

21 Apr '84

Sam this is a quick cut but better
than anything ^{else} I know of. Please consider
it & let's talk when I get back. It
will require little effort but obviously
must be coordinated (Jim, Joe, Logans)
and sold (FOD, Astros) -

I would appreciate your keeping it
out of the larger effort for the time
being - W.T.

N.B. Crip told me a very different
story about +3,4c

the Operational
Continuation of Investigation of SMS

Background

The approach to this problem has been characterized by a series of fits and starts usually driven by publicity, the ^{individual} experience of a crew or crews or the plans of investigators. In perspective it appears that 1) certain ~~missions~~ missions may be impacted depending upon the mission and chance appointment of crewmen 2) we have no effective countermeasure 3) we have no ^{mission} selection criteria. Further we have no ~~plan~~ plan likely to yield early results.

It still seems realistic to say ~~that~~ that ground based studies have been unproductive. Two in-flight efforts have been mounted, 1) 54-1 and I frankly don't know what it produced other than convincing the MIT group that ^{response to} visual conflict was a predictor of SMS. Maybe we will learn more ^{from their} publication, and 2) the 54-8 series we mounted.

The following seem ~~to be~~ reasonable conclusions based on 54-8: There is little ~~or no~~ or no support for a pathological ^{*} basis of the problem ~~based on~~ based on ~~the absence~~ the absence of abnormalities in good ECG and audio evoked potential studies on a small sample of subjects and the absence of illusions and other symptoms. Also from a too small sample ^{and subjective + theoretical considerations} it appears that an intra-vestibular conflict conflict, produced by motion during

labyrinth

* i.e. anatomical changes or fluid pressures on the CNS or [?]

the first day or two of weightlessness is the most likely cause which may be more or less aggravated by visual ~~and~~ and other inputs in some subjects. This conflict produces symptoms in two areas 1) gut and 2)

CNS. There is evidence that the primary event in the gut is loss of motility. The CNS problems can only be described symptomatically including malaise, lethargy, somnolence, headache, etc. There are undoubtedly autonomic responses but they have not been adequately studied but are not consistent $\bar{c}$ those caused by acute 1g M.S. eg cold sweat, pallor, nausea.

No agent has been effective in preventing or modifying the problem including preflight conditioning (including, I suspect, one case of biofeedback), ^{mechanical} loading of the ~~body~~ during SMS in two subjects and a variety of medications. Two individuals reported striking resolution of gut symptoms ~~by~~ by an agent but this may have been placebo.

At this time then there is incomplete evidence that in the majority of cases SMS is a transient syndrome which [&] still allows a well trained crew to function ~~but~~ which is caused ^{by} an otolith-canal conflict $\bar{c}$ CNS + gut manifestations.

The best indicator we ~~have~~ have at this time for the course of SMS may be bowel sounds. There are other possibilities for increased understanding and even amelioration of symptoms but these have been slowed by administrative and other considerations.

The following is a proposed plan to

expedite ability to operationally deal c the problem, or at least know what we face.

Rationale: the following admittedly hypothetical scheme is the basis for [redacted] the proposal. A ^{strictly} heuristic ^{diagram} [redacted] is attached. The conflict arises when anomalous inputs from ① g-dependent & ② independent sensors are processed and compared to previously learned reference ④.

Error signals are sent to the ANS ⑤ which may directly affect gut, brain & other functions (solid lines) or they may be affected by hormonal substances (dashed lines).

This plot largely delineates our ^{possible} approaches to the problem eg -

Orbflight conditioning / selection: ^{A.} if weightlessness [redacted]

[redacted] could be obtained on earth it would be simple to select or train subjects. In this case the reference ④ would be reprogrammed. Presumably this is what happens in space.

Alternatives: ^{B.} [redacted] If it were possible to [redacted] eliminate or distort the otolith signal the same effect ^{might} be achieved and at least one drug is supposed to be otolith effective only but I doubt that A or B is possible at this time.

C. If ^{another} signal, ^{such as reversed vision} produced the equivalent effects of the distorted [redacted] otolith signal then possibly the same results could be attained. This seems unlikely but should be explored.

D. Presumably autogenic feedback, etc. is operative by blocking or modifying the response at ⑤ and if this is the case might be effective. I personally suspect

that the response may be specific i.e. require the same conflict hence it would only be effective if ~~the~~ ^{it} were also possible.

~~_____~~

Modification of neurological reaction⁵: If the sx. are directly mediated by the ANS ⁽⁵⁾ then it seems we are faced $\bar{c}$ either D, pharmacologically altering the ANS response, or E, altering brain-gut response at the receptor level. It seems very unlikely that we will know enough for D ~~for~~ for any attraction there will have the most profound effects generally. Authorities also predict E is not possible but I still have hope for altering gut motility ^{if} it is in fact inhibited by ^{direct} nervous action.

Modification
of
hormone(like)
reaction

If as I believe the symptoms are caused by hormone(like) action ⁽⁶⁾ then - I feel we have a much better chance for F, blocking or modifying their actions by some agent.

The following is an operational ~~_____~~ plan based on this schema:

Plan

Our first problem is to replace subjectivity $\bar{c}$ objectivity i.e. we need some reliable indicator or marker of SMS. Modification of gut motility and bowel sounds seems the best indicator at this time and it is simple and easy to obtain. We should make every effort to obtain a reasonable sampling and correlate a semi-quantitative analysis with other ~~sy~~ indicators and symptoms. This should no longer be left to the whim of various administrative agents for it is as innocuous as a

test is likely to be. In addition we should look for other reliable ~~indicators~~ objective and non obtrusive indicators such as temp., heart rate, B.P., EKG changes, etc. It would be highly desirable to have a 'brain' indicator and I suspect ~~EEG~~ EEG might be useful.

Specifically and beginning c 5-14 we should have as part of the on Board medical facilities a small SMS kit which would contain bowel sound recorders, a physiological recorder (Holter type) for EKG, EEG etc, thermometer, color chips etc., a kit which can be easily changed as conditions warrant & rewriting the NASA charter, etc. It should be under the direction inflight of one or two well trained individuals. Physically it would be no larger than the existing med kit and would require no more than 30 mins/day inflight and would be unobtrusive. It need not, should not be time lined but should be used by everyone c SMS and by a limited number of controls. I can get pre post flight data informally. This must be limited to SMS and not become a hobby horse for everyone's interests.

The kit should also contain test medications. We should as rapidly as possible document Reglan's utility or lack of. I would like to follow up c 2nd generation analogs on SL-3 for they are I.V. It should only be used c bowel sound recordings. It might consider using it I.V. when there is a physician on board. Any other meds that become available should have some means

for objective evaluation.

We should immediately start evaluation of other possibilities. My choice at this time are 1) Biofeedback + 2) Reversed visual fields.

1. cannot be done per ARC's massive instrumentation but should have some objective measurement from the SMS bit. Volunteers from the crews should be sought but only $\bar{c}$ objective means of evaluation. in 1g
2. Reversed fields should be tried on individuals who have been sick in flight and on whom we have some data. If it should look promising we should do a pre & in flight series but again objective means should be used for monitoring from the SMS bit.

Every effort should be made to get blood and any other (tears, urine, etc.) samples to note ~~modification~~ changes in any neuro-hormone substances. The ^{flatter} must be a flexible program. It will only be possible $\bar{c}$ 1) a physician aboard and 2) realistic inflight ~~sample~~ ^{$\bar{c}$ realistic} & preservation means ~~available~~ available. The latter can be protyped in a month.

If we can prove we have a good objective marker it should be used continuously during launch until first symptoms ^{in a few subjects} for the time course will give an indication of hormone vs neurological propagation.

In summary we should -

1. ~~Establish~~ Establish a reliable marker, gut & brain, for SMS.
2. Establish a simple bit of procedures acceptable to a reasonable crew & control it carefully
3. Establish the need for & right to study SMS as above - this implies ability to change as req'd.

4. Look at treatment modalities now under carefully controlled conditions i.e. document the markers. Candidates include ~~but~~ but are not restricted to drugs (Reglan & derivatives esp.), Biofeedback and reversed visual images
5. Look for causative agents in body fluids -

At this time I don't believe you can do better $\bar{5}$ affecting operations -

Sh. Thornton

Establish
Marker for
SMS

Use Sx +
Markers to
Evaluate
MCP

Gut

bowel sounds

Brain

B.S.

EEG

Other

EKG, Temp,
etc.

Compare
finds
courses,
Sx

fails → look for other
markers

works → use in testing

works

works → implement

works → implement

fails → discard & look for ways to block at
earlier level

fails →
Change route,
Use more
potent med. ②

Test
Biofeedback
using Sx
and Markers

Voluntary
Astronauts

Yes/No

Test Reversed
Vision, using
prev. sick
subjs - Sx
+ Markers

+ Test for
prediction,
conditioning,
for flight

Causative agents
Blood, ①
etc

① physician

② 5L-3

3

discard

In flight -
compare
sick + well
subjs. &
correlate
markers

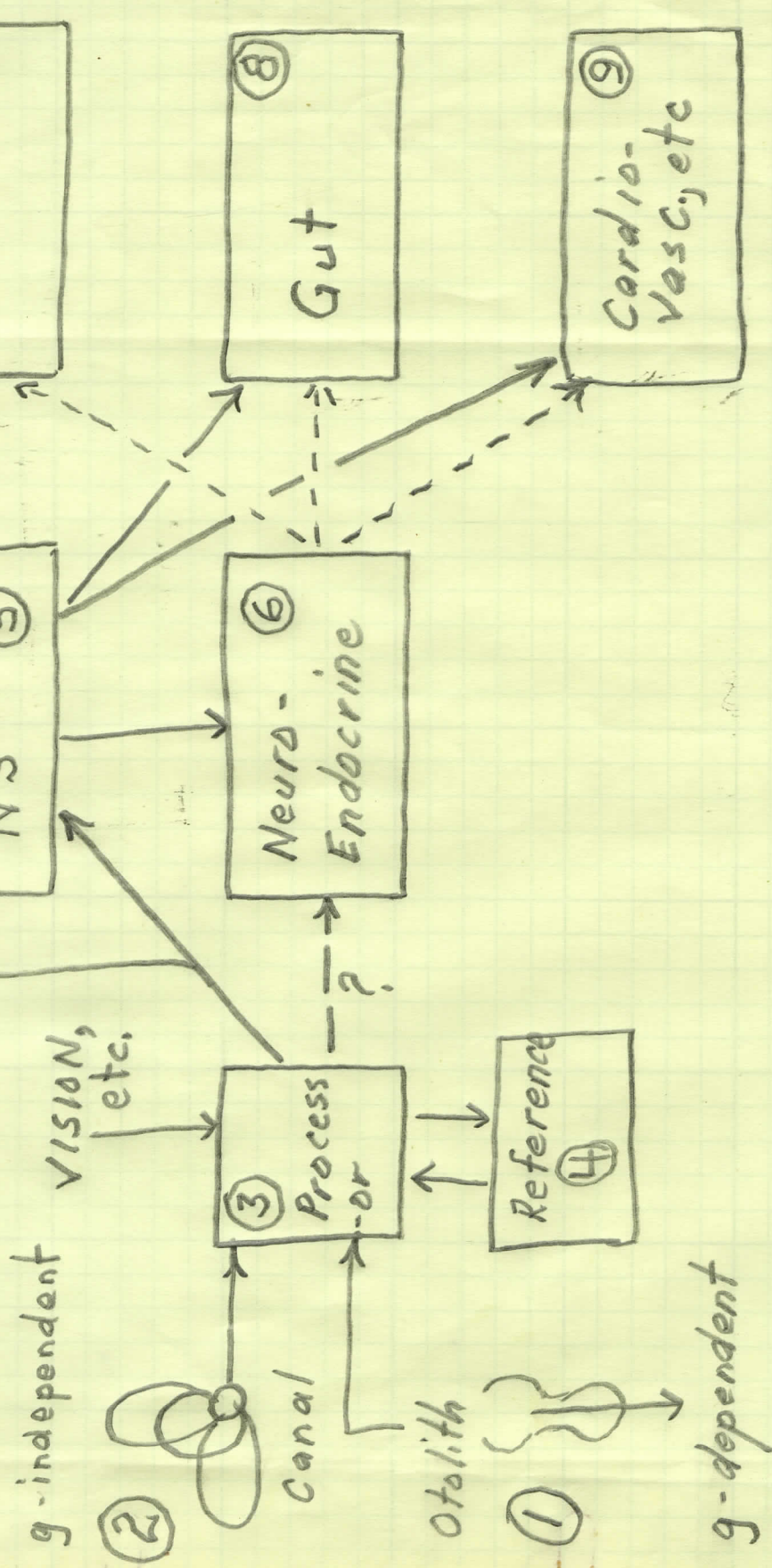
look for antidotes
(blockers, etc.)

Discard (after
reasonable search)

& look for neurological
pathways

SMS Schema

Visual, Muscular, etc. Controls



2hr.