PREFACE

We progressed so far as our relationship with nature was on a sustainable level. But we will be doomed if in our greed, we kill the goose laying golden eggs. The situation began to change rapidly with the advent of the "Industrial Revolution" in the West in the eighteenth century. When man's appetite for comfort and prosperity began to grow rapidly, he began to loot nature and pollute the environment without a thought for the consequences. As a result of which, with the passage of time, the pace of industrialisation increased, accompanied by a corresponding increase in pollution.

Plato lamented the destruction of soils in ancient Greece. Dickens and Engels wrote eloquently of the wretched conditions brought about by the industrial revolution. 'Pollution' is an act of making something foul, unclean, dirty, impure, contaminated, defiled, tainted, desecrated..., Which releases materials into atmosphere to make the air unsuitable for breathing, harm the quality of water and soil, and damage the health of plants and animals. The impacts of natural habitat destruction are felt by the millions of people who depend directly on natural resources for their livelihood. Think of the condition of 5 million poor fisherman who form 70% of the total fisher folks of the country and who depend on fish from rivers and lakes, which in turn is mainly dependent upon unhampered biological production.

Powerful people are able to exploit these resources for their own greed, with little regard for the survival needs of forest dwellers, shepherds, fisherfolk and other "ecosystem people". The tremendous diversity of crops and livestock developed
and maintained by traditional communities is also facing erosion by modern agricultural practices.

The presence in water of "micropollutants" like toxic chemicals, metals and disease causing micro-organisms has increased over the years. The wastes drained from domestic and industrial sources, sewage pipes, factories and run off from farm lands tends to carry fertilisers, pesticides and organic matter, oil, toxic metals, and other pollutants into canals, lakes streams and rivers. This may become lethal to some aquatic life and sediments of this pollutants leads to its bio-accumulation in fish.

Many workers have reported that a number of important bio-chemical changes take place in almost all the important tissues of different fishes due to toxic substances. Heavy metals pose a serious threat to aquatic environment because of their toxicity and tendency to accumulate in organisms and undergo food chain amplification. They cause severe damage to the aquatic fauna, including fishes, thereby telling upon their health and population. They may indirectly enter the body of human being as the edible fishes form an important link in the food chain. Keeping these facts in view, the present work was under taken to evaluate the toxic effect of Arsenic, a highly toxic metal, on a fresh water fish, *Channa Punctatus* (Bloch).

Arsenic from industries through industrial process such as smelting of other metals, as residue from arsenate, rodenticides, insecticides, fungicides, wood preservatives, soil sterilants, defoliants, weed killers, feed additives, from the manufacture of antifouling paints and pigments, from the textile, glass and tanning industries, from therapeutical use and the generation of power from coal or geothermal
Sources is cumulatively added to inland waters, which render tremendous metallic load on inhabiting aquatic flora and fauna, including fish. At higher concentration arsenate can act as a dangerous pollutant, producing a wide range of serious health hazards in different animals including human beings.

Ingestion of excess arsenic causes fever, vomiting, and pathological changes in some tissue. The accumulation of arsenic in food chain, its toxicity to aquatic organisms and their potential health hazards have lead to an upsurge in interest to study the effects of this metals at sublethal and lethal doses on some physiological and biochemical parameters of different fishes.

The present investigation was undertaken to assess the toxic effects of arsenic on *Channa punctatus* due to long term exposure to sub-lethal concentration and short term exposure to higher concentration.

The 96 hour LC₅₀ values, skeletal abnormalities and morphological and behavioural changes in the fish due to exposure to Arsenic has been studied. The blood is said to be the mirror, in which all the vital processes are taking place in an organism are reflected. It is therefore a sensitive index to understand the physiology of fish in normal and stressed conditions. So an attempt has been made to study the haematological abnormalities induced by this toxic metal in *Channa punctatus*. Liver and intestine are two vital organs which are severely affected by arsenic. Any biological change in liver and intestine leads to other abnormalities in almost all metabolic processes of fish. Brain controls the activities of all the organs directly or indirectly. So if there is any biological change in the brain, it is likely to effect the regulatory activities of brain and may also endanger the very survival of fish.
In this perspective the present work reports the alterations in certain biochemical parameters in the liver, brain and intestine, apparently due to arsenic exposure of the fresh water fish, *Channa punctatus* (Bloch).

The bones are also affected by toxic metals. The bone is a dense, hard and mineralised connective tissues. It is composed of organic, inorganic and aqueous fractions. A tough fibrous protein net work called collagen, hexoses in the form of a semifluid cement substance and cells constitute the organic material while the inorganic part is composed primarily of crystalline hydroxylapatite (CaHA), Ca₁₀(PO₄)₆(OH)₂. It has recently become an important subject of physico-chemical and biological investigation. It undergoes a series of cationic and anionic isomorphous substitution reactions.

Arsenic can replace PO₄³⁻ and thus incorporate itself into the fish skeleton. Substitution of ions in the crystal solid, HA by similar ions in solution is called isomorphic substitution. It is also capable of undergoing heteroionic substitution, which result due to substitution of anion in the crystal by different ions of the solution without disrupting the general symmetry.

Arsenic replacement is an anionic substitution leading to the replacement of PO₄³⁻ by AsO₄³⁻. This isomorphic substitution will result in contraction of unit cell dimension. This difference in the length of the axis of the unit cell, can be detected by X-ray diffraction.

The present investigation was intended to prepare a series of homogenous solid solutions of HA containing arsenate covering the entire compositional range under the optimum conditions worked out for the purpose.
The molecular formulae of the synthetic solid solution were determined by the application of a new and convenient complexometric procedure specially worked out for this purpose. The X-ray diffraction and IR studies were undertaken to establish the formation of solid solution in each case.

Since the physiology of bone is governed by resorption and calcification, it is essential to understand the relationship between the pH of the dissolving medium and the solubility of hydroxylapatite.

This work has been divided into four sections. In section I, an attempt has been made to compile information on Arsenic toxicity available in diverse branches of research. More emphasis has been given to the physiochemical and biochemical changes due to arsenic toxicity. Section II gives a detailed description of the materials and methods used by the present worker during the present investigations. Section III & IV deals with the results and the analysis and discussions of the obtained results of the work. A brief Summary of the work done and result obtained has also been given. At the end of the thesis a consolidated list of books and journals consulted have been given to facilitate easy reference and the titles of papers published by the worker has been given in appendix.