Comment on Adaptation to the Environment

Introd - v. good P-6 Animal studies - should contain a warning that they must be appropriate models for the phenomena being studied. This is especially true where hydrostatic columns are involved, otherwise much of your excellent introduction goes for naught.

P-10 Line 3 would use 'probably' vs 'maybe'

P-11 Lines 3-5 Bravo!; might add a footnote on parabolic flight that states zero G times and entry/exit G loads depend on aircraft performance. Note that few pilots can fly ~~point~~ .05 G in maneuver over 5 turbulence.

P-12 - Line 2-4 Bravo

P-12-13 - It was a small study, 5 subjects, for 2 hrs in launch posn. but we found no significant leg volume loss. It's not written up yet but I'll be happy to give you the data.

15 L-3 ~~may~~ leg vol. decrement may be due to elevation - No data exists, or this that I'm aware of ~~on this~~ except our unpub. studies which ~~obviously~~ need confirmation.

P-22 - There is a lot of old EKG heart rate data also that was valid & could be used to ~~support~~ augment the one quoted - There are some poorly shown EKG launch records ~~shown~~ in NASA SP-121 Gemini Mid Program Conf.

L-4-9

P-19 - n's of 1 have always been dangerous esp. when

not repeated eg Hunter and syphyllis - gonorrhea.
consistently
If you want to be ~~as~~ rigorous in your ~~eval~~
evaluation ~~yo~~ point out that jugulars are always
full in flight and this requires at least a few
cm. H_2O press. for and the jugular strial course
should be have low impedance - and pressure
drop.

P-27 L-2-3 This was my original thought also. ~~but~~
~~while~~ increased compliance inflight would certainly
be a detriment during the entry period + must. ~~may in fact~~
account for some of the immediate problems seen. On R+1
compliance on all three ? crewmen had returned ~~was essentially~~
to ~~at~~ preflight levels in hours and 'crazy legs' Cass, who was
also most resistant to orthostatic stress (Ch. 29 -
Biomed. Results Skylab), had lower compliance than
preflight. Also the ~~evidence~~ leg fluid vols. of the SPT-PLT
had not recovered at that time and ~~I concluded that~~
My conclusions were that altered compliance did not play a
role in S/S after the say the first day and that
compliance had moved toward a new lower set point on
this mission consistent ~ the chronically reduced volume

Dr. ~~at some point~~ you should point out somewhere that upper and lower leg vols. ~~but~~ and ~~probably~~ possibly compliance + flow behave differently. While the calf is always (reasonably) measured as typical it in fact shifts far less fluid absolutely and relatively than the thigh in ~~this ma~~ 1g vs ~~w~~ weightlessness.

P-28 L-7 would add ↑emptied [superficial] leg veins.

P-28 Do you want to consider the reduced blood volume of deep veins (venous 'sinuses') as an independent factor i.e. working at a steeper portion of the compliance vs pressure curve or do you consider ~~this~~ ↑volume a function of counter pressure?

P-29 The large changes ~~seen~~ we recorded have bothered me but I don't believe ↑they can be explained by temp. humid. as you suggest. ↑There was enough ~~leakage~~ leakage + air flow in the LBNP to replace convection. Also I don't recall the ~~ΔT~~ ΔV/ΔTemp response as being ~~to~~ sufficient but don't have time to review it.

P-30 last line - seems to ~~§~~ me that the sensation

300 E. 54

of 'blood rushing--' is extra cranial vs the intra cranial effects you are discussing. I believe they have different innervation & response.

P-31 L-14 Are you postulating increased jugular impedance in the thorax? If so, how? The more likely cause is ~~threat~~ non zero atrial filling pressure reflected into the jugular in the absence of hydrostatic pressure, also impedance measurements remain electrical phenomena until correlated ~~c~~ physical phenomena on a case by case basis, in my experience. ~~Eg.~~ eg. 32 L-17, we saw no change in directly measured forearm vols. on Skylab. (Ref 254)

P-33 ~~L-1 should add "most" existing data.~~
~~NB a segment fluid calorimeter would be a way to settle some of the flow questions.~~
2nd Sect. L-3,4,5 It would be more meaningful to insert time estimates eg. blood, secs. to mins., vs fluid, hours to days.

34. ~~I think~~ L-3 You should ~~emphasize~~ point out the differences ~~in~~ between Lg tilt and $\bar{w}$, for + and the need for measuring not inferring volume changes. Whether you believe it or not the my volume review + study were at least as well done as most and should be disqualified not ignored. Upper body tilts results in tilts are probably far more relevant to $\bar{w}$ than lower body.

P-35 L-9 You don't have to wait for SL5-1 data to integrate ē S.L. mass data for I used S.L. ~~blood~~ Hct/Hgb data Chap. 26 Skylab and my mass data & drew the same conclusions, albeit less elegantly (Ref 354) ~~that Chap. 26~~; that the first step ~~is~~ in adjusting the blood volume to a reduced vascular volume is reduction in P.V. followed by decreased erythropoiesis until the HCt is brought into balance. I ~~was~~ still remember being hosted at by the Hematologists at the Skylab conference.

P-36 L-20 ~~This was~~ This facial puffiness was first documented, albeit it poorly & qualitatively, by the first crew comments. ~~Skylab~~ inflight photos taken for that purpose on SL-2, ~~this was~~ for me not clear at the end of mission after ~~the first Ad Hoc 'study' done,~~ I was Cap Com & awakened

~~at 0400 by a senior astronaut who wanted to know what I was thought I was doing.~~ Later did a semi quantitative photo study on legs + facies throughout several Shuttle missions + they are still around albeit unpublished.

P-37 L-1 would replace eventually ~~add~~ partially ~~between 'may'~~ &

P-37 L-15 to 20 It seems to me you are pushing an indirect measurement very hard. Further ~~there are~~ I recorded extraordinarily low ambulatory blood pressures during sleep on S-8 and normally or low pressure on 7 others ~~in STS~~ on Shuttle (unpub but data available)

Thornton, W. + J. Wallace - Ambulatory Aerospace Applications of Ambulatory Blood Pressure Monitoring in Ambulatory B.P. Monitoring, pp 95-104, Springer-Verlag, N.Y. 1984

P-39 At do you really believe a few ~~mm~~ cm H_2O pressure change in rats will affect the myocardium. Simple disuse atrophy secondary to ~~pc~~ reduced peak metabolic loads are a more plausible cause. Someone really should ~~treat~~ address this scale factor in animal models.

P-40 & good conclusions - L-4-5 body
should add caveat that peak ↑ metabolic
(work) loads must remain the same or atrophy
will occur as in bedrest ≅ exercise -
Second sect. L-1 also good conclusion
2nd sect. L-7 you might as well ~~throw in~~ add my
ref. for it was the first ambulatory study
of B.P. & just for such purposes

P-41 L-1 One has to be very careful about the
conditions under which H.R. is recorded. Using
data from 'resting' LBNP, echo studies, etc.
is not resting for the average astronaut nor
is data taken during resting preparation.
My inflight ambulatory ~~data~~ BP/HR data does not
support a general increase in true resting data, &
Some individuals may increase their rate - this
data is available ~~&~~ albeit unpublished.
L-8-15 you approach the above obliquely

P-43 As I'm sure you know PVC's &
other arrythmias are so common that their
absence during stress causes me to look for other abnormalities.
~~to~~ There should be plenty of references on this.

P-44 You can make a stronger case for
this obligatory fluid and mass loss, which

~~occurs~~ S.L. 2 mass data was complicated by a very inadequate diet & heavy work load but the stet ~~early~~ leg volume losses on S.L. 3&4 correlate nicely c̄ the mass loss over the first 3-5 days in rapid phase all crewmembers and c̄ the post flight mass & leg volume tissue recovery i.e. ~~metabolic~~ losses must be allowed for esp. on S.L. 3. Unfortunately the published mass S.L.S-1 data was worthless through calibration error but I was able to find a couple of good cal. points and the mass correct data which I have & will be happy to give you shows the same pattern albeit it more scattered. Unfortunately they would not let me show them how to use the stockings & ~~that da~~ the S.L.S-1 leg vol. data was so worthless I couldn't salvage it. S.L. 2 ~~shows~~ mass data show the same

rapid obligatory mass loss and gain on entry to & exit from W. The mass and leg vol. curves are about as ~~definitive~~ striking an illustration as one ~~would~~ could ask for.

P. 45 L-18 It does not seem reasonable that the upper body i.e. ~~above~~ supra cardiac fluid gains exceed the lower body losses; ≥ 2-4 L ?!

P-47 second sect. I first proposed the schema (Ref 254) of reduced hematopoiesis based on reduced vascular volume and supported by changes in hgb., hct., reticulocytes, etc.

Pp-48-52 I strongly fel you are remiss not to consider the differences between W & simulated W which are in the literature & which were demonstrated. Not only do people generally ignore total leg volume changes but they don't even weigh bed rest subjects during the course of such simulations.

P-52 Thermoregulation - At still have some Δ masses from SL-3 crew before + after known amounts of exercise on the ergometer + they were quite large. I can dig this up for you if you want it.

P-55 Second para. I don't have the Essfeld ref (73) and can't comment specifically but I shall be interested to see how he elevated the leg to cause local tissue dehydration' for we have tried; recumbency, recumbency c one leg elevated up to 90°, + head down tilts to 30° & significant leg volume change.

P-56 L-5-6 This is the opposite of what the crews claimed which was water surface tension caused it to gather in a globules in the axillae + on the scalp + I seem to recall a cine film of Gemini (cms) on the cycle c a thick, oscillating cap of sweat. Moreover in heavy exercise much if not most of the sweat is shed by gravitoinertial forces not evaporated.

P-57 If you will read ref 259 & look at the exaggerated color sketch I think you will

have to admit this anticipated Buckey + Covertino by some time. Buckey at least ~~admits~~ admits that this ref. is what triggered his study.

At this point my paranoia is aroused:
P-58 2nd Para. Why not discuss recorded muscle pumping in space as was done (ref. 251) rather than simulation on Earth.

P-60 2° Para - Good, but why not show some measured difference - Ref X.

P-61 60-61 agree but should have refs.
P-61 Para 2 - L 5-9 good

P-62 missing

P-63 2° Para - L 3-4 This needs qualifying for if this statement were taken at face value all the SL-1 troops should have been severely orthostatic and the SL-4 should have been O/S for days but they were standing easily & the next day & c less distress than the difficulty than the SL-2 crew. I was there - This I have seen videos of some Russians also standing & apparent difficulty hours after landing following years in flight. ~~There is~~ It seems safer to say that O/S seems duration dependent for shorter, days flight but is very much dependent on individuals &

their activities) in flight. These activities are difficult to specify but one major difference in SL-3 + 4 was the use of (poorly simulated) locomotor exercise. c a sharp improvement in past flight leg strength over SL 1+2. (Ref-253)

~~I certainly wouldn't wash~~ As you know the Russians had people return in very poor condition after 30-60 day flights + some in "good condition" after a year. This is a v. soft area. + they related this to inflight activity esp. exercise.

P-63 last two lines through P-64 L-1-4 - good - I recorded the absence of hypotension + tachycardia in two ambulatory B.P. records on two subjects who had real post flight O/S difficulty -

P-66 L-1-2 This is also consistent c S.L. results where there was little change or decrease (Ref-251)

not

P-66 2° Para This was consistent c no measured flows in 2 of 3 SL-4 crew (Ref 251) + though resistance is not shown the B.P.s were not sig. different-

P-69 Top Sect - Good -

P-70 General - While measured ECF may not be increased there is obviously a fluid (surmised from rapid (days) recovery) loss somewhere based on a far more reliable ~~mo~~ & consistent measure - weight - Ref. 252

P-71 2° Para L 4-7 need to separate relative & absolute changes

P-72 ~~2~~ last line - you should include the 5,6,4 study done ~~c~~ the bike ~~in~~ horizontal & normal position which supports your argument.

P-74 ~~last para~~. see comment on P-

P-77 see P-72 comment

P-78 L 4-5 gives wrong impression RCM is reduced as a function of flight duration until a new & stable level is reached - increased

P-78 2nd Para L-7 leg compliance is not ~~reduced~~ post flight -

P-79 2 2nd Para L-1 same previous comment - yours confusing in & post flight compliance & consequently your argument - Also what evidence do you have for ~~decreased~~ decreased post flight upper body compliance -

P-80 general comment - you should address fluid ~~loading~~ loading problems more completely esp. the timing, and intolerance of some timing

subjects to large vols of saline.

P 80 ~~2nd P~~ Last line loose,

~~P-80~~ this is a general & imprecise statement which ~~that in my opinion has no place in scientific literature~~ of the kind that is seen too often in descriptions of exercise. Unless some more definite statement which includes type & duration of exercise & individual result can be made you should say that ~~data~~ adequate data is not available.

P-80 2° Para L-8 penguin is not a 'whole body compression' suit but applies only axial not radial loads. Why don't you reference ~~the~~ my first and subsequent exercise papers.

P-81 General Comment

It is my understanding that enough results are in on the one hour of exercise & LBNP soaks ~~to~~ that they are being dropped from use, this is not surprising when viewed against the physiology involved. This should if possible be included for it would help focus the current countermeasure muddle. This is an appropriate place for it.

P-84 You should point out that no confirming measurements of leg volume (vs calf volume which is not representative) ~~the~~ changes have not been made and that static LBNP is

currently much less than 100 mm Hg. I discussed these problems in more detail in ref X-1.

P. 85 Line 3 ~~in to~~ g should insert a 'theoretically' optimized for in practice ~~many of~~ some of the features you describe have not been shown to be necessary. This is especially true of item 5) which has ~~so~~ already cost a fortune at JSC & any return. What does eccentric micro stress mean?

P-87 To be as objective here as in the rest of the paper you should briefly review the advantages + deficits of the other major counter measures including cycle + treadmill.

Figs -

25 - The heart rate of STS-2 Cdr. is anomalous for he was clinically dehydrated

24, 31 - The explanation offered doesn't fit the facts for recorded aerobic, cycle, exercise of SL-3 was increased ↑ 108% while that of SL-4 over SL-3 was increased only 9% (Ref ~~#~~ 253) the real exercise difference was that an (inadequate) locomotor strength exercise was added which sharply reduced leg strength loss.

leg/arm
entry + recovery volume Δ's

Al, a good side by side of ~~fluid shifts~~ ↑ and mass Δ's might aid in emphasizing what is the most unambiguous and probably significant effects of $\overline{w}$. I have plenty of graphics if you're interested.