CHAPTER I

INTRODUCTION
The corpuscles of stannius are small, oval shaped discrete bodies on the kidney of bony fish, which are first described and identified by Stannius (1839) in teleost fish. These are also designated as Suprarenals by Dismare (1896), Pettit (1896) and Vincent (1896). Balfour (1878) suggested the names "Corpuscles of stannius" and "Interrenals" in various components of suprarenals. Giacomini (1902) has considered corpuscles of stannius as a part of adrenal cortex, hence called them "posterior interrenals" which were subsequently found to be developmentally different from interrenals. Thus the gland has finally been given the name "Corpuscles of stannius" which was first appeared in the chondrostean and also found in the teleostei (Garrett, 1942; Baushot, 1953).

Development of corpuscles of stannius has been studied in a few species of fish. Available data on this aspect are still conflicting. Corpuscles of stannius originate exclusively from the pro or mesonephric tubules (Hust, 1898; Giacomini, 1933; De Smet, 1962; Krishnamurthy, 1967; Barr, 1969; Sasayama, 1983).
Recently Sasyama (1986) has confirmed that corpuscles of stannius originate from pronephric duct.

The corpuscles of stannius are flattened oval and white glandular bodies found embedded on the kidney of teleosts. Gupta and Shrivastava (1971) have reported corpuscles of stannius in *Xenentodon cancila* where these are found embedded at the hinder part of the kidney. Individual differences with regard to their number, position and size of the corpuscles of stannius are closely related to species which also show wide variations as in *Solea* and *Salmonida* (Garrett, 1942), *Ania* and *Lepisosteus* (Baushot, 1953), *Colisa lelia* (Krishnamurthy, 1966) and also in *Heteropneustes fossilis* (Prasada Rao, 1974).

Lobular differentiation in corpuscles of stannius depends on the degree of penetration of connective tissue. Such structural pattern in corpuscles of stannius is divided into five types (Krishnamurthy and Bern, 1969). Nerve fibres and ganglia have also been observed in connective tissue capsule of the corpuscles of stannius in *Scorpaenichthys marmoratus* (Krishnamurthy and Bern, 1971).

A central cavity in the lobule of corpuscles of stannius is seen in several species like *Anguilla anguilla*, *Anarchiches*, *Tilapia*, *Gymnothorax* and * Mugil* (Pettit, 1896; Vincent, 1898; Bobin, 1949; Olivero, 1961; Krishnamurthy and Bern, 1969; Johnson, 1972). Central cavity in the lobules has been observed in cryostate sections (Chieffi and Botte, 1963a, b; Ogawa, 1963). Newly formed cells accumulate in the central cavity of the

Histological studies have also revealed differences in the patterns of lobular organization and cellular details of corpuscles of stannius. There are two types of cells, present in the corpuscles of stannius of *Salmo gairdneri* (Krishnamurthy and Bern, 1969 and Meets, 1978), *Anquila anquilla* (Oliverseau, 1978), *Oncorhynchus kisutch* (Aide, 1980), *Oreochromis mossambicus* (Bonga, 1985). The cells of the first type are big and spindle shaped with large and clear nuclei. The cells belonging to the second type are comparatively smaller, irregular with dense cytoplasm and distinct nuclei.

Some workers (Madkarni and Gorbman, 1966; Krishnamurthy and Bern, 1969; Lopes, 1969) have reported two types of cells according to their staining properties by Aldehyde fuchsin (AF) and periodic acid schiff (PAS) stains in salmonid fish like *Gymnothorax flavimarginatus*, *Salmo gairdneri*. Recently, Lopes (1984) has observed immunocytologically that corpuscles of stannius have three types of cells.
Histochmical studies confirmed that corpuscles of stannius consist DNA, RNA, proteins, lipids, lipopigments, cholesterol and ascorbic acid, differentiated by various staining methods (Robin, 1949; Fontaine and Hasey, 1955; Ogawa, 1963; Krishnamurthy, 1968; Banks et al., 1966, 1967) have also observed the structure of corpuscles of stannius by various histological and histochemical examinations in Anguilla anguilla.

Histophysiological investigations have also been performed in this organ and valuable suggestions are proposed by Rasquin (1956) in Astyanax mexicanus, Anguilla anguilla by Oliverseau (1961, 1966) and in Carassius auratus by Ogawa (1963) and in Clarion lasere by Khalil (1965).

On the other hand, biochemical studies have confirmed steroidogenesis in the stannius corpuscles of teleost but the results are very contradictory in S. salar, Salmo gairdneri and Anguilla anguilla (Fontaine and Leloup-Hasey, 1959; Cadet and Fontaine, 1963; Butler, 1965; Chesterjones and Henderson, 1965, 1966; Chan, Rankin et al., 1969). Corpuscles of stannius, when incubated with labelled substrate have failed to produce adrenocortical steroids as transformation products (Ford, 1959; Phillips and Mulrow, 1959b; Chesterjones et al., 1963). In contrast, Idler and Freeman (1966) were able to demonstrate a slight conversion of progrenolone to labelled progesterone and progesterone to docycorticosterone by sliced cod corpuscles in Gadus morhua.

There have been reports that stannius corpuscles in Atlantic salmon contain cortisol and cortisone (Fontaine and
Leloup-Hatay, 1989; Cedard and Fontaine, 1963) and goldfish corpuscles of stannius contain 11-deoxycorticosterone (Ogawa, 1963). Subsequently Colombo (1971) has reported 5α-pregnanedione and 5β-pregnanedione in corpuscles of stannius extract. Estrone, estradiol 17β and estadiole were also detected in the corpuscles of stannius of Atlantic Salmon (Cedard and Fontaine, 1963). Conversion of estradiol 17β to estrone by corpuscles of stannius was also reported by Breuer and Ozon (1963). Pandey (1966) has reported a karyometric investigation in corpuscles of stannius of the snake headed murrel Ophiopophalus punctatus (Bloch) which were exposed to thiodan treatment. Nardi, Piepsey and Bern (1967) reported the presence of DOCA in corpuscles of stannius of trout. The presence of renin activity in corpuscles of stannius extracts, which caused a rise in blood pressure in eels Anguilla anguilla has also been reported by Chesterjones and Henderson (1965), Chesterjones (1966), Chan et al (1969) and Sekabe, Nishimura et al (1970). Incubation of corpuscles of stannius extract produced angiotensin like substance in Anguilla anguilla (Chesterjones et al, 1969).

Secretory activity of corpuscles of stannius is related to physiological experiment. Secretion of protein like hormones, hypocalcemic in nature has been suggested in the corpuscles of stannius of different teleosts like goldfish (Oguri, 1966), Carassius auratus (Ogawa, 1967), Onchorynchus keta (Hiroi, 1970). Previously the corpuscles of stannius were also considered as a source of insulin in fish (Nagafusa et al, 1953).
Pang et al (1974) have reported the presence of protein-like hormone "hypocalcin" in the corpuscles of stannius, which is hypocalcemic in nature. Secretion of calcitonin from ultimobranchial gland, which is also hypocalcemic, seems to be under calcium regulation (Pang, 1971c). Ma and Copp (1978) also reported a hypocalcemic glycoprotein in the corpuscles of stannius of trout, Salmo gairdneri and called it "Telecalcin".

The corpuscles of stannius are reported to be independent of pituitary control (Rasquin, 1951; Pickford, 1953; Chavin, 1956; Botte et al, 1964) which was corrected by later workers (Oliveau and Fontaine, 1965; Oliveau, 1966; Harke et al, 1967; Ogawa, 1967).

Corpuscles of stannius also play a role in ionic and osmotic regulation (Ogawa, 1968). Recently, they are known to play a role in calcium metabolism and renin-angiotensin system, which are some of the functions attributed to the corpuscles of stannius but the chemical nature of secretion by corpuscles of stannius remains a subject of controversy in Fundulus heteroclitus (Pang et al, 1973; Nishimura and Ogawa, 1973). A parathyroid-like function by the corpuscles of stannius was suspected by Giacomini (fide De Smet, 1962) which was later confirmed by Lopez (1984) in Anguilla anguilla.

This famous group (Tisserand-Jochem, Lopez, Milet, Vidal, Eyquem and Cohn, 1987) localised the parathyrin glycoprotein, secretory protein I in the corpuscles of stannius in European eel Anguilla anguilla. Bonga et al (1986) have also observed effects of parathyroid hormone (1-34) in stannius corpuscles.
homogenates in teleost fish adapted to low calcium water. Srivastava et al (1987) have reported the response of corpuscles of stannius extract administration in the prolactin cells of Carassius auratus. Recent workers (Milet et al, 1987) have identified a precursor of the parathyroid in the corpuscles of stannius while Yamada and Kobayashi (1987) have isolated the immunoreactive angiotensin II in the corpuscles of stannius of the rainbow trout Salmo gairdneri.

Removal of corpuscles of stannius lowers blood pressure and elevates of plasma calcium and also affect other electrolytes. Corpuscles of stannius are stimulated by the surrounding media. They are more active in calcium enriched environment (Pang, 1974) than in freshwater. Some other substance affecting hypocalcemia by direct or indirect action may also be produced by the corpuscles of stannius (Krishnamurthy, 1974). A substance "Aldosterone" that stimulates interrenal secretion or inactivates corticosteroids may occur in the corpuscles of stannius. Calcium regulation is regulated by the secretion of corpuscles of stannius, which acts synergistically with the secretion of ultimobranchial gland (Krishnamurthy, 1976).

In Hokuopterus notolitterus (Pallas), one or two corpuscles of stannius are located on the anterior-most part of the mesonephric kidney (Fig. 1). They are white to pale cream oval bodies encapsulated by a fibrous connective tissue sheath, which penetrates the corpuscles of stannius and divides it into many lobules. The corpuscles of stannius are richly vascularized and blood capillaries and nerve fibres also enter along with the
connective tissue. A considerable part of corpuscles of stannius is surrounded by interrenal tissue as well. There seems to be two types of cells as regarding their staining properties. One type shows deeply stained nuclei and agranular cytoplasm while the other with light stained nuclei with granular cytoplasm. Since the developmental study of the corpuscles of stannius for this fish is not available, no definite explanation regarding this aspect can be given.

Another informative aspect of this Chapter is the inclusion of comprehensive and up-to-date bibliography dealing with the developmental, morpho-anatomical, cytophysiological and biochemical studies.

The present study has been planned to observe the cytophysiological studies of the corpuscles of stannius in the local teleost fish Notoperus notoperus (Pallas) and also to elucidate their functional aspects. Emphasis is given on the experimental results relating to their functions.

Due suggestions are also made to meet the missing steps in our knowledge. Seasonal changes in the corpuscles of stannius have been studied in this fish for the first time. As mentioned earlier, there is only a single reference available up-to-date, describing the seasonal changes in Heteropneustes fossilis. Effect of gonadectomy in corpuscles of stannius is also being studied for the first time. Interesting clues have also been observed by the treatment with prostaglandin inhibitors.

The Chapters have been planned for direct publication of the results and a separate section of bibliography was found unnecessary.
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* Not seen in original.
Fig. 1  A ventral dissection of the abdominal region of *Notopterus notopterus* (Dallas) to show the position of corpuscles of stannius.

*Abbreviations:*

- ABD = Abdomen
- CS = Corpuscles of stannius
- HK = Head kidney
- MK = Middle kidney
- PK = Posterior kidney
- PCV = Posterior cardinal vein
- S = Snout
- T = Tail