Vision Research. Vol. 18, pp. 1079–1081

0042-6989/78/0801-1079$02.00/0

TECHNICAL NOTE

ORIENTABLE HEAD-HOLDER FOR USE IN VISUAL RESEARCH

E. Oswaldo-Cruz and R. Gattass
Department of Neurobiology, Instituto de Biofísica da UFRJ,
Centro de Ciências da Saúde, Bloco G,
20.000, Rio de Janeiro, RJ, Brazil

(*Received* 11 *October* 1977)

Physiological studies of the visual system frequently require that the relationship between visual space and its representation in neural centers be accurately established. The methods most frequently used are based on the classical techniques developed for clinical perimetery, i.e. the use of campimeters or tangent screens. Both methods present its advantages and limitations. Perimetry using Landolt type campimeters or hemispheres enables the exploration of a large extent of the visual field without requiring re-alignment of the apparatus. When using this method, polar coordinate systems are commonly employed to define location in space. This method has been widely used in the study of the topography of visual projections in both cortical and sub-cortical structures in which displacement of the stimulus is manually con-

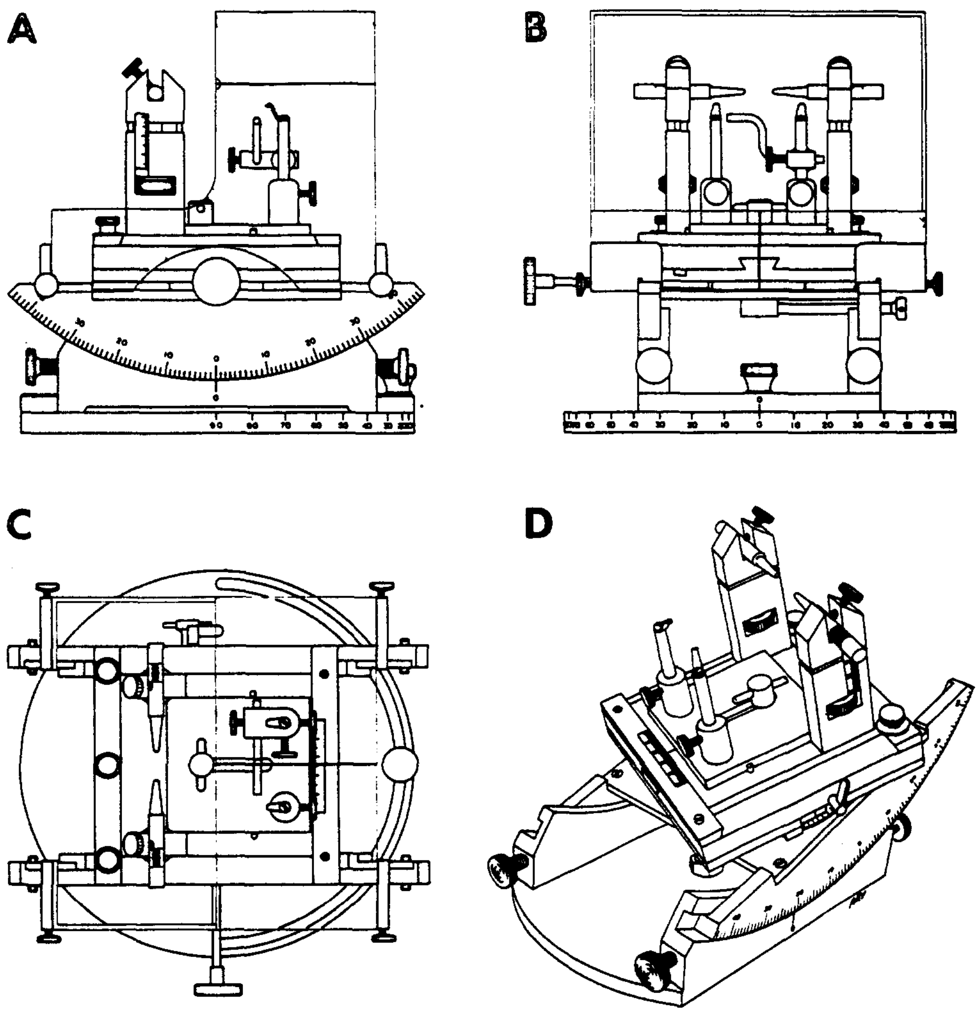

Fig. 1. Lateral (A) frontal (B) and dorsal (C) views of the instrument with alignment enclosure in position. In (D) the apparatus is shown with pitch and yaw angles introduced to the head-holder assembly. Notice that the alignment enclosure was removed and the mouth piece is absent.

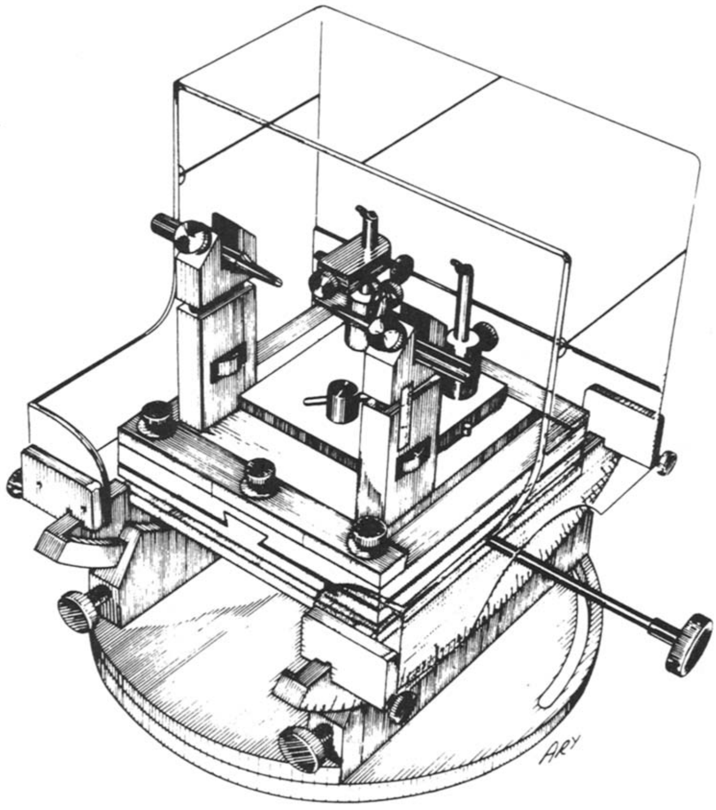

Fig. 2. Perspective drawing of the complete apparatus with pitch and yaw adjustments at central position. After centering, the plastic enclosure and the knob controlling the rack and pinion adjustment are removed.

trolled. However, automatic control of stimulus position and displacement requires a complex optical and mechanical arrangement (Reinig, 1973–1974).

The use of the tangent screen, on the other hand, greatly facilitates the construction of automatic systems for controlling stimulus position and displacement; however, with the tangent screen it is not possible to explore a large extent of the visual field without re-aligning the animal or the screen–projector system (see Bishop, Kozak and Vakkur, 1962).

Since repositioning of the screen–projector system involves the displacement of large and heavy components such as optical benches and the screen support, it has been considered easier to realign the animal's head in relation to the stimulus presentation system. In this paper we describe a head-holder that enables the displacement of the animal's head according to a coordinate system. Thus it becomes possible to bring to the center of the screen the visual field region under study by displacements of the animal's head that are precisely defined by two angular values.

The present apparatus was developed for use with the opossum; however, only minor modifications of the stereotaxic assembly in the upper carriage are needed for its use with other experimental animals.

The instrument is placed on a table in such a way that its center of rotation lies on a projection line normal to the screen at its center. The animal's head is rigidly held by means of ear and orbital bars and a mouth piece as in conventional stereotaxic instruments (see Fig. 1). The eye bar supporting pillars are mounted on a flat sliding surface allowing antero-posterior displacements in order to accommodate different sized animals. This sliding surface lies over the ear bars supporting base which rests on top of an assembly that permits the adjustment of the angle made between the base plate and the horizontal plane. The center of curvature of the supporting assembly lies on a plane situated in the vicinity of the plane defined by the ear and orbital bars. As the heights of the pillars supporting the ear and eye bars are individually adjustable it is possible to make the plane containing the anterior nodal point of the eye coincident with that of the center of rotation of the system.

Antero-posterior adjustments of the animal's head are made possible by a rack and pinion mechanism interposed between the base plate and its supporting surface. The base plate can also be displaced laterally enabling the anterior nodal point of each eye to be brought to the axis of rotation of the system. Adjustment of the animal's head so as to make the anterior nodal point of the eye coincident with the rotation center of the apparatus is facilitated by coupling to the instrument an ensemble of orthogonally disposed transparent plastic surfaces in which engraved lines indicate the position of the center of rotation of the system.

After fixing the animal's head by means of the supporting bars, the plastic enclosure is placed over the instrument and, using the horizontal engraved lines as references, the height of both ear bars and orbital pieces is adjusted so as to place the eyes at the correct level. Antero-posterior position of the base plate is then adjusted by the rack pinion mechanism until the plane of the anterior nodal point of the eye coincides with the vertical reference plane.

A perspective drawing of the instrument is presented in Fig. 2; a removable extension knob used to move the rack and pinion mechanism is shown in position. For proper alignment it is necessary to know the distance separating the anterior nodal point from an external reference such as the anterior corneal vertex or the plane of the limbus. In the opossum, for example, the anterior nodal point lies 0.4 mm behind the corneo-scleral junction (Oswaldo-Cruz, Hokoç and Sousa, 1977).

After these preliminary centering procedures it remains to determine the position of the center of each eye along the mediolateral plane. Readings are taken on the scale of this plane and thus each eye can be individually centered using the reference line as a guide. With the centering procedure completed the reference plastic enclosure is removed and the animal's head can be oriented to the desired plane.

The position of a point in visual space can be defined by the angles of pitch and yaw. The former describes the deviation from the conventional Horsley–Clarke horizontal plane. Lateral rotations with respect to the midline correspond to the angle of yaw. This angle is adjusted rotating the base plate surface, its angular value being read on the scale engraved in its supporting surface (see Fig. 1D).

The use of pitch and yaw angles to define a position in space results in a coordinate system of the spherical-polar with horizontal axis type corresponding to Bishop *et al.*'s type D (Fig. 2, Bishop *et al.*, 1962). Conversion from this type of notation into other coordinate systems such as polar or azimuthal can be easily accomplished by means of adequate algorithms (Gattass and Gattass, 1975).

The instrument as a whole is mounted on a rotatory base. If the adjustement of yaw is kept at angle 0, lateral rotation along this plane results in another coordinate system, corresponding to Bishop *et al.*'s type B (Fig. 2, Bishop *et al.*, 1962). This coordinate system is not suitable for bringing receptive fields in the far periphery to the center of the screen. On the other hand, it will not impart rotation of the head about the AP-axis (angle of roll). In its present form the instrument does not incorporate an electrode positioner since an Evart's type hydraulic microdrive is used. If desired, a compact micromanipulator, such as Narishigi's K3 could be easily affixed to the base plate.

Acknowledgements—We are indebted to our colleagues, C. E. Rocha-Miranda for suggesting the problem and reviewing the manuscript and Aglai P. B. Sousa for helpful suggestions on the text. The apparatus was skilfully constructed by Mr. Oswaldo R. Costa, the drawings are by Ary L. Miranda. Supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNP_9-Proc. 2222.0010/75) and Financiadora de Estudos e Projetos (FINEP-445).

REFERENCES

Bishop P. O., Kozak W. and Vakkur J. (1962) Some quantitative aspects of the cat's eye: axis and plane of reference, visual co-ordinates and optics. *J. Physiol., Lond.* **163**, 466–502.

Gattass M. and Gattass R. (1975) Algorítmos para a conversão de coordenadas da representação do campo visual. *An. Acad. brasil. Ciênc.* **47**, 317.

Oswaldo-Cruz E., Hokoç J. N. and Sousa A. P. B. (1977) A schematic eye for the opossum. Submitted for publication.

Reinig H.-J. (1973–1974) Un aparato destinado a la excitación visual, para estudios electrofisiológicos del sistema visual. *Zeiss Werkzeitschrift* **21**, 16–18.