F. Let it dry in the air, protected from dust.

The specimen is claimed to retain its natural volume, distinction of color, and elasticity.

§ 119. A *temporary* dry preparation for demonstrative purposes has been recommended by Lenhossek (*Anat. Anzeiger*, 1887, ii., 3–17; also *Amer. Nat.*, xxii., 858–859). A thoroughly hardened alcoholic specimen, when needed

FIG. 984.—Transection of the Brain of a Sheep, Prepared by the Castor-Oil Method, and Exhibiting the Differentiation of the Alba and Cinerea. ×1. (From Fish, 1896.)

for demonstration, is dried in soft linen [or absorbent cotton], and coated with a thin layer of celloidin with a soft brush. The celloidin dries in a few minutes, forming a thin and transparent yet tough membrane. After two hours' exposure the brain will begin to shrink and should be returned to alcohol.

§ 120. *Starch-Injection Mixture.*—Of the mixture first proposed by Pansch, the following modification has been devised by S. H. Gage and the writer:

Dry starch powder	100 c.c.
Chloral hydrate	10 gm.
Water	50 c.c.
Alcohol (ninety-five per cent.)	50 c.c.
Glycerin	25 c.c.
Coloring matter.	

After thoroughly mixing the mass it should be filtered through one or two thicknesses of wet cheese cloth. To prevent the starch from settling, the cloth should be tilted from side to side or the mass may be stirred during the filtration. If the mass is not freshly prepared for every injection, the stock mass should be filtered occasionally to remove hair or any other object that might clog the cannula.

Among the colors that are available, probably vermilion, red lead, ultramarine, Berlin blue, chrome orange, yellow, or green, is preferable.

§ 121. *A Fine, Gelatin Injection-Mass.*—The following ingredients represent about 2 litres, enough for a human brain; gelatin may be used instead of the glue, and no egg would then be needed, but it costs three or four times as much: Best clear glue, 200 gm. (about 7 ounces); carmine, 20 gm. (about 0.7 ounce); glycerin, 240 c.c. (about 8 fluidounces); alcohol, 80 c.c. (about 3 fluidounces); strong ammonia, 30 c.c. (about 1 fluidounce); acetic acid (50 per cent.), 30 c.c. (about 1 fluidounce); one egg. Grind the carmine to a paste with a little water; mix the ammonia with 250 c.c. (about 8 fluidounces) of water, add the carmine paste, and filter through filter paper. Place the glue in a clean dish and cover with cold water; after two or three hours pour off the unabsorbed water, and melt the softened glue. Beat the white of an egg well and mix it with the glue. Heat until it begins to bubble, then filter through fine flannel. Add the coloring liquid to the glue while warm. Neutralize the ammonia by stirring in the acid, a little at a time, until there is no distinct odor of either the acid or the ammonia. Until one has had considerable experience it will be necessary to close the ammonia and acid vials, let a current of air sweep over the mixture, and then determine the presence of the odor. Blue litmus paper may be used until there is no distinct coloration of the band formed by absorption just above the line made by the mass itself. Mix the alcohol and glycerin and add to the mass. Unless, as with a freshly killed animal, the injection is made before the body has cooled, the part to be injected must be heated, in water, to 40° C. (about 105° F.).

§ 122. *Alcohol.*—Unless otherwise specified, the alcohol mentioned in this article is of the usual strength, ninety-five per cent. The admixture of alcohol with water in the following proportions gives various percentages: Alcohol 6, water 1 = 84 per cent.; 5:1 = 82; 4:1 = 78; 3:1 = 75; 2:1 = 67; 1.5:1 = 62; 1.25:1 = 60; 1.1:1 = 55; 1:1 = 48; 1:1.25 = 45; 1:1.5 = 42; 1:2 = 35; 1:3 = 30; 1:4 = 22; 1:5 = 18.

§ 123. *Obtaining Alcohol Free of Tax for Scientific Purposes.*—Blank forms for this and all the information required may be obtained from collectors or deputy collectors of United States Revenue or from manufacturers of alcohol. See U. S. Revised Statutes, Section 3297, Treasury Circulars of July 2d, 1886, and March 26th, 1889, and New York *Medical Journal*, March 30th, 1889.

§ 124. The surface of a fresh brain is never exposed to strong alcohol without a previous wetting with salt solution or water.

§ 125. The alcohol in which brains are stored is maintained at *not less than eighty-two per cent.* upon the alcoömeter scale of Tralles (§ 126). Weaker alcohol is employed for the immersion of fresh brains, for soaking out the dark coloring matter from brains that have been hardened in Müller's liquid, or for the preservation of other specimens requiring a less strength.*

§ 126. *Alcoömeter* (*Alcoholometer*).—This form of hydrometer, for determining the percentage of alcohol in a given liquid, should be marked with Tralles' scale. With the slender jar for containing the tested liquid, the cost is about $2.50, but its employment is to be recommended upon the ground of ultimate saving of alcohol.

§ 127. *Dilute Nitric Acid.*—This is useful for softening the cranium of infants or small animals so as to permit cutting with knife or scissors. A ten-per-cent. solution is sufficient. Ordinary commercial acid is about sixty per cent.; the desired reduction is accomplished by adding five parts of water to one of the acid by weight, or seven of water by volume. The specific gravity of the mixture is about 1.057. In any mixture the per cent. of acid may be determined by the method recommended by Fresenius, second American edition, p. 688.

§ 128. *Storage of Hemicerebrums.*—The human hemicerebrum is a somewhat bulky mass, and may occupy a six-by-eight-inch Whitall & Tatum jar (Fig. 990). Sometimes both halves of a cerebrum may be accommodated, although the undivided cerebrum or entire brain commonly requires a nine-by-eight-inch jar.

The most favorable method of storing several hemicerebrums is in jars nine inches in diameter and of any desired height. The specimens are set in tiers of three, their dorsal convexities against the sides of the jar. Successive tiers are so placed that a hemicerebrum rests upon the interval between two below. There will be a central vacancy which, if the jar is to be transported, may be filled with absorbent cotton; the alcohol (ninety-five per cent.) should be introduced last.

§ 129. *Transportation of Fresh Brains.*—Without affirming the impossibility of transporting a fresh brain safely in a bed of cotton or other soft material, I have found it much better to employ a liquid of approximately its own specific gravity, about 1.04. The most easily prepared is brine, nearly saturated. Nor is it best to put in cotton or other material. The brain should just float, without pressing upon the bottom of the pail or rising above the surface. The cover of the pail may be secured with strips of surgeon's plaster.

In cool weather a journey of two or three days may be safely accomplished. In warm weather, if the brain is well cooled in advance and the smaller pail set in a larger and surrounded with rather large pieces of ice, a day's journey may be accomplished safely. Such open packages should be plainly marked "Specimens of Natural History. This side up with care." (See also p. 206.)

§ 130. *Other Liquids.*—It must be remembered that while brine supports the brain and thus averts mechanical injury, and while it retards decomposition, it is not strictly a preservative of nervous tissue. Hence, especially if the weather is warm or transportation is to occupy more than a few hours, it is well to place the brain at once in a liquid which will not only support but preserve it. Several such are enumerated in §§ 81–90.

§ 131. *Transportation of Hardened Brains.*—Already hardened brains may be transported either in a small pail of alcohol with cotton as a padding; or in a soldered box; or in a jar (the rubber of which must then be well covered with vaseline *to be afterward removed*);* or simply wrapped in alcoholic cotton covered with paper and oiled silk, or rubber sheeting, and packed in a box with soft material. Glass and metal packages are always enclosed in wood† or corrugated pasteboard.

§ 132. *Removal of the Pia.*—The early removal of the pia‡ has been already recommended, § 40. I have seen some otherwise valuable cerebrums materially injured by faulty methods, and a few suggestions are here offered.

A. Begin with the central fissure, if it can be recognized, and at about the middle of its length. Apply the coarse forceps so that their approaching points move in the direction of the length of the fissure; pinch up a fold of pia; with the scissors snip at either side of the fold so as to raise it a little; then carry the forceps, held in the same way, more deeply into the fissure, not more than 1 cm. deep, and attempt to draw out the intrafissural fold of pia. If successful, continue to pull *lengthwise of the fissure*, cutting the pia at either side whenever necessary.

B. Most of the other fissures may be dealt with in the same way; but some, notably the occipital and calcarine, are very deep, and arteries traverse them which must usually be cut more than once.

C. The Sylvian fissure is not only deep, but spreads laterad over the insula, and there are several arteries. Rather than run the risk of tearing the adjoining gyres it is better to remove only so much pia as easily separates, leaving the rest and the arteries until one of the operculums can be cut off and afterward replaced.

D. While removing the pia or studying the lateral fissures of young or fetal brains, breaking is avoided and divarication of the gyres facilitated if the hemicerebrum is placed on its meson on a piece of thick Manila paper (such as is used for the portfolios), which is sufficiently firm to support the organ and yet yields so as to permit the exposure of the fissural depths. When the mesal surface is studied the specimen should rest in a thick bed of cotton.

§ 133. *Prevention of Drying.*—The strong alcohol in which brains are preserved (eighty per cent. and upward) evaporates rapidly while the brain is exposed, as in examination or dissection. It may be dipped in the alcohol occasionally, or—which is preferable with delicate specimens—the alcohol may be allowed to drip gently upon it from a pledget of absorbent cotton. When a specimen only partly submerged in alcohol has to be left for a short time, drying may be prevented by covering it with a thin layer of cotton, one end of which dips into the liquid.

§ 134. *Dissection of the Brain.*—As commonly practised this contrasts strongly with the examination of the rest of the body. With the latter dissection is universal, and sections are seldom made or even studied;§ but with the former, sections, macroscopic or microscopic, are the rule, and dissections, careful, prolonged, and thorough, are nearly unknown in medical schools. Like the preponderance of osteology over neurology, the difference is due to the "nature of things"; but like many other natural conditions it may need modification.

The advantages of sections for surgical, pathological, and regional study are obvious; they are easily made, even with the fresh adult human brain, especially by means of the apparatus devised by Professor Dalton.* If the human brain were like that of the frog or opossum, with the several segments of approximately equal size, and nearly upon the same plane, the common method would be more appropriate for macroscopic study. But, in view of the extreme cranial flexure and the overlapping of certain segments by others, the objections to sections are as follows:

1. They present plane surfaces which do not naturally exist in the brain.

2. They are almost invariably oblique with respect to the axis.

3. They commonly include more than one encephalic segment, and are, therefore, so far as the beginner is concerned, apt to be more confusing than instructive.

4. They present the parts in contiguity rather than continuity.†

The foregoing objections apply to all sections. A macroscopic section, especially of a brain which has had the cavities alinjected, presents the advantage of exhibiting in perspective enough of the natural contours of parts to facilitate their recognition and comparison.

Admitting, then, that sections have their uses, what is urged is, not that section-making be practised less, but dissection more.

§ 135. *Preliminary Dissection of Alcoholic Brains.*—I am yearly more convinced of its importance on four grounds:

A. The brain is a complex organ and at the best perplexing; the simpler features of form, location, and relation to cavities are morphological, while color, like histological composition, has a physiological significance.

B. The fresh brain is less easy to dissect neatly, and requires constant support against its own weight, whereas the alcoholic may be held in any position and carved like cheese.

C. The beginner should advance cautiously, and therefore slowly, and the medical student is especially liable to interruption. The fresh brain remains fresh but a very short time, while the alcoholic is in itself imperishable. Leisure means not only more careful dissection, but also the taking of notes and the making of drawings; hence all the arguments which I have advanced (W. and G., pp. 55, 56) in favor of preliminary anatomical work upon a small animal, which may be kept in alcohol for an indefinite time at slight expense, apply to all alcoholic brains in general, and to those of moderate size in particular.

D. After repeated dissection of alcoholic preparations, the anatomist is better qualified to manipulate the fresh brain and to appreciate its beauty. The last word is used advisedly, for, however unattractive may be "subjects" and pathological "cases," the most exacting artistic sense can hardly fail of satisfaction with the soft white and gray and pink of the newly extracted brain. Resting securely in its calva, for him who has been disciplined by prolonged experience with the "pickled" organ, there are few more attractive, stimulating, or nourishing articles of intellectual pabulum than a fresh brain "upon the half shell."

§ 136. *Dissection.*—Whether fresh or hardened, I be-

* The "economics of alcohol" is treated somewhat fully in W. & G., pp. 111–130.

* Vaseline will prevent the leakage of alcohol or other liquid; but, like oils and grease, it disintegrates rubber; hence the rubber rings should be thoroughly cleansed from it after use.

† For mailing alcoholic specimens contained in vials of not over four-ounce capacity, see circular of the Denison Manufacturing Company, New York City, as to "liquid mailing boxes." See also a paper by F. T. Gordon, *Medical Record*, lvii., 696.

‡ It is understood that this includes the arachnoid, which on most parts of the cerebrum adheres closely to the pia; Fig. 796.

§ Notwithstanding the example and opportunity offered by works like Braune's "Atlas of Topographical Anatomy" and Dwight's "Frozen Sections of a Child" and "Anatomy of the Head."

* "Topographical Anatomy of the Brain," Philadelphia, 1885, vol. i., pp. 4–10; abstracts in New York *Med. Record*, February 15th, 1879; July 31st, 1880.

† Solly's vigorous reprobation refers particularly to horizontal slicing: "It is unfortunate indeed that candidates for the medical diploma are still very generally required to describe the appearances presented by the brain dissected, or rather destroyed, by the old method of slicing—a method most unphilosophical in its conception, and totally inadequate to impart any real information in regard to the structure of the brain."

lieve the first step should be to slice off the dorsal parts of the cerebrum to near the level of the callosum and the next the exposure of the paraceles as described in connection with Fig. 735.

The occipital lobes may then be cut off opposite the splenium and one or both medicornua followed to the tip of the temporal lobe.

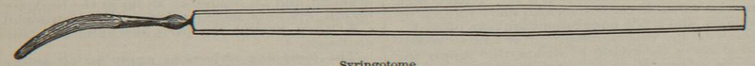
The next object should be to remove the overlapping parts of the cerebrum from the subjacent diencephal (and so much as may remain of the other segments) so as to obtain a view of the ventral aspect of the splenium and fornix. These may be transected a little caudad of the portas.

There will then appear the velum, with the epiphysis. If the velum be lifted carefully there will be recognized the attachments along the dorso-mesal curvature of the thalami which are commonly ignored but insisted upon in Fig. 732.

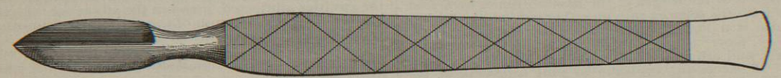
A transection through the portas will give a view of their boundaries, of the cephalic aspect of the medicommissure, and of the caudal surface of the fornix and the precommissure; most of the other features are more easily examined upon the mesal aspect of the mediseсted brain.

Somewhat full directions for dissection are given by Edinger. Complete directions are desirable, accompanied by figures indicating the appearances presented at each

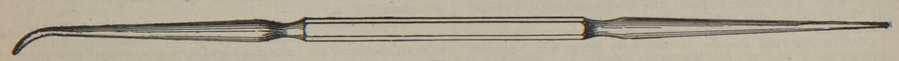
Blunt-Pointed Scalpel.



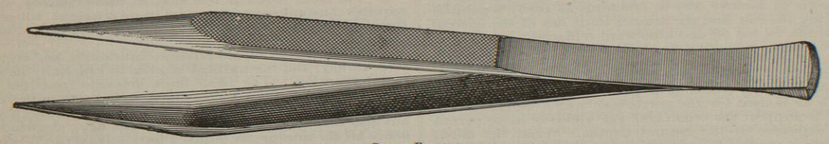
Syringotome.



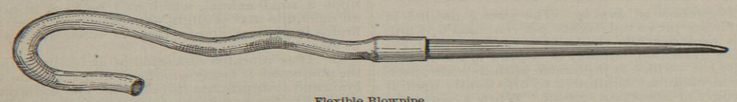
Arthrotome.



Tracer.



Coarse Forceps.



Flexible Blowpipe.

Fine Curved Forceps.

FIG. 985.—Some of the Instruments Useful in the Removal or Dissection of the Brain. All of actual size. (From "Anatomical Technology.") The two upper are eye-knives; the syringotome is commonly called *canaliculus knife*; it is of great use for exploring orifices, the porta ("foramen of Monro") and the metapore ("foramen of Magendie"), and for dealing with membranes and plexuses where a point or a prominent edge might do injury; it has been my favorite instrument since 1890. The tracer may be employed sometimes in place of the more costly syringotome, but its chief use is in isolating nerves and vessels by tearing the connective tissue. Most forceps are too stiff and soon tire the hand or hinder delicacy of manipulation; the coarse "Coxeter" forceps represented have the blades excavated so as to be lighter than usual. The flexible blowpipe is most readily made by attaching to a piece of rubber tubing, 30 to 40 cm. long, the smaller half of the metal blowpipe commonly sold with dissecting instruments. The length of the tube enables the object inflated to be held at a convenient distance from the eye; since inflation is temporary injection, the advantages of witnessing the effects are obvious. A larger volume of air may be utilized by using the larger half of the metal pipe, and glass cannulas of any size may be employed. The arthrotome has the handle continuous with the blade, and one edge of the blade is rounded, excepting near the tip; it is practically a cartilage knife. The fine curved forceps represented have the points simply serrated; but for the removal of the pia from the brain surfaces, and especially from the depths of fissures, a pair with interlocking teeth, like those of artery forceps, will be found very useful.

stage, such as I have framed for the brains of the cat (W. and G.) and sheep ("Physiology Practicums").

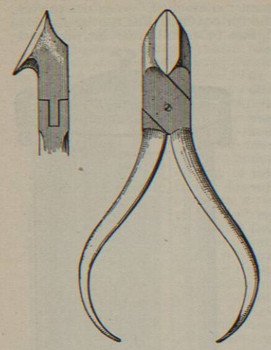


FIG. 986.—Diagonal Side-Cutting Nippers. A little less than actual size. From "Anatomical Technology." This is the smallest size of the English make (Stubs'), and for most purposes should have the handles lengthened by pieces brazed on. The German and Swiss instruments (for sale by large hardware dealers) are less highly finished and costly, but answer nearly as well. Of these, seven sizes are made, ranging in length from 10–20 cm. (4–8 inches), and in price from 60c. to $1.50. Surgical bone forceps and dental wedge-cutters have a spring between the handles and are more expensive. The nippers are most serviceable for removing the calva of infants and fetuses and of small animals. In use they must cut or squarely break the bone; the pulling and tearing to which one naturally resorts will inevitably tear the brain or its meninges.

§ 137. *Instruments.*—The instruments employed in the removal or dissection of the brain (§§ 50, 136) should, as a rule, be reserved for that purpose. If used in ordinary dissection their points and edges should be attended to without delay. Some of the less familiar instruments are shown in Fig. 985.

§ 138. *Probe-Pointed Curved Bistoury.*—This is practically a longer and stronger syringotome (Fig. 985), the cutting edge being about 5 cm. (2 in.) long, ending in a probe point. The curve is less than that of the syringotome. It replaces the latter in the dissection of the entire human brain, and it is particularly applicable to transecting the brain through the mesencephal, to tracing the medicornu, and to slitting the arachnoid in following the Sylvian or other deep fissures.

§ 139. Besides the instruments shown in Figs. 985 to 987, the following, more familiar, are indispensable: Scalpels of three sizes: large for sections; medium for ordinary dissection; small ("Charrière") for finer dissection. Scissors, curved flatwise, three sizes. A hand lens, tripod magnifier or "linen tester." A bone-chisel, or ordinary chisel of moderate width, or even a screw-driver sharpened slightly. A syringe, metal, or rubber bulb. Absorbent cotton; if common cotton is used it must be first thoroughly wet in alcohol or water. Cannulas, rubber tubing, and the Y-tubes or T-tubes for branching of injection tubes may be had of dealers. The smaller end of a straight "medicine dropper" makes a fair cannula.

FIG. 987.—Steel-Handled Spatula. ×0.5. (From catalogue of Whitall, Tatum & Co.) This (or a palette-knife, or round-ended shoe-knife, ground thin so as to be flexible) is indispensable for detaching the dura when the calva is to be removed.

The methods of making and securing cannulas, and of making injections, are detailed in "Anatomical Technology," pp. 137–148. Cheap and efficient pinch-cocks may be had in the form of the wooden, spring clothes-pin, which may be variously attached to the wire cranes or used independently upon the tubes.

§ 140. *Saws.*—There is no special advantage of the expensive surgical or anatomical saw over the ordinary carpenter's instrument; it should be kept sharp and well-set, and used for no other purpose. For dividing the cranium any small saw will answer, but the edge should be rather wide so as to make a broad kerf. For medisection of the head, however, the saw should be very large, fine toothed, thin (*i.e.*, make a narrow kerf), have a removable back, and be very sharp and free from rust.

§ 141. *Saw-Box.*—This (which might be called a macrotome) is a coverless box made of boards about 2.5 cm. (1 in.) thick, and with the following inside dimensions: length, 30 cm. (12 in.); height, at middle, 25 cm. (10 in.) sloping to 15 cm. (6 in.) at the ends; width, according to the length of the neck attached to the head, 25–40 cm. All the parts must be accurately squared and put together with screws. The sides should go outside the bottom and ends, and the bottom have a cleat at each end. Each side is to be divided squarely at the middle of its length by a saw of the same thickness as that with which the head is to be cut; the bottom also is to be sawn to the depth of 1–2 mm. When finished the box should be thoroughly oiled, inside and out, with linseed or olive oil, to prevent warping when it is wet.

§ 142. *Head-Rest for the Removal of the Brain.*—The following description and figures (988, 989, and 982) are from the paper of B. B. Stroud (1900, *b*) who devoted much time to the device. The apparatus was shown at the meeting of the Association of American Anatomists in Washington, May 2d, 1900.

"This apparatus was devised for the purpose of holding the head firmly with the base of the cranium horizontal. This enables the base of the skull to serve as a shallow tray in which the brain is supported during its removal. The subject lies upon the belly, being supported by adjustable clamps fitting into the auditory meatuses, and the head naturally assumes a position in which the long axis of the cerebrum is nearly horizontal. Repeated trials in the neurological laboratory at Cornell University this spring have shown that with a maximum of convenience to the operator there is a minimum of danger of rupturing the cranial nerves and certain delicate structures of the brain itself, which are frequently torn when the usual methods are employed. Fig. 988 shows a general view of the apparatus. Fig. 989 shows details of construction. In Fig. 982 it is represented in use.

"The device consists of a baseboard *A* to which is attached at right angles a second board *B*. Both are of seven-eighths-inch oak. Professor Wilder suggested that the upright board should be hinged to the base for con-

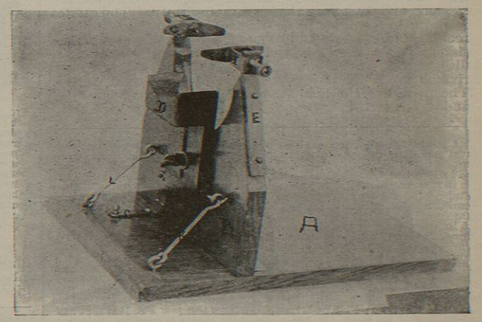


FIG. 988.—Head-Rest for the Removal of the Brain. Devised by B. B. Stroud. A, Baseboard; B, upright board, hinged to A and secured by hooks. (From Stroud's paper, 1900, *b*; see Figs. 982 and 989.)

venience in storage and transportation. This is a very valuable improvement.

"The upright *B*—Figs. 988 and 989, A—has a middle emargination and the sides are cut at an angle as shown in Fig. 989, A. The chin-rest *D* is hollowed upon the top to fit the chin. It slides in a shallow groove 0.5 cm. (¼ in.) deep, cut in *B*, and is adjustable by means of the thumbscrew. The two lateral bars *E* are of iron. They project 3.5 cm. (1¼ in.) above the board *B*, and serve to support the two jaws *F* and *G*.

"The two clamps for grasping the head, Fig. 982, shown in detail in Fig. 989, B, consist of the jaw *F*, the guides

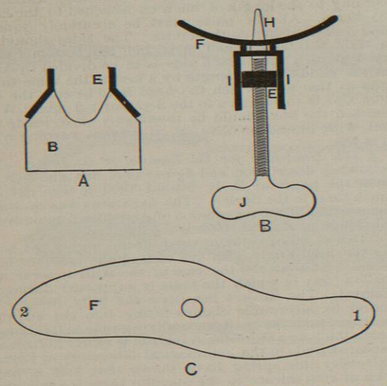


FIG. 989.—Portions of the Head-Rest. A, the upright board, with its side irons, *E*. B. One of the two clamps for grasping the head. C, improved form of the jaw-piece, *F*.

I, and the screw *J*, which pierces *F* in the form of a spike *H*, 2 cm. (¾ in.) long, to enter the auditory meatus. A flat head *J*, Fig. 989, *B*, is more convenient for turning the screw than the round milled head shown in Fig. 988. The jaw *F* is bent flatwise to fit the curve of the skull and grasp it dorsad of (posterior to) the mastoid process. The other end is curved downward, to fit under the zygoma and thus hold the head more firmly. The guides *I* are made from one piece of steel bent in the form of a rectangle and made to fit very closely to the top of the side iron *E*. They and the curved form of *F* prevent a disagreeable rocking motion of the head. *F* is firmly riveted to *I* by means of four double-headed rivets. The upright *B* is held in position by the two hooks *K* and *L*."*

* For the convenience of those who may desire to construct the headrest the detailed specifications are here reproduced: *A* and *B* are made of ⅞-in. oak. *A* is 30 x 40 cm. (12 x 15 in.). *B* is 30 x 26 cm. (12 x 10¼ in.). It is cut as indicated in Fig. 989, A. The middle cut is 15 x 13 cm. (6 x 5 in.). The front side contains a groove 1/16 in. deep and 3⅜ in. wide to receive the chin support *D*. *D* is of oak 5 x 9 x 17 cm. (2 x 3½ x 6¾ in.). The top is hollowed out to fit the chin 4.5 cm. One and seven-eighths in. from the top it is cut down so as to be only .5 in. thick. There is a slot in the middle to accommodate a set screw for fastening it at the different heights. *E* is an iron bar, 17 x 2 x 1 cm. (6¾ x ¾ x ⅜ in.), and is bent at a point 3.5 cm (1⅜ in.) from the top so as to be perpendicular to the base *A*. *F* is of ⅛ in. steel, 9 x 3 cm. (3½ x 1¼ in.) and formed as shown in Fig. 989, B and C; 1 is the front end shaped so as to fit under the zygoma; 2 is the rear end and grasps the temporo-occipital bone dorsad of the mastoid process. The clamps *I* are made of ⅜-in. steel 12 x 2.5 cm. (4¾ x 1 in.) and bent as shown in Fig. 989, B. The screw *J* operates the jaw *F*. It is made of ⅜-in. iron 4 in. long. It has a shoulder which is received between *F* and *I*. The spike *H* projects one inch beyond *F* to be inserted into the auditory meatus. A flat head is more convenient than the round one shown in Fig. 988. All sharp edges should be rounded and smoothed to avoid accidental injury to the operator's hands.

§ 143. *Agate-Ware Pans.*—The brain anatomist will find most convenient, and in the end most economical, one or two "nests" of iron pans, "enamelled," so as not to rust, with plates of the same for covers. For the largest size (11 × 4 in.) covers of glass or metal must be provided; this size will accommodate a half head.

§ 144. Butter jars, 10 × 10 cm., or 10 × 20 cm., with tin screw-cap, parchment lined, are sold by the Excelsior Package Co., 49 Warren Street, New York. They are very convenient for temporary storage or for transportation.

§ 145. *Labelling Specimens.*—Much of the real value of a specimen depends upon its identification as being a certain part of a certain brain, taken from an individual of a certain age, sex, and nationality, and preserved in a certain way. Even if the possessor has so few specimens that he feels sure of remembering the entire history of each, his death would abolish the source of information. I have observed surprising instances of carelessness in this regard, even upon the part of some who should set an example of scientific accuracy.

Were the specimen never to be removed from the jar in which it alone is kept, the object could be accomplished by inserting the label in the jar or attaching it thereto; but this is rarely an adequate precaution, neither is it often possible to state all the desirable data upon a label attached to the specimen itself. The most satisfactory plan tried is *the adoption of a serial number for each brain.*

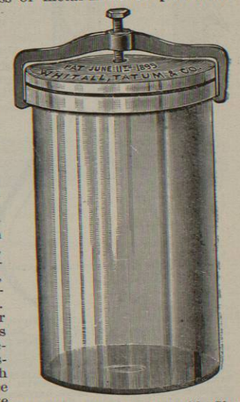


FIG. 990.—Specimen Jar, with Glass Top, Rubber Ring, and Clamp. (Made by Whitall, Tatum & Co., New York.) Fourteen sizes are made, ranging from three to nine inches in diameter, and of various lengths. The size here shown is 6 × 12, and will receive a half brain or the two halves of a mediseected cerebrum; for undivided brains and for mediseected heads the size 9 × 8 suffices. These two sizes cost, respectively, $10 and $18 a dozen. The prices given in the catalogue are subject to a discount of fifty per cent.

FIG. 991. — Landenberger's Specimen Jars. These have a rubber ring and a glass top retained by a wire. The smaller size is 3 × 3 in., capacity 6 oz. (180 c.c.); the larger, 3 × 4 (high), capacity 10 oz. (300 c.c.). 25 N. Thirteenth Street, Philadelphia.

§ 146. *All Specimens are Numbered.*—As soon as received every brain is assigned a number which permanently designates it and all parts into which it may at any time be divided; the same number pertains to all notes, photographs, and drawings of it.

§ 147. Sometimes, as with entire brains or half-brains, it is possible to attach with a cord a metal (sheet block tin, stamped) number. But commonly the numbers are written with India ink* upon bits of parchment and attached by small (ribbon) pins.†

§ 148. For purposes of dissection, photographing, or drawing it may sometimes be necessary to remove the label, but ordinarily it should be affixed to some other region, so that there may be no possibility of misplacement.

* Good pencil marks last a long time in alcohol, but ordinary black ink is speedily washed out.

† In time ordinary pins corrode and may break the brain substance when withdrawn; pins of aluminum or silver should be available at a moderate cost.

§ 149. *Distinctive Labels.*—The ready recognition of cerebrums belonging to groups may be provided for as follows:

A. The sexes are distinguished by using quadrangular labels for males and circular ones for females.

B. Presumed normal white brains have white labels; Africans (of all shades), gray; murderers and other criminals, red; insane and idiots, blue.

§ 150. *Immediate Records are Made.*—No one's memory is conceded to be infallible. All data concerning a brain not obtainable from the specimen itself are recorded without delay under the number assigned to it; *e.g.*, the sex, age, known, believed or estimated, race, known or supposed weight when fresh, donor, mode of initial preservation, weight or bodily condition of the individual, and his character or mental state.

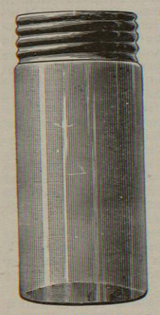


FIG. 992.—Tall, Round, Screw-Capped Jar, with Nickel-Plated Caps, Cork-Lined. Three sizes, viz.: four ounces, eight ounces, and sixteen ounces. (Whitall, Tatum & Co., New York.) Answers well for dry or non-volatile contents or for the temporary storage of alcoholic specimens.

§ 151. *Card Catalogue.*—The basis of the records of each brain is a card bearing the number of the specimen at an upper corner. Upon the face of the card are written the data mentioned in § 150; also, or continued upon the back, the numbers of negatives, and references to published figures or descriptions; suggestions of points to be elucidated are commonly put on paper slips.*

§ 152. Drawing is insisted upon.† These drawings should be, primarily at least, in outline only; shading, like charity, "covereth a multitude of sins."

§ 153. In beginning the study of a difficult region, the student is advised to determine at once some prominent feature as a landmark, as a "base," so to speak, "of intellectual supplies," from which he may explore in any direction, and to which he may return when doubts arise.

§ 154. No observation involving either complex manipulation or novel results is published until it has been submitted to at least one other trained observer.

§ 155. It is freely admitted that rarely, if ever, is all possible information gained from a specimen at one examination or by a single observer; hence specimens are preserved.‡

§ 156. *Methods of Representing the Brain.*—The following considerations and suggestions apply more or less directly to all natural history illustrations, but with especial force to the human brain, on account of its softness when fresh, the difficulty of preserving it, the great size of the entire organ, the minuteness of certain portions, the large number of recognizable parts within a small area, the continuity of all, the contiguity of some which are otherwise associated but remotely, the intermixture of two differently colored substances, the complicated relations of the meninges to each other, to the vessels, and to the cavities, and the preponderance of curved and oblique contours over straight lines and planes.

§ 157. *Importance of Orientation.*—With all organs, but especially with the brain, it is essential that the location of the region represented be easily recognized; otherwise details may be unappreciated or even misapprehended. So far as possible, therefore, less familiar parts should be accompanied by such as are unmistakable. It might seem that useless expense was incurred by the publishers of Bourgery and Jacob's magnificent plates in the introduction of faces artistically drawn and colored; but even the expert neurologist is guided in the comprehension of the relative position of brain parts by reference to the apparently superfluous facial outlines.

§ 158. *Enlargement of Complex Regions.*—It often happens that the same section or dissection includes regions that are comparatively simple, and others that are very complex; shown upon a single scale, either the complex parts are unintelligible, or the total is undesirably and needlessly large. Hence, just as the histologist aims first to obtain a general view of all the parts in their gross relations, and then focuses a higher power upon a selected region, so the delineator of encephalic structures should give first a view of the whole, if only an outline, and then an enlargement of complex parts to any extent required for their complete elucidation; he can hardly make this enlargement excessive. Compare, *e.g.*, Quain's figures, 258 and 290, and Figs. 669, 670, 671, and 695 in this volume.

§ 159. Terminal and limiting parts, membranes, and apparently atelic (functionless) parts and conditions should be distinctly shown, or the insufficiency of their representation admitted. "The little things of the brain" might well form the subject of an entire article. From the standpoints of physiology and medical practice such parts as the terma, valvula, crista, epiphysis, hypophysis, and habena, and such conditions as the reflection of the endyma upon the plexuses, and the dorsal limitation of the porta, are of comparatively slight importance. But their morphological significance is, at least in some cases, inversely to their functional activity, and they cannot be ignored without endangering the success of any attempt to understand or explain the structure of the brain.

§ 160. Anatomical figures should be something more than pictures conveying a general and vague idea. Where is there an adequate representation of the relation of the diatela to the habena, and of the cephalic end of the latter? From the published figures could any student be expected to comprehend the locations and boundaries of the "foramina of Monro" or of "Magendie"? The tenia is easily enough shown as a white band throughout most of its course, but where are its extremities accurately delineated? Any one can see the caudate prolongation of the striatum, but representations of its termination at the tip of the medicornu are as rare as are figures of the extremity of the filum terminale. Even so considerable a part as the flocculus is seldom figured in such a way as to display either its form or its attachment.

§ 161. The avoidance of the morphological incongruities and deficiencies which are to be detected in nearly every portrayal of encephalic anatomy demands the admission of three propositions, which are mere truisms in themselves, but radical affirmations when contrasted with their almost universal non-recognition in anatomical works:

1. Every part, organ, membrane,* or surface is either

* My own use of slips of convenient size for notes and drawings and descriptions began in 1867 while I was assistant in comparative anatomy at the (Agassiz) Museum of Comparative Zoology at Cambridge, Mass. The slips were about three by five inches. When the first United States postal card was issued that size (13.5 × 7.6 cm., 5.35 × 3 in.) was adopted. But the subsequent introduction of other sizes has invalidated that standard, and the common and increasing employment of the catalogue card of the Library Bureau (7.5 × 12.5 cm. or 3 × 5 in.) may render it desirable to adopt that size for notes as well. The time has not yet come, and indeed shows no signs of approach, when I can look at even a familiar brain preparation without learning a new fact, gaining a better insight into what was already known, or receiving an impulse toward some special inquiry. A good example of the desirability of preserving specimens for later scrutiny is furnished in my last paper, 1900, *a* (see p. 196).

† Every student of any branch of natural history should compel himself to learn to draw, however slight may be his inherited artistic capacity. Notwithstanding the laboratory students in Cornell University, but the members of the large general classes in physiology and zoology are required to make drawings of entire animals, and of the parts exposed in their dissections.

‡ The time has not yet come, and indeed shows no signs of approach, when I can look at even a familiar brain preparation without learning a new fact, gaining a better insight into what was already known, or receiving an impulse toward some special inquiry. A good example of the desirability of preserving specimens for later scrutiny is furnished in my last paper, 1900, *a* (see p. 196).

* So essential is the exemplification of celian circumscription and endymal continuity that the endyma should be represented by a distinct and rather heavy line, continuous excepting at the metapore: see p. 152, Fig. 687.

limited or continuous with some other part. If limited, its limits must be defined; if not, its extension must be indicated.

2. Every cavity is either open or closed. If closed, the continuity of its parietes must be demonstrated; if open, its communications must be shown.

3. Every elongated part has a middle and two extremities; not only the former, but the latter must be represented.

§ 162. Figures—original ones especially—should be multiplied and descriptions reduced. In descriptive anatomy, whether human or comparative, the text should be subordinate to the illustrations. Some treatises (Charles Bell, Meckel, Milne-Edwards, etc.) seem to have been prepared upon the idea that the description is essential and the figures merely supplementary; on the contrary, words should be employed only when pictures will not suffice—that is, for explanation, commentary, generalization, hypothesis, and manipulative directions.

The arguments for the multiplication of figures may be summarized as follows:

1. A figure is usually a guaranty that something like the object represented has been seen, at least by the artist, and that a certain amount of time has been devoted to its contemplation.

2. The information conveyed by a figure is more real, and likely to be more lasting, than that which is expressed in words. In respect to reality and impressiveness, the sources of knowledge may be ranked as follows, in an ascending scale: (1) Description; (2) picture; (3) model; (4) object seen; (5) object handled; (6) object personally prepared. The picture is thus intermediate in value between the thing itself and a description of it.

3. A figure, if clear and properly placed, is more readily understood than a description, and a saving of time is thus effected. It may be easier for the author to write than to draw, or even than to supervise a drawing, but his personal inconvenience or loss of time should not outweigh the gain to his readers. This applies particularly to dictionaries, cyclopedias, and journals, which are commonly read or consulted in haste. Editors and publishers would find eventual profit in offering to authors the fullest encouragement to employ illustrations so far as possible and curtail their descriptions in proportion. That it is rather the exception than the rule for such encouragement to be offered is probably due to several causes: (*a*) Publishing houses have usually a staff of printers who must be employed, whereas the various processes involved in the making of pictures are commonly done outside at extra expense; (*b*) authors too often content themselves with carelessly made copies of "stock figures" instead of insisting upon original representations of objects prepared by themselves. Hence, on the one hand, the exceptionally liberal publisher is liable to get a poor return for any allowance made for drawings, and, on the other, the exceptionally painstaking author is apt to be told that, at best, the engraving will be done if he will furnish the drawings; and, if he cannot draw himself, their cost is likely to deter him from their introduction. In short, all the existing conditions work to the disadvantage of the reader, who gets but a "pennyworth of [pictorial] bread to a monstrous deal of [verbal] sack."

Before this state of things can be amended the authors of books and papers must see clearly the importance of illustration; to paraphrase an epigram as to the making of an index, the drawings should be made or personally superintended by the author, even if some one else has to write the text.

4. Figures usually occupy less space than descriptions conveying an equal amount of information. This means condensation, convenience, and economy in the present, and a due consideration for our successors in the not far distant future. Exact data are not accessible, but no thoughtful and public-spirited person (unless he be a publisher or printer) can contemplate without concern the logical results of the present rate of book-making activity.

§ 163. Borrowed figures should be fully credited, and all modifications, whether of size or features, explicitly stated. To copy is to compliment, but unacknowledged copying is theft, and unspecified change is misrepresentation.

The ill effects of omitting to state the source of a figure are two: (1) The originator loses credit to which he is justly entitled; (2) the reader may be seriously misled by the apparent duplication of some really unique feature or the confirmation of an error. For example, in the representations of the meson of the cat's brain by Leuret (Leuret et Gratiolet, Pl. V., Fig. 2), the pseudocele ("fifth ventricle") is made even more extensive than in man, reaching almost to the splenium. The figure is reproduced, without credit or correction, in Mivart's "The Cat" (Fig. 129). Whoever remarks the coincidence in respect to the pseudocele, but fails to note that one figure is simply a copy of the other, may naturally infer that the feature in question is normal, or at least not anomalous.

On the other hand, if informed that three of Mivart's figures (125, 126, 129) were copied from Leuret, the student might conclude that the representation of the base of the brain (Fig. 128) was derived from the same source. This would be most injurious to the reputation of Leuret, for the figure in question displays several features (the size and direction of the hypophysis, the disconnected fissure on the temporal lobe, the relations of the pons to the trifacial and abducens nerves) which it is safe to say never were observed in a feline brain.

Nor is it enough to give the sources of figures in a list, or in the preface, as in Huxley's "Vertebrated Animals"; so great is the labor of preparing an original figure that the acknowledgment of it should be equally as explicit as that of a verbal quotation.

Finally, in the case of modified figures, it needs but a moment's reflection to see that nothing short of an accurate statement of the nature and extent of the alteration can insure full justice to the originator.

§ 164. Drawings should be made as notes. In many cases an outline* drawing, even if hastily made, would convey to the maker, or any one else, at a future time more prompt and complete information than could be embodied in writing covering the same space. But the general employment of sketches, in addition to words, or in place of them, can hardly be looked for until children are taught to draw the intelligible objects about them before they are drilled in the making of the—to them—unmeaning pot-hooks of the alphabet.

§ 165. Figures should be more frequently employed in preliminary or incomplete publication. Probably one of the reasons for the comparative infrequency of pictorial representations of normal, abnormal, and pathological structures, especially in journals, is the difficulty, often the impossibility, of preparing a detailed figure in time for publication. But this need not prevent the early appearance of a figure, if only in outline, illustrating one or more points of greatest importance.

§ 166. Figures should be based upon photographs. Photography enables the anatomist to (*a*) record the appearances of perishable specimens, or of such as are in course of dissection; (*b*) insure the proper perspective; (*c*) save time and labor upon the part of the draughtsman, and thus either reduce the cost of the drawings or render a larger number attainable.

It is seldom that a single anatomical preparation is so perfect as to display all that is needed, and yet present no superfluous parts; often, too, certain points are to be brought out with "diagrammatic clearness," others being subordinated or omitted altogether. Hence, as a rule, the photograph forms rather the basis for the completed figure, and two or more similar preparations may be required for the elucidation of all the desired features.†

*There is a general and almost unconquerable predilection for shaded drawings. However advantageous shading may be in ordinary art as an element of finished pictures, and when merely a general effect is desired, in anatomical figures correct outlines are essential, and shading should be deferred until the last.

† A chief obstacle to the employment of photographs as a basis for figures of brains and embryos has been the difficulty of supporting such delicate objects within range of the camera in its usual horizontal, or nearly horizontal, position. This obstacle is wholly removed by the photographic table devised by Professor Gage and used by us in Cornell University since 1873. With this the camera may be readily adjusted to any angle, and brought into a vertical position so as to cover an object lying upon cotton, or in alcohol, or even alive in water. The apparatus is described and figured in *Science*, April 11th, 1884.

§ 167. Figures should be placed so as to be most readily understood and instructively compared. In comparing pictures of two or more houses, ships, or stoves, the architect, ship-builder, or dealer places them in such positions with regard to one another and his own eyes as may minimize the effort at mental transposition. If asked the principle on which he acts, he will probably say that no principle is needed, that he simply follows nature, experience, and common sense.

With few exceptions it seems to be reserved for those whose business is the contemplation of natural objects, who are credited with more than the average degree of intelligence, and who have at command the recorded experience of centuries, to disregard a matter whose simplicity is equalled only by its importance. In most works there is an utter absence of system. Seldom, indeed, are symmetrical figures placed otherwise than with the meson coinciding with that of the observer; but even this would be less likely to confuse than the apposition of transections of a subcylindrical mass like the myel with the dorsum above in one case and below in another.*

The prevalent carelessness in this regard may be ascribed to three sources: (*a*) The still too common idea that illustrations are of secondary importance; (*b*) the fact that most figures have been copied and thus placed without regularity, as in the original; (*c*) some time and trouble are required to reverse them.

§ 168. *General Rules for the Placing of Figures.*—These rules are based upon a consideration of the whole subject. There is probably no one of them to which exceptions may not exist; but such exceptions should always have a well-defined reason and not occur through inadvertence.

1. Figures should be coadjusted so as to facilitate comparison with one another and with typical structures in normal positions.

2. The dorsal side should be uppermost.

3. Direct views are to be preferred to oblique, though the latter are at times indispensable; *e.g.*, Figs. 720, 769, and 775.

4. Symmetrical figures, or parts thereof, should be so placed that the meson is vertical, *e.g.*, Figs. 664, 672, and 682.

5. When there is no choice between the right and left sides, the latter should be represented.

6. Of medisected organs, unless there is special reason for choice, the mesal aspect of the right half is to be shown.†

§ 169. *Designation of Parts upon Figures.*—The full technical names of parts should be given if possible. From the purely artistic point of view, of course, any extraneous line upon a picture is a disfigurement. But if it be once admitted that the primary object of an anatomical drawing is to convey accurate information, then, unless the shaded figure can be duplicated in an outline (as in Tiedemann, Vicq d'Azyr, and Dalton), there should be no sacrifice of the essential to the accessory.

It may be a question whether the names should be upon the parts (as in Gray), or at the sides of the figure and connected with the parts by lines (Gegenbaur). Upon the whole the latter method seems preferable, especially if the technical names are used.

§ 170. Abbreviations should represent technical terms; they should be uniform throughout the work, and be placed at the sides of the figure.

Four methods of designating parts by abbreviations have been employed: 1, By numbers and non-significant and ununiform letters, which may or may not be explained in the text (Owen); 2, by non-significant characters, uniform only in part, and explained at a distance from the figure (Reichert); 3, by uniform and significant, but partly vernacular, abbreviations (Parker); 4, by uniform technical abbreviations (W. and G.).

The advantages of uniformity in the use of abbreviations are obvious, but it is by no means easy to avoid the charge of ambiguity. Where uniformity is not attempted, care should at least be taken to avoid the use of the same abbreviation for the names of parts which are liable to be taken for one another. For example, in Schwalbe's two representations of the lateral aspect of the crura and adjacent parts (Figs. 280, 281), not only are opposite sides shown for no good reason, with some differences of detail which are puzzling rather than instructive; not only is the pons designated in one by *p* and in the other by *po*, and the tractus opticus by *to* in one and *tr.o* in the other; but the letters *tp* stand for the *tænia pontis* in Fig. 280, and in Fig. 281 for the *tractus pedunculari transversus* [cimbia]. Since these parts are similar in general appearance and direction, and only one appears in each figure, it is doubtful whether any but the most expert anatomist, thoroughly familiar with this somewhat obscure region, could escape at least a temporary misapprehension.

§ 171. Abbreviations should be explained in alphabetical order. The "practical" business man would exclaim, "Of course, how else should they be?" An "unscientific" child would adopt the alphabetical order with letters as he would the order of notation with numbers. But the super-scientific writer, especially if he be a German, scruples not to save a few moments of his own time at the expense of others, by giving the verbal equivalents of ten (Huxley, Fig. 19), fifteen (Balfour, ii., Fig. 271), twenty (Quain, Fig. 263), twenty-five (Schwalbe, Fig. 279), forty (Meynert [Stricker], Fig. 253), or even fifty-eight (Marchand, *Arch. f. mik. Anat.*, xxxvii., 331, 332) abbreviations, either in no recognizable order at all or as they occur upon the figure.* The time wasted by each consulter of the figure (not to mention the effect of just indignation) would nearly equal what it would have cost the author to place the abbreviations in alphabetical sequence.

Burt G. Wilder.

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BRAIN: PACCHIONIAN BODIES.—These granulations, once falsely called glands, were perhaps first mentioned by Willis (1676), then by Méry (1701), and almost simultaneously described by A. Pacchioni. They start as minute spheroidal, partially vesicular outgrowths (villi of Luschka) from the arachnoidal layer of the pia—where it bridges fissures as well as where it rests on the gyres,—retaining its epithelial covering. They must not

*If the fuller discussion of this subject in the New York *Medical Journal*, August 2d, 1884, be consulted, the following corrections should be made:
Explanation of Fig. 57, last line, transpose *antimesal* and *symmesal*.
Fig. 59, for *antimesal* read *symmesal*.
Fig. 64, for *symmesal* read *antimesal*.

† Even more objectionable is the omission of the original pagination upon the reprints of papers. The printer does not always realize the conditions and the author often remembers when it is too late.