INTRODUCTION

Fresh water fish culture is a profitable undertaking, with low investment, quick result and low cost. The most production rate of fish culture is highest among all forms of animal culture. In case of fish culture, the problem of fry supply can be solved easily. Production in water can be done in a vertical way and the waste of agriculture can be used in fish culture. The development of agriculture, fisheries and animal husbandry can promote one another.

Clarias batrachus (Linn.) and Heteropneustes fossilis (Bloch) are known for their nutritive, invigorating and therapeutic qualities. In some parts of this country these fishes are preferred
over major carp and as such, are often in great demand, fetching a much higher price.

**Clarias batrachus** inhabits fresh water rivers, swamps and ponds. It breeds in confined waters during monsoon months. It is a highly esteemed food fish and is cultured in India, Thailand and Cambodia. In its adult stage, it subsists on insect larvae, shrimps, worms, fish and organic debris found in the pond bottom. Young fry feed on protozoans, small crustacean, rotifers and zooplankton.

**Clarias batrachus** is known to be a carnivore in nature, yet when stocked in silt laden swampy ponds, it subsists on bottom detritus. By virtue of their hardy nature and airbreathing habit, **Clarias** and **Heteropneustes** are excellent material not only for utilizing swampy, shallow derelict waters in rural areas, but also for intensive culture operations in urban areas as they permit high stocking density and respond to supplementary feeding. Their production potential is by and large directly proportional to input and intensity of operational management.

Intensive culture of **C. batrachus** in recirculatory filtering ponds has been initiated at the Central Inland Fisheries Research Institute Campus, Barrackpore, West Bengal.
Diseases of cultured fish present management problems for as long as they are held in confinement. Ten per cent of all cultured catfishes are lost due to infectious diseases in USA (Plumb, 1979).

Some of the behavioral signs exhibited by the diseased catfish are:

(1) slowing down or complete cessation of feeding,
(2) a loss of equilibrium and swimming erratically or in spirals, (3) schooling just below the surface, (4) swimming lethargically, or (5) scraping against the bottom of some object in the pond.

Some of the physical signs that the diseased catfish show are:

(1) Excess mucus production giving the fish a grayish or bluish appearance, (2) abnormal colouration (lighter or darker), (3) erosion of skin or fins, (4) gills swollen or eroded, (5) gills pale, (6) abdomen swollen and filled with a cloudy, bloody or clear fluid, or, (7) eyes bulging (exophthalmia).

Chemotherapy of diseased fish is extensive. Preventive medicine is the best and least expensive method of disease control.

Three factors occurring concurrently cause development of a disease: (1) presence of a pathogenic
organism, (2) a susceptible fish and (3) a predisposing condition. Fish that are well fed, uncrowded and in good environment are less likely to develop a disease. Environmental stressors include low oxygen levels, temperature shocks, inadequate diet, sublethal chemical exposures like ammonia, nitrite levels and many others. Pesticide contamination at sublethal level constitutes a poorly understood hazard to fish health; toxaphene, causing broken back syndrome in cat fish is only just an example; certain pesticides may accumulate in tissues and under stressful conditions may be released into bloodstream causing toxicosis or increased disease susceptibility. Pale bleached colour is an example of severe stress.

Stress reduces resistance of fish to bacterial infection and resistance to parasitism (Meyer, 1979). Injecting brood fish with an antibiotic to provide temporary protection against bacterial pathogens is a measure to overcome the problem of reduced resistance.

The key to disease control lies in the reduction of stress factors. Some disease preventing measures could be, (1) using water that is free of wild fish such as a well or a spring (sand gravel filters can be installed to prevent introduction of wild fish), (2) water of good quality and without harmful substances, (3) avoiding overcrowding fish at
any time and particularly during hot weather,
(4) wherever possible, fertilized eggs rather than
fish be transferred for stocking.

Disease treatment would require knowledge of
water (hardness, pH and temperature), chemical and
the disease.

Bychowskaya-Pavlovskaya (1969) stated, "The
study of parasitic diseases of fish and the biology
of their parasites constitutes one of the most
important steps towards increasing fish productivity
of reservoirs and inherently, to the complex task of
improvement and increase of productivity of the fish
cultural establishment in the Soviet Union".

International Epizootiology Commission for
the study on diseases of fish (1968) recommended:
(1) systematic examinations of diseases among wild
living fish should be given all possible support and
include: (a) investigation of disease circumstances;
(b) postmortem examination of fresh materials includ-
ing patho-anatomical, microbiological, parasitological
and chemical investigations; (c) related analysis of
waters; (2) modern diagnostic means commonly used in
veterinary medicine should be applied also when fish
diseases are concerned.

Diseases of fish, caused by cestode parasites
the world over include Trichinophorosis, Cyathosephalosis,
Bothriocephalosis, Diphyllobothriasis, Ligulosis, Digeniasis, Khawiosis and Carpophyllosis.

Kupersman (1973), in an extensive monograph, incriminated Triacanthorhynchus nodulosus, T. grassus, T. meridionalis, T. orientalis and T. amurenensis with causing Triacanthorhysis of fresh water fishes of USSR, T. nodulosus to be of very great epizootiologic significance. Plerocercoids were described from Trout, Grayling, Stickleback, Perch, Rockperch, and other fishes; adults infested Pike and Trout. Cyprinids were found refractory to Triacanthorhysis. Plerocercoids were described to cause swelling of abdomen, inflammation of liver or penetrating hepatic parenchyma, causing heavy mortality of juvenile rainbow trout, the worms becoming encapsulated within a host contributed cyst. T. nodulosus was reported to be a serious threat causing large scale infection and mortality; T. grassus, T. meridionalis and T. orientalis, all localizing in the muscles, posed not much of a threat but did cause commercial loss; T. amurenensis produced no noticeable pathogenic effect.

Cystocephalus truncatus (Cystocephalidae) has been incriminated with Cystocephalosis of trout in U.S.A., causing a general emaciation, decolouration of musculature, inflammation (swelling) of pyloric caeca, sometimes even general anaemia. Vik (1958)
observed that a single C. truncatus can cause fatal effect in small trout.

*Bothriocephalus kowkongensis* (Bothriocephalidae) caused Bothriocephalosis of carp, white Amur, spotted Silver Carp, Silver and Gold Carp, etc. Diseased fishes were weak, floating at surface, refused food, emaciated and with distended abdomen. The worms caused trauma, focal haemorrhage and inflammation in severe infestation. The damaged areas of mucosa of gut were said to serve as sites of various microflora complicating the etiology of the disease.

Chaloner (1942) described Diphyllolobothriasis as a plerocercoid disease of *Salmo fario*, the plerocercoids found encysted in the intestinal wall and adjacent organs. Hickey & Harris (1944) described an epizootic due to plerocercoids in the trout. Baylis (1945) identified the species *Diphyllolobothrium* in food fishes in Britain while Hickey & Harris (1947) attributed two species, *D. dendriticum* and *D. ditremum* to be responsible for an epizootic disease in trout.

Pathological changes in trout included an oedematous granulation tissue in the body cavity in a large tumour like mass.

A white subperitoneal nodule was found at the point of entry of the larva into the stomach wall of *Leox lucius*. The plerocercoid of *D. latum* was even
found to cause death of Salmon by invasion of the
ventricle of heart thus causing a block in the blood
supply to the gills.

Plerocercooids of Lignula intestinalis and
Digenema interrupta, occurring in several species
of Cyprinidae, feeding on zooplankton are described
to cause massive death of creek, white creek, Roach
and spotted silver carp. Worms grow to very large
size in body cavity of fish, greatly affecting
internal organs even leading to sterility; sometimes
even bursting through abdomen and causing death of
fish. The negative effects could be basically
reduced to: (1) mechanical effects, (2) robbing of
nutrients from host, (3) severe disruption of carbo-
hydrate and fat metabolism, (4) significant changes
in the composition of blood, (5) under-development
of reproductive glands or castration.

As a result of ligulosis, fish productivity
was greatly reduced due to direct and massive fish
kills, significant decreases in weight and quantity
of diseased fish and great losses of potential fish
populations.

Caryophylloids are known to cause Khawiosis
(pathogen, K. sinensis) and Caryophyllosis (pathogen,
C. fimbriiceps), affecting their hosts in several ways,
namely, mechanical obstruction of intestinal tract, production of lesions or other conditions of intestinal tract and causing a general physiological imbalance in the host.

The clinical symptoms of Khawiosis includes general weakening, reduced activity, loss in weight and anaemic condition of fins and skin (Shaherban, 1955); of Caryophyllosis includes anaemia (Plehn, 1924) and pronounced emaciation (Shaherban, 1965).

Fish pathology has been a neglected field in Asia and near Eastern countries (Gopal Krishnan, 1968), although it is in this region that progress in fish culture has been making rapid strides, creating conditions favourable for fish disease to occur more frequently and in epidemic proportions. Rai (1967) made an attempt to point out pathogenic significance of *Ictyoccephalus vitellarius*, *Vermeis neudotropii*, *Ceratocoryx pungens*, *Senga pycnomerus* and *Senga lycodonensis* infection in *Callago attu*, *Eutropiichthys vaigi*, *Sangerius sarbei*, *Ophioccephalus murilus* and *Kastoccephalus brunatus*.

Satpute and Agarwal (1974a) described 'Diverticulosis' caused by *Bjombangia indica* in the duodenum of *C. batrachius*, forming numerous diverticulae on duodenal surface in heavy infections;
thickening of muscles, shortening of villi, interruption of muscle layers and enormous leucocytic infiltration were said to occur.

Satpute and Agarwal (1974b) described pathogenesis of Lytoceustus indicus in C. batrachus, penetrating deep into duodenal tissue, causing damage to villi, submucosa and musculosa.

Chaud and Ansullah (1976, '79) observed remarkable pathogenicity caused by D. penetrans, L. indicus and L. p. r. v reducing to C. batrachus in Bangladesh; these caryophyllacids were said to affect their host in three ways: (1) mechanical obstruction of intestinal tract, particularly in small fish; (2) production of lesions or other pathological conditions; (3) a general physiological imbalance that might predispose the host to other infections.

Caryophyllidiasis thus is a very important disease of Clarias batrachus in India; considering five species of caryophyllacids, namely, Lytoceustus indicus, Biosbenzia indica, Introvertus raipurnensis and Lucknowia indice (all belonging to Lytocestidae of the order Caryophyllidea) and Fagudos Caryophyllacidae indicus (Capingentidae; Caryophyllidea) are known to parasitize C. batrachus either singly or concurrently (Niyogi et al, 19-2b).
Carophyllideae Wardle & Macleod, 1932 (Cestoda)

are characterised by: (1) monozooy; (2) lack of external segmentation; (3) presence of genital apertures in the same ventral surface as the uterine aperture; (4) occurrence of the uterine aperture between male and female apertures; and (5) the tendency of the uterus and vagina to open at the bottom of a utero-vaginal depression.

Monozootic condition was considered sufficiently fundamental to justify separation of Carophyllideae as a separate order.

Jackiewicz (1972) recognized Carophyllideae Wardle & Macleod, 1932 and included in it three families, namely, Carophyllidae, with yolk glands medullary; Latoboeidae, with yolk glands wholly cortical; and Cepingentidae, with yolk glands partly cortical.

Family Carophyllidae is characterised by the presence of a holdfast varying in shape; genital apertures in the last fourth of the ventral surface; presence of an utero-vaginal atrium without sphincter muscles; longitudinal muscles in two layers; yolk glands medullary; it includes the type genus: Carophyllideus Mueller, 1787;

Monophyrium Diesing, 1853 [= Carophyllideus pp.]

according to Woodland (1923).
Archigetes Leuckart, 1878 [ = Brachyurus Szidat, 1938 and Peraeolaridacria Janiszewska, 1950, according to Kennedy (1965b); Ozidatinae McCrane, 1961 ],

Glaridacria Cooper, 1920 [ = Caryophyllaeus pp., according to Woodland (1923); Brachyurus Szidat, 1938 according to Wardle & McLeod (1952) and Yamaguti (1959) ],

Wenyonia Woodland, 1923,

Micetetium Hunter, 1927 [ = Archigetes according to Szidat (1937a)],

Hypocaryophyllaeus Hunter, 1927,

Pterovitellaria Vischthel, 1951,

Pterovitellaria Vischthel, 1953,

Pterocaryophyllaeus Kulakovskaya, 1961,

Hunterella Mackiewicz & McCrae, 1962,

Isoglaridacria Mackiewicz, 1963,

Promonobotromium Mackiewicz, 1968,

Liarchigetes Mackiewicz, 1969,

are the other genera included in Caryophyllidae.

The genus Caryophyllaeus Mueller, 1787, is characterised by the presence of a broadened, curled or folded holdfast and without pseudobothrial
depressions; cirrus pouch opening into a shallow, non-eversible atrium and absence of an external seminal vesicle and including the following species:


C. appendiculatus Retzel, 1858 nec Mrázek

1-97 fide Mybelin (1922)].

C. teretipes (Linton, 1893) Woodland, 1925.

C. synderjensis Skrjatin, 1913.

C. timbriceps Annenkova-Chlopina, 1919.

C. prechycollis Janiszewska, 1953.

C. kashmiresis Meera, 1939, species inquirenda;

Fonobothrius Diesing, 1863, by the presence of a hold fast with a terminal introvert, hexagonal in shape, with six weak, shallow grooves; cirrus pouch and uterovaginal canal opening together in the last fourth of ventral surface, in a shallow eversible atrium, and including the species:

M. wagneri Mybelin, 1922 [ = M. tuba (V. Siebold, 1853) Diesing, 1863 fide Mybelin (1922)].

M. ingens Hunter, 1927.


Archigetes Leuckart, 1878, by the absence of uterine coils in front of the cirrus pouch; found in body cavity of freshwater annelids and including the species:

A. sieboldi Leuckart, 1878 (sensu Wiśniewski, 1930)

= Biscetabulum sieboldi Szidat, 1937,
A. appendiculatum (Szidat, 1937)
Janiszewska, 1950 fide Kennedy (1965b)

A. appendiculatum Krázek, 1997 nac Hatzel, 1966

= A. sieboldi Leuckart, 1878 according to Kennedy (1965b)

A. brachyurus Krázek, 1908

= Brachyurus brachyurus Szidat, 1938; Ceroliridaecria silesiana
Janiszewska, 1950, and Cerolidaecria
brachyurus Yamaguti, 1959 fide Kennedy
(1965b)

A. cryptogastrius Wiśniewski, 1928,

A. limnodrili (Yamaguti, 1934) Kennedy, 1965

= Cerolidaecria limnodrili Yamaguti, 1934,
Brachyurus gobii Szidat, 1938 and
A. gobii Yamaguti, 1959 fide Kennedy,
(1965b), A. gobii (Yamaguti, 1959)
Kennedy, 1964

A. loweae Calentine, 1962,

A. hepaticus Kennedy, 1965 nomen nudum
*Gleridaorina* Cooper, 1920, by the presence of a well-defined holdfast and with three pairs of pseudobothrial depressions and an external seminal vesicle and including the species:

*G. oesostomi* Cooper, 1920,

*G. leruci* (Lamont, 1921) Hunter, 1927 \[ = *G. intermedium* Lyster, 1940 *fide* Beckiewicz (1965a) \],

*G. confusus* Hunter, 1929,

*G. eilae*oderrie, 1955;

*Kenyonia* Woodland, 1923, by the presence of either an undifferentiated or longitudinally grooved holdfast; genital apertures in anterior half of the ventral surface; presence of uterovaginal atrium and H-shaped, medullary ovary and including the species:

*G. scuminata* Woodland, 1923,

*G. virilus* Woodland, 1923 \[ = *Caryophyllaeus niloticus* Kulmatycki, 1924 *fide* Woodland (1926), Hunter (1930). *V. niloticus* (Kulmatycki, 1924) Yamasuti (1959) \],

*V. longicauda* Woodland, 1957;

*Diesetabulum* Hunter, 1927, by the presence of a holdfast with a pair of saucerlike depressions and an external seminal vesicle and including the species:
B. *Infrequens* Hunter, 1927,  
B. *giganteum* Hunter, 1929,  
B. *meridianum* Hunter, 1929,  
S. *macrocephalum* McCrae, 1962,  
B. *biloculoides* Mackiewicz & McCrae, 1965,  
B. *banghami* Mackiewicz, 1968,  
S. *carpiodi* Mackiewicz, 1959;  

*Hypocaryophyllaeus* Hunter, 1927, by the presence of a poorly defined holdfast, with three pairs of shallow pseudo-thoral depressions and cirrus pouch opening ahead of uterovaginal atrium and including the species:  
B. *peristerius* Hunter, 1927, 
B. *hilae* Fischthal, 1953;  
*Hilovitellaria* Fischthal, 1951, including  
S. *wiscensesis* Fischthal, 1951;  
*Hilovitellaria* Fischthal, 1953, including  
S. *mocoris* Fischthal, 1953;  

*Peracaryophyllaeus* Kulakovskaya, 1961;  

*Huntarella* Mackiewicz & McCrae 1962, by the absence of suckers or any other organs of attachment, cirrus opening separately from female gonopore; presence of post-ovarian vitellaria and external seminal vesicle;
inner longitudinal muscles arranged in broad bands around the medullary region, and including the species:

*Leptocentrum* Mackiewicz & McCrea, 1962;

*Pogonolepis* Mackiewicz, 1965, including the species:

1. *hexagotyle* (Linton, 1897) Mackiewicz, 1968;

2. *buclacirrus* Mackiewicz, 1965;


5. *Lenorocentrum* Mackiewicz, 1968, by the presence of a coelom with a pair of shallow median loculi and two small lateral depressions, cirrus and uterovaginal canal open separately, preovarian and lateral vitellaria present and absence of post-ovarian vitellaria, presence of external seminal vesicle and including the species:


7. *remurigetes* Mackiewicz, 1969, including;


Easily *lytocentridae* is characterized by

1. holdfast end being undifferentiated, (2) cirrus pouch and uterovaginal atrium opening separately, (3) vitellaria wholly cortical, (4) ovarian wings cortical but bridge medullary, (5) adults in morayrid and silurid fishes.
Satpute and Agarwal (1980b) recognized two sub-families of Lytocestidae, viz. Lytocestinae and Lytocestinae, distinguishing the latter sub-family from the former in the presence of a feeble sucker at the tip of holdfast end, uterus extending anteriorly through out the testicular region and in the presence of embryonated eggs in uterus, including the genus:

*Umbella* Bovien, 1926 including, as the type species,

*U. penetrans* Bovien, 1926,

*U. cabellaroi* Sahay & Sahay, 1977,


Lytocestinae, however, included, as the type genus, *Lytocestus* John, 1908;

*Sarcocephylleides* Bovien, 1922 [ = *Sarcocephylleus* pp. according to Woodland (1923)].

*Saranostomiea* Johnston, 1924,

*Haplocestridae* Fuhrmann & Beer, 1925,

*Lytocestoides* Baylis, 1928,

*Bovienia* Fuhrmann, 1931,

*Bowenia* Bäü, 1935,

*Stocksia* Woodland, 1937,

*Notolytogestua* Johnston & Muirhead, 1950,
**Atractolytostoma** Anthony, 1958 [= *Khatia Haü*, 1935 according to Tamaguti, (1959)].

**Lucknowia** Gupta, 1961.

**Crespmodonitus** Kurbar, 1963.

**Karkevitschia** Kulakovskaya, 1965.

**Introvertus** Batpute & Agerwal, 1980, are the other genera included in Lytocestinae.

**Lytocestus** Cohn, 1903, is characterised by the holostei end undifferentiated, no post-ovarian glands, inner longitudinal muscles in a ring round the testes and including the species:

*L. adhaerens* Cohn, 1903,


*L. indicus* (Hohe, 1925) Woodland, 1932 [= *Monobothriodiscus indicus* (Hohe, 1925) according to Woodland (1937)],

*L. javanicus* (Sovien, 1926) Surtado, 1963 [= *Carpocestus javanicus* (Sovien, 1926) Anthony, 1952],

*L. lirmanicus* Lysdale, 1956 [= *L. alcestes* Lysdale, 1956 according to Johri (1969)],

*L. parvulus* Surtado, 1963,

*L. longicollis* Ramadevi, 1972,

*L. fossiliis* Singh, 1975;
Carophyllacidae Nybelin, 1922, by the presence of a common genital atrium, including the species:

*C. fennica* (Schneider, 1902) Nybelin, 1922 = *Carophyllacidae skriabinii* Popoff, 1924 fide Kulakowskaya (1961);

*C. calerotaenia* Johnston, 1924, by absence of post-ovarian yolk glands, presence of inner longitudinal muscles in two parallel sheets between testes, including the species:

*C. kentrofti* Johnston, 1924;

*C. concinna* Fuhrmann & Baer, 1925, by the presence of a longitudinal furrow and terminal introvert in the holotest end, uterine coils reaching less than the length of the testes field, including the species:

*C. cunningtoni* Fuhrmann & Baer, 1925,

*C. chalmersii* (Woodland, 1924) Woodland, 1937,

*C. woodlandi* Heckiewicz and Beverley-Burton, 1967;

*Lyttosticta* Saylis, 1928, by the presence of post-ovarian vitellaria, including the species:

*C. tanganyikae* Saylis, 1928;

*Bovienia* Fuhrmann, 1931, by the presence of two geno-pores, but no post-ovarian vitellaria and including the species:

*C. aeriolis* (Ovien, 1926) Fuhrmann, 1931;
Klavina Haiü, 1935, by the presence of common genital atrium, both pre and post ovarian vitellaria and including the species:

*K. armeniae* (Cholodkowski, 1915) Shulman, 1938,

*K. sinensis* Haiü, 1935,

*K. japonensis* (Yamaguti, 1934) Haiü, 1935 [*Bothrio-scolex japonensis* (Yamaguti, 1934), according to Szidat (1935) ],

*K. loweae* Calentine & Ulmer, 1961;

Stockxia Woodland, 1937, by the presence of pseudobothrial depressions in scolex & crescentic yolk glands and including:

*N. pujebuni* Woodland, 1939;

*N. tropicalis* Johnston & Muirhead, 1950, by the presence of medullary ovarian lobes and uterine coils in testicular zone, including the species:

*N. major* Johnston & Muirhead, 1950,

*N. minor* Johnston & Muirhead, 1950;

*Atractolycestes* Anthony, 1958, by the presence of postovarian vitellaria continuous with the pre-ovarian ones, testes randomly distributed, length of uterus one half of the testicular zone, including the species:

*a. huronensis* Anthony, 1959;
Lucknowia Gupta, 1961, by the presence of an unspecialized scolex not broader than the rest of the body, utero-vaginal canal open separately, vitellaria continuous, including the species:

L. fossilis Gupta, 1961,

L. indica Niyogi, Gupta & Agarwal, 1962;

Crescentovitrus Murhar, 1963, by the presence of scolex with pseudobotriarial depressions and introvert, U-shaped ovary, including the species:

C. bilocularis Murhar, 1963;

Markevitschia Kulakovskaya, 1965, by the presence of post-ovarian vitellaria: continuous, ovary H-shaped, randomly distributed testes, including the species:

K. angitata Kulakovskaya, 1965;

Introvertus Satpute and Agarwal, 1980, by presence of terminal introvert in the holdfast, a very long neck, post-ovarian vitellaria, including the species:


Family Cepingentidae is characterised by the presence of partly cortical yolk glands and including the genera:

Cepingens Hunter, 1927,

Pseudolytogenus Hunter, 1929,

Spartoides Hunter, 1929,

Adenoecolex Fotedar, 1958.
Pseudocaryophyllelus Gupta, 1961,
Capingsentoideis Gupta, 1961,
Breviscoclex Kulakovskaya, 1962, and
Edlintonia Mackiewicz, 1970.

The genus Capingens Hunter, 1927, is characterized by the presence of a large holdfast, \( \frac{2}{5} \)th of body length, one pair of bothriotial depressions, post-ovarian vitellaria, including the species:

G. singularis Hunter, 1927;
Pseudolytocestus Hunter, 1929, by the presence of an undifferentiated holdfast and H-shaped ovary, including the species:

P. differtus Hunter, 1929;
Spartoides Hunter, 1929, by the presence of three pairs of depressions and U-shaped ovary, including the species:

S. waldi Hunter, 1929;
Adenoscolex Fotedar, 1953, including the species:

A. oreini Fotedar, 1953;
Pseudocaryophyllelus Gupta, 1961, by the presence of a smooth oval scolex, truncated anteriorly and marked off from rest of the body, long narrow neck, absence of post-ovarian vitellaria and common genital atrium, including the species:
P. indicus Gupta, 1961;

Capingentoides Gupta, 1961, by the presence of common genital pore, including the species:
P. betrechii Gupta, 1961;

Breviacoilex Kulakovskaya, 1962, including the species:
B. orientalis Kulakovskaya, 1962;

Eolintonia Mackiewicz, 1970, including the species:
E. ptychocheila Mackiewicz, 1970.

Diagnostic features of species found parasitizing Clarias betrechus at Raipur are:

Lytocestus indicus Koshe, 1925:

Holdfast end undifferentiated; neck relatively short; testes numerous, spherical or ovoid, extending anteriorly to the level of the vitelline follicles and posteriorly to cirrus sac; vas deferens loosely coiled, cirrus sac massive in the last ninth of body; ovary in the last tenth of body; bilobed ovarian follicles cortical in the two lobes and medullary in isthmus, ootype at posterior end, uterus joins vagina to form uterovaginal canal which opens through uterovaginal aperture lying well-separated from the cirrus aperture; vitellaria in two lateral rows, entirely cortical, extending anteriorly to level of testes; but not extending in the ovarian and uterine zones; eggs small, operculate and unembryonated (Fig. 1a, b & c);
penetrates deep into the duodenal wall of *S. latistoma* (Fig. 46).

**Pseudoecaryophyllopus indica** Gupta, 1961:

Scolex oval, cone shaped, truncated anteriorly; long neck; testes numerous, rounded, oval, strewn throughout most of the body medially, bounded on lateral sides by vitelline follicles, extending from posterior region of neck to a little anterior to cirrus sac; *v* *v* *a* deferens, a small duct lying in median part of body, vesicula seminalis externa absent, cirrus sac large, oval, vesicula seminalis interna bell shaped; ovary follicular, irregular in outline, ovarian isthmus in middle of body, follicles overlap vitelline glands laterally; vitellaria follicular, occupying greater part of body, post-ovarian median vitelline glands absent, vitellaria partly cortical and partly medullary; common genital aperture absent, uterovaginal canal present; *eg.* oval (Fig 2a, b, c & d); worms found embedded in the duodenal villi.

**Elometria indica** Satpute & Agrawal, 1980:

Holdfast bearing at the tip a feeble sucker, lined with radial muscles; testes numerous, spherical or ovoid, extending in two lateral rows anteriorly to some distance behind neck and posteriorly to anterior levels of ovary; *v* *v* *a* deferens loosely coiled, cirrus sac ovoid in the last seventh of body, genital atrium
opening opposite uterovaginal aperture; ovary in the last tenth of body, bilobed, with ovarian follicles cortical in the two lobes and medullary in the isthmus, ootype at posterior end, uterus with an ascending and descending loop, extending to anterior end of testicular zone and opening through uterovaginal aperture on ventral surface; vitelline follicles entirely cortical, extending throughout uterotesticular region and even invading post-ovarian zone; eggs small, operculate, embryonated and covered with spinous projections on surface (Fig 3c & d); worms occurring in diverticula of duodenum of C. batrachus (Fig. 4c).

Introvertus reipurensis Satpute & Agarwal, 1980:

Holdfast with a pair of longitudinal grooves, a terminal introvert; neck narrow and very long; testes numerous, medullary, strewn in the middle of the body, extending anteriorly to level of vitelline follicles and posteriorly to level of cirrus sac, vas deferens loosely coiled, vesicula seminalis externa present, cirrus sac massive, bell shaped, in the last tenth of body, cirrus aperture on ventral surface; ovary in the last tenth of body, bilobed, ovarian follicles cortical in the two lobes and medullary in the isthmus, ootype at posterior end, receptaculum seminis present, uterus joins vagina and opens through uterovaginal aperture, opposite cirrus aperture. Vitellaria in

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*Introvertus reipurensis* Satpute & Agarwal, 1980:

Holdfast with a pair of longitudinal grooves, a terminal introvert; neck narrow and very long; testes numerous, medullary, strewn in the middle of the body, extending anteriorly to level of vitelline follicles and posteriorly to level of cirrus sac, vas deferens loosely coiled, vesicula seminalis externa present, cirrus sac massive, bell shaped, in the last tenth of body, cirrus aperture on ventral surface; ovary in the last tenth of body, bilobed, ovarian follicles cortical in the two lobes and medullary in the isthmus, ootype at posterior end, receptaculum seminis present, uterus joins vagina and opens through uterovaginal aperture, opposite cirrus aperture. Vitellaria in
pre and post-ovarian zones; eggs thick shelled, smooth, operculate (Fig 4a, b, c, d & e); worms occurring in duodenum of *C. batrachus* (Fig. 39):

***L. indicus*** Niyogi, Gupta & Agarwal, 1962:

Holdfast end stumpy, narrow and undifferentiated; pretesticular zone very long, testes numerous, spherical, oval or elliptical, or tapering to a point at one end, strewn in the middle of the body, extending anteriorly to level of vitelline follicles and posteriorly to cirrus sac, vas deferens loosely convoluted, no vesicula seminalis externa, cirrus sac massive, vesicula seminalis interna not distinguishable; ovary H-shaped, ovarian follicles cortical, presence of common uterovaginal canal, but absence of common genital atrium; vitellaria cortical in two groups, pre and post ovarian; eggs thin shelled, operculate, without polar filament (Fig 5a, b, c, d, e, f & g); worms occurring embedded in the villi of posterior intestine of *C. batrachus* (Fig 52).

Occurrence of five species of caryophyllaeids in *C. batrachus* alone in this area raises very interesting questions. What is the basis of this very narrow specificity? The factors which determine host parasite compatibility are largely unknown (Soulby, 1976). *Heteronemus fosillaris* (Bloch) lives in the same macroenvironment and has similar
food habits as *C. betraghus* and yet is seldom found infected. What is the basis of this resistance of *H. fossilis* or, for that matter, of the other species of fishes? How are the five species able to avoid interspecific spatial competition? Whether by niche diversification? They occur both in single or in concurrent infections, the incidence and intensity quite often is very high in concurrent infections. Whether on account of reciprocal cross immunity or weakening of host resistance? The reasons for the unusually high incidence and intensity in concurrent infections are hardly known. Aside these, nothing is known of the physiology of these Caryophyllaenid worms.

Worms are quite often thought to mimic host physiology. Whether it is so or do they have biochemical individuality? How do they osmotically regulate?

They follow a definite seasonal cycle; the recruitment period being in spawning season, when the fishes are under hormonal stress, the stressors being cortisols and ACTH, which are known to cause leucocytopenia in low and high dose (Roberts, 1978).

ACTH and corticosteroids injected into a teleost fish can cause depopulation of lymphoid tissue. Stress is known to affect immune responsiveness in a deleterious manner and this increases susceptibility
to infections (Wademeyer, 1970). GTH level of blood also increases at spawning time, further increasing susceptibility (Lawrence, 1970).

Increased susceptibility to caryophyllacida during spawning time is thus obviously due to both environmental and hormonal stressors. This is followed by rejection of worms during winter months. Why? Is it because of host immune reaction, or, do the worms have a limited life span, or, is it related entirely to the economics of the intermediate host?

There can be many more questions deserving to be answered. This author has found caryophyllaeida to be a very fascinating subject with prospects of finding answers to as many as possible of the questions raised above.