about half its length. Surface regularly, closely and strongly concentrically ribbed, the ribs disappearing near the umbo. Lunule small; indistinct.

Miliolina seminulum Linné sp.

One specimen has been found only and has been determined as above by Mr. A. Woodward, in New York. Though no foraminifera is mentioned in Meek's Miocene Check List (Smithsonian Miscellaneous Collections, 1864), J. Lea has described a species from the Miocene of Maryland as Miliola marylandica,* and it is very probable that this name is a synonym of above.

EXPLANATION OF PLATE.

Fig. 1. Pyramis promilium n. sp. ..... Yorktown, Va.
" 2. Turbonilla paucistriata ? Jeffreys..... " "
" 3. Cæcum virginianum n. sp..... " "
" 4. Cæcum stevensoni n. sp..... " "
" 5. Cæcum glabrum Montague var..... " "
" 6. Astarte orbicularior n. sp..... " "
" 7, 7a. Leda pygmæa ? Muenster..... " "
" 8. Modiolaria petagnæ Scacchi..... " "
" 9. Modiola phaseolina Philippi. ..... " "
" 10, 10a. Semele ? virginiana n. sp..... " "
" 11, 11a. Carina of Scalpellum magnum..Petersburg, Va.
(type of Patella acinaces H. C. Lea.)
" 12, 12a. Scutum of Scalpellum magnum.. " "
(type of Avicula multangula H. C. Lea.)

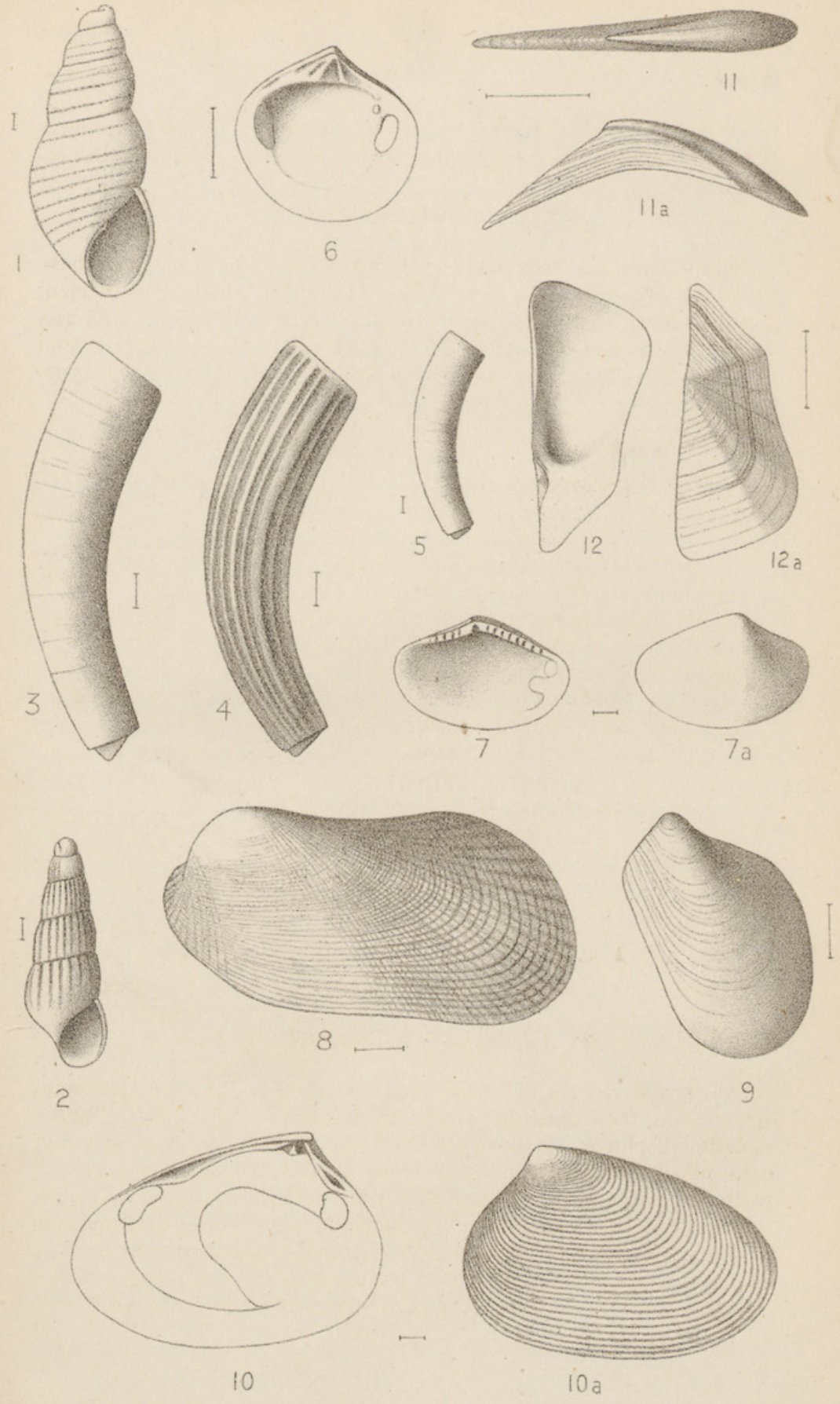
On some Possible Methods for the Preparation of Gramophone and Telephone Records. By Prof. Edwin J. Houston.

(*Read before the American Philosophical Society, April 20, 1888.*)

Phonograph records, of the type employed by Mr. Berliner in his gramophone, *i. e.*, those obtained by causing the point or stylus attached to the vibrating diaphragm to move parallel to the recording-surface instead of perpendicular thereto, can be prepared more readily, and by a greater variety of methods, than is possible with record-surfaces of the old forms.

In a study of the later forms of phonographic apparatus, several methods of preparing gramophone plates have suggested themselves to the author, which he hopes soon to be able to put to the test of actual trial. These methods, though particularly applicable to records horizontally traced,

* Contrib. to Geology, p. 215, Pl. 6, fig. 227.



O. Meyer, Del. MEYER—MIOCENE INVERTEBRATES J.W. Ross, Lith.

may, in certain cases, by slight modifications, be applied also to those vertically traced.

In order to place some of these methods on record, a brief description will be given of a few of the most promising. At the same time, the author admits that serious difficulties may lie in the way of practically carrying out some of the methods proposed.

Mr. Berliner, as is well known, prepares his record-surfaces by moving the tracing point over the surface of a plate of inked glass or metal, covered with a uniform deposit of lamp-black. The record thus obtained is either mechanically copied on a metal surface, or is reproduced thereon by the process of photo-engraving, or etching. I would suggest the following methods, viz.:

(1.) After the record on smoked glass is obtained in the usual manner, expose the plate to the action of a regulated sand-blast so as to obtain cuttings or groovings on the surface of the plate, suitable for the movements of the reproducing diaphragm. Roughness in the edges of the lines so obtained would probably cause screaming sounds in the words reproduced, which might be removed by a few applications of an emery-covered tracing point.

Should the action of the sand-blast remove the coating of lamp-black and ink on the covered portions of the plate, these portions might be rendered more adherent by the freer use of a more viscous ink, and the deposition of finer spiculæ of carbon.

(2.) The phonogram record-surface is composed of a smooth surface of hardened wax, on a composition of wax and resin which is *locally heated* so as to *slightly soften the surface* directly under the tracing point or stylus.

In order to ensure the rapid cooling and hardening of the surface, immediately after the impression has been impressed thereon, the heating must be local and not general. To more thoroughly ensure local cooling, a light blast of cool air might be directed on the surface almost immediately after the tracing has been made. To prevent the air so applied from cooling the surface that is being warmed in order to receive the record, a suitably arranged diaphragm may separate adjacent cooled and heated portions.

(3.) Instead of heating the record-surface itself, a local source of heat may be used to heat the tracing point or stylus. This heat may be either ordinary heat, or that of electrical origin. When the stylus, instead of the record-surface, is heated, the latter may be made of much harder material.

Any tendency of the record-surface to run and thus mar the correctness of the recorded sounds, may be checked by the use of a properly directed blast of cold air as already suggested under (2).

It is evident that the use of cold air, or its equivalent, is much more suitable in this case than where the record-surface itself is heated.

Any tendency of the surface or tracing-point to clog may be remedied by suitably shaping the cutting-surface of the point, or the composition of

the record-surface, or the degree of temperature employed for the softening.

(4.) The record-surface consists of a glass plate covered with a thin layer of wax. Either the record surface itself, or the marking stylus, is locally heated as before, only the layer of wax is so thin as to leave the glass exposed after the passage of the tracing-point. The cooling blast of air, and the separating diaphragm described in (3) are applicable to this process.

A permanent record is then etched in the surface of the plate so prepared either by the sand-blast process, or, preferably, by the action of hydro-fluoric acid.

Before the application of either the sand-blast or the acid, care should be taken to see that the lines traced are free from wax.

(5.) Instead of employing the records on the lamp-blackened glass surface as a photographic negative for the purpose of reproducing them by photo-engraving or etching, they may be used for transferring the record to a glass surface covered with a film of sensitized gelatine. The portions of the glass that are left uncovered after the plate is fixed are then deeply cut or etched by treatment with either gaseous or diluted liquid hydro-fluoric acid.

I have treated a gelatine-covered glass plate printed from a photograph by means of this process, and find that it produces a very fair and permanent picture on the glass.

It is evident that this process will leave the design either in relief or intaglio according as a photographic negative or positive is used.

(6.) The recording diaphragm, in its movements to and fro, is caused to deposit, on the surface of the record-plate, a uniformly thick line or layer of some rapidly hardening substance. This substance is contained in a vessel provided with a pointed outlet tube, and attached to the diaphragm. The material either runs out by its weight and is deposited on the record-surface, or is forced out by the movements of the diaphragm itself.

The substance may be rendered fluid while in the containing vessel by the action of heat, hardening on cooling, which latter may be hastened by a suitably directed blast of cooled air.

A record, thus prepared, would consist of a uniformly thick, sinuous ridge of the hardened material. The reproducing stylus, or that giving motion to the diaphragm that reproduces the speech, could, it is evident, be operated either from the upper or the lower surfaces of the sinuous ridge independently, or from both simultaneously.

(7.) If the movements of the receiving diaphragm of a telephone be sufficiently amplified or intensified to permit it to trace or cut a sinuous record on a suitably prepared record-surface by any of the methods proposed in this article, or by any other method, then there would be produced a simple, yet effective method for obtaining not only a permanent record of a telephonic dispatch, but as well a means of reproducing it as often as might be desired.