INTRODUCTION

The Government of India has opened Inland Fisheries Departments and Fisheries Seed Farms in all States and is developing fish hatcheries for hatching and distribution of adult edible fish. These departments, in their laboratories, are making ecological, morphological and economic surveys of fish fauna but are not investigating the infection of Protozoa which produce certain contagious maladies that play havoc with the stock of freshwater fish and constitute a serious menace to fish culturists.

Fishes in India have been less thoroughly surveyed for their Myxozoan (Protozoa: Myxozoa) fauna than those of other regions of the world. Majority of the work done on Myxozoa, in India is from West Bengal and Andhra Pradesh; other states have contributed almost nothing to the knowledge of the phylum. Thus, studies were undertaken for obtaining more information on the occurrence, cytochemical architecture, physiology and pathogenicity of these parasites of freshwater fishes of Northern India.

Many of these parasites are economically significant, particularly in marine environment. Sometimes they cause necrosis of the flesh of living fish with rapid postmortem deterioration and liquification rendering the product unsaleable. Halibut muscle can be infected with two species of Myxosporea, one, *Unicapsula muscularis*, causes 'wormy'
halibut (Thompson, 1916) and the other, Chloromyxum sp., causes 'mushy' halibut (Davis 1924). 'Boil disease' is caused by Henneguya zschokkei in a number of Pacific salmon (Petrushevski and Schulman, 1961). Another species Henneguya salminicola causes 'tapioca' disease in Pacific salmon (Wood 1968). Infection rates can reach up to 40% and heavily infected fish are unsaleable. Myxosoma cerebralis, which attacks the supporting tissue of salmonid fish, is known to be responsible for the so called 'twist disease' or 'whirling disease' (Plehn, 1904) which is often fatal especially to young fishes and occurs in an epidemic form. Chloromyxum thyrsites attacks the body muscle fibres of the barracouta in which the infected muscles become liquified. This condition is known as 'milky barracouta' or 'pap snoek' and may affect as much as 5 per cent of commercial catch (Willis, 1949).

Myxozoan diseases in the muscle of freshwater fish can also be significant. For example, Myxobolus pfeifferi the causative agent of 'boil' or 'bubonic' disease of barbel in Europe and USSR, apparently developed into epizootic levels in the wild when the rivers became polluted (Petrushevski and Schulman, 1961). The combination of pathogen and pollution has been blamed for the extermination of stocks of barbel from various Rhine tributaries in Germany and the Seine in France.

Myxozoans (Myxosporea) are small, multicellular, spore-forming parasites, occurring almost exclusively in cold-blooded vertebrates (predominantly fish). These spores are generally
contained in the cysts. The epidermis of the gills, the fins and internal organs develop white tumours. The gills of healthy fishes have a reddish colour unless they are pigmented when the colour is dark. Pale gills are always a sign of disease in living fish.

Twentyfive species of myxosporeans belonging to six genera have been described in this work. Identification of species relies primarily on measurements of spores, polar capsules and polar filaments; on external sculpturing and relief on the valves; and on host. Though early developmental stages of some species are observed during the present investigations but descriptions are given only of spores as identification of species depends upon the spore characters. The revised classification of the class Myxosporea Bütschli, 1881 by Lom and Noble (1984) has been followed for classifying these parasites. The class Myxosporea Bütschli, 1881 along with class Actinospora Noble, 1980 have been quite recently (Levine et al. 1980) included under an independent phylum Myxozoa Grassé, 1970 in the subkingdom Protozoa on the basis that the spores are multicellular in origin, with one or more polar capsules and sporoplasts, with 1, 2 or 3 (rarely more) valves.

Recently in 1984 Wolf and Markiw reported that, an actinosporean and a myxosporean are not separate entities, but are alternating life stages of a single organism. They
experimentally proved this in case of *Myxosoma cerebralis*, which causes whirling disease in salmonid fish. According to them, whirling disease in the fish results in the formation of myxosporean spores that are incapable of infecting other salmonids but which, when released into the environment, initiate an infection in an oligochaete of the family Tubificidae. Infection in tubificid results in the production of an actinosporean that is incapable of infecting other forms, but which is the long sought infective agent of salmonid whirling disease. Earlier, two investigators, Upsenskaya (1978) from USSR and Prihoda (1983) from Czechoslovakia have independently claimed to have infected trout with whirling disease by using *M. cerebralis* spores simply aged in water - a finding contradictory to that of Wolf and Markiw. According to the latter authors in neither study (Upsenskaya, 1978; Prihoda, 1983) details of the work were sufficient to judge whether tubificids were involved.