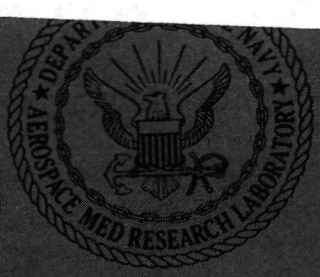
NAMRL-1151

AD-738 434

GOGGLE DEVICE FOR MEASURING THE VISUALLY PERCEIVED DIRECTION OF SPACE

Earl F. Miller II, and Ashton Graybiel



NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

November 1971

Prepared for the NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Approved for public release; distribution unlimited.

Approved for public release; distribution unlimited.

GOGGLE DEVICE FOR MEASURING THE VISUALLY PERCEIVED DIRECTION OF SPACE

Earl F. Miller II, and Ashton Graybiel

NASA Order T-81633
Biomedical Research Office, Manned Spacecraft Center
NASA Order L-43518
Office of Life Sciences

Released by

Captain N. W. Allebach, MC USN
Officer in Charge

30 November 1971

Naval Aerospace Medical Research Laboratory
Naval Aerospace Medical Institute
Naval Aerospace Medical Center
Pensacola, Florida 32512

SUMMARY PAGE

THE PROBLEM

To develop a target system that not only is suitable for accurately measuring the perceived direction of space but also is self-contained in a device worn as a goggle.

FINDINGS

A detailed description is given of a miniature line-target system that is illuminated by a radioactive source, collimated, and provided with suitable scales to indicate its position within the roll and pitch planes. These components are assembled in a lightweight goggle that can be precisely positioned by means of a biteboard attachment. Uses of the goggle in the measurements of the perceived direction of space under ordinary and extraordinary test conditions are illustrated. Modifications are suggested that can extend its usefulness.

INTRODUCTION

Devices for studying the visually perceived direction of space in the absence of visual cues have long been in use, but the principle underlying such devices is so simple that its elegance is seldom appreciated. The basic element is a visual target, usually a line pattern of light on a dark background, that can be manipulated to indicate the direction of space yet afford no clue to its orientation. The apparatus typically designed for this purpose incorporates a relatively large target system that is remote from the subject and moved by means of mechanical, electrical, or hydraulic linkages. Considerable space and background illumination control are thus required and severely complicate or prevent perceptual studies in the laboratory as well as in field situations. These disadvantages were overcome by the development of a miniature device that can be worn as a goggle. A comparison of measurements obtained with the large remote-target device (1) and an early model of the goggle device revealed no significant differences. Prototype versions of the goggle device have been used successfully in the measurement of the oculogravic illusion (2) and the judgment of horizontality by astronauts prior, during, and following Gemini flights V and VII (3).

CHARACTERISTICS OF THE GOGGLE DEVICE

The overall appearance of the goggle developed under NASA contract for "Apollo In-Flight Human Otolith Function Experiment M-9A" is shown in Figures 1 and 2. The inner surface of the goggle forms the soft-cushion carrier portion structured so that it may be pressed firmly against the subject's face without discomfort. The mask section of the goggle forms the rigid base for: 1) attachment of the target and optical system, 2) gear mechanisms and scales for adjusting and reading out the positions of the target in the roll and pitch planes, 3) stabilization of the coupling to the biteboard assembly, and 4) the external cover.

The slit target consists of a single 0.1 mm x 0.55 mm sealed vial of tritium gas [U. S. Radium Corporation (AEC license 09-06979-03)] which requires licensing for handling. The self-luminous light source has a relatively constant level of illumination over a half-life of 12 years without bulbs, batteries, and wiring, which would require periodic servicing and replacement. High reliability and essentially complete safety of this light source are assured by a rugged housing qualified to withstand spacecraft launch forces. The target light is collimated by a triplet located near the subject's eye. The position of this triplet can be adjusted toward or away from the target with a fine threaded screw adjustment to correct for a wide range of spherical refractive errors of the subject, thereby ensuring a sharp image of the test target for each subject.

The pitch of the target is adjusted (throughout a range of ± 20 degrees relative to a reference plane normally at eye level when the subject is upright) by means of a knurled knob (A, Figures 1 and 2) that activates a mechanical link to a rank and pinion gear. The target's roll position can be changed by rotating a second knurled knob (B, Figures 1 and 2) linked to a helical gear arrangement (36:1 ratio); fine rotary adjustments can be made without limit in the clockwise or counterclockwise direction. The line

pattern target was designed with a break at its center serving as a visual reference point and a break near one of its ends to indicate polarity. The entire target and optical system is arbitrarily placed in the right half of the goggle for viewing by the right eye only, although left eye and binocular models could be fabricated.

The device weighs less than one pound and is easily supported and held firmly against the subject's face solely by his teeth interfacing with the biteboard assembly. The goggle portion of this assembly is a square shaft that extends (Figures 1 and 2) from the bottom right side of the goggle. The sleeve portion of the biteboard slides over the closely fitting shaft and presses into a bushing that can be vertically adjusted to compensate for individual differences in the distance separating the subject's occlusal and ocular planes. Dental-impression material softened by heat or more permanent material fashioned by a molding process is deposited on the biteboard for custom fitting. Repeated testing with the goggle device and its attachments in the same position relative to a given subject can be achieved.

One model of the goggle is provided with scales for direct read out, another with potentiometers for continuous write outs. Prototype variations of the basic goggle have been designed to support electrodes for nystagmographic recordings, and for inclusion of special visual-test targets and optical systems to introduce concordant or discrepant visual cues to the left eye.

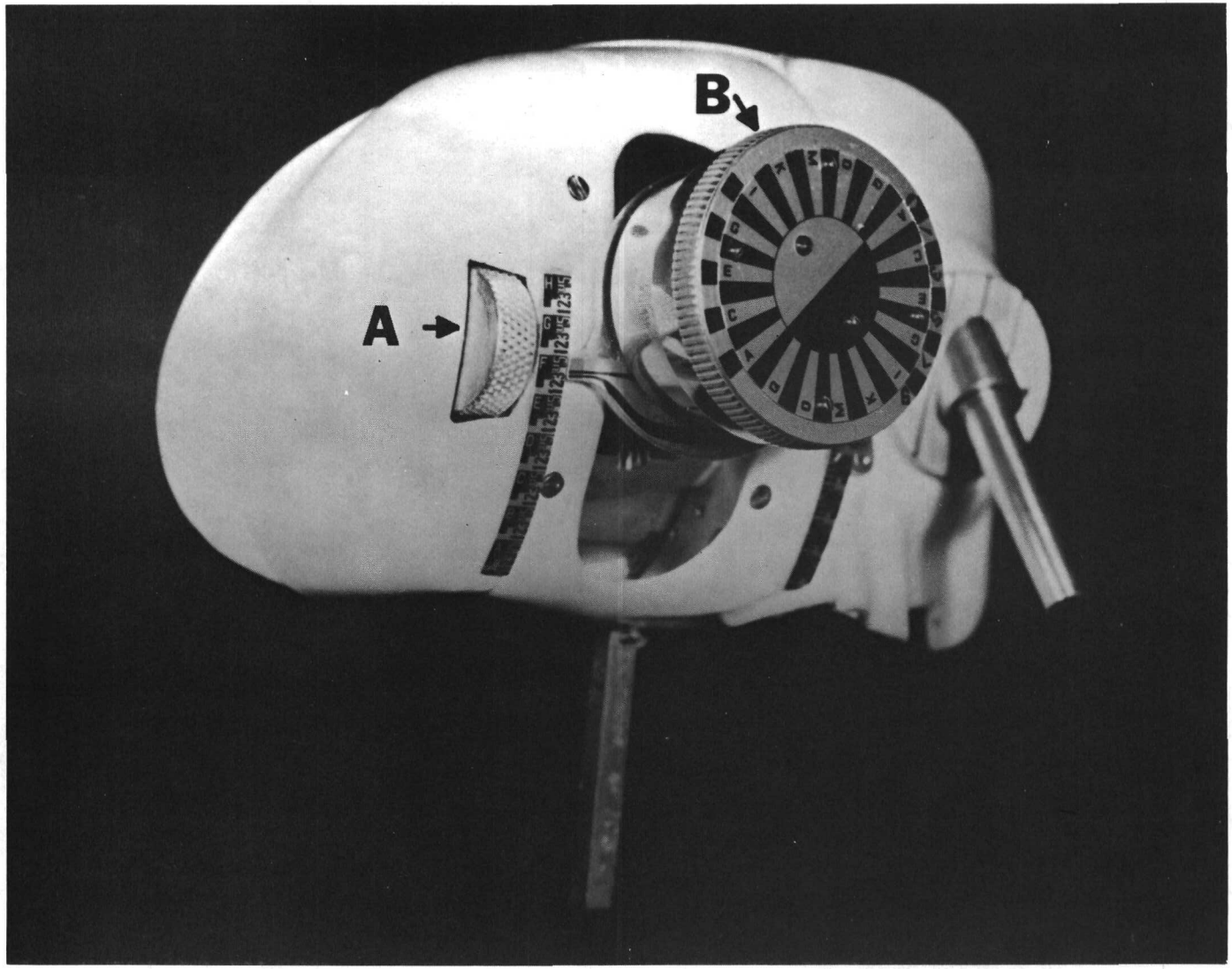


Figure 1

Goggle Device
A: Knurled Knob for Adjustment of Target in the Pitch Plane
B: Knurled Knob for Adjustment of Target in the Roll Plane

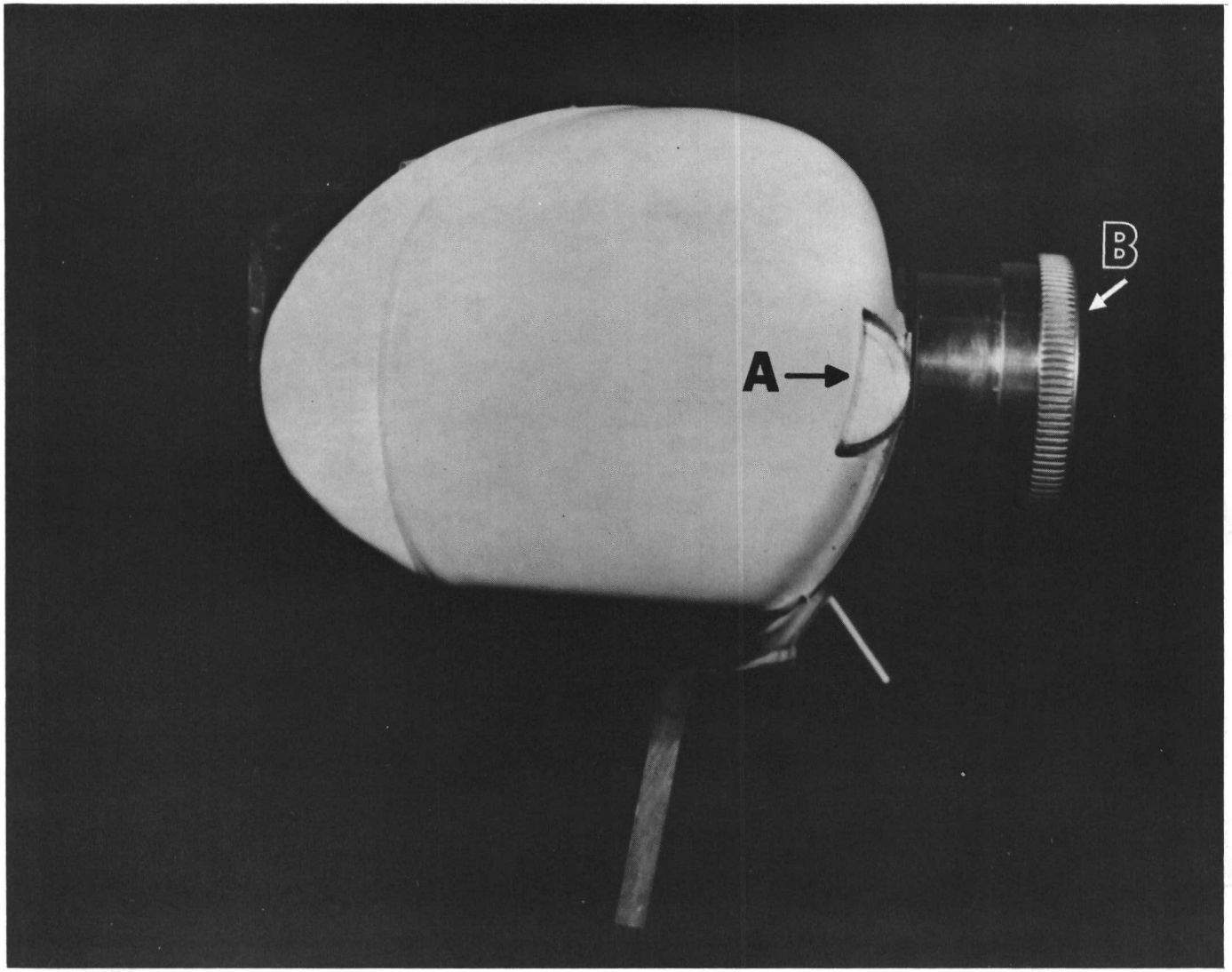


Figure 2

Side View of Goggle Device
A: Knurled Knob for Adjustment of Target in the Pitch Plane
B: Knurled Knob for Adjustment of Target in the Roll Plane

REFERENCES

1. Clark, B., and Graybiel, A., A device to manipulate and to indicate the position of remote test-objects. Amer. J. Psychol., 65:286-287, 1952.

2. Graybiel, A., and Miller, E. F. II, The effect of water immersion on perception of the oculogravic illusion in normal and labyrinthine-defective subjects. Acta otolaryng., Stockh., 65:599-610, 1968.

3. Graybiel, A., Miller, E. F. II, Billingham, J., Waite, R., Berry, C., and Dietlein, L., Vestibular experiments in Gemini flights V and VII. Aerospace Med., 38:360-370, 1967.

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Naval Aerospace Medical Research Laboratory
Pensacola, Florida 32512

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP
N/A

3. REPORT TITLE
GOGGLE DEVICE FOR MEASURING THE VISUALLY PERCEIVED DIRECTION OF SPACE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
N/A

5. AUTHOR(S) *(First name, middle initial, last name)*
Earl F. Miller II, and Ashton Graybiel

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
30 November 1971	6	3

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
NASA Orders T-81633 and L-43518	NAMRL-1151
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d.	

10. DISTRIBUTION STATEMENT
Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Prepared for the National Aeronautics and Space Administration	N/A

13. ABSTRACT

A detailed description is given of a miniature line-target system that is illuminated by a radioactive source, collimated, and provided with suitable scales to indicate its position within the roll and pitch planes. These components are assembled in a light-weight goggle that can be precisely positioned by means of a biteboard attachment. Uses of the goggle in the measurements of the perceived direction of space under ordinary and extraordinary test conditions are illustrated. Modifications are suggested that can extend its usefulness.

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Vestibular test device						
Space perception						
Visual perception						
Apparatus						