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PREPARATION OF LARGE SIZE THIN SECTIONS

ANDREW J. LANG, JR. and HARRY W. SMEDES

ABSTRACT. A description of the apparatus for and the technique of making lantern-slide size thin sections is presented. Special precautions are emphasized in the hope that by observing them other workers will be able to duplicate the writers' results.

INTRODUCTION

TO the writers' knowledge, the first attempt to prepare large 3¼ x 4 inch thin sections was that of Arthur W. Schmidt at the University of Washington in 1941. Schmidt has subsequently prepared and used large sections in connection with his work with the U. S. Army Engineers.

Dr. V. C. Clauson, also of the University of Washington, and Mr. L. B. Jensen, preparator for the geology department, developed improved techniques which enabled them to make large size sections of standard thickness. Through their cooperation, the present writers were enabled to duplicate their results.

Many rock specimens show features of such scale that standard size sections are inadequate and often misleading. On the other hand, the magnitude of these features does not always warrant the preparation of sections of lantern-slide size. To satisfy such a size requirement, 2 x 2 inch slides are used. Since they are intermediate in size between standard and large thin sections, and since the same techniques are used in making them, it is considered advisable to attempt this 2 x 2 inch size first.

A successful technique depends principally upon the observance of certain precautions. Clauson recognized these and the present writers wish to emphasize them as each step of the procedure is described.

GRINDING APPARATUS

Two laps are used, one for preliminary grinding, and the other for final grinding. A simplified drawing of the construction is shown in figure 1. Only the overall dimensions are given; the details can be varied according to the individual.

The most important single variation from standard grinding apparatus is the variable-speed friction-drive constructed

by Mr. L. B. Jensen. When the operator's body presses against the "speed-control" board, the motor base pivots, causing the small friction drive cylinder on the motor to contact the large main drive wheel whose axle is also that of the lap wheel. By pushing gently on this board the lap will rotate slowly due to slight contact of drive wheels, and also to frictional drag created by pressure of the section being ground. The rim of the wooden main drive wheel is surfaced with rubber to increase friction. By applying increasing pressure to the control board, speeds up to 175 rpm may be attained. It should be mentioned

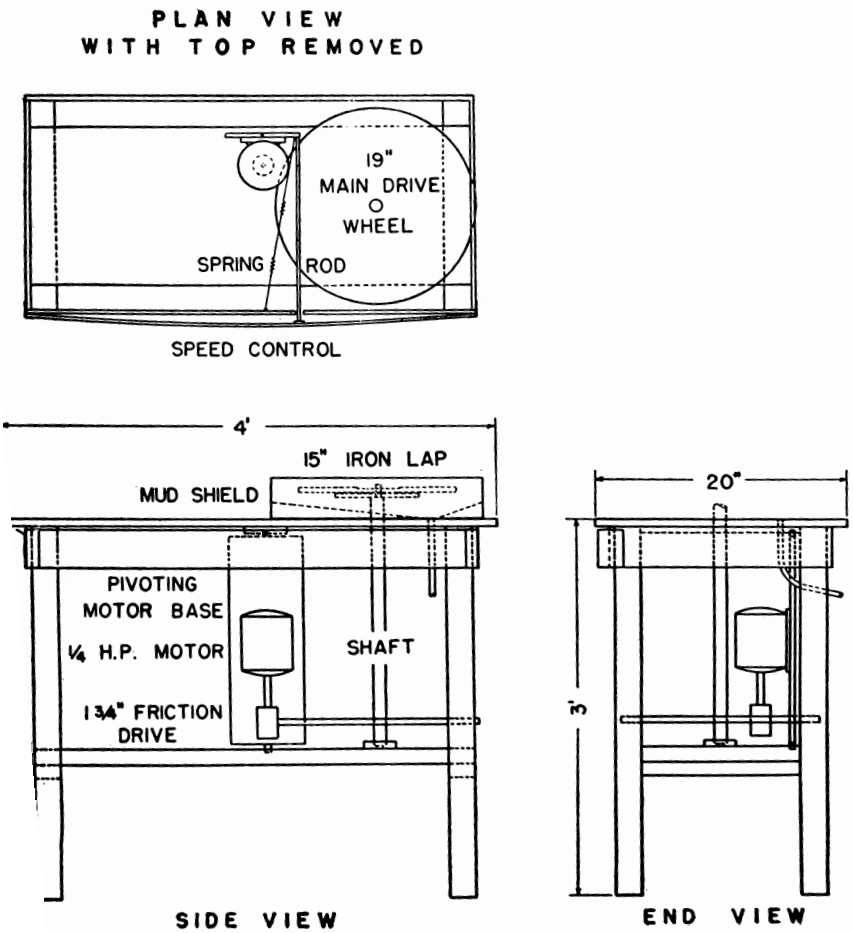


Fig. 1. Grinding apparatus

that at very low speeds the lap may have a tendency to pluck mineral grains from rather poorly consolidated rock slices.

The grinding laps are made of 15 x ½ inch boiler plate. a 4 x ⅛ inch well is ground at the center of the lap to aid in keeping the surface of the lap flat. The base of the main drive shaft is mounted in a socket lined with roller bearings, as is the upper part of the shaft at table-top height. Welded onto the top of the shaft is an 8 inch metal disc upon which the lap rests.

TECHNIQUE

Cutting.—A standard 8 inch Di-Met diamond saw is used by the writers. The rock is cut into as thin a slice as possible. The thickness may vary from 1/16 inch for hard compact rocks, to ⅛ inch or more for soft, granular, coarse or brittle rocks. The slices are then trimmed to the desired size and prepared for mounting.

The authors have found it timesaving to make several sections at one time, and to complete each phase of the process for all of the sections before carrying them to the next step.

Preliminary Grinding.—After the slices have been cut and trimmed to the desired size, one surface of each slice must be polished to eliminate all irregularities. Saw marks are removed on the coarse lap by using 220 abrasive. The rock slice is held in place by the pressure of index and fore-fingers of both hands. To maintain a flat working surface, the slice is moved back and forth from the rim to the center of the lap. After a plane surface has been ground the slice and hands are thoroughly washed to remove abrasive before proceeding.

Polishing of the slice is done on the fine lap with FFF abrasive to insure a flat surface upon which the glass slide is to be cemented. The abrasive is mixed with water into a thick paste and applied to the rotating lap by means of a small paint brush. It is essential to use laps that have a perfectly flat working surface.

After polishing the slice it is thoroughly washed and transferred to the hot plate for drying.

Mounting.—While the slices are drying on the hot plate, a great deal of time can be saved by preparing the glass slides for mounting. Several lantern slide coverglasses are washed with liquid soap and water to remove grease and lint and are

then thoroughly rinsed with hot water to remove all soap film.

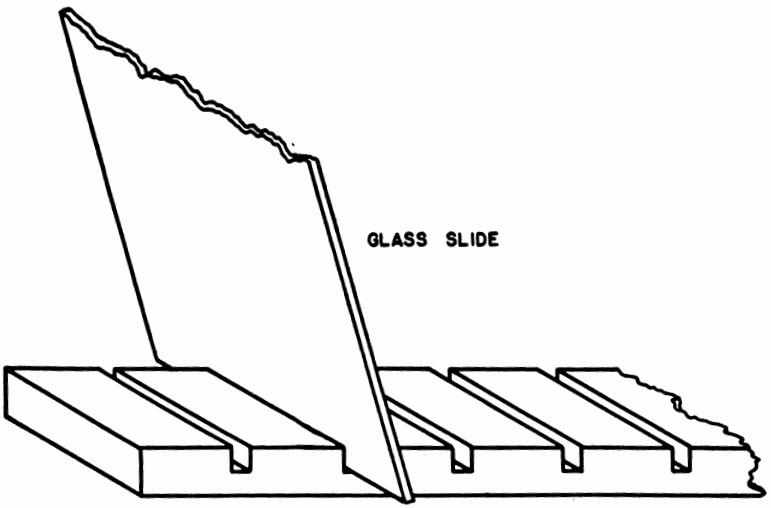
To facilitate drying the glasses a simple rack can be made by cutting parallel grooves (ca. 1/8 inch deep) across a long narrow strip of plate glass. The glass slides are then placed in the grooves and the rack can be placed near the hot plate to hasten drying (fig. 2).

A piece of plate glass placed over the entire heating surface of the hot plate insures a flat working surface for more perfect contact between rock slice and glass slide during mounting.

After the glass slides are dry, all dust and lint is removed by wiping with lens tissue or other suitable material. They are then placed flat on the hot plate and allowed to heat.

For a mounting medium the writers have found Lakeside #70 Transparent Cement a very satisfactory material. It is manufactured in stick form and is therefore easier to apply and store than Canada balsam. It also requires less rigid heating time-temperature controls, and has a refractive index and dispersion similar to Balsam. It is necessary to maintain a constant hot plate temperature of ca. 145°C.

After the rock slices have been thoroughly dried (a period of 20 minutes or more) the cement is spread evenly over the polished surface of the slice and over the heated glass slides.



DRYING RACK

Fig. 2. Slide drying rack

A slide is then inverted and placed at a tilt upon one edge of a rock slice and allowed to drop slowly in order to remove all air bubbles by forcing them outward. Any remaining bubbles may be removed by applying pressure with a pencil or similar object to force the bubbles outward. By inverting the slide in this manner rather than the rock slice, it is possible to see that all bubbles are removed. The mounted slices are then removed from the hot plate and permitted to harden, after which they are ready for the final grinding.

Final Grinding.—Most of the thickness is removed by using coarse abrasive (No. 90). This may be replenished from time to time and if necessary the old abrasive can be removed by washing. Grinding is continued until the slice is about 1 mm thick, at which time the lap, slice, and hands are thoroughly washed.

The above procedure is repeated by using 120 abrasive until the slice is about 0.5 mm thick, and then on 220 until the inherent colors of the minerals are visible. After thorough washing the slice is ready for the fine lap.

Again a paste of FFF is applied to the lap. Great care must be taken to exert a uniform pressure over the entire slice. This can most easily be done by using a plate glass "holder" as shown in figure 3. As skill and confidence develop the glass "holder" may be eliminated. The rate of cutting can be controlled by variable lap speeds (25-175 rpm). At intervals the lap is stopped, the slice is washed, and examined under a polarizing microscope. Further grinding is preceded by thorough washing of the lap and then application of fresh FFF paste. This is continued until standard thickness (0.03 mm) is attained.

Cleaning and Covering.—After the slide has been ground to proper thickness, the excess cement is removed by scraping

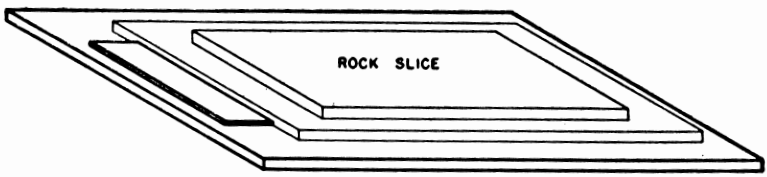


Fig. 3. Thin section "holder"

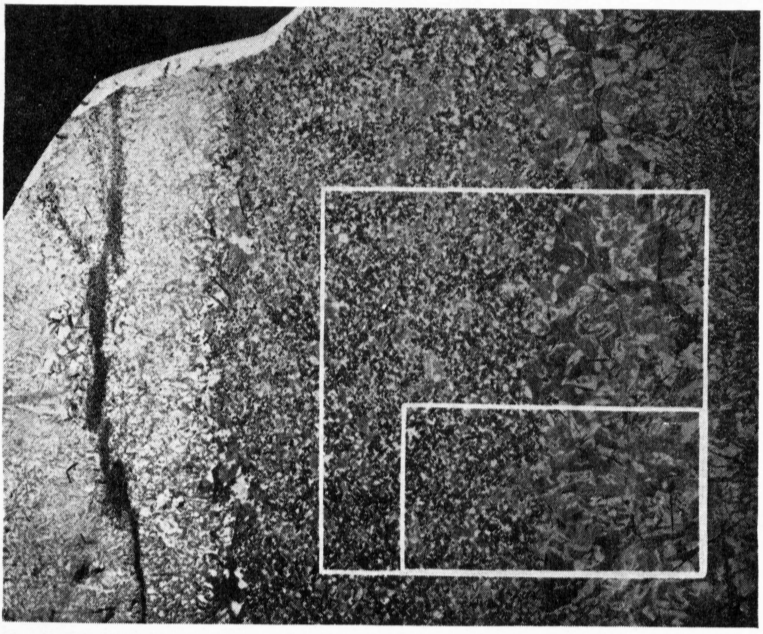


Plate 1. Photograph of 3¼x4 inch thin section with outlines showing relative sizes of 2x2 inch and 22x40 mm sections.

with a razor blade. Thorough washing with soap and water and then thorough rinsing will remove all particles of abrasive. When the cleaned slides are dry they are covered with clean dry cover glasses. Ordinary lantern slide cover glasses 1 mm thick are satisfactory unless the use of high-power short-focus objectives is contemplated, in which case special thin cover glasses should be used. The writers have found Permount a good substitute for Canada balsam as a cementing medium.

The covered slides should be put away flat for at least two days to allow the Permount to harden, after which time the excess cement can be scraped off with a razor blade and the slide washed with soap and cold water. The sections can now be bound with slide binding tape and are ready for use.

Precautions.—

1. During all grinding operations both laps must be kept perfectly flat.
2. The rock slice must have a smooth flat surface and be thoroughly dried before mounting.
3. It is especially important, when changing to a finer abrasive, that the grinding apparatus, rock slice and hands be thoroughly washed to remove all previously used abrasive.
4. Uniform pressure must be applied to the entire surface of the slice while grinding.
5. The fine lap must be washed before each application of fresh FFF paste.
6. The importance of thorough cleanliness throughout the grinding room cannot be over-emphasized.

Applications.—Many standard size sections are required to accomplish the work of one large section, but they fail in that they do not readily integrate the whole picture for the observer. This is easily done in the large sections where the different portions of the rock are spatially oriented.

Whenever the detail in the rock sample does not warrant the preparation of sections of lantern slide size and yet cannot be adequately covered on a standard size section, 2 x 2 inch slides may prove satisfactory. In plate 1 the advantages of large sections over those of standard size are readily seen. It is apparent, moreover, that standard size sections are ample when dealing with homogeneous rock material. Both of these

large sizes (3¼ x 4 inch and 2 x 2 inch) can be used in standard lantern slide projectors; the 2 x 2 inch size will also fit 35 mm projectors.

These large thin sections have wide applications. Goodspeed (1948) and other members of the Geology Department at the University of Washington, Seattle, use large thin sections for research, classroom demonstration, lecture illustration, and the presentation of scientific papers.

A projector can be adapted for polarized light by placing a strip of sheet polaroid on each side of the thin section. The projector thus becomes a polarizing microscope. Also, large thin sections may be studied under a wide-field binocular microscope converted for use with polarized light by using two sheets of polaroid, one below the stage, and the other suspended beneath the objectives and above the section.

References

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University of Washington
Seattle, Washington