

Introduction

① Title ✗

Asked to make presentation - to U.S. and others interested -

Based on experience in every U.S. TM flown to date - Whitmore

Will briefly introduce: 2 List ✗

- Rationale
- Human Locomotion [on Earth]
- Replacement for Locomotion [on Earth]
- Treadmill Theory and Practice
- Treadmill Status and Problems
- Special Purpose Treadmills

No Russian Information

Handouts

Name & addresses for Follow on pub.

Rationale

3 (Title) ✗

Loss of Locomotor Function

4 Cartoon ✓

↓ Muscle

↓ Bone, Wolff's Law

↓ Cardio Respiratory Capacity
Fat For Muscle

↓ Neuromuscular Function

45 ✓
List

Rationale, cont'd.

Experience - Muscle

Sky Lab - missions (describe)

6-SL

1^o mission { Bicycle7 ϕ - SL Biker8 $\dagger$ - strength Curve ✓2^o mission, Arm Exer.9 ϕ - Arm Ex. ✓
⑧3^o mission, 'T.M.'10 ϕ - T.M. Slide ✓
⑧

Leg Vol.

← 11 ϕ Leg Vol.

Bone

12. Ca⁺⁺ Curve

Cardiorespiratory

13

12. Bed Rest ✓

Have not allowed to happen

Neuromuscular —

Solution - Replace $\bar{c}$ Equivalent
Exercise

What kind ?

How much ?

Must first understand what
kind & how much -

Human Locomotion

+314 Title ✓

Motion - Kinesiology - Clinical

✗

Beautifully Complex

15 + # Swing/Supp. ✓

Swing Support ϕ

1832

Stride - Step -

15

Stride/Step ✓

Variation $\bar{c}$ Speed.

↑ Cadence } ~ Linear 50-200

↑ Stride } Height

Walking Parameters

+617 Walk ✓

Running Parameters

+718 Run ✓

Biomechanics - Forces

Vertical

1819

V. Force ✓

Fore-Aft

1920

F/A Force ✓

Lateral

2120

Lat. Force ✓

22

Combined ✓

Comparison

Stand

2123

Stand Force ✓

Walk

234

Walk Force ✓

Run

245

Run Force ✓

Bike

26

Pedal Force ✓

All

207

All Forces ✓

Muscle & Bone Forces

Lever Arm

28

Lever Arm ✓

Bone & Muscle

209

Forces ✓

Human Locomotion, Cont'd.

Muscle -

Strength

Force, Max

29 - Stren. Exer ✓

Endurance

30 - Endur " ✓

Comparison in Runners

31 - Data " ✓

Number of Steps/day

32 - Steps/day X

Cardio-respiratory

33 - Metab. data ✓

34 - Effects ✓

~~EMG~~ Neuro-Musc.

35 - EMG X

Replacement for 1 Locomotion -
Basics -Thousands of Reps - 33A ~~8~~ reps

Large Forces

Mimics Kinesiology ✓ Stick Fig.

Large Metabolic Loads

Hdwr. Candidates

36 List X

Treadmill

differences

Wind Velocity

Body Position

Cadence diff.

37 Cadence X

Jog in place

Kinesiology

Forces -

38, 39 Jog 1.P. Forces X

40 ~~39~~ Engle X

Hdw. Contd-

Bicycle -

low forces

totally different kinesiology
good metabolic loading

41 SL ✓

42 Force ✓

Rowing Machine

Poor force loads

Poor Kinesiology

Good Metabolic

✓ 43 RM

✓ 44 Row M. Forces

Climber

Poor force loads

Poor Kinesiology

Fair Metabolic

✓ 45 climber

Stepper

Stepper ✓

Ski Machine

✓ 46 Ski Mach

Fair force loads

Fair Kinesiology

Good + Metabolic

Treadmill -

Protocol -

How Much -

↑ Intensity & ↓ Time

Will discuss Errors

May be aided by device

to document work in lg

442

TM-88

Tread Mill Theory & Practice 47 Title X
Elements -

Frictionless Machine

Support - Vertical 48 Cartoon X
Horizontal 49 Cartoon X

Speed Control 50 cartoon X
Curves 51, 2 XX

Power Into Mill ~~53 Horse~~ X

Frictionless - Horiz., Vertical - ← ✓

Force Vector 54 } Vector X
✓

Power " 55 } Vector X
Brake ← ✓

Passive TM in lg ← 56 ✓

← Motor Driven Machine

Power Input ← 57 ✓

Metabolic ← 58 ✓

Active vs Passive ← 59 ✓

Describe lg Machine ← ✓

Operation in Weightlessness
Harness vs Distrib. WT- ✓

K, Force Generation

~~Mo~~

Bungees ← 60 ✓

Magnitude of Force

Reduced Impulse

Reduced Cadence

Russian Loads

TM-88

Vectors

Basic Vector

61 X

Grade

62 X

Speed Grade Curves

63, 64 XX

Zero, low grades need motor

On current devices speed
 & grade are interdependent -
 Can be measured separately.

New T.M. can adjust Vectors
 which is equivalent to adjusting grade

Motor needed for low speed operation

New T.M. 65 X

Problems

Noise - Variation in Speed - ← 66 X

Comparison - ← 67 X

Spectra - ← 68 X

Need better mounting in STS -

Need to have Gym area -

Uniflex belt effectively solves
 noise problem -

Problems, cont'd.

Shock & Vibration -

Basic Data is Foot Grnd Force $\leftarrow 69$ X

Simple solution to problem

Need better instrumentation

Differences in Ig + $\bar{n}$ T.M. $\leftarrow 70$ XTreadmill Hx. & Status

S.L. T.M.

71 Underwater X

72 Sketch $\checkmark$ 73 Photo $\checkmark$

STS - MK I

74 Boiler Plate $\checkmark$ 75 Schematic $\checkmark$

Demo

MK II

76 - Studies $\checkmark$ 77 - Photo $\checkmark$ 78 - " $\checkmark$

Sp-Sta -

Proto - 79 Photo $\checkmark$ Dwg - $\leftarrow$ 80 " $\checkmark$ 81 Dwg in Sta $\checkmark$

TM 88

9

Status -

Special Purpose -

Horizontal T.M.

16 mm

Force Meas -

82 - sketch ✓

83 - Photo ✓

84 - Results ✓

85 - " " ✓

Other Instr.

Loco Monitor

86 - 24 hrs Gr. ✓

87 - " " Summ. ✓

88 - study ✓

Demo -

Orig. Proto -

1g. -

STS -