# SCIENTIFIC APPARATUS AND LABORATORY METHODS

## GYROSCOPES AND TOPS WITH BALL BEARINGS

IN the usual form of gyroscope, the spinning member is attached to one end of a rod and a counter weight to the other. The rod is supported at its center by a stand in such a way that it can rotate about one horizontal axis and the vertical axis. The gyroscope is thus free to move up and down in nutation and also to rotate about the vertical axis in precession. If, however, the rod is placed in a bearing at the point of support (Fig. 1) it can also rotate about its own axis.

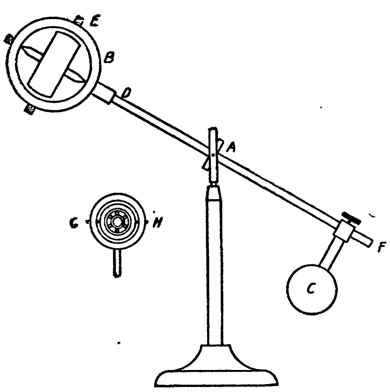


FIG. 1. The rod FD turns in the bearing at A; the bearing turns about a horizontal and vertical axis; the counterweight C is adjustable. The frame of the rotating member B is screwed to the rod at either D or E. GH shows the mounting of the bearing at A.

This gives another degree of freedom to the top and if the counter weight is placed on a second rod as shown in the diagram, it is possible to give two couples to the gyroscope. In this way the different types of precession and nutation can be shown as desired. The frame which contains the spinning wheel of the gyroscope may be screwed into the rod in three different ways so that the plane of the rotating wheel may be (a) parallel to the rod, (b) perpendicular to the rod in a horizontal plane, (c) perpendicular to the rod. In all three positions, the gyroscope, on account of the bearing, will give many new combinations of nutation and precession.

The mathematical theory of tops shows that it is extremely difficult to make a tall thin top (such as a lead pencil) stand up while spinning. The reason for this is that a tall top must be rotating at a very high speed. We have designed a special type of tall top which we spin by means of a rotating magnetic field. This field is produced by a spinner (Fig. 2) consisting of a laminated iron core with a two-phase winding

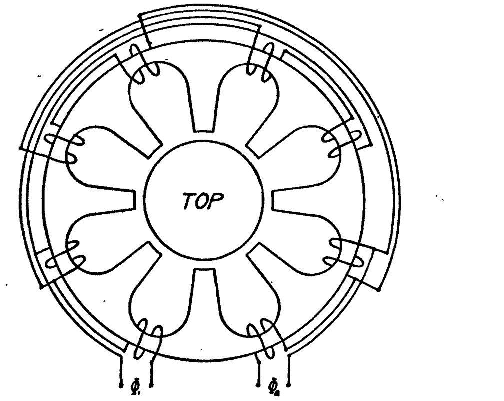


FIG. 2. Laminated iron spinner with two-phase windings for producing the rotating magnetic field.

on it. An Alexanderson alternator supplies the high frequency alternating current for the spinner. When the top is placed in the rotating magnetic field, it is caused to rotate as an induction motor. Thus with an input frequency of 600 cycles, the speed of the top is nearly 600 revolutions per second (36,000 revolutions per minute). The top itself consists of a solid copper disk (Fig. 3, A) two inches in diameter and one inch thick, attached to a five-inch spindle (C) by means of a high-speed ball bearing, B. The spindle of the top is held in the hand and the copper disk is placed in the rotating magnetic field of the spinner. This top will stand upright at first, but as air friction reduces its speed, it will gradually lean over and will finally precess in an almost horizontal position. In this position, centrifugal force (which is usually neglected in theory) will cause the point of the spindle to describe a spiral. This particular top spins best on a fairly rough surface.

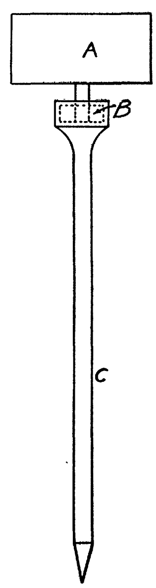


FIG. 3. The Top.

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[1] Preliminary note.

## MOUNTING MEDIUM FOR CLEARED SPECIMENS

THE interest shown at the St. Louis meeting in our cleared specimens of frog tissue mounted in Petri dishes and the requests for further information about our demonstration encourage us to offer this brief account of our methods.

The arterial system of the frog was injected in the usual way and the whole frog was dehydrated, cleared and mounted in oil of wintergreen. A well-injected and adequately cleared frog was dissected for the purpose of studying the course of certain arteries, especially in the tongue, tympanic and nictitating membrane and the fat bodies. These parts of the frog were at first mounted on a microscopic slide and immersed in a Petri dish of oil of wintergreen for careful inspection under a binocular microscope. Later the specimens were mounted on celluloid, which began to soften in the oil of wintergreen and finally dissolved completely without any harm to the tissue. In the course of several weeks some of the oil evaporated, leaving the cleared tissue embedded in a solid medium. Quantitative experiments show that at least 25 grams of celluloid will dissolve in 100 cc of oil of wintergreen and that by adding acetone up to 20 cc a few more grams of celluloid will dissolve in the same amount of oil. However, care must be had in the use of acetone, as it may cloud the cleared specimen and discolor the celluloid-oil mounting medium.

After a sufficient quantity of celluloid has been dissolved in the oil of wintergreen any entrapped air may be removed with the pump. This stock may be kept for months without any noticeable deterioration or marked hardening; it will remain sufficiently labile to be poured into the Petri dishes when the cleared specimens are ready. Air bubbles may again cause some trouble, but they soon come to the surface and explode. When the specimen is properly oriented, the air bubbles have disappeared and the medium has set to the shape of the container, the cover of the Petri dish can be sealed on by forcing the air ahead of the celluloid-oil mounting medium as the two parts are brought slowly together. The medium seems to harden from week to week, does not discolor, does not shrink or crack. The Petri dish may be handled in any way, on edge or upside down; may be put in the hands of students as demonstration material; may be used for other than cleared specimens, such as small jellyfish or sea serpents which are thoroughly dehydrated before being mounted.

Should it be necessary to remove the cover of the Petri dish at any time put a few drops of acetone or oil of wintergreen around the edge where the two dishes are sealed together by the medium and turn the cover slowly until completely loosened. If the specimen is to be taken out of the medium cut around it carefully and lift out the block which can be put in fresh oil of wintergreen and soon the specimen will be freed from the mounting medium and in as perfect a condition as if it had never been used.

Whole animals, dissected parts, delicate tissues and individual injected blood vessels have been mounted during the past six months with perfect satisfaction from this celluloid-oil combination. The celluloid is obtained from any large stationery supply company in $20 \times 50$ inch sheets; the synthetic oil of wintergreen is quite satisfactory; the 50 and 70 mm Petri dishes are good for small specimens; the quantity of the medium to be made up will depend on the size of the specimen to be mounted.

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## APPLICATION OF THE PRINCIPLE OF THE ROSIWAL PETROGRAPHIC ANALYSIS TO GEOGRAPHIC RECONNAISSANCE

THIS method is based on the principle that the percentages of surface areas of differentiated types correspond to the sum of their intercepts on linear transects across the total area, reduced to percentages. The method proposed is to lay out a number of traverses across an area under consideration such that the total length of the traverse is not less than one hundred times the average length of the intercept of the various types differentiated. The field man paces each of the traverse routes and records the length of intercept of each type of land character. The fractional system of notation, now in common use by field geographers,[1] may be used in juxtaposition to the traverse line platted either in the notebook or on a suitable base map. Supplementary information should be kept in the note record. The amount of detail recorded on these traverses will vary with the aims and purposes of the reconnaissance. The results obtained are quantitative as well as qualitative. The method has the advantage of covering areas away from road frontage and thus gives a more accurate picture of the areal content of the region as a whole. It requires a minimum of equipment and but one worker. It is estimated that at least 50 square miles can be covered in a week. Furthermore, office analysis of land use maps is facilitated by this method, as it eliminates tedious planimeter measurements.

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[1] See V. C. Finch, Geog. Soc. of Chicago, *Bull.* 9, Pt. II, 1933.

## BOOKS RECEIVED

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