ARCHAEOBOTANY LABORATORY MANUAL:

PROCEDURES AND RULES

HEIDI A. LENNSTROM

AND

CHRISTINE A. HASTORF

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GENERAL LABORATORY PROCEDURES
PALEOETHNOBOTANY LABORATORY
UNIVERSITY OF MINNESOTA
1991-92

At the beginning of each quarter fill out a schedule of the hours you wish to work. It is important to work for more than one hour, but less than 3 at a microscope at one time. A total of FOUR hours a day at the microscope is the allowed maximum. If you need to work for more that three hours at the microscope in one day, sign out and take a break for at least half an hour. This is very important, and these rules cannot be broken. Remember to stick to your schedule, and if you cannot come in, please call and let us know.

Please be neat and keep areas around microscopes clean, as we have to share equipment and space. Wash counter space from time to time to keep work areas and data sheets clean.

Keep the sample you're working on, your sorting box, your data sheets, brushes, tweezers, etc., in your own personal drawer.

When storing unfinished samples, make sure they are well LABELED, and covered.

Keep the eyepieces of your microscope clean. Clean by blowing gently on eyepieces to remove dust before rubbing VERY GENTLY with a piece of lens paper. Be very careful with the eyepieces to make sure they do not get scratched.

It is best not to turn illuminators off except when you are done for the day, this saves on bulbs and mechanical failures.

Feel free to bring in tapes, or play the ones in the lab. Please don't ever play them loudly (even on week-ends). Do not take any of the resident tapes out of the lab.

Please keep conversations quiet, work may seem mindless, but it is important to pay attention to what you're doing, and try not to disturb or distract others. Be especially mindful on days when there are many workers in the lab.

Please hang up coats, and put book bags under desks, or out of the way. Keep other personal belongings in your drawer. Throw newspapers in the recycling box. Bottles and cans for recycling go under the sink.

Everyone working on sorting and ID's must sign in on the sign-in sheet.

Keep time cards up to date, and remember to get Dr. Hastorf's signature and turn them in to Terri V. in Anthropology on time.

Time cards should include time spent sorting, working on identifications, stamping boxes, weighing samples, and mandatory lab meetings; they should not include time spent eating lunch, talking on the phone, or optional lab meetings or presentations.

Please fill in only the actual hours you work, remember it takes time to get to and from classes.

There is a hot plate and refrigerator available for everyone to use. Please clean up after yourself, and keep clutter away from microscope stations near the sink.

Please use the telephone sparingly, no long distance calls.

Remember to cover your microscope when you are finished, and to turn out the lights, turn off the humidifier (if it's on), and lock the door if you are the last to leave.

If there are any building problems tell them downstairs in the main office.

Shepherd labs is locked after about 4:30 weekdays and on week-ends.

There is no smoking in the lab.

1982, 1983, and 1990 PROVENIENCES

The 1982, 1983 and 1990 field seasons used a provenience sequence of seven numbers. Each number slot designates a location or a cultural connotation of the collection sample. A typical provenience designation is:

2=1-1-2-3-5/2

This is read as Site=Architectural Division-Architectural Subdivision-Unit-Level-Locus/Slash Number

Sites are discrete human use areas.

Architectural Divisions (ArcDiv, or AD) are patio groups, made up of many structures, and open space.

Architectural Subdivisions (ASD or ArcSub) are parts of the patio, usually a portion of the patio, or a structure.

Units are normally 1/4 of an ASD.

Levels are natural stratigraphy within the site.

Loci are the smallest defined cultural divisions within any level.

Slash numbers refer to samples or items that were point provenienced.

ASD numbers refer to the following:
1-10 circular structure
11-19 subsurface structure
20-30 rectangular structure
50-59 patio area
90- open plaza

Filling in forms for 1990 Cachi-Argentina samples:

SITEs are number 1, 12, 42, or 65. ARCDIV is the second number, right after the = sign. ASD is the third number, UNIT is fourth, LEVEL is fifth, and LOCUS is sixth. On some samples these numbers are followed by a slash number. Often, if it is a scatter or screen material there will be no slash number. FEA (feature) was not used. FLOT is the 4-digit number on the flot sample bag. All should be between 6000 and 6500.

On the right-hand side of the form COLL TYPE should be "bulk" or "scatter". This information is on the label of the flot sample. CC stands for cultural context. This is a three digit number found in the field notes, you can leave this for Heidi to fill in. SCREEN Y/N If there were any bags of screen material for that locus circle "Y" if not, circle "N".

In the left-hand box marked LIGHT, put your initials in as SORTER, and the date you started the sample.

On the back of the sheet fill in the FLOT# and the provenience. At the bottom of the back page fill in what percent of the sample was sorted, and if you split any portion of the sample write in the amount it weighed. E.G.: LF>2mm =100%, LF<2mm and >1.18 =50% (1.2g), LF<1.18 and >0.5 =12.5% (2.1g), and LF<0.5 =12.5%

(1.5g). If any portion of the sample was split circle the 2 next to the SORTING STRATEGY, if the entire sample was sorted circle 1. Check off and write in qualitative estimate of amounts of fish scales in the fractions you have sorted (if we are not currently picking them out). Also draw rough sketch of any land snails, with an estimate such as "lots" or "few". Don't bother to count them. Under "comments" add any other information on the tags.
Under COMMENTS fill in the initials of the excavator and the excavation date that should be on the tag in with the flot sample.

For each locus with accompanying screen material one SCREEN SAMPLE form should be started. As with the flot forms, Site ARCDIV, ASD, UNIT, LEVEL, and LOCUS should be filled out. There is no flot number. On the back of the Screen form fill in the provenience as above, and again fill in the initials and date of the excavator/excavation.

1986 PANCAN PROVENIENCES

Related to the 1982-83 recording system, proveniences at Pancán may contain all of the seven number slots. All have site number, unit, level, and locus. They may also include ArcDiv, ASD, slash number, and feature number. But because Pancán was a more complex, buried site, not all loci could be assigned to a patio group or structure. Unlike the 1982-83 proveniences, each locus number is unique. These can be seen in their chronological sequence in the Harris Matrix. Also, the ASD numbers are not related to what sort of building it represents, and are instead arbitrary. ASD's can be seen in the three level plans. Also, because of the two sampling schemes employed at Panc†n, not all flot samples have slash numbers, and each provenience usually has two samples.

Filling in forms for Pancán samples:

SITE all Pancán samples are number 1. AD and ASD check your computer printout for these, if none please draw a line through the blank to indicate so. U (Unit) and L (level) are also on the printout, these can not be blank. LOC (locus), is on your flot sample, as is SL (slash number) if it is a scatter or screen scatter type there will be no slash number. FEA (feature) can also be found on the computer printout. FLOT is the 4-digit number on the flot sample bag. All should be between 2000 and 3200.

On the right-hand side of the form COL TYPE should be "bulk", "scatter", or "screened scatter", this information is on the label of the flot sample. CC stands for cultural context. This is a three digit number on the printout, please leave room for description. SCREEN Y/N If there were any bags of screen material for that locus circle "Y" if not, circle "N".

In the left-hand box marked LIGHT, put your initials in as SORTER, and the date you started the sample.

On the back of the sheet fill in the FLOT# and the PROV
for the provenience simply put the site number-locus/slash number, E.G.: 1-75/1. At the bottom of the back page fill in what percent of the sample was sorted, this is normally 100%, unless the sample was split. Drawings of the types of shells found is done during the sorting procedure. They need only be sketches, and some estimate such as "lots" or "few" should also be made. Under COMMENTS fill in the initials of the excavator and the excavation date that should be on the tag in with the flot sample. Please check to see that this matches with the information on the computer printout.

For each locus with accompanying screen material one SCREEN SAMPLE form should be started. As with the flot forms, SITE, AD, ASD, UNIT, LEV, LOC, and FEA should be filled out if they are pertinent. In addition there is no flot number, but there are two places to fill in EXC VOL, which can be found on the computer printout, either one can be filled in, but it isn't necessary to fill in both. PHASE and COL TYPE should be left blank. On the back of the Screen form fill in the provenience as above, and again fill in the initials and date of the excavator/excavation.

BOLIVIAN MATERIAL FROM DR. ALAN KOLATA'S WILA JAWIRA PROJECT

This includes material from excavations at Lukurmata, and all parts of Tiwanaku, and flots from valley sites from 1989-1990 surveys. Flotation samples from these sites were taken starting in 1986 (at least), and continue through the present. His excavation and recording strategy centers around an infinitely expandable grid, noted as UNIDADs North and East of a single datum. Each samples can have the following information:
F# = Flot number, unique w/in our lab. Starts at 5000
SITE = site, TIW=Tiwanaku; TMV558, etc. =Jim's survey area,
ALLK, GUAQUI, PUK, OBS, etc. =Juan's survey.
CUADRA = Can be numbers or letters, is sub-section of site
NIVEL = Level
SPECIMEN # = Bag number which is unique to each site
FECHA = Date excavated, watch out for order of month and date
UNIDAD = Unit (nearly always given as Nxxxx Exxxx)
RASGO = Feature number, sometimes w/description
EXCAVATOR = Initials of head of dig team

Other information to be filled in on our laboratory analysis forms:
FLOTVOL = Volume of sample in liters, found in flot log
COLLTYPE = whether sample is BULK (101) or PINCH (102). Check flot log for details. Screen material (1/4") is 201
LFWT = Combined total of Light Fraction, both carbon and remains (No longer being done 10/90).
PICKWT = Weight of carbon sorted out of the sample
CC = Cultural Context of sample. This is found in the field notes
SCREEN Y/N = Do we have some material from the screen for this location?

Filling in forms for Bolivian (Wila Jawira) samples:
Select a provenience, and check for all samples that were taken. For each sample there may be a heavy fraction, if so, it should be attached to the light fraction bag. Screen material have the same provenience number, and take care as there can be more than one for each provenience, or none at all. A data sheet should be started for the flot and the associated screen. Remember to use a (sharp) pencil.

On the flot sample form the following should be filled out by the sorter: SITE, CUADRA, NIVEL, SPECIMEN#, FLOT#, UNIDAD, RASGO, SCREEN Y/N, Sorter's initials and date sample was started in the correct spot, I.E.: if you are doing the LIGHT fraction and /or the HEAVY fraction. On the back fill in the provenience and flot number again, as well as the initials of the excavator and the date excavated. Fill in what percent of the sample was sorted, and if you split any portion of the sample write in the amount it weighed. E.G.: LF>2mm =100%, LF<2mm and >1.18 =50% (1.2g), LF<1.18 and >0.5 =12.5% (2.1g), and LF<0.5 =12.5% (1.5g). Check off and write in qualitative estimate of amounts of fish scales in the fractions you have sorted (if we are not currently picking them out). Also draw rough sketch of any land snails, with an estimate such as "lots" or "few". Don't bother to count them. Under "comments" add any other information on the tags.

Processing flotation samples:

Empty the light fraction into the geologic sieves, replace lid, and shake carefully. If necessary, carefully loosen roots with probes. Do not touch the sample with your hands, in case the material is needed for Carbon-14 dating. Save plastic bag, and the label.

Gently shake the material to the side of the sieves, and pour each portion into a different sorting tray, putting a tag with the SITE name and FLOT NUMBER on EACH one.

NB: Check the section of this document for sorting strategies (p9-11), especially if you are going to do less that a "complete" sort.

Shake the sample box slightly so the sample is spread thinly across the whole tray, so that you can see all the material easily. Sort each fraction twice, systematically.

Remove all carbon from the >2mm fraction (the top sieve). All seeds, lumps and dung should be removed from the material that is >1.18mm (the top TWO sieves). Do not pick out any wood that is <2mm. Seeds and any lumps with surfaces should be pulled from the remaining two fractions (<1.18mm and >0.3mm).

Do remove bone and fish scales, whether charred or not, and make sure that you check off the appropriate places of your form if they occur in the sample. (Bone on the front, fish scales on the back.)

Put all picked carbonized items in a used vial, and all remains in a used box (if you are not working on identifications). Make sure that each vial or box has a paper tag with the SITE name and the FLOT NUMBER on it. If you are working on identifications put different seeds into separate gelatin capsules as you sort. If possible separate unidentifiable seeds from lumps. Keep the capsules in the holder, and avoid contact with your hands as much as possible. When you have finished a sample take all capsules and place them in a clean vial or box, be sure to include a label.

Put all the sorted remains, carbon, empty plastic bag or labels, and the unsorted heavy fraction and screen bots into a paper bag and put them with the form on Heidi's desk.

Weighing samples:

After samples are checked and are ready to be put away they must be weighed, and the boxes stamped.

Count the number of gelatin capsules and vials used for picked and identified material for the light fraction. Take the same number of "empties" and place them in a plastic weighing boat. Turn on the balance, wait until it reads 0.0000 g, when it is ready, put the dummy sample into the boat, press bar to re-zero. When it reads 0.0000 g again, open the door, take out the dummy sample, pour out the capsules, and put in the real sample into the weighing boat, and put it

on the balance, shut the door, and take the reading. Round off estimates to 0.01 g. Fill this value in as the PICKED WEIGHT of the sample.

After weighing remove all capsules with colored labels from the light fraction, heavy fraction, and the screen bots. In the upper right hand section of the form, use the appropriate stamp to indicate that these materials have been removed, and put them in the boxes with others that have been removed from other samples. Yellow tags are for bones, pink for fish scales, blue for unknown seeds, and orange for artifacts.

Return the material to the box, being careful that the lid fits securely, and that none of the capsules are broken. On the upper right hand corner and one end stamp the provenience, year of excavation, and the flot number.

For Peruvian UMARP samples:
E.G.: 1-477/2 2=1-1-3-2-5/7
1986 1983
2553 # 1279

For Bolivian Wila Jawira samples:
E.G.: SITE TIW UNIDAD N788 E5125
CUADRA AK-E RASGO 1
NIVEL 3 FLOT # 4023
SPECIMEN 15223 YEAR 1989

For Cachi (Argentina) samples:
12=3-41-1-5-1/1
1990
#6002

See the examples on the shelves. Then put each sample in order by provenience within each of the three box sizes.

--PLEASE WRITE NEATLY ON DATA SHEETS, REMEMBER SOMEONE ELSE WILL HAVE TO READ THEM--

SORTING STRATEGIES FOR ARCHAEOBOTANICAL MATERIAL IN THE LAB

Because time and money are always in high demand in the lab there are several different strategies that can be used when sorting and identifying archaeobotanical material in the lab. Other considerations are the goals of the study at hand, the quality of the collection and recovery techniques used to retrieve botanical material, and the overall quality of archaeological information available for the interpretation of the materials.

Below are schemes devised especially for flotation samples, where the study of domesticates is the main focus.

Strategy 1: Complete sort

In the best of all possible worlds it is nice to be able to sort out and identify all useful material from a sample. It is especially desirable because a single flot samples is already only a small sample of any given archaeological context, and one wants as complete a picture as possible. In our case, one would sort out, and identify all charred material, except <2mm wood, which is usually unidentifiable. All bones and other animal and artifactual materials are pulled out and given to appropriate specialists.

This type of strategy gives RATIO level data, with exact counts (and/or weights) entered onto the computer. Descriptive statistics such as RELATIVE PERCENTAGES, DENSITIES, UBIQUITIES, and DIVERSITIES can be generated from this type of data.

This strategy is the most labor intensive, and can be a waste of time when you sort past the point of diminishing returns, i.e., you get the exact same values by sorting entire sample that you would by making estimates based on some fraction of the whole (50%, 25%, etc.).

Prior to 1989 Bolivian and 1990 Argentine material (I.E.: All UMARP Peruvian material) we sorted everything, all the way to the material caught in the closed pan below the sieves. Starting with these later samples we did not sort material less than 0.3mm, as it was found to be almost always completely devoid of usable material.

Strategy 2: Sample splitting

In this strategy time is saved by splitting (by weight) some or all of the sample. It is usually done at one of the smaller fractions separated by the geologic sieves, e.g., 100% of the material that is >2mm is sorted, while 50% of all material <2mm is sorted and all counts of the identified specimens are doubled. The decision to split a sample should be based on the following guidelines. The average amount of time spent on a sample is about 2 1/2 hours, including sorting and identifying light and heavy fractions, as well as material recovered from the sieves in the field. The two main factors that should be considered are both the volume of the sample, and the density of the seeds. The desired amount of material to sort from each size fraction of the sample is enough to fill one of the sorting trays (in a thin layer, as when ready for sorting). If a brief scan of even this amount appears to contain hundreds of seeds, it should be split again. A rule of thumb that has proven effective for the 1986 Panc†n (Peru) material was never to let the sorted portion fall below 1.0g or 12.5% (3 times though the sample splitter). In these samples it was found that this was approximately the point of diminishing returns for very dense samples such as those from burnt stores of crops, where seeds and tuber densities per 6-liter of soil averaged in the thousands.

That is, if at least these 12.5% or 1.0g of each size fraction was sorted the estimates of total densities and taxa diversity were found to be insignificantly different than if the whole sample had be sorted. It should be noted on the form which fractions were split, what percentage was sorted, and the weight of the material prior to sorting. Of course, special circumstances may occur, and less may be sorted without losing accuracy.

Trials with a 0.3mm geologic sieve show that very, very few seeds will pass through this mesh size. Another time saving measure in dusty samples is not to sort the material that is less than 0.3mm. If bones and fish scales are too numerous, they can be left in remains and notes of their occurrence and/or abundance can be put on the data sheet. If very small lumps are overabundant one can leave those <1.18mm (with no distinctive characteristics, such as a surface) in the remains.

As with the complete sort, one gets RATIO level data, and can generate RELATIVE PERCENTAGES, DENSITIES, UBIQUITIES, and DIVERSITIES. Because actual counts are estimated this type of data can be used in comparison with that of Strategy 1 with no conversion.

This method is a good time saver, especially for samples that are quite homogeneous. Drawbacks are that diversity may be lost, and rare species are either missed or over represented.

Strategy 3: Scanning with estimates and removal of special taxa

In this scheme only domesticates are removed from the remains. The samples are scanned and the weedy species are recorded as "common", "occasional", or "rare" (corresponding to values of 3, 2 and 1, respectively). Each of these categories is based on a visual estimate of the number of each different taxon. Counts corresponding to each category should be determined so that all workers are making the same estimates.

This will result in ORDINAL level data, and UBIQUITIES and DIVERSITIES are possible, as are some other nonparametric statistics such as Spearman's Rho.

Remember the size of the pre-flot soil sample must be taken into consideration, and that this should only be done when samples were originally similar in size. If any sorter is unfamiliar with any taxon it too must be removed for identification. For this reason this strategy is less time-efficient with beginning sorters. Simple routines on the computer can be used to assign data form strategies 1 and 2 to the same format as these, e.g. "if Verbena=1 then Verbena=1; if Verbena >1 and <5 then Verbena=2; if Verbena >5 then Verbena=3.

Strategy 4: Scanning

In this scheme no specimens are removed from the sample. Instead, a complete scan is made of the sample, and the presence of taxa is marked off the data sheet.

This results in NOMINAL level data, from which can be used to generate UBIQUITIES and DIVERSITIES, and any scheme that only requires presence/absence data.

The computer can again be used to assign data to presence/absence level very simply (usually as 1 and 0), e.g., if Verbena >0 then Verbena =1, etc. This routine is the fastest, and can be useful when only a rough sketch is needed from the data set, often as a preliminary method to further detailed work. The drawbacks can be the loss of quantitative data, and requires all workers to know all taxa.

Strategy 5: Complete sort >0.5 mm

After working with the 1986-90 Bolivian and 1990 Argentine data, where the flots were poured straight into chiffon out of the flot machine we found that the samples were full of much of dusty material, and varying amounts of small (0.5 to 0.3 mm) seeds. That samples were averaging 6-7 hours each. We also felt a bit uncomfortable with material that was less than 0.5 mm (500 microns), as the bottom mesh inside the flot machine is only 0.5mm, and there is a possibility that anything smaller than that could be a contaminant from some other samples. This type of exchange through the "inner bucket" mesh is known to happen, as it occasionally happened with the modern poppy tracers when this mesh was only doubled window screen.

Tests with the Bolivian material (famous for tons of small, weedy seeds) showed that the percentage of differing small taxa are not at all the same from sample to sample, so there is unfortunately no systematic way of calculating the amount of material that will missed by not sorting material between 0.5 and 0.3 mm. At least there did not seem to be taxa that would be completely missed, except perhaps UNK 264 and 190. Most heavily lost are Small Poaceae, Nicotiana, and Juncus.

Strategy 6: Sample splitting, sorting only >0.5mm

This is a combination of strategies 5 and 2, where a fraction of the sample may be sorted, and no material less than 0.5 mm is checked.

SPECIAL NOTES TO THE PERSON(S) IN CHARGE OF FINAL IDENTIFICATIONS, FINISHING THE FORMS, AND FILLING IN THE COMPUTER FORMS:

When samples come to you check to make sure all the information on the forms is correct, if anything is missing fill it in. Put in your initials and the date you do the ID's on the form.

After you have checked the identifications made by the students sort through the remains one more time, adding any seeds that have been missed. Count each type and put the numbers in the appropriate spaces. Do the same with the Heavy fraction and Screen materials. Counts (or estimates) of each size of bone should be added in the check-off box.

It is very important that the plant names are put on the form in the proper order, I.E. the way they go on the computer. This is only a problem for species which are not printed on the forms. Please make a list of the order and stick to it (and add new species as needed).

Fill in the counts next to each taxon. If the sample was split please include the actual count, and then the number you've used to calculate the total next to it. Put this entire expression in parentheses. For example, if 100% of the <2mm & >1.18, and 25% of the <1.18 & >0.3mm was sorted the <2LF line for a given taxon would look like this:

<2LF Wild legume 3 + (100 x 4) = 103.

This would let us know that 3 seeds were recovered from the first, unsplit part of the <2 sample, and that 100 seeds were recovered from the <1.18 & >0.3, which had been split twice, and only 25% sorted. The total is the estimated total for the entire sample (see attached data sheet).

Take the sticky labels off the sample bag and tape them inside of the lid of the box the sample is stored in, and include the inner tag, as well. When putting labels on vials use tape, too. Otherwise they will peel off. (This is not necessary for sticky labels on plastic bags.)

When putting tags in full gelatin capsules try to get the taxa name to show on the outside.

When the sample is finished, put the things from the light fraction into a box, and put the heavy fraction and screen materials into plastic bags or vials and put them in the box as well. Note on the screen form which flotation sample the material is stored with. Choose the smallest box that the sample will fit in. For samples with 0-2 vials use a small one. Samples with 3-6 vials will fit in a medium sized box, and all larger ones have to go in a large one. If convenient use a plastic bag instead of a vial to contain the heavy fraction or screen materials, they're cheaper.

When you are finished with a sample please circle the appropriate box size so anyone using the computer printout can easily locate the sample on the shelves.

The three check-off columns on each line of the form correspond to the three questions on the back of the form "SPOTCHECK", "ON COMPUTER", AND

"PRINTCHECK". When you spot-check a sample reconfirm the counts of each taxa in the gelatin capsules and tick off the first column, and then fill in the appropriate spot on the back. The second column is checked as you enter the counts onto the computer. Again, when this operation is finished tick off the corresponding place on the back of the form. The third column and "PRINTCHECK" are marked off when you have checked the hard copy of the SAS data set against the data sheets to make sure the information is correct.

Have the stamping and weighing of samples done about once a week.

On the weekly sign-in sheets tally the total number of hours done each week, along with the number of samples completed that week, and the running total number of samples finished. You may also want to indicate other tasks such as computer work separately. Keep these in the lab statistics file.

Keep an eye on all the supplies, and order as needed. There is a file containing all invoice slips that will help to figure out where to order things from. Clear ALL expenses with Dr. Hastorf.

Keep the lab tidy. Wash counters, put materials away, and check reference collection for pests from time-to-time.

Fill out alcohol reports for Dr. Hastorf to sign every month if necessary.

Instructions for mixing and using FAA solution for the preservation and storage of soft tissues.

Soft tissues, such as tubers can be preserved in the following way. It is best not to put them straight into alcohol, as this will destroy the cellular structure. Instead they should go through the steps of fixation first, that will prepare them for final storage.

First, cut pieces small about 1-2" square. This helps preserve structure by allowing FAA solution to penetrate the entire tuber. If you want to keep a few whole ones that's fine, just remember to use the cut pieces if you wish to do any further work on microscopic cellular structure. Place the tubers in an FAA solution for two weeks.
After two weeks, change to fresh FAA, and wait two more weeks. At the end of this time drain, and store in 70% ethynol. They should be in good shape, and store for years.

Recipes
FAA: 1 liter

663 ml 95% ethynol
237 ml distilled H2O
50 ml Formalin (Formaldehyde 37-50% & water)
50 ml Glacial Acetic Acid

70% Ethynol: 1 liter

737 ml 95% ethynol
263 ml distilled H2O

This information came from Dr. Biesboer in Botany (histology specialist).