UNIVERSAL STEREOTAXIC APPARATUS DB-2-59 (SECOND MODEL)

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In 1957 we designed and constructed the stereotaxic apparatus DB-1-57 [1]. The present model (see figure) is considerably improved and is intended for neurophysiological and neuromorphological investigations in the region of the brain and spinal cord of cats, rabbits, and small monkeys.

BRIEF DESCRIPTION OF CONSTRUCTION

The main bearing frame (1) of the apparatus, as distinct from the first model, is also a rotating frame and consists of two longitudinal square steel rails parallel to one another. At the rear end the rails are cylindrical. The ends of the rails are fixed by screws in holes in two transverse triangular plates (2), thus forming a rigid frame. The frame can rotate through 360° on two half-axles (3) inserted in the holes of the L-shaped stands (4), which form the support of the apparatus. The two stands are bolted on to a laboratory bench.

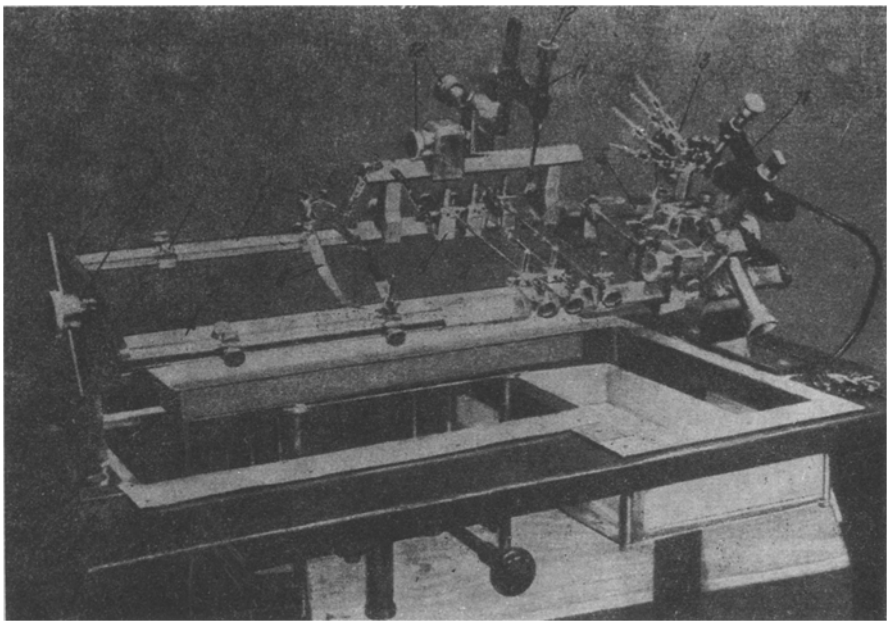
Thus, the main portion of the apparatus consists of two L-shaped stands and a frame rotating on two half-axles. The experimenter can fix the frame in any desired position by tightening the retaining nuts on the half-axles. Thus, the apparatus allows rotation of the secured animal with the inserted brain electrodes and micromanipulators attached to the apparatus, and permits easy access to different parts of the animal's body.

The known models of stereotaxic instruments [2-11] do not provide such an opportunity. An exception is Delia's modification, but the absence of a second pivot in that apparatus makes rotation practically impossible. We have become convinced of this by more than two years' experience of working with that model.

For the attachment of the interchangeable head-holders there is a special II-shaped frame (5) which allows rotation of the head-holder round a main axis passing through the external auditory passages of the animal. As distinct from the first model, the motion is effected by a skew-toothed circular rack driven by rotation of a pinion. The segment is graduated and allows the animal's head to be tilted upward to 45° and downward to 55°. The frame of the head-holder is rigidly connected to the rack and can be fixed in any of the above positions. The transverse stage of the frame carries the removable head-holder and also posts for the attachment of small appliances (electrode distributing panel, flexible electrode-holders, etc.).

The head-holder for a cat consists of a rectangular stage with a lengthwise groove for the fixing nut. Two orbital fixers, which can easily be adjusted to the size of the skull, are screwed to the top of the stage. The stem of the triangular frame for fixing the upper jaw is also attached here by a side screw.

The auditory passage fixers are cylindrical and are furnished with millimeter divisions for setting the animal's head on the center line of the apparatus. For adjustment of the electrode to the vertical zero position the auditory passage fixers are fitted with calibrated rings of radius 10 mm (corresponding to the zero horizontal of Horsley and Clarke). There are marks on the rings for determination of the zero frontal plane. This important feature is absent in other models of stereotaxic instruments. In R. M. Meshcherskii's model [2] an independent post is used for fixing the position of the zero horizontal.



Universal stereotaxic apparatus DB-2-59 as most generally seen. Explanation in text.

In works on rabbits another head-holder is used (not shown in figure). The head-holder assembly includes a rectangular plate with a recess for the cutters and capable of travel in the anteroposterior and vertical directions, two brackets with orbital and jaw fixers, the brackets being attached to the side arms of the II-shaped frame of the head-holder in place of the auditory passage fixers for the cat. In work on small monkeys (rhesus) it is sufficient to replace the orbital fixers of the cat head-holder.

This model, as distinct from others, is provided with metal straps (6) embracing the animal's body above and below and preventing sagging of the body when the frame of the apparatus is rotated. The straps are attached to two pairs of brackets, which can be moved along the rails of the apparatus. There is also a pair of brackets for securing the hind limbs (7).

During work on the spinal cord the spine is held by steel spokes 2 mm in diam. which are fitted with tube stops (8), the heads of which bear on the spine and restrict lateral movements. The spokes with the tube stops are held in special sockets, which in turn are attached to sliding brackets (9). The brackets can travel along the rails and can be fixed in the required position.

In another arrangement the sockets holding the spokes are attached to special rails lying alongside the main rails of the apparatus. These extra rails are fastened to the same brackets, but the latter are placed far apart. In the first case the micromanipulator travels along the spinal cord on a special rail fastened parallel to the apparatus frame by two brackets. In the second case the micromanipulator travels along the main rail. The second arrangement is better, but both methods ensure rigid fixation and effective operation with the microelectrodes.

This model differs from all other known models in possessing a hot table (10) consisting of a rectangular brass box (screen) covered on top with a sheet of transparent plastic. Inside the box are an electric heater (127 v) and a contact thermometer with a controlling magnetic head to which a direct current of 24 v is supplied. The box is grounded. The power is fed through a screened cable. The controlling relay is located outside the chamber. There is practically no interference. The system ensures automatic maintenance of the preset temperature. The hot table is provided with a lifting mechanism and is mounted in a separate frame attached to the bench by cap screws. For turning the animal the heated stage must be lowered and then raised again after the animal is turned.

Micromanipulators. The assembly includes two micromanipulators (11) which provide coarse and fine adjustment of the electrode to within 5 μ in three mutually perpendicular planes. The coarse adjustment is effected as follows: in the frontal plane—by sliding the main bracket of the manipulator along the rail of the

instrument; in the sagittal plane—by sliding the bushing in the bracket; in the horizontal plane—by the movement of the rack connected to the vertical arm of the micromanipulator. The fine adjustment is provided by the rotation of verniers (12), the circumference of which is graduated in 100 divisions.

The vertical arm of the manipulator can be tilted through 90° left and right in the sagittal plane and through 45° in the frontal plane. Thus, the design of the manipulators allows operation in a system of rectangular co-ordinates or in a system of tangential (equatorial) co-ordinates. This ensures much greater accessibility to any structures of the brain.

The assembly of the apparatus includes eight flexible hinged electrode-holders (13) attached by a special shoe to the posts on the head-holder or to the brackets of the spine fixer. Before the electrode is inserted by the manipulator, the thick end of the former is fitted into the split socket of the electrode-holder. When the electrode has been inserted into the appropriate brain structure, the split socket of the micromanipulator is released and the vertical arm is raised. The electrode is held in place by the flexible electrode-holder. Hence, several electrodes (up to eight) can be inserted by the one micromanipulator, and placed fairly close together. This feature is not provided by any other model, and yet it greatly enlarges the range of investigations.

Thus, the second model of the stereotaxic apparatus allows simultaneous work in the region of the brain and spinal cord of laboratory animals (cats, rabbits, monkeys). It has a device for holding the spine in position and allows rotation of the frame together with the secured animal, micromanipulators, flexible electrode-holders, and inserted brain electrodes. The design of the micromanipulators permits operation in a system of rectangular or tangential co-ordinates. There is a device for tilting the head and a set of interchangeable head-holder parts. The apparatus is provided with a device for fixing the body and limbs of the animal and a hot table with lifting mechanism.

These design features of the described model, which distinguish it from all other known instruments, considerably extend the range of investigations and justify its being called a universal stereotaxic apparatus.

SUMMARY

The authors describe a new model of a universal stereotaxic instrument, intended for the neurophysiological and neuromorphological investigations in the area of the brain and spinal cord of cats, rabbits, and small monkeys. The instrument is supplied with two micromanipulators operating in the system of rectangular and equatorial co-ordinates. The stand of the device is capable of being turned around 360°, together with the fixated animal and inserted electrodes. The head-holder may be tilted. The instrument is provided with an automatic heating device and an adjustment for the fixation of the spinal column.

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