonia.
Arrow with spot shows normal secondary spermatogonia.
Arrow with two spots shows normal spermatids and sperms.
Arrow with into shows normal primary spermatocytes.
Arrows with cross show degeneration and rupture of wall of primary spermatogonia.
Arrow with dash and spot shows normal secondary spermatocytes.

Fig. 101. Photomicrograph of T.S. of 15 days malathion treated testis of *A. testudineus*. AZAN. X 600.
Arrows show thick wall of seminiferous tubules.
Arrow with spot shows normal primary spermatocyte.
Arrows with into show enlarged cytoplasm of primary spermatogonia.
Arrow with cross shows normal spermatid.
Arrow with dash shows normal secondary spermatocyte.
Arrow with dash and spot shows sperms.

Fig. 102. Photomicrograph of T.S. of 30 days malathion treated testis of *A. testudineus*. AZAN. X 600.
Arrow shows ruptured wall of seminiferous tubule.
Arrow with into shows clumped spermatocytes, spermatids and sperms.
Arrows with dash show hypertrophy and deformities in shape in primary spermatogonia.
Fig. 103. Photomicrograph of T.S. of 30 days malathion treated testis of *A. testudineus*. AZAN. X 600.

Arrows show complete degeneration of wall of seminiferous tubule and germinal epithelium.

Arrow with into shows degenerating germinal epithelium.

Arrow with cross shows degenerating interstitial cell.

Arrow with dash shows hypertrophy and deformities in shape in primary spermatogonia.

Fig. 104. Photomicrograph of T.S. of 4 days BHC treated testis of *A. testudineus* showing seminiferous tubules filled with spermatogonia, spermatocytes, spermatids and sperms. AZAN. X 600.

Arrow shows normal primary spermatogonia.

Arrows with spot show primary spermatocytes.

Fig. 105. Photomicrograph of T.S. of 10 days BHC treated unaffected testis of *A. testudineus*. AZAN. X 600.

Arrow shows normal primary spermatocyte.

Arrow with spot shows normal sperms.

Arrow with into shows normal spermatids.

Arrow with cross shows normal secondary spermatocytes.

Fig. 106. Photomicrograph of T.S. of 15 days BHC treated testis of *A. testudineus* showing seminiferous tubules filled with primary and secondary spermatocytes, spermatids and sperms. AZAN. X 600.

Arrow shows thick wall of seminiferous tubule.

Arrow with spot shows necrosis in interstitial cell.
Fig. 107. Photomicrograph of T.S. of 30 days BHC treated testis of *A. testudineus*. AZAN. X 600.

- Arrows show reduction in size of primary spermatogonia.
- Arrow with spot shows secondary spermatocyte.
- Arrow with into shows acute necrosis in interstitial cell.
- Arrow with cross shows reduction in size of primary spermatocyte.

Fig. 108. Photomicrograph of T.S. of ovary of control *H. fossilis* showing ovarian wall and lumen containing large number of ova. AZAN. X 100.

Fig. 109. Photomicrograph of T.S. of ovary wall of control *H. fossilis* showing peritoneum, tunica albuginea, blood vessel and germinal epithelium. AZAN. X 400.

Fig. 110. Photomicrograph of T.S. of ovary of control *H. fossilis* showing ovigerous lamellae, different stages of oocyte and chromaffin tissue. AZAN. X 100.
Fig. 111. Photomicrograph of T.S. of ovary of control H. fossilis showing oocytes - II, III, IV and chromaffin tissue. AZAN. X 280.

Fig. 112. Photomicrograph of T.S. of ovary of control H. fossilis showing oogonia. AZAN. X 280.

Fig. 113. Photomicrograph of T.S. of ovary of control H. fossilis showing oocyte - III stage. AZAN. X 280.

Fig. 114. Photomicrograph of T.S. of ovary of control H. fossilis showing nuclear extrusion and yolk nucleus in oocyte IV stage. AZAN. X 100.
Fig. 115. Photomicrograph of T.S. of ovary of control H. fossilis showing yolk vacuoles and undulated nuclear membrane in oocyte IV stage. AZAN. X 280.

Fig. 116. Photomicrograph of T.S. of ovary of control H. fossilis showing nucleoli in the ooplasm of oocyte IV stage. AZAN. X 280.

Fig. 117. Photomicrograph of T.S. of ovary wall of 30 days control H. fossilis showing peritoneum, tunica albuginea, blood vessel and germinal epithelium. AZAN. X 400.

Fig. 118. Photomicrograph of T.S. of ovary of 30 days control H. fossilis showing oocytes I, II and III. AZAN. X 100.
Fig. 119. Photomicrograph of T.S. of ovary of 30 days control H. fossilis showing oocyte IV stage. AZAN. X 100.

Fig. 120. Photomicrograph of T.S. of 4 days carbaryl treated ovary wall of H. fossilis. AZAN. X 400.

Arrow shows broken peritoneum.
Arrow with spot shows enlarged blood vessel.
Arrow with into shows compact tunica albuginea.

Fig. 121. Photomicrograph of T.S. of 4 days carbaryl treated ovary of H. fossilis. AZAN. X 100.

Arrow shows deformed stage III oocyte.
Arrow with spot shows deformed stage IV oocyte.
Arrow with into shows normal stage I oocyte.
Arrow with dash shows normal stage II oocyte.

Fig. 122. Photomicrograph of T.S. of 4 days carbaryl treated ovary of H. fossilis. AZAN. X 280.

Arrow shows ruptured follicular layer and wrinkled appearance of margin of stage III oocyte.
Arrow with spot shows broken ovigerous lamellae.
Arrow with into shows acute shrinkage in chromaffin tissue.
Arrow with cross shows acute shrinkage in oogonia.
Fig. 123. Photomicrograph of T.S. of 10 days carbaryl treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows degenerating nuclear material in stage IV oocyte.

Arrow with spot shows withdrawal of cytoplasm from the follicular layer in stage IV oocyte.

Arrow with into shows enlarged nucleus of stage IV oocyte.

Arrow with cross shows normal ovigerous lamellae.

Arrow with dash shows hood like appearance of cytoplasm of stage III oocyte.

Arrow with two dash shows enlarged nucleus of stage III oocyte.

Fig. 124. Photomicrograph of T.S. of 10 days carbaryl treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows degenerating nuclear material in stage III oocyte.

Arrow with spot shows normal chromaffin tissue.

Arrow with into shows withdrawal of cytoplasm from the follicular layer of stage III oocyte.

Arrow with cross shows hood like appearance of cytoplasm of stage II oocyte.

Arrow with dash shows normal stage I oocyte.

Fig. 125. Photomicrograph of T.S. of 10 days carbaryl treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows degenerating nuclear material in stage IV oocyte.

Arrow with into shows withdrawal of cytoplasm from the follicular layer of stage IV oocyte.

Fig. 126. Photomicrograph of T.S. of 10 days carbaryl treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows elongated blood vessel.

Arrow with into shows thick tunica albuginea.
Fig. 127. Photomicrograph of T.S. of 15 days carbaryl treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrows show thick fibrous part of tunica albuginea detached from germinal epithelium.

Arrow with into shows reduced blood vessels with few clumped erythrocytes.

Fig. 128. Photomicrograph of T.S. of 15 days carbaryl treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows migration of nucleus to the periphery in stage III oocyte.

Arrows with spot show irregular shaped stage II oocyte with big nucleus and reduced cytoplasm.

Arrow with two spots shows broken ovigerous lamellae.

Fig. 129. Photomicrograph of T.S. of 15 days carbaryl treated ovary of *H. fossilis*. AZAN. X 280.

Arrows show degenerating follicular layer and cytoplasm of stage IV oocyte.

Fig. 130. Photomicrograph of T.S. of 30 days carbaryl treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows fibrosis in ovary wall.

Arrow with into shows broken germinal epithelium.

Arrow with cross shows swollen blood vessel with an increase in number of erythrocytes.
Fig. 131. Photomicrograph of T.S. of 30 days carbaryl treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows reduced cytoplasm and irregular shape of stage II oocyte.
Arrow with spot shows disintegration of nuclear material in stage III oocyte.
Arrow with two spots shows damage in the cytoplasm of stage IV oocyte.
Arrow with into shows disintegration of nuclear material in stage IV oocyte.
Arrow with cross shows degenerating ovigerous lamellae.
Arrow with dash shows damaged cytoplasm of stage III oocyte.

Fig. 132. Photomicrograph of T.S. of 30 days carbaryl treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows shrunk chromaffin tissue.
Arrow with into shows degenerating ovigerous lamellae.

Fig. 133. Photomicrograph of T.S. of 30 days carbaryl treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows rupture and detachment of follicular layer from the cytoplasm in stage IV oocyte.
Arrow with into shows rupture and detachment of follicular layer from the cytoplasm in stage III oocyte.

Fig. 134. Photomicrograph of T.S. of 4 days malathion treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows compact appearance of ovarian wall.
Arrow with into shows hypertrophy of blood vessel.
Fig. 135. Photomicrograph of T.S. of 4 days malathion treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows normal ovigerous lamellae.
Arrow with spot shows normal stage IV oocyte.
Arrow with into shows normal chromaffin tissue.
Arrows with cross show reduced cytoplasm in stage II oocyte.
Arrow with dash shows migration of nucleus to the periphery and disintegration of nuclear material in stage III oocyte.

Fig. 136. Photomicrograph of T.S. of 10 days malathion treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows ruptured peritoneum.
Arrow with into shows shrunk blood vessel with clumped erythrocytes.

Page 137. Photomicrograph of T.S. of 10 days malathion treated ovary of *H. fossilis* showing an increase in number of stage II oocyte. AZAN. X 100.

Arrow shows normal ovigerous lamellae.
Arrow with spot shows normal chromaffin tissue.
Arrow with into shows cytoplasmic vacuolization in stage II oocyte.


Arrow shows normal stage I oocyte.
Arrow with spot shows stage IV oocyte.
Arrow with into shows normal stage II oocyte.
Arrow with dash shows elongated stage III oocyte.
Fig. 139. Photomicrograph of T.S. of 10 days malathion treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows reduction in size of nucleus of stage IV oocyte.

Arrow with into shows degenerating follicular epithelium of stage IV oocyte.

Fig. 140. Photomicrograph of T.S. of 15 days malathion treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows compact tunica albuginea.

Arrow with into shows ruptured germinal epithelium.

Arrow with cross shows reduced blood vessel.

Fig. 141. Photomicrograph of T.S. of 15 days malathion treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows ruptured ovigerous lamellae.

Arrow with into shows cytoplasmic vacuolization and migration of nucleus to the periphery in stage II oocyte.

Fig. 142. Photomicrograph of T.S. of 15 days malathion treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows nucleus of stage II oocyte without nuclear material.

Arrow with spot shows reduced nucleus and ruptured follicular epithelium of stage IV oocyte.

Arrow with dash shows reduction in size of stage I oocyte.

Arrow with into shows deformities in shape and migration of nucleus to the periphery in stage III oocyte.
Fig. 143. Photomicrograph of T.S. of 30 days malathion treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows atretic oocytes.
Arrow with spot shows normal chromaffin tissue.
Arrow with two spots shows normal stage II oocyte.
Arrow with into shows normal stage III oocyte.

Fig. 144. Photomicrograph of T.S. of 30 days malathion treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows thick ovary wall.
Arrow with into shows reduced blood vessel.

Fig. 145. Photomicrograph of T.S. of 30 days malathion treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows normal stage I oocyte.
Arrow with spot shows normal ovigerous lamellae.
Arrow with cross shows normal stage IV oocyte.

Fig. 146. Photomicrograph of T.S. of 4 days EHC treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows thick ovary wall.
Arrow with into shows reduced blood vessel.
Fig. 147. Photomicrograph of T.S. of 4 days BHC treated ovary of *H. fossilis* showing increased interfollicular space. AZAN. X 100.

Arrow shows broken oвigious lamellae.
Arrow with spot shows migration of nucleus to the periphery in stage II oocyte.
Arrow with into shows slight reduction in size of stage I oocyte.
Arrow with dash shows chromaffin tissue.

Fig. 148. Photomicrograph of T.S. of 4 days BHC treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows degenerating follicular epithelium in stage III oocyte.
Arrow with spot shows thin follicular epithelium of stage IV oocyte.

Fig. 149. Photomicrograph of T.S. of 4 days BHC treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows slight reduction in size of oogonia.

Fig. 150. Photomicrograph of T.S. of 10 days BHC treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows thick ovary wall.
Arrow with into shows abnormal swelling and thick wall of blood vessel.
Fig. 151. Photomicrograph of T.S. of 10 days BHC treated ovary of H. fossils showing reduction in number of stage I oocyte. AZAN. X 100.

Arrow shows normal chromaffin tissue.
Arrow with spot shows degeneration of nuclear material in stage IV oocyte.
Arrow with two spots shows degeneration of nuclear material in stage II oocyte.
Arrow with into shows degeneration of nuclear material in stage III oocyte.
Arrow with cross shows normal ovigerous lamellae.

Fig. 152. Photomicrograph of T.S. of 10 days BHC treated ovary of H. fossils. AZAN. X 280.

Arrow shows degenerating oogonia.

Fig. 153. Photomicrograph of T.S. of 15 days BHC treated ovary wall of H. fossils. AZAN. X 400.

Arrow shows ruptured peritoneum.
Arrow with spot shows compact ovary wall.
Arrow with into shows swollen blood vessel having clumped and hypertrophied erythrocytes.
Arrow with dash shows degenerating germinal epithelium.

Fig. 154. Photomicrograph of T.S. of 15 days BHC treated ovary of H. fossils. AZAN. X 100.

Arrow shows vacuolization and clumping of cytoplasm in stage III oocyte.
Arrows with spot show vacuolization and clumping of cytoplasm in stage II oocyte.
Arrow with cross shows degenerating ovigerous lamellae.
Fig. 155. Photomicrograph of T.S. of 15 days BHC treated ovary of *H. fossilis*. AZAN. X 100.

Arrow shows increased interfollicular space.

Arrows with spot show shrunk stage I oocyte.

Fig. 156. Photomicrograph of T.S. of 15 days BHC treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows degenerating follicular layer of stage IV oocyte.

Fig. 157. Photomicrograph of T.S. of 15 days BHC treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows degenerating oogonia.

Arrow with spot shows degenerating follicular layer at stage III oocyte.

Arrow with cross shows shrunk chromaffin tissue.

Fig. 158. Photomicrograph of T.S. of 30 days BHC treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows compact ovary wall.
Fig. 159. Photomicrograph of T.S. of 30 days BHC treated ovary of *H. fossilis* showing absence of stage IV oocyte. AZAN. X 100.

Arrow shows stage II oocyte.
Arrows with spot shows stage III oocyte.
Arrow with dash shows degenerating ovigerous lamellae.

Fig. 160. Photomicrograph of T.S. of 30 days BHC treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows degenerating follicular layer of stage III oocyte.
Arrow with spot shows degenerating oogonia.

Fig. 161. Photomicrograph of T.S. of 4 days endosulfan treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows ruptured peritoneum.
Arrow with spot shows thick and enlarged blood vessel with few clumped erythrocytes.
Arrow with two spots shows detachment of germinal epithelium from tunica albuginea.
Arrow with cross shows thick tunica albuginea.

Fig. 162. Photomicrograph of T.S. of 4 days endosulfan treated ovary of *H. fossilis*. AZAN.X 100.

Arrow shows clumped cytoplasm in stage II oocyte.
Arrow with spot shows broken ovigerous lamellae.
Arrow with into shows clumped cytoplasm in stage IV oocyte.
Arrow with cross shows clumped cytoplasm in stage III oocyte.
Arrow with dash shows clumped cytoplasm in stage I oocyte.
Fig. 163. Photomicrograph of T.S. of 4 days endosulfan treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows badly damaged chromaffin tissue.
Arrow with spot shows shrinkage and deformity in shape of oogonia.
Arrow with cross shows wrinkled appearance of follicular layer of stage III oocyte.
Arrow with dash shows wrinkled appearance of follicular layer of stage IV oocyte.

Fig. 164. Photomicrograph of T.S. of 10 days endosulfan treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows ruptured germinal epithelium.
Arrow with spot shows thick fibrous part of tunica albuginea.
Arrow with into shows enlarged blood vessel.

Fig. 165. Photomicrograph of T.S. of 10 days endosulfan treated ovary of *H. fossilis* showing increased interfollicular space. AZAN. X 100.

Arrow shows reduction in size of stage I oocyte.
Arrow with cross shows deformities in shape in stage III oocyte.

Fig. 166. Photomicrograph of T.S. of 15 days endosulfan treated ovary wall of *H. fossilis*. AZAN. X 400.

Arrow shows thick ovary wall.
Arrow with into shows thick and enlarged blood vessel.
Fig. 167. Photomicrograph of T.S. of 15 days endosulfan treated ovary of H. fossilis showing compactly arranged and elongated appearance of all stages of oocytes. AZAN. X 100.

Arrow shows reduced nucleus and degenerating nuclear material in stage III oocyte.

Arrows with spot show broken ovigerous lamellae.

Arrow with into shows elongated appearance of stage II oocyte.

Arrow with cross shows elongated appearance of stage IV oocyte.

Arrow with dash shows normal chromaffin tissue.

Fig. 168. Photomicrograph of T.S. of 15 days endosulfan treated ovary of H. fossilis. AZAN. X 280.

Arrow shows degenerating follicular layer in stage IV oocyte.

Arrow with spot shows degenerating follicular layer in stage III oocyte.

Arrow with dash shows acute shrinkage of oogonia.

Fig. 169. Photomicrograph of T.S. of 30 days endosulfan treated unaffected ovary wall of H. fossilis. (Arrow). AZAN. X 400.

Fig. 170. Photomicrograph of T.S. of 30 days endosulfan treated ovary of H. fossilis showing ovocoeel filled with mostly stage I and II oocytes. AZAN. X 100.

Arrow shows stage II oocyte.

Arrow with cross shows stage I oocyte.
Fig. 171. Photomicrograph of T.S. of 30 days endosulfan treated ovary of *H. fossilis*. AZAN. X 280.

Arrows show shrunk oogonia.

Fig. 172. Photomicrograph of T.S. of 30 days endosulfan treated ovary of *H. fossilis*. AZAN. X 100.

Arrows show enlarged nucleus in stage II oocyte.

Arrow with cross shows degenerating cytoplasm of stage III oocyte.

Fig. 173. Photomicrograph of T.S. of 30 days endosulfan treated ovary of *H. fossilis*. AZAN. X 280.

Arrow shows degenerating follicular epithelium, cytoplasm and nucleus of stage IV oocyte.

Fig. 174. Photomicrograph of T.S. of 30 days endosulfan treated ovary of *H. fossilis*. AZAN. X 280.

Arrows show degenerating follicular layer of stage III oocyte.

Arrow with spot shows unaffected ovigerous lamellae and chromaffin tissue.
Fig. 175. Photomicrograph of T.S. of ovary of control M. tengara showing peritoneum, oogonia, stage I oocyte, residual eggs, chromaffin tissue and corpora atretica. AZAN. X 150.

Fig. 176. Photomicrograph of T.S. of ovary wall of control M. tengara showing peritoneum, tunica albuginea, blood vessel and germinal epithelium. AZAN. X 400.

Fig. 177. Photomicrograph of T.S. of ovary of control M. tengara showing ovigerous lamellae, stage I and II oocytes. AZAN. X 150.

Fig. 178. Photomicrograph of T.S. of ovary of control M. tengara showing chromaffin tissue near the tunica albuginea and along the ovigerous lamellae. AZAN. X 280.
Fig. 179. Photomicrograph of T.S. of ovary of control *M. tengara* showing oogonia.  AZAN. X 280.

Fig. 180 Photomicrograph of T.S. of 4 days carbaryl treated ovary wall of *M. tengara*.  AZAN. X 400.

Arrow shows enlarged blood vessel.

Arrows with cross show fibrosis in tunica albuginea.

Fig. 181. Photomicrograph of T.S. of 4 days carbaryl treated ovary of *M. tengara*.  AZAN. X 150.

Arrow shows unaffected stage II oocyte.

Arrow with spot shows unaffected corpora atretica.

Arrow with two spots shows unaffected ovigerous lamellae and oogonia.

Arrow with into shows unaffected chromaffin tissue.

Arrow with cross shows unaffected stage I oocyte.

Arrow with dash shows unaffected residual egg.

Fig. 182. Photomicrograph of T.S. of 10 days carbaryl treated ovary wall of *M. tengara*.  AZAN. X 400.

Arrow shows broken peritoneum.

Arrow with spot shows reduced blood vessel with few erythrocytes.

Arrow with cross shows degeneration of tunica albuginea.
Fig. 183. Photomicrograph of T.S. of 10 days carbaryl treated ovary of *M. tengara*.  AZAN. X 150.

Arrows show cytoplasmic clumping and migration of nucleus to the periphery in stage II oocyte.

Arrow with spot shows on increase in number of chromaffin tissue.

Arrow with into shows ruptured ovigerous lamellae.

Fig. 184. Photomicrograph of T.S. of 15 days carbaryl treated ovary wall of *M. tengara*.  AZAN. X 400.

Arrow shows fibrosis in ovary wall.

Arrows with spot show reduced blood vessels with few erythrocytes.

Fig. 185. Photomicrograph of T.S. of 15 days carbaryl treated ovary of *M. tengara* showing reduction in number of stage I and II oocytes.  HE. X 150.

Arrow shows ovigerous lamellae.

Arrow with spot shows stage II oocyte.

Arrow with into shows corpora atretica.

Arrow with cross shows unaffected chromaffin tissue.

Fig. 186 Photomicrograph of T.S. of 30 days carbaryl treated ovary wall of *M. tengara*.  AZAN. X 400.

Arrow shows fibrosis in tunica albuginea.

Arrow with spot shows slight reduction in size of blood vessel.

Arrows with cross show an increase in number of chromaffin tissue seen near the germinal epithelium.
Fig. 187. Photomicrograph of T.S. of 30 days carbaryl treated ovary of *M. tengara* showing reduction in number of stage I and II oocytes. HE. X 150.

Arrow shows stage II oocyte in the process of atresia.

Arrow with spot shows stage I oocyte.

Arrows with into shows increased interfollicular space.

Arrow with cross shows stage II oocyte.

Fig. 188. Photomicrograph of T.S. of 4 days malathion treated ovary wall of *M. tengara* showing abnormal swelling of blood vessel(Arrow). AZAN. X 400.

Fig. 189. Photomicrograph of T.S. of 4 days malathion treated ovary of *M. tengara*. AZAN. X 150.

Arrow shows poor staining of cytoplasm of stage I oocyte.

Arrow with spot shows poor staining of cytoplasm of stage II oocyte.

Arrow with into shows comparatively less active nuclear material in stage I oocyte.

Arrows with cross show comparatively less active nuclear material in stage II oocyte.

Fig. 190. Photomicrograph of T.S. of 10 days malathion treated ovary wall of *M. tengara*. AZAN. X 400.

Arrow shows swollen blood vessel with an increase in number of erythrocytes.

Arrow with spot shows thick and broken ovary wall.
Fig. 191. Photomicrograph of T.S. of 10 days malathion treated ovary of *M. tengara* showing reduction in number of stage I and II oocytes. HE. X 150.

Arrow shows reduction in size of stage II oocyte.
Arrow with spot shows unaffected chromaffin tissue.
Arrow with into shows normal ovigerous lamellae and oogonia.
Arrow with cross shows reduction in size of stage I oocyte.
Arrow with dash shows corpora atretica.

Fig. 192. Photomicrograph of T.S. of 15 days malathion treated ovary wall of *M. tengara*. AZAN. X 400.

Arrow shows enlarged blood vessel.
Arrow with spot shows an increase in number of erythrocytes.
Arrow with into shows fibrosis in the tunica albuginea.

Fig. 193. Photomicrograph of T.S. of 15 days malathion treated ovary of *M. tengara* showing reduction in number of stage I and II oocytes. AZAN. X 150.

Arrows show an increase in number of corpora atretica.
Arrows with into show cytoplasmic clumping in stage II oocytes.
Arrow with cross shows stage I oocyte.

Fig. 194. Photomicrograph of T.S. of 30 days malathion treated ovary wall of *M. tengara*. AZAN. X 400.

Arrow shows fibrosis in tunica albuginea.
Arrow with into shows broken peritoneum.
Arrow with cross shows dilated blood vessel with few erythrocytes.
Fig. 195. Photomicrograph of T.S. of 30 days malathion treated ovary of *M. tengara* showing reduction in number of stage II oocyte. AZAN. X 150.

Arrow shows degenerating ovigerous lamellae and oogonia.

Arrow with into shows necrosis and reduction in the size of nucleus in stage II oocyte.

Arrow with cross shows necrosis in stage I oocyte.

Arrows with dash show residual eggs.

Fig. 196. Photomicrograph of T.S. of 30 days malathion treated ovary of *M. tengara* showing degenerating oogonia (Arrow). AZAN. X 280.

Fig. 197. Photomicrograph of T.S. of 4 days BHC treated ovary wall of *M. tengara*. AZAN. X 400.

Arrow shows compact ovary wall.

Arrow with spot shows reduced blood vessel.

Fig. 198. Photomicrograph of T.S. of 4 days BHC treated ovary of *M. tengara* showing ruptured ovigerous lamellae (Arrows). AZAN. X 150.
Fig. 199. Photomicrograph of T.S. of 4 days BHC treated ovary of *M. tengara* showing scattered oogonia, stage I and II oocytes, corpora atretica, residual eggs, chromaffin tissue and ruptured ovigerous lamellae. AZAN. X 150.

Fig. 200. Photomicrograph of T.S. of 10 days BHC treated ovary wall of *M. tengara*. AZAN. X 400.

Arrows show compact and ruptured ovary wall.
Arrow with cross shows reduced blood vessel.

Fig. 201. Photomicrograph of T.S. of 10 days BHC treated ovary of *M. tengara*. AZAN. X 280.

Arrows show degenerating ovigerous lamellae and oogonia.

Fig. 202. Photomicrograph of T.S. of 10 days BHC treated ovary of *M. tengara*. AZAN. X 150.

Arrow shows acute shrinkage and deformity in shape in stage I oocyte.
Arrow with spot shows degenerating chromaffin tissue.
Arrow with into shows degenerating ovigerous lamellae.
Arrow with cross shows acute shrinkage, reduction in size of nucleus and deformity in shape in stage II oocyte.
Fig. 203. Photomicrograph of T.S. of 15 days BHC treated ovary wall of *M. tengara*. AZAN. X 400.

Arrow shows thick ovary wall.
Arrow with cross shows reduced blood vessel.

Fig. 204. Photomicrograph of T.S. of 15 days BHC treated ovary of *M. tengara* showing much decrease in number of stage II oocyte. AZAN. X 150.

Arrows show degeneration of ovigerous lamellae and oogonia.
Arrow with spot shows reduction in the cytoplasm and size of nucleus of stage II oocyte.
Arrow with into shows unaffected chromaffin tissue.
Arrow with cross show stage I oocyte.

Fig. 205. Photomicrograph of T.S. of 30 days BHC treated ovary of *M. tengara* showing slight recovery. AZAN. X 150.

Arrows show broken ovigerous lamellae.
Arrow with spot shows degenerating chromaffin tissue.
Arrow with two spots shows normal stage I oocyte.
Arrow with into shows normal stage II oocyte.

Fig. 206. Photomicrograph of T.S. of 30 days BHC treated ovary of *M. tengara* showing normal oogonia (Arrow). AZAN. X 280.
Fig. 207. Photomicrograph of T.S. of 30 days BHC treated ovary wall of *M. tengara*. AZAN. X 400.

Arrow shows ruptured peritoneum.
Arrow with spot shows enlarged blood vessel with hypertrophied erythrocytes.

Fig. 208. Photomicrograph of T.S. of ovary of control *A. testudineus* showing ovary wall, immature, maturing, mature and atretic oocytes. AZAN. X 100.

Fig. 209. Photomicrograph of T.S. of ovary wall of control *A. testudineus* showing peritoneum, tunica albuginea and germinal epithelium. AZAN. X 400.

Fig. 210. Photomicrograph of T.S. of ovary of control *A. testudineus* showing blood vessel in ovary wall and maturing oocyte. AZAN. X 400.
Fig. 211. Photomicrograph of T.S. of ovary of control A. testudineus showing mature oocytes. AZAN. X 100.

Fig. 212. Photomicrograph of T.S. of 4 days carbaryl treated ovary wall of A. testudineus. AZAN. X 400.

Arrow shows compact ovary wall.
Arrow with spot shows ruptured peritoneum.

Fig. 213. Photomicrograph of T.S. of 4 days carbaryl treated ovary of A. testudineus. AZAN. X 100.

Arrow shows interfollicular space.
Arrow with spot shows immature oocytes.
Arrow with into shows maturing oocyte.

Fig. 214. Photomicrograph of T.S. of 4 days carbaryl treated ovary of A. testudineus. AZAN. X 100.

Arrow shows detachment of theca, zona granulosa and zona radiata from the cytoplasm of mature oocyte.
Arrow with spot shows wrinkled appearance of outer margin of mature oocyte.
Fig. 215. Photomicrograph of T.S. of 10 days carbaryl treated ovary wall of *A. testudineus*. AZAN. X 400.

Arrow shows thick fibrous part of tunica albuginea.
Arrow with spot shows ruptured blood vessel.

Fig. 216. Photomicrograph of T.S. of 10 days carbaryl treated ovary of *A. testudineus*. AZAN. X 100.

Arrow shows interfollicular space.
Arrow with spot shows shrinkage and deformity in shape of immature oocyte.
Arrow with into shows broken thecal wall of mature oocyte.
Arrow with cross shows maturing oocyte.

Fig. 217. Photomicrograph of T.S. of 15 days carbaryl treated ovary wall of *A. testudineus*. AZAN. X 400.

Arrow shows detached germinal epithelium from the tunica albuginea.
Arrow with spot shows thick tunica albuginea.

Fig. 218. Photomicrograph of T.S. of 15 days carbaryl treated ovary of *A. testudineus*, showing reduction in size of mature oocytes. AZAN. X 100.

Arrows show interfollicular space.
Arrow with into shows ruptured theca, zona granulosa and zona radiate of mature oocyte.
Arrows with cross show degenerating theca, zona granulosa and zona radiata of mature oocyte.
Fig. 219. Photomicrograph of T.S. of 30 days carbaryl treated ovary wall of *A. testudineus*. AZAN. X 400.

Arrows show much thickened ovary wall.
Arrow with spot shows turgid blood vessel.

Fig. 220. Photomicrograph of T.S. of 30 days carbaryl treated ovary of *A. testudineus* showing an increase in number of immature oocytes. AZAN. X 100.

Arrow shows immature oocytes.
Arrow with into shows broken and degenerating ovigerous lamellae.
Arrow with cross shows reduction in size of mature oocyte with damaged and ruptured thecal wall.

Fig. 221. Photomicrograph of T.S. of 4 days malathion treated ovary wall of *A. testudineus*. AZAN. X 400.

Arrow shows fibrosis of the ovarian wall.

Fig. 222. Photomicrograph of T.S. of 4 days malathion treated ovary of *A. testudineus*. AZAN. X 100.

Arrow shows interfollicular space.
Arrow with spot shows detachment of theca, zona granulosa and zona radiata from the cytoplasm of mature oocyte.
Fig. 223. Photomicrograph of T.S. of 4 days malathion treated ovary of *A. testudineus*. AZAN. X 100.

Arrows show normal immature oocyte.
Arrow with spot shows detachment of theca, zona granulosa and zona radiata from the cytoplasm of mature oocyte.
Arrow with into shows normal atretic oocytes.
Arrow with cross shows normal maturing oocytes.

Fig. 224. Photomicrograph of T.S. of 10 days malathion treated ovary wall of *A. testudineus*. AZAN. X 400.

Arrow shows acute fibrosis of tunica albuginea.
Arrow with into shows degenerating germinal epithelium.

Fig. 225. Photomicrograph of T.S. of 10 days malathion treated ovary of *A. testudineus* showing shrunken and deformed mature oocytes. AZAN. X 100.

Arrow shows interfollicular space.
Arrow with spot shows detachment of zona granulosa from zona radiata and theca in mature oocyte.

Fig. 226. Photomicrograph of T.S. of 10 days malathion treated ovary of *A. testudineus*. AZAN. X 100.

Arrow shows interfollicular space.
Arrow with into shows normal immature oocyte.
Arrow with cross shows normal maturing oocyte.
Fig. 227. Photomicrograph of T.S. of 15 days malathion treated ovary wall of A. testudineus. AZAN. X 400.

Arrow shows acute fibrosis of ovary wall.
Arrow with cross shows degenerating germinal epithelium.

Fig. 228. Photomicrograph of T.S. of 15 days malathion treated ovary of A. testudineus. AZAN. X 100.

Arrow shows degenerating tunica albuginea.
Arrow with spot shows shrinkage and detachment of thecal wall from the zona granulosa in mature oocyte.
Arrows with into show degenerating ovigerous lamellae.
Arrow with cross shows normal immature oocyte.

Fig. 229. Photomicrograph of T.S. of 30 days malathion treated ovary wall of A. testudineus. AZAN. X 400.

Arrow shows detachment of peritoneum from tunica albuginea.
Arrow with spot shows thick ovary wall.
Arrows with cross show swollen blood vessel with some erythrocytes.

Fig. 230. Photomicrograph of T.S. of 30 days malathion treated ovary of A. testudineus. AZAN. X 100.

Arrow shows immature oocyte in the process of atresia.
Arrow with into shows maturing oocyte in the process of atresia.
Fig. 231. Photomicrograph of T.S. of 30 days malathion treated ovary of A. testudineus. AZAN. X 100.

Arrow shows broken theca, zona granulosa and zona radiata of mature oocyte.
Arrow with spot shows interfollicular space.
Arrow with cross shows atretic oocyte at their final stage.
Arrow with dash shows mature oocyte in the process of atresia.

Fig. 232. Photomicrograph of T.S. of 4 days BHC treated ovary of A. testudineus. AZAN. X 100.

Arrow shows normal ovary wall.
Arrow with spot shows normal maturing oocyte.
Arrow with two spots shows normal atretic oocyte.
Arrow with into shows normal immature oocyte.
Arrow with cross shows normal mature oocyte.

Fig. 233. Photomicrograph of T.S. of 10 days BHC treated ovary wall of A. testudineus. AZAN. X 400.

Arrow shows broken peritoneum.
Arrow with cross shows slight fibrosis in tunica albuginea.

Fig. 234. Photomicrograph of T.S. of 10 days BHC treated ovary of A. testudineus showing an increase in number of immature oocytes than maturing oocytes. AZAN. X 100.

Arrow shows maturing oocytes.
Arrow with spot shows irregular appearance of outer margin of mature oocyte.
Arrow with into shows immature oocyte.
Fig. 235. Photomicrograph of T.S. of 10 days BHC treated ovary of *A. testudineus*. AZAN. X 100.

Arrows show detachment of theca and zona granulosa from zona radiata in mature oocyte.

Fig. 236. Photomicrograph of T.S. of 15 days BHC treated ovary wall of *A. testudineus*. AZAN. X 400.

Arrow shows thick ovary wall and separation of peritoneum along with part of connective tissue and muscle fibres from tunica albuginea.

Arrow with into shows elongated blood vessel.

Fig. 237. Photomicrograph of T.S. of 15 days BHC treated ovary of *A. testudineus* showing an increase in number of immature oocytes and few maturing oocytes. AZAN. X 100.

Arrow shows thin and detached theca, zona granulosa and zona radiata of mature oocyte.

Arrow with spot shows maturing oocyte.

Arrow with into shows immature oocyte.

Arrow with cross shows ruptured ovigerous lamellae.
Fig. 238. Photomicrograph of T.S. of 15 days BHC treated ovary of A. testudineus showing shrunk and deformed mature oocyte. AZAN. X 100.

Arrow shows interfollicular space.

Fig. 239. Photomicrograph of T.S. of 30 days BHC treated ovary of A. testudineus showing shrunk and deformed mature oocytes. AZAN. X 100.

Arrows show ruptured theca, zona granulosa and zona radiata of mature oocyte.

Fig. 240. Photomicrograph of T.S. of 30 days BHC treated ovary of A. testudineus showing normal ovarian wall and different stages of oocyte. AZAN. X 100.

Arrow shows immature oocyte.
Arrow with spots shows mature oocyte.
Arrow with into shows maturing oocyte.
Arrow with cross shows atretic oocyte.