II. Pectoral sinuses absent
  A. Lateral fields single: Dartmuthiidae.
  B. Lateral fields paired: Tremataspidae.

This classification is provisional, as considerable work is being carried out on the members of the order at present. A considerable number of species of Cephalaspidae have been recognized, as well as several genera, whereas Trematapidae includes only one genus with but four well-authenticated species, and Dartmuthiidae and Oeselaspidae include but one genus and species each. Further study may result in additions to these families or perhaps in reducing one or more to lesser rank. It has seemed desirable to publish this classification, however, since no general accounts of the order have been published which include the Dartmuthiidae or Oeselaspidae, forms which add to our knowledge of the order.

The writer is at present working through the Trematapids in the Patten collection, material which, thanks to the excellent state of preservation, should yield much additional information regarding this group.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE ULTRA SONIC VIBRATIONS OF SMALL PLATES[1]

IN a previous communication,[2] it was shown that a triode valve could be made to vibrate a Chladni plate at frequencies up to twelve kilocycles and so produce very complicated sand figures. Since then we have been able to vibrate small glass plates and large brass plates as high as eighty kilocycles. In order to do this, it is necessary to use a nickel rod as the mechanical vibrator and to actuate the rod from the coil of a wireless sending set. The reason for this is that all audio amplifiers and all loud speakers are insensitive to these high vibrations. The ear is also unaffected by frequencies above twenty kilocycles (*circa*), so that no note is heard while these figures are being formed.

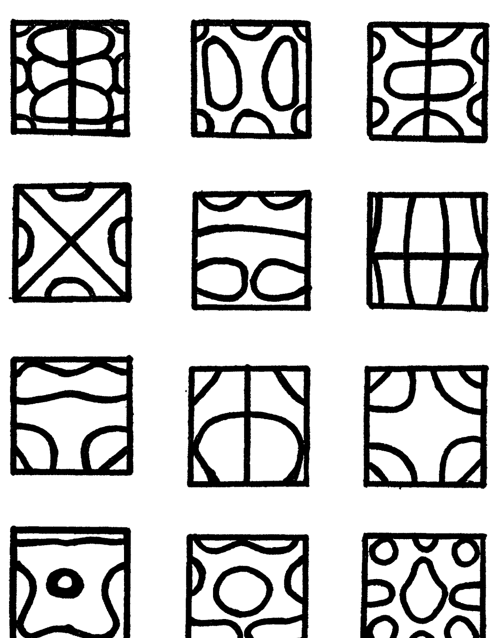

FIG. 1. Small brass plates vibrated at fifty kilocycles.

Fig. 1 shows the results upon small brass plates one inch across at fifty kilocycles. It will be noticed that some of these patterns are exactly similar to those upon large brass plates ten inches across vibrated at very much lower frequencies. The nodal lines in Fig. 2 were formed at a frequency of eighty kilocycles.

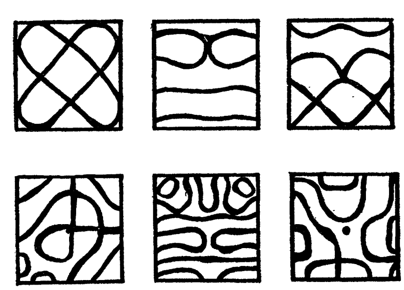

FIG. 2. Plates vibrated at eighty kilocycles. Upper row, glass; lower row, brass.

The upper row shows glass plates one inch across, while the lower row gives patterns on brass plates. It was much easier to make the sand dance up and down on the glass than on the brass, so that in the actual photographs from which the tracings were made, the figures on the glass were much better defined than the others.

We finally decided to vibrate large brass plates at eighty kilocycles. This proved to be very difficult. To make a brass plate ten inches across vibrate eighty thousand times a second with such regularity that the sand will move to the nodal lines and stay there demands a very careful adjustment of each vibrating part. The brass plates were polished brightly and given a wax finish. Each plate was clamped at a point on the periphery and the vibrating nickel rod applied at the opposite side.

The patterns are shown in Fig. 3. Incidentally the

[1] Contribution No. 107 of the Division of Industrial Sciences, West Virginia University.
[2] SCIENCE, 76: 1980, 547–548, December 9, 1932.

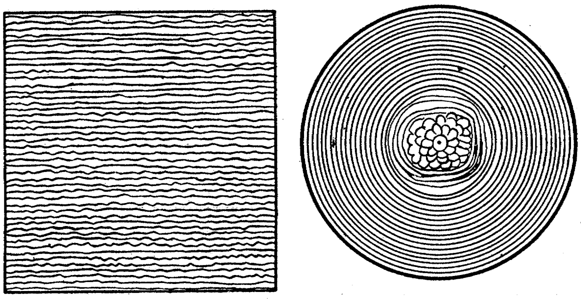

FIG. 3. Large brass plates at eighty kilocycles.

mathematical equations for the lines on the circular plate satisfy Kirchhoff's equation[3] except at the center; while the forty-five lines on the square plate may be calculated from the Ritz[4] formulas.

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A METHOD OF PASSING AIR, GAS OR VAPOR OVER OR THROUGH MICRO-ORGANISMAL GROWTHS[1]

THE apparatus herein described can be used to study toxic and stimulating effects of gases or vapors on colonies of micro-organisms. As illustrated, it is adapted to solid medium. Liquid medium may be used, in which instance gas or vapor bubbles through the medium.

The gas or vapor may be drawn through the culture with suction as with the water pump A, or it may be forced through by pressure. In the latter instance, if the gas is inflammable the culture tube is connected with bottle I and the gas burnt at its nozzle. When suction is used a trap such as B is interposed between culture and the source of suction. This contains water, except where pathogens are studied, when an antiseptic is substituted. The glass tube connecting bottle with culture tube projects just below the surface. By this means an idea of the rapidity of passage of gas or vapor can be gleaned from the number of bubbles. The water pump should be shut off slowly in order to avoid any possibility of soilage. The bottle B may receive connections from many culture tubes instead of the one.

At stand C will be noted culture tube D, which is bent on itself slightly. After planting, the plug of cotton is forced further into the tube so that the stopper with glass tubing and connecting rubber can be fitted. The shaded area illustrates solid medium. E is a rubber vaccine stopper into which is plunged a 23–25 gauge hypodermic needle so that it rests on the medium. The needle connects with a bottle, such as H, which contains water except when the effect of a volatile liquid is to be studied. H in turn connects with a glass cleaning tube containing cotton which filters out organisms from air or gas. D and all parts distal to it

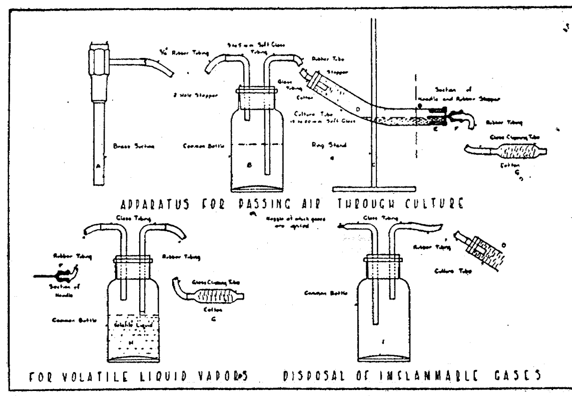

FIG. 1

must be sterile and adjusted, using sterile precautions. Without bottle H containing a liquid, excessive drying will be encountered.

This apparatus is easily constructed of stock laboratory material. It is inexpensive, easily adjustable and has many adaptations. A liquid medium may be used instead of solid. Gas or vapor may be passed through or over the culture only a short time in order to determine its noxiousness. Glass parts may be substituted for rubber where desired. When liquid medium is used frothing must be compensated for either by length of tube or other means. It is wise to have stop-cocks in the system so that any sudden change of gas pressure may be avoided. Hypodermic needles can be inserted, withdrawn and reinserted. Care must be taken that rubber of the vaccine cap is good and that all fittings are sound.

In conclusion, the variation of this method is largely in the use of the vaccine cap. In my experience I have found this a valuable adjunct. Many culture tubes can be run in the same suction or pressure set-up at one time.

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[3] Rayleigh, "Sound," Vol. I, Chapter X.

[4] Ritz, *Ann. der Phys.*, 28: 737 *et seq.*, 1909.

[1] Contribution No. 58 from the Department of Biology and Public Health, Massachusetts Institute of Technology, Cambridge, Mass.