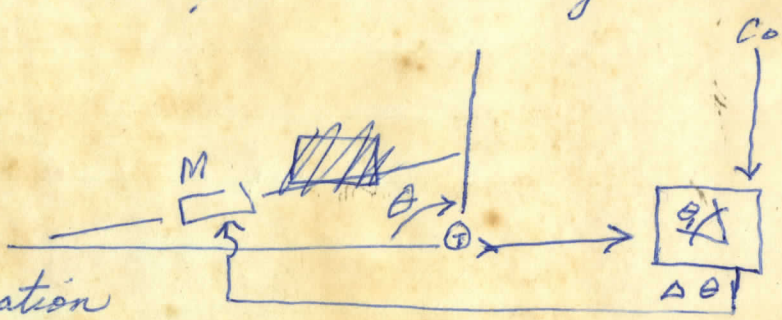
~~S.M.S.~~ Neurological Studies

Kinesthetic ~~position~~ memory:

Background: Rationale -

~~The~~ loss abrupt loss of a major source of sensory input and of significant force on the muscle ~~servo~~ systems ~~as well~~ might be expected to have major effects on many ~~aspects~~ functions of the nervous system. ~~In an attempt~~ to document possible effects on the various neurological subsystems I undertook functional examinations of several. One of the simplest such loops is kinesthetic or position sense. ~~Although~~



For illustration ~~5~~ fig. 1 shows the simplest possible schema of the far more complex system. T is an angular transducer with its output compared to a commanded angle ~~and the difference signal is then passed to a motor unit which dynamically controls the angular position~~ to minimize Δθ. Changes in force, gravity - in this case, could affect the system at several points, the transducer, the servo driver and ~~indirectly~~ the command system. In the actual case of the human body, the transducer system is far more complex and theoretically

subject to gravitational forces ~~while~~ as are both motor (muscle system) and command system (CNS). At the same time this is one of the simplest systems that could be examined easily.

~~While~~ If there were no ~~upsets~~ anomalies of function caused by weightlessness, one might assume that neither the sensor nor command functions were ~~sufficiently~~ sufficiently disturbed to be outside the control limits of the system. By making serial measurements if any changes were detected the effects of adaptation could be followed. If significant change were found additional study would be required to isolate it. If changes were small or non existent in this system one could argue by analogy ~~that adaptatat~~ adaptation to somatosensory inputs ~~here~~ should also be possible in the equilibrium system i.e. somato sensory inputs were probably not a major ~~causes~~ contributor of SMS conflict. This argument is tenuous.

On STS-5, 7 + 8 measurements of kinesthetic memory were made as follows:

On 5, two subjects made a series of measurements ~~c~~ wrist, elbow & shoulder by inscribing a point on a record and then attempting to repeat it for 10 trials ~~c~~ eyes averted and ~~3~~ + ~~c~~ ~~too~~ 'vertical' loading approximately equivalent to forearm weight. ~~Sets of records were made pre + in flight.~~ Although ~~simple this~~ This force was supplied by a long bungee cord through a 'glove' on the hand. Fig - 2

~~the disadvo~~ Two preflight & 2 inflight records from each crewman were obtained. The difficulty ~~c~~ this technique is that the ~~p~~ individual points are not identified hence secular trends cannot be ~~followed~~ determined ~~It has the~~ & only static points can be measured. No significant difference was found.

A ~~dynamic system~~ single axis transducer system ~~&~~ which ~~could be~~ was recorded electrically & which allowed static + dynamic measurements was devised for + flown on STS-7. Both static location and dynamic movements were recorded ~~in~~ th from 3 ~~se~~ arm segments in the vertical + two in the horizontal planes by 1 subject pre flight, daily inflight + post flight on ~~&~~ that mission.

The equipment was flown on STS-8 but the number of in-flight studies precluded performance of this one.

Hardware - Protocol -

The eye hand tracking recorder developed for STS-8 was refined as was the recording system.