M074/172

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Draft

Inflight mass measurement was accomplished on all residual; i.e., opened but uneaten food, all feces, and vomitus. Daily mass of each crewmen was also measured immediately upon arising. Devices used for this were two Specimen Mass Measurement Devices in the Ward Room and Waste Management Compartment and a Body Mass Measurement Device. (Since the MMD units are fundamentally similar they will be described under this common heading.) These devices are mass dependent translational spring/mass oscillators which allow mass calculation from the period of oscillation measured by a high resolution counter and display unit.

In addition to routine mass measurement, several repair and investigative procedures were performed as well as several new proceudres in support of other investigations.

<u>Methodology and Operations - M074</u> - On SL-2 the WMC electronics unit failed and was replaced by the WR unit. On this flight a spare electronics unit was carried and used to replace the WR unit. There is a small unit-to-unit optical mismatch which can result in slight degradation of resolution, but it was elected to accept any such possible loss of resolution in preference to attempting to perform a complex zero crossing adjustment. Changeout of this WR unit was accomplished on MD-4 placing it back in operation. Calibrations using the precision cal masses were performed on the WR unit on MD-4, and the WMC unit on MD-4. Data was routinely received, enspected, and tabulated for a curve fitting up to the 5th order. The best fit was then used by Whittle to calculate values every 1 - 2 gm over the operational range. All subsequent mass period to mass conversions were made by use of this table.

Special Studies - A procedure had been supplied to SL-3 to allow some evaluation of: 1) the adequacy of the SMMD restraint system (an elastomer sheet over the specimen), and 2) effects of mass accuracy sample position on the specimen tray.

After a zero added mass run of 10 reps. to establish resolution, a 500 gram mass was first placed in its milled cavity and then moved to four other positions on the tray, extreme right and left and top and bottom. Ten repetitions were made and recorded in each position. Results are shown below.

TABLE 1 - Effects of moving 500 gm cal mass to different positions on SMMD speciman tray.

| Mass Position | Center | Top | Right | Bottom | Left |
|---|---|---|---|---|---|
| Period[1] (sec) | 2.62136 | 2.62209 | 2.62117 | 2.62108 | 2.62237 |
| Period[3] (sec) $X10^{-5}$ | -- | +73 | -19 | -26 | +101 |
| Equiv. M gm | | +31 | -.08 | -.11 | -.429 |
| Resolution[2] (sec)$X10^{-5}$ | 25 | 40 | 40 | 33 | 22 |

[1] Value is actually sum of 3 periods which for our purposes may be treated as actual period.

[2] Resolution is given as standard deviation of 10 repetitive measurements.

[3] Referred to center position.

From these studies it appears that a definite position effect remains in weightlessness, but that it can be neglected for the kind of operational measurements we are making. This effect is probably a lack of perfect rigidity in the tray spring assembly allowing assymetrical $2^{o}$ order oscillations to occur.

The clastomer restraint assembly appears to work well since variation in repeated measurements remained low--on the order of .2 gm or .025% at this mass.

Routine calibrations were made on both SMMD's on MD-27 and 52. For operational purposes the cal curves remained stable and will not be discussed here. All fecal samples were measured, but raw data has not been received. Two vomitus samples were received and measured with net masses of 108 and 140 gms.

Discussion - SMMD's continue to operate adequately for operational purpose & should do so for the life of the mission. The complete goals of this experiment cannot be met because of previously described inherent equipment limitations.

BMMD - Daily crew masses were taken immediately after arising and the last or closeout void. The same clothing was worn by a given individual. Three repetitions were made and recorded.

In an attempt to overcome some of the previous difficulties with calibration masses, spring-loaded clips had been provided to hold the lids to food tray, and a spring-loaded clamp to hold M-509 batteries to the cal adapter. This required elimination of the film magazines and T-003 and one food tray from calibration masses; but the gain in ease of operation and confidence in rigidity was considered worth the loss of calibration over the PLT's mass range. Calibrations were performed routinely this flight. Although calibrations are adequate for so-called operational purposes; i.e., crew weights, there is obvious variation in cal masses which make the original intent of precise determination of the devices characteristics impossible.

Figures 1, 2, and 3 are records of SL-3 crew masses, and Figures 4, 5, and 6 are those of SL-4 crew. The data has been smoothed by plotting a 3-day sliding average.

There are marked differences between this flight and SL-2 which begins with the preflight stabilization period. SL-2 all had significant losses during this period which simply increased in space. In contrast, two of three SL-3 crewmen were more or less stable in this period. The SPT had a small loss in this period. There was an initial inflight period of sharp loss when food and water intake was curtailed. PLT and CDR masses remained relatively stable until 6 days before reentry when both sustained sharp losses probably secondary to recovery preparations. The same accelerated loss prior to recovery was also seen on SL-2. SPT body mass continued to decrease slowly at a rate of approximately 2 lbs/month. Another consistently seen phenomena is the sharp post recovery rise for 3 - 5 days followed by a plateau or inflection point. A corollary change is seen in leg sizes and other body dimensions. This probably represents a marked fluid shift. Actual body tissue loss is probably represented by this postflight plateau and launch weight. In SL-3 this amounted to: CDR 4 lbs, SPT 4 lbs, and PLT $3\frac{1}{2}$ lbs.

It should again be noted that there is little justification for the 300 cal reduction rather the opposite would be more reasonable in two crewmen. In this case the CDR averaged 220 cal/day above baseline[1], the SPT 510 cals to which must be added an equivalent loss of 200 cals/day for weight loss (7000 k cal/Kgm) and 405/day for the PLT.

There should be no difficulty with the BMMD for as long a mission as can be continued.

A series of special studies were run with the BMMD which will be reported more fully later.

Human subject resolution was experimentally determined by adding and removing known masses to a subject. This was found to be on the order of

[1] During the last 3 weeks.

50 - 75 gm.

Repeatability was examined by having the subjects make consecutive measurements and getting in and out of the BMMD between runs. This was found to be less than ±.1 lb.

The largest potential source of absolute error is the restraint system which was investigated for adequacy by adding a second system and noting effects. It now appears that absolute subject accuracy may be +.25 to +1.0, probably nearer the smaller figure.

Insensible water losses during various activities were recorded and will be reported elsewhere.

The BMMD is demonstrating excellent performance and only wants a good calibration mass to meet all mission requirements.

# Caloric Intake

## SL-3 last three weeks, flt.

Cdr-

| WK | Avg./Day | Baseline | Deficit |
|---|---|---|---|
| 1 | 2671 | 2450 | 221 |
| 2 | 2637 | | 187 |
| 3 | 2685 | | 235 |
| | | Av. | 214.3 |

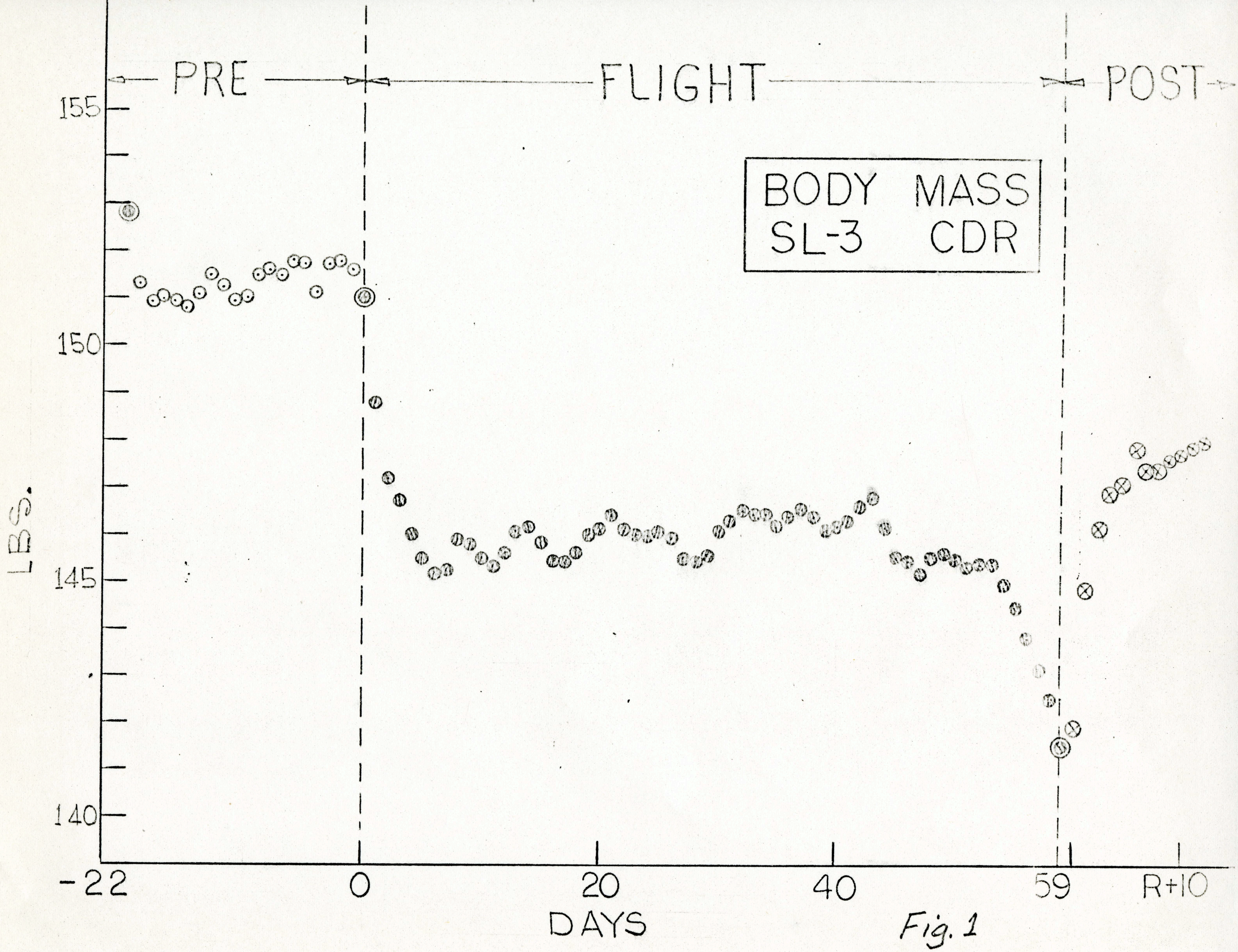
Spt.

| WK | Avg./Day | Baseline | Deficit |
|---|---|---|---|
| 1 | 2770 | 2250 | 520 |
| 2 | 2745 | | 495 |
| 3 | 2751 | | 501 |
| | | Av. | 505.3 |

Note: Spt lost ~ 1/2 lb./wk
or > 200 cal./day -

Plt.

| WK | Avg./Day | Baseline | Deficit |
|---|---|---|---|
| 1 | 3765 | 3300 | 465 |
| 2 | 3738 | | 438 |
| 3 | 3622 | | 322 |
| | | Av. | 408.3 |


PRE
FLIGHT
POST
BODY MASS
SL-3 CDR
LBS.
155
150
145
140
-22
0
20
40
59
R+10
DAYS
Fig. 1

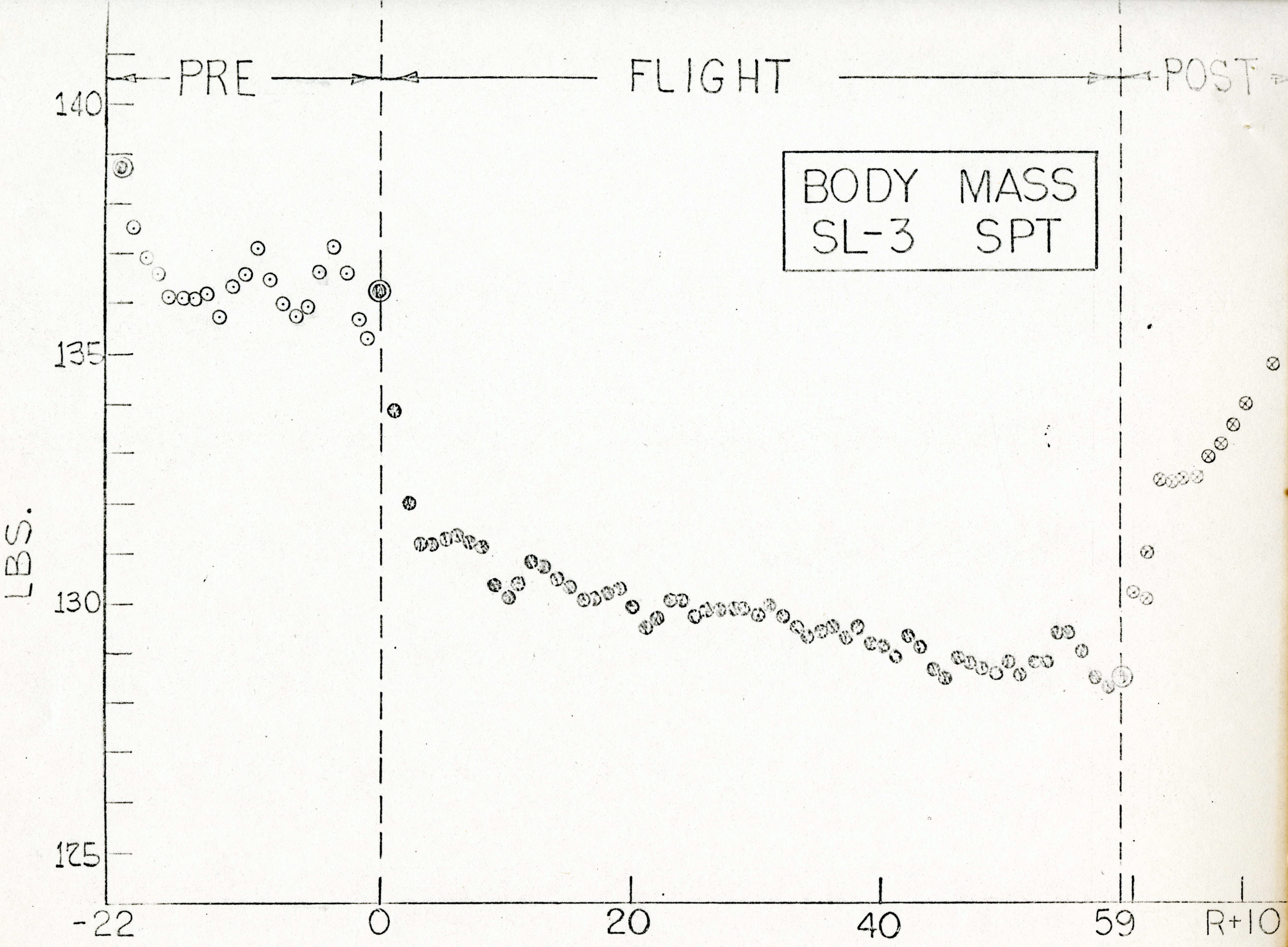
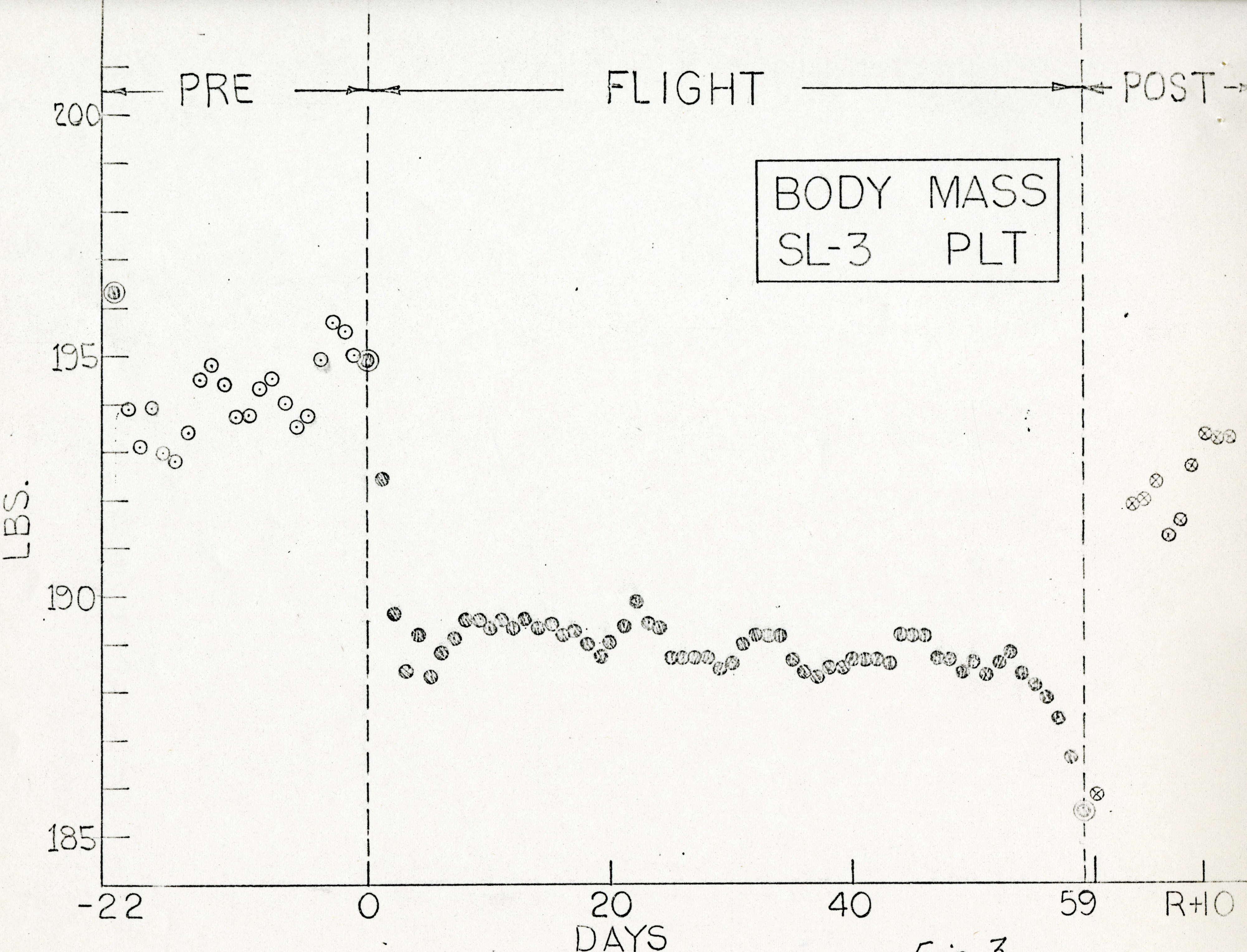
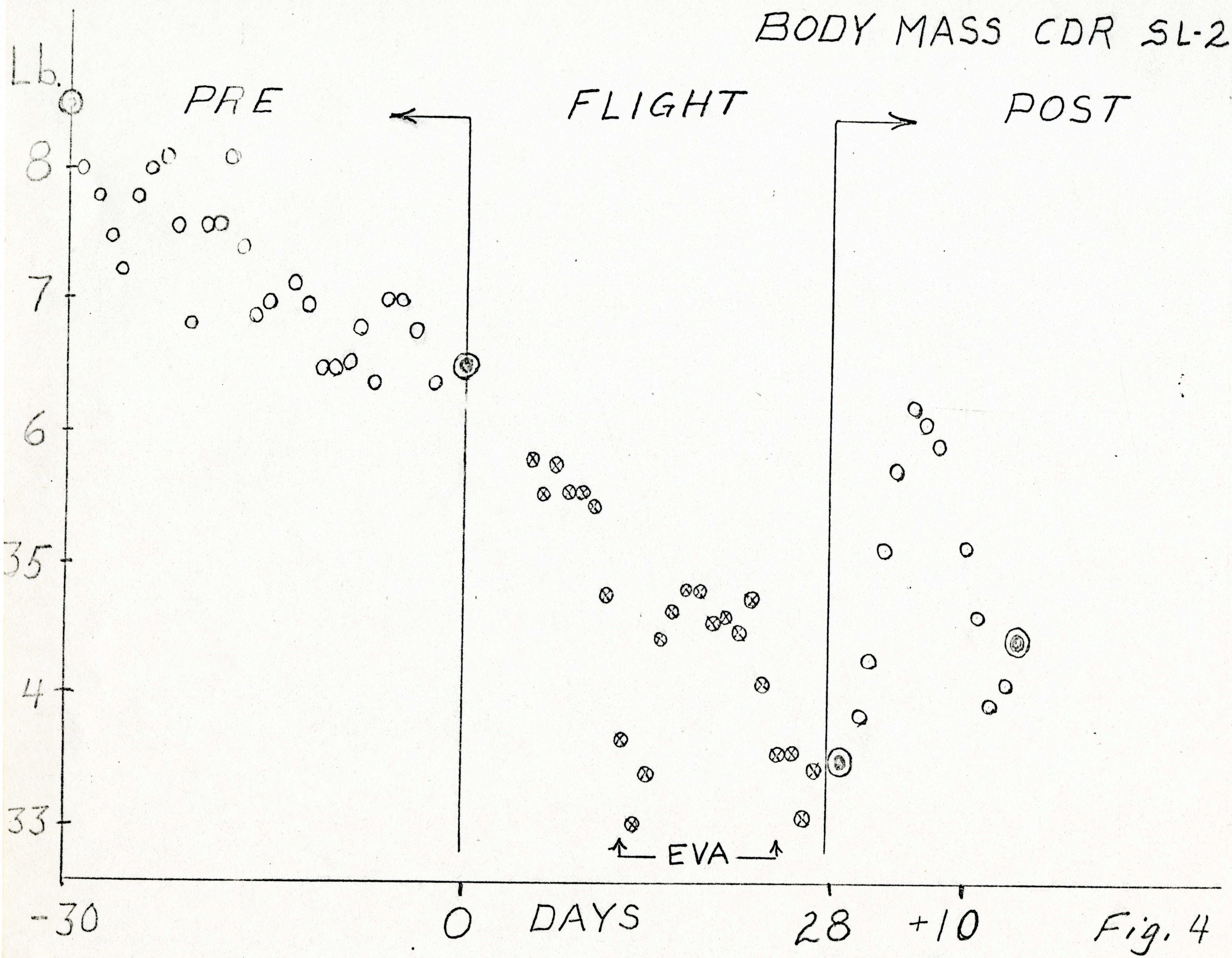

PRE
FLIGHT
POST
BODY MASS
SL-3 SPT
LBS.
140
135
130
125
-22
0
20
40
59
R+10
DAYS

*Fig-2*


PRE
FLIGHT
POST
BODY MASS
SL-3 PLT
LBS.
200
195
190
185
-22
0
20
40
59
R+10
DAYS
Fig. 3


BODY MASS CDR SL-2
Lb.
PRE
FLIGHT
POST
8
7
6
35
4
33
EVA
-30
0
DAYS
28
+10
Fig. 4

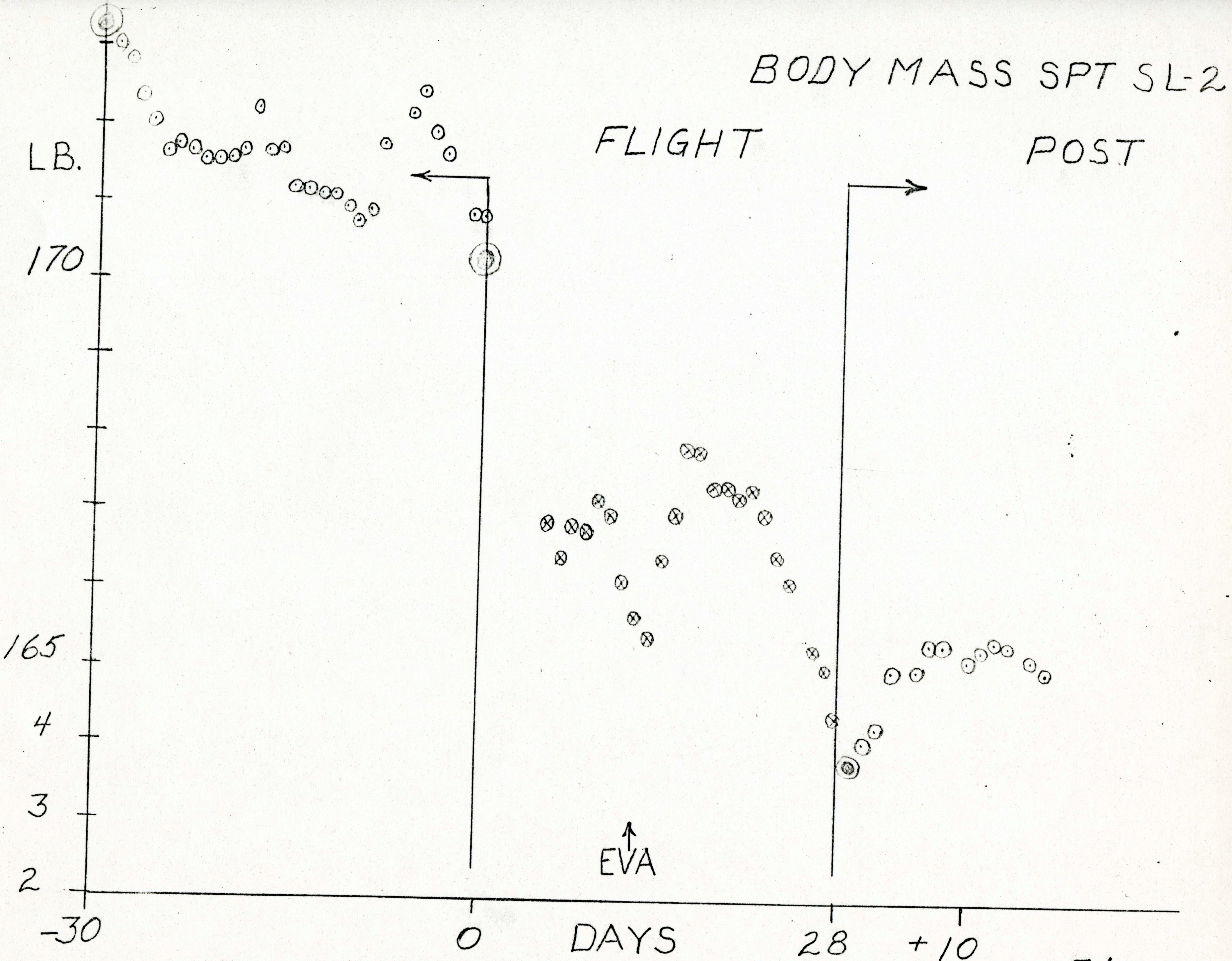


Fig. 5

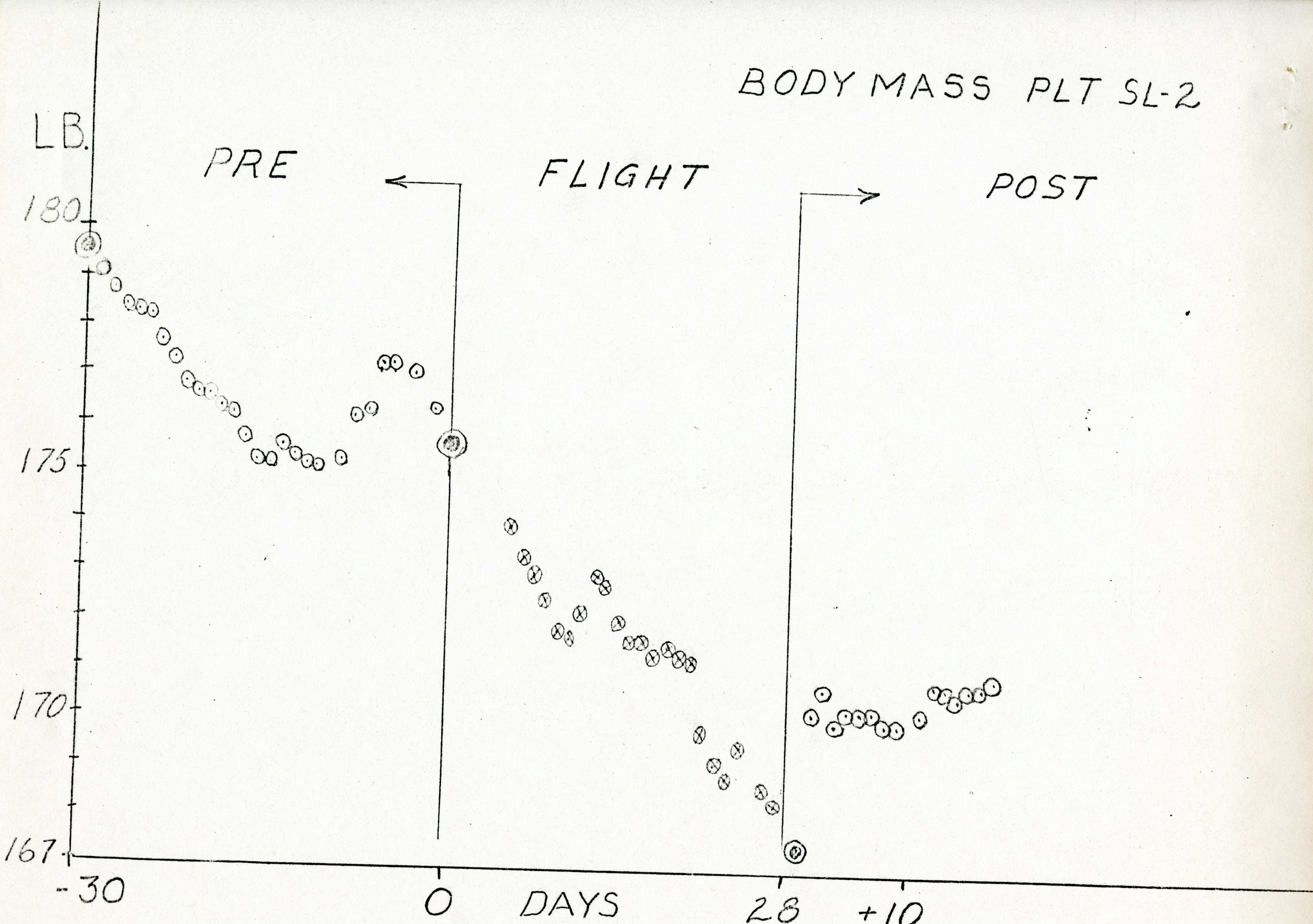

BODY MASS PLT SL-2
LB.
PRE
FLIGHT
POST
180
175
170
167
-30
0
DAYS
28
+10

Fig. 6