OBJECTIVE:
The research proposed will utilize data derived from studies of the barrel cortex to elucidate the functional organization of the cerebral cortex as a whole.

Our research will focus on the representation, within the somatosensory cortex, of the whiskers on rodents' snouts. The cortical area known as the barrel cortex contains discrete physiological representations of individual whiskers which coincide with discrete anatomical structures, termed barrels because of their shape. The anatomy of the barrels correlates so well with their physiological map that many of the receptive field properties of individual neurons can be deduced from the location of a cell within the barrel field. This orderly arrangement, together with the wealth of data on the anatomy, physiology, development and plasticity of this area provide a comprehensive framework for more sophisticated studies of the functional organization of this cortical region. We will investigate the potential contribution of these neurons to intra-cortical synaptic interactions.

Research design:
Examples of CT neurons will be identified and labeled during electrophysiological recordings in Dr. Keller's lab in Baltimore. The axon collaterals of these cells will be reconstructed at the light-microscope level in drawings, with the use of the NeuroLucida® morphometry system. Correlated light microscope drawings and electron-microscopy will be used to identify individual synapses formed by these collaterals, and to characterize their postsynaptic targets.

The tissue blocks will be embedded in plastic and sent to us by Dr. Keller. They will be sectioned using an RNIC MT 7000 Ultramicrotome. Semithin sections cut with a glass knife will be collected, stained (1% toluidine blue in 1% borax), and examined with the light microscope. The blocks will be trimmed to encompass areas suitable for study. Unbroken series of ultrathin sections will be cut with a diamond knife (DDK) to a thickness of approximately 60 to 80 nm and the sections will be placed on formvar coated copper slot grids to be examined and photographed with a Phillips 200 electron microscope.

The postsynaptic targets of labeled axon collaterals will be identified by reconstructing, from serial thin sections, long dendritic segments postsynaptic to each labeled axon terminal. In addition, post-embedding immunocytochemistry for (IABA will be used to identify postsynaptic targets as inhibitory neurons. The proportion of distinct postsynaptic targets (dendritic shafts or spines belonging to spiny vs. non-spiny neurons) will be quantified and will be described as the percentage of the total number of synapses. Synaptic density of all types of synapses in the neuropil, will be determined using the dissector technique (Steno, 1984).

We will examine the postsynaptic targets, in layers IV to VI, of at least 10 corticothalamic neurons, and will include at least 300 synapses in the analysis.

Clinical significance:
Since the function of the CNS is predicated by its synaptic organization, these studies will form the basis for understanding brain pathology caused by injury and disease processes. The information will help guide the formation of therapies for patients suffering from traumatic or chemical brain injury, seizure disorders and amyotrophic lateral sclerosis, to name a few.