SPECIFICITY OF THE REGENERATING AXONS FOLLOWING SPINAL CORD LESIONS

THESIS

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BY

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CONTENTS

V. DISCUSSION:

INTRODUCTION AND AIM OF WORK

INTRODUCTION AND AIM OF WORK

Transection of the spinal cord in man results in paralysis, loss of sensation below the lesion, and unfortunately, there is little regeneration or recovery of normal function (Windle, 1956; Clemente, 1964; Pettegrew and Windle, 1976; Puchala and Windle, 1977; Kiernan, 1979; Freed et al., 1985; Collins and West, 1989). In contrast to the limited regenerative capabilities of the mammalian spinal cord, in goldfish, regeneration of the transected spinal cord and recovery of function are well-documented. Out of 17 brain centers found to project to the goldfish spinal cord (Prasada Rao et al., 1987, 1993), only 11 participated in the process of regeneration of the descending spinal projections (Sharma et al., 1993).

Reviewing the literature, it was found that the sources of normal descending projections to the spinal cord were investigated in the goldfish (Sloan and Demski, 1985; Prasada Rao et al., 1987, 1993); adult zebrafish (Becker et al., 1997); Himé salmon (Oka et al., 1986a); European eel (Bosch and Roberts, 1994); lungfish (Ronan and Northcutt, 1985); electric fish *Eigenmannia* (Behrend and Donicht, 1990); agnathans (Ronan, 1981; Ronan and Northcutt, 1981; Ronan, 1989); Chondroichthyans (Smeets and Timerick, 1981). Moreover, the normal ascending spinal projections to various brain centers were reported in the adult zebrafish (Becker et al., 1997); Himé salmon (Oka et al., 1986b); *Cyprinus carpio* (Xu et al., 1994); the teleost *Sebastiscus marmoratus* (Murakami and Ito, 1985); the teleost *Gnathonemus petersii* (Libouban and Szabo, 1975); dogfish (Hayle, 1973a); agnathans (Ronan and Northcutt, 1981, 1990); nurse shark (Ebbesson and Hodde, 1981). However, in goldfish, the fate of the ascending spinal projection, to our knowledge, was not reported

Most of the studies, dealing with the descending and ascending spinal projections in various animals, used either the degeneration techniques or horse radish peroxidase (HRP) method. However, with these techniques neither the detailed course and distribution of the spinal pathways, nor the terminal arbors of the nerve fibers were clearly defined. New avenues to investigate the spinal pathways have been opened by the recent introduction of Dextran amines, as anterograde and retrograde tracers. Dextran amines are readily taken up only by cut axons, do not leak out of intact profiles, lack any transcellular staining (Fritzsch and Wilm, 1990), and show a fast transport, long persistance in the axonal terminals (Fritzsch, 1993, Matz, 1995). Accordingly, the present study was planned to investigate and compare both normal and regenerated spinal projection patterns in the adult goldfish with special reference to their terminal arbors using the Biotinylated Dextran Amines (BDA). Therefore, the question of whether the restoration of function resulted from the formation of appropriate synapses by the regenerated axons with their targets, or whether that was due to adaptation following the formation of “new” projection patterns will be addressed, thus the specificity of the regenerated axons following spinal cord transection will be screened.

REVIEW OF LITERATURE