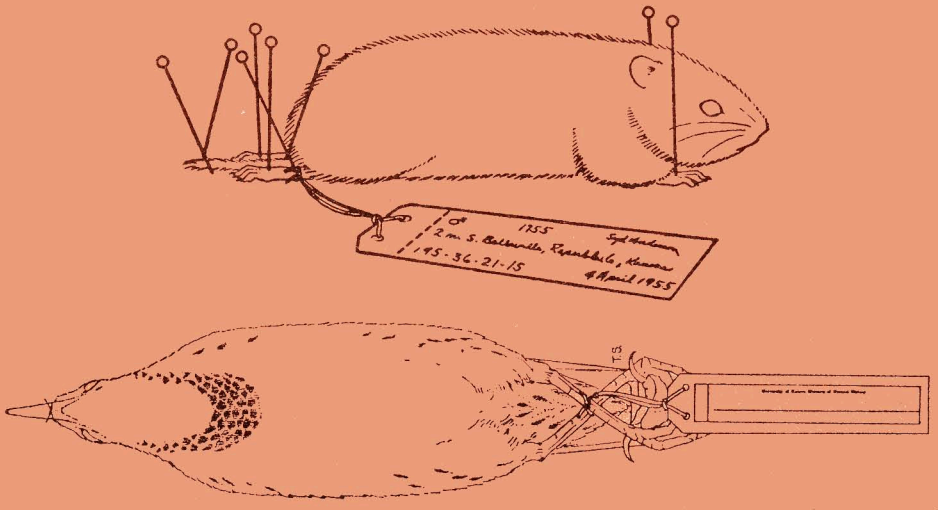
Collecting and Preparing Study Specimens of Vertebrates

by E. Raymond Hall



Museum of Natural History
The University of Kansas

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BY

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MUSEUM OF NATURAL HISTORY

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RECENT VERTEBRATES

MAMMALS

In the first place the value of specimens is greatly enhanced by having them in excellent condition, and, of course, they must be accompanied by adequate data. Often a specimen may be well prepared and adequate data for it recorded, but subsequently, through faulty packing, incorrect method of labeling, or improper care and protection against pests and climatic conditions, it may be rendered worthless. Proper care at all stages of field work, therefore, is required to insure good quality in specimens. More details than are provided here on the techniques of preparing mammalian specimens are given in other authors' publications that can profitably be consulted. One of the best publications in this field is R. M. Anderson's "Methods of Collecting and Preserving Vertebrate Animals" (Bulletin No. 69, Biology Series No. 18, pp. vii + 164, illustrated, National Museum of Canada, Ottawa, Canada, 1960).

What to Collect

In preparing mammals caught, divide your efforts between common and rare species. As a rule, even with the more common species, save a pair from each locality. Series of up to thirty from one locality should be saved in each center of suspected differentiation—these to include young of different ages as well as adults.

Weathered skeletons or skulls of animals found may be desirable as specimens. For these, care must be taken to obtain all bones, and also teeth, as these frequently will have fallen out.

Contents of cheek pouches and samples of feces may be saved dry.

If lice, earwigs, flies, fleas, and other ectoparasites are to be preserved, it is desirable to examine not only the mammals but also their nests.

Plants to be saved should be placed in presses according to usual botanical practice. Seeds may be collected dry in any adequate containers.

Equipment and Proprieties

Mouse traps of the variety that snap shut on the animal can be purchased in almost every hardware store. These traps are satisfactory for shrews. For mice, however, the larger "Museum Special," manufactured by the Animal Trap Company of Lititz, Pennsylvania, is best because the wire that strikes and kills the mouse is far enough from the treadle to keep the head of the mouse from being struck and crushed. Broken skulls are less desirable than unbroken skulls. The still larger rat trap is stocked in most hardware stores and is suitable for taking animals the size of wood rats and small ground squirrels. Steel traps in sizes 0-4 are used in many areas to secure other animals. McAbee gopher traps are the best yet devised for taking pocket gophers. A variety of mole traps are on the market; the stabbing variety is preferred by most of the collectors that I know.

Many specimens are most effectively taken by shooting. For smaller and medium-sized kinds a shotgun is recommended, and, furthermore, shot of small size should be used in order to avoid unnecessary mutilation of the animal.

For many years the double-barreled 16-gauge shotgun has been a favorite of collectors; it is customary to carry a standard 16-gauge shell in the left barrel and a metal bushing in the right barrel. The bushing is drilled to chamber a 32-caliber metal shell loaded with No. 12 shot. The collector is ready to shoot animals of fox- or eagle-size with the charge from the left barrel, or mice, chipmunks, or small birds with the charge from the right barrel.

Nets of silk, such as are manufactured in Japan, are useful in capturing several kinds of bats.

Metal forceps, 10 to 14 in. long, frequently come in handy when bats or other small mammals have to be removed from crevices.

For safely storing prepared specimens in accessible fashion, a museum cabinet that excludes insects, dust, and light is essential. A visit to the nearest museum maintaining a collection of study specimens of mammals, or a letter of inquiry addressed there, will yield all needed information on the type of container best suited to the needs of the collector. Advice concerning the cleaning of skulls can be obtained from the same source.

Every state has its own laws relating to hunting, and the collector should obtain and read the laws so as to carry on his collecting in conformance with the law. The State Fish and Game office can provide a copy of the laws, and that office, in most states, is the place to apply for a "scientific collecting permit." The collector should also find and inform the local game protector of proposed collecting, because this can be of mutual benefit; the collector often receives valuable advice as to where certain species occur locally, and the Game Protector needs to know who is afield in his area and oftentimes obtains information valuable to him from the catches of the collector.

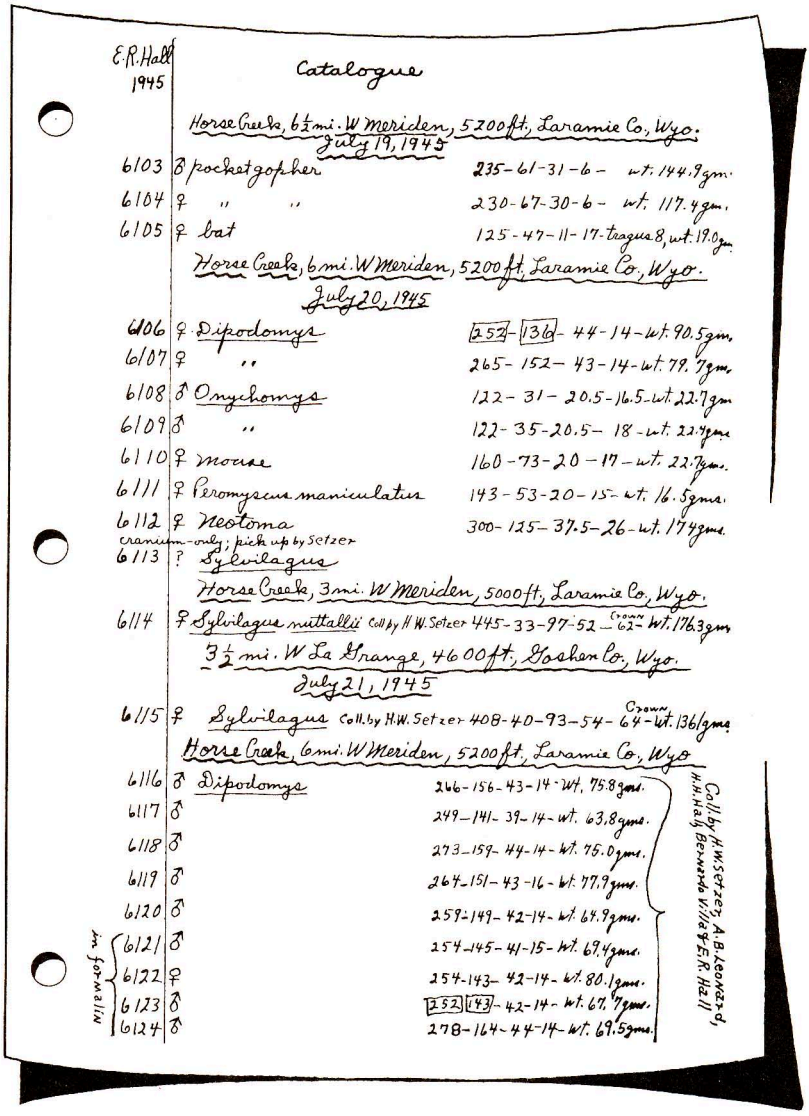
Wherever animals are collected on privately owned lands the permission of the land owner or his tenant must be obtained in advance. Application of the Golden Rule with land owners and the Game Protector will avoid trouble for the collector and bring him welcome assistance.

NOTE-TAKING

Field notes can usefully be divided into: (1) catalogue of specimens, (2) itinerary or journal, (3) accounts of species. Enter the name of the collector and the year in the upper left-hand corner of every page, but far enough from the margin to permit binding of the pages. Each page should be filled before another page is started. Use only Higgins Eternal Black Ink. For convenience all three sections of the notes ordinarily are kept in a single binder, but separate binders may be used.

CATALOGUE

In the catalogue, all specimens of vertebrate animals should be given consecutive numbers. Never repeat a number; for instance, do not begin a new series each year. One line of the notebook page should be devoted to the precise locality. Include distance in air-line miles from some well-established landmark. Include also elevation, county, and state. Devote one line to each specimen. If a specimen is not a conventional one, indicate the nature by entry directly above the field number, whether (if) skeleton, skull-only, skin-only, or alcoholic. Use the vernacular name of the species if you are not *sure* of the scientific name.


E. R. Hall
1945

Catalogue

Horse Creek, 6½ mi. W Meriden, 5200 ft, Laramie Co., Wyo.
July 19, 1945

6103 ♂ pocket gopher 235-61-31-6- wt. 144.9 gm.
6104 ♀ " " 230-67-30-6- wt. 117.4 gm.
6105 ♀ bat 125-47-11-17- tragus 8, wt. 19.0 gm.

Horse Creek, 6 mi. W Meriden, 5200 ft, Laramie Co., Wyo.
July 20, 1945

6106 ♀ Dipodomys 252-136- 44-14- wt. 90.5 gm.
6107 ♀ " 265-152-43-14- wt. 79.7 gm.
6108 ♂ Onychomys 122-31-20.5-16.5- wt. 22.7 gm.
6109 ♂ " 122-35-20.5-18- wt. 22.4 gm.
6110 ♀ mouse 160-73-20-17- wt. 22.7 gms.
6111 ♀ Peromyscus maniculatus 143-53-20-15- wt. 16.5 gms.
6112 ♀ Neotoma 300-125-37.5-26- wt. 174 gms.
cranium only; picked up by Setzer
6113 ? Sylvilagus

Horse Creek, 3 mi. W Meriden, 5000 ft, Laramie Co., Wyo.
6114 ♀ Sylvilagus nuttallii Coll. by H. W. Setzer 445-33-97-52 Crown 62- wt. 1763 gms.

3½ mi. W La Grange, 4600 ft, Goshen Co., Wyo.
July 21, 1945

6115 ♀ Sylvilagus Coll. by H. W. Setzer 408-40-93-54- Crown 64- wt. 1361 gms.

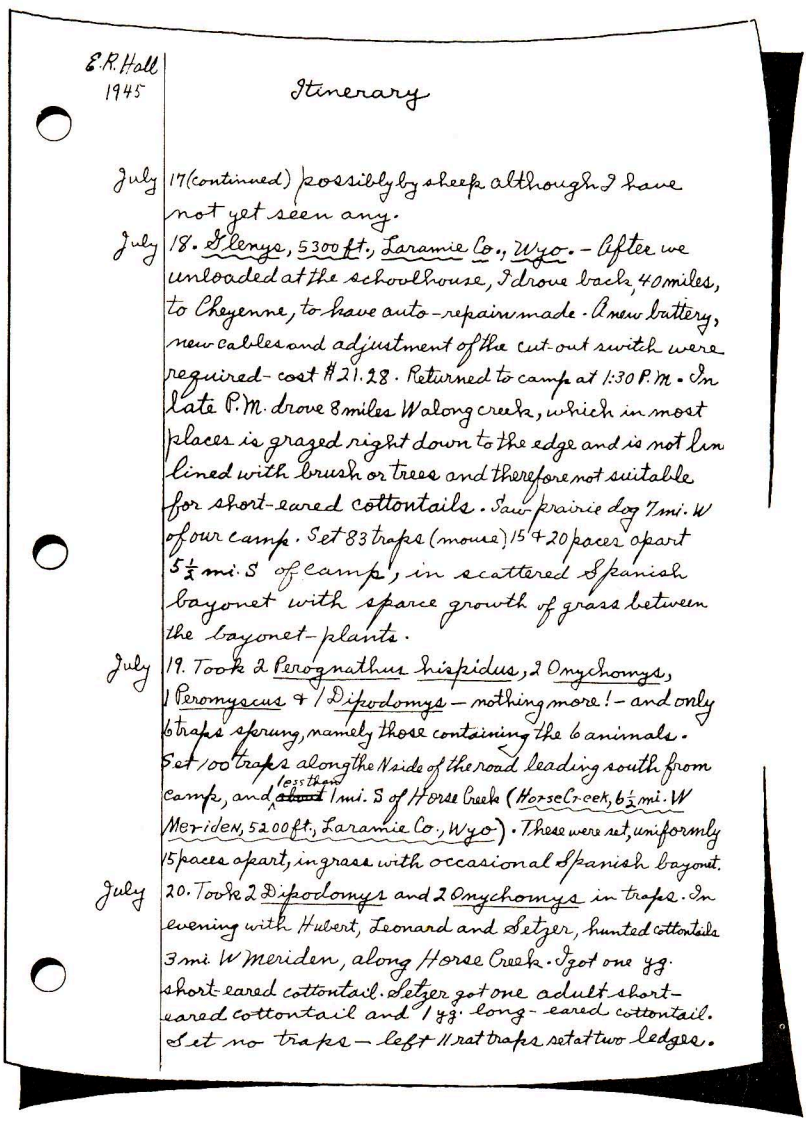
Horse Creek, 6 mi. W Meriden, 5200 ft, Laramie Co., Wyo.
6116 ♂ Dipodomys 266-156-43-14- wt. 75.8 gms.
6117 ♂ 249-141-39-14- wt. 63.8 gms.
6118 ♂ 273-159-44-14- wt. 75.0 gms.
6119 ♂ 264-151-43-16- wt. 77.9 gms.
6120 ♂ 259-149-42-14- wt. 64.9 gms.
6121 ♂ 254-145-41-15- wt. 69.4 gms.
6122 ♀ 254-143-42-14- wt. 80.1 gms.
6123 ♂ 252-143-42-14- wt. 67.7 gms.
6124 ♂ 278-164-44-14- wt. 69.5 gms.
in formalin
Coll. by H. W. Setzer, A. B. Leonard, H. H. Haig, Bernard White & E. R. Hall

FIG. 1. A page from the author's field catalogue, slightly less than three-fifths natural size. Blue horizontal lines fail to show in this reproduction.

ITINERARY

On the first line of the itinerary enter date and locality. Follow with a concise account of route and travel area and habitats studied, and record number and kinds of traps set, distance between traps, number of vertebrates collected, as well as other pertinent information—for example, record number

of traps sets in each type of vegetation and numbers and kinds of animals caught therein. Section, township, and range comprise useful information. Sketch-maps can be included. Censuses of birds and censuses of other classes of vertebrates can better be included in the itinerary than in the accounts of species. Any general types of information that would have to be repeated if entered in other parts of the notebook are appropriate for the itinerary.



E. R. Hall
1945

Itinerary

July 17 (continued) possibly by sheep although I have not yet seen any.

July 18. Illenya, 5300 ft., Laramie Co., Wyo. – After we unloaded at the schoolhouse, I drove back, 40 miles, to Cheyenne, to have auto-repairs made. A new battery, new cables and adjustment of the cut-out switch were required – cost $21.28. Returned to camp at 1:30 P.M. In late P.M. drove 8 miles W along creek, which in most places is grazed right down to the edge and is not lined with brush or trees and therefore not suitable for short-eared cottontails. Saw prairie dog 7 mi. W of our camp. Set 83 traps (mouse) 15 + 20 paces apart 5½ mi. S of camp, in scattered Spanish bayonet with sparse growth of grass between the bayonet-plants.

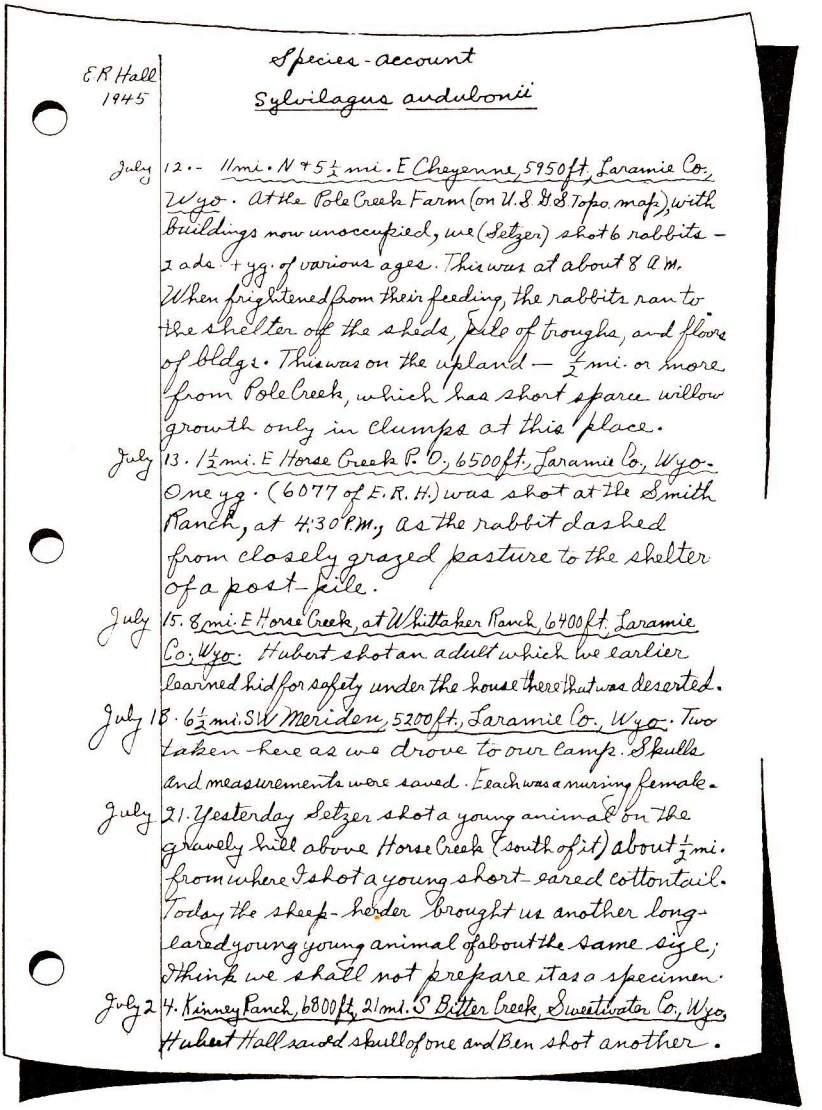
July 19. Took 2 Perognathus hispidus, 2 Onychomys, 1 Peromyscus & 1 Dipodomys – nothing more! – and only 6 traps sprung, namely those containing the 6 animals. Set 100 traps along the N side of the road leading south from camp, and ~~about~~ less than 1 mi. S of Horse Creek (Horse Creek, 6½ mi. W Meriden, 5200 ft., Laramie Co., Wyo.). These were set, uniformly 15 paces apart, in grass with occasional Spanish bayonet.

July 20. Took 2 Dipodomys and 2 Onychomys in traps. In evening with Hulbert, Leonard and Setzer, hunted cottontails 3 mi. W Meriden, along Horse Creek. I got one yg. short-eared cottontail. Setzer got one adult short-eared cottontail and 1 yg. long-eared cottontail. Set no traps – left 11 rat traps set at two ledges.

FIG. 2. A page from the author's field catalogue, slightly less than three-fifths natural size. Blue horizontal lines fail to show in this reproduction.

ACCOUNTS OF SPECIES

Accounts of species should be headed with either the scientific or common name, as preferred. The date and locality for the account should be given on the first line. Only one species should be written about on a single page. Information in the account should not be a repetition of material given in the itinerary or journal. Do not only include facts, but make interpretations and



E R Hall
1945

Species-account
Sylvilagus audubonii

July 12.- 11mi. N + 5½ mi. E Cheyenne, 5950 ft, Laramie Co., Wyo. At the Pole Creek Farm (on U.S.B.S. Topo. map), with buildings now unoccupied, we (Setzer) shot 6 rabbits - 2 ads + yg. of various ages. This was at about 8 P.M. When frightened from their feeding, the rabbits ran to the shelter of the sheds, pile of troughs, and floors of bldgs. This was on the upland — ½ mi. or more from Pole Creek, which has short sparse willow growth only in clumps at this place.

July 13. 1½ mi. E Horse Creek P.O., 6500 ft, Laramie Co., Wyo. One yg. (6077 of E.R.H.) was shot at the Smith Ranch, at 4:30 P.M., as the rabbit dashed from closely grazed pasture to the shelter of a post-pile.

July 15. 8 mi. E Horse Creek, at Whittaker Ranch, 6400 ft, Laramie Co., Wyo. Hubert shot an adult which we earlier learned hid for safety under the house there that was deserted.

July 18. 6½ mi. S.W. Meriden, 5200 ft, Laramie Co., Wyo. Two taken here as we drove to our camp. Skulls and measurements were saved. Each was a nursing female.

July 21. Yesterday Setzer shot a young animal on the gravely hill above Horse Creek (south of it) about ½ mi. from where I shot a young short-eared cottontail. Today the sheep-herder brought us another long-eared young young animal of about the same size; I think we shall not prepare it as a specimen.

July 24. Kinney Ranch, 6800 ft, 21 mi. S. Bitter Creek, Sweetwater Co., Wyo. Hubert Hall saved skull of one and Ben shot another.

FIG. 3. A page from the author's field catalogue, slightly less than three-fifths natural size. Blue horizontal lines fail to show in this reproduction.

generalizations. The accounts should be written in a style suitable for quoting in any publication. Accounts of species need not be restricted to kinds collected. If the account is about animals collected, it is wise to refer to the animals by your field-catalogue numbers.

Head each notebook page with collector's name and year, page number (if number system is used), locality (in *detail* the first time used), and date.

Write *full* notes, even at risk of entering much information of seemingly little value. One cannot anticipate the needs of the future, when notes and collections are worked up. The following are suggested topics, but do not restrict yourself to these alone. Be alert for new ideas and new facts.

Describe vegetation (saving plant-press samples of species not positively known), nature of ground, slope exposure, and drainage in each belt of animal life sampled. Describe exact location of trap lines, referring to your topographic maps, and also enter a sketch, in profile or surface view or both, to illustrate the location and relations of the different habitats crossed. Properly marked maps for each region worked should ultimately be bound in with the field notes of at least one member of your field party.

Keep full record of breeding data: number and approximate size (length) of embryos or of young found in nests. Dig out burrows if practicable; make drawings to scale, showing plan, and elevation; describe fully.

Record food plants; keep specimens for identification where not known by a definite name; preserve contents of cheek pouches and stomachs. If these are not saved, identify and record contents.

Note regularly in notebook all "pick-ups," that is, odd skulls or fragments of animals of whatever sort or source, serially numbered along with specimens of the more usual sort. Give full information, as with odd skulls secured from trappers. Label all such specimens adequately, as elsewhere described.

When leaving a well-worked locality, enter in the journal section of your field notes a summary of species observed, with remarks of a general nature, relating to local conditions of terrain, human activities, and other pertinent conditions.

Where feasible, interview old residents, trappers, National Forest and National Park rangers in each locality visited. Always record accurately the name, official position or occupation, and address of each person giving information; also give your opinion as to his reliability. Note general attitude of persons interviewed as to game laws, conservation, and effects of settlement by Man, and record specific comments, complaints, or criticisms.

In newly settled country, ascertain present numbers and distribution of large mammals as compared with their former status. So far as is possible get definite statements expressing ratio of present abundance compared with that of a definite number of years back. Seek information, where feasible, by indirect query. Do not risk influencing your informant's statements by leading questions. Record fully all evidence as to human influence upon original or "natural" balance. Record present economic relations of vertebrate animal life, that is, effect on agriculture and stock-raising, with full details. Note opinions of persons interviewed as to whether species should be protected or destroyed. Describe local methods of capture or destruction; give your opinion as to their effectiveness and justification.

Opportunity offering, record detailed observations on effects upon vertebrate animals of: severe storms; floods; forest, brush, or prairie fires; overgrazing; tree-cutting; road-building; or tree-planting. Some other matters on which

information can profitably be recorded in your species accounts concerning vertebrates include the following:

Markings and coloration (meanings apparent as associated with significant circumstances; directive, disruptive, concealing).

Speed (gait, climbing, swimming, walking, running, flying); tracks.

Abundance: by impression; censuses.

Plant associates: habitat; environment (define distinctive ecologic niche or biotope in which each animal is found).

Range (home range or "cruising radius" of individual, topographic and geographic range of species, indications of change in range).

Call-notes or voice (interpretations whenever circumstances give any clue); "songs" of birds.

Migrations (regular, irregular, local, altitudinal, geographical); movements and flight.

Degree of gregariousness (including "social instincts"); manner or means of communication (as voice, gesture, touch, and smell-signals).

Nests, dens and lairs; breeding habits (including number of young, length of breeding period, mating; whether promiscuous, polygamous, monogamous; relations of individuals of family group to each other); modes of locating nests or homes; sanitation; solicitude; reactions of young; care of young; mastology (distribution of mammary glands).

Boldness; belligerence; intolerance; shyness.

Food-habits; forage range; manipulation of food; storage. Scatology (dung or feces).

Acuteness of the various senses (touch, taste, sight, hearing, smell, and direction).

Enemies; disease (parasites, internal and external).

Odd partnerships; commensalism; any biotic interrelationships apparent.

Age (length of life of individual).

Refuges: from enemies; for resting or roosting.

Dormancy: hibernation or estivation; places where undergone.

Read above suggestions every week when on a field trip, devoting half an hour or so to thoughtful consideration of the objects of your field work, which probably are: To ascertain everything possible in regard to the natural history of the vertebrate life of the regions traversed, and to make careful record of the facts gathered in the form of specimens and notes, to be preserved for all time. All this is for the *information* of others; strive to make your records in all respects clearly intelligible. Remember that the value of your notes increases as the years go by and faunal changes take place. Some earlier note-books describe conditions now vanished in the localities with which they dealt.

LABELING OF SPECIMENS

Use one serial set of field numbers for *all* specimens (including "pick-ups," wet preservations, and ectoparasites).

Of course every specimen is to be fully labeled at the time it is prepared—and before the preparation of another is begun. A complete, authentic label for a mammal in most instances is scientifically more valuable than the skin to which it is attached. Beginners may not realize the prejudice engendered in careful zoologists by sight of a specimen unlabeled, incompletely labeled, or with a complete label unattached or insecurely attached to the specimen.

For each specimen always give altitude and county as well as exact place; for example: "3 mi. NE Lone Star, 850 ft., Douglas Co., Kansas." Attend minutely to proper punctuation. If not true NE, give miles north and miles east. Distances always to be air-line. Locality data to be given in notebook precisely as on specimen label.

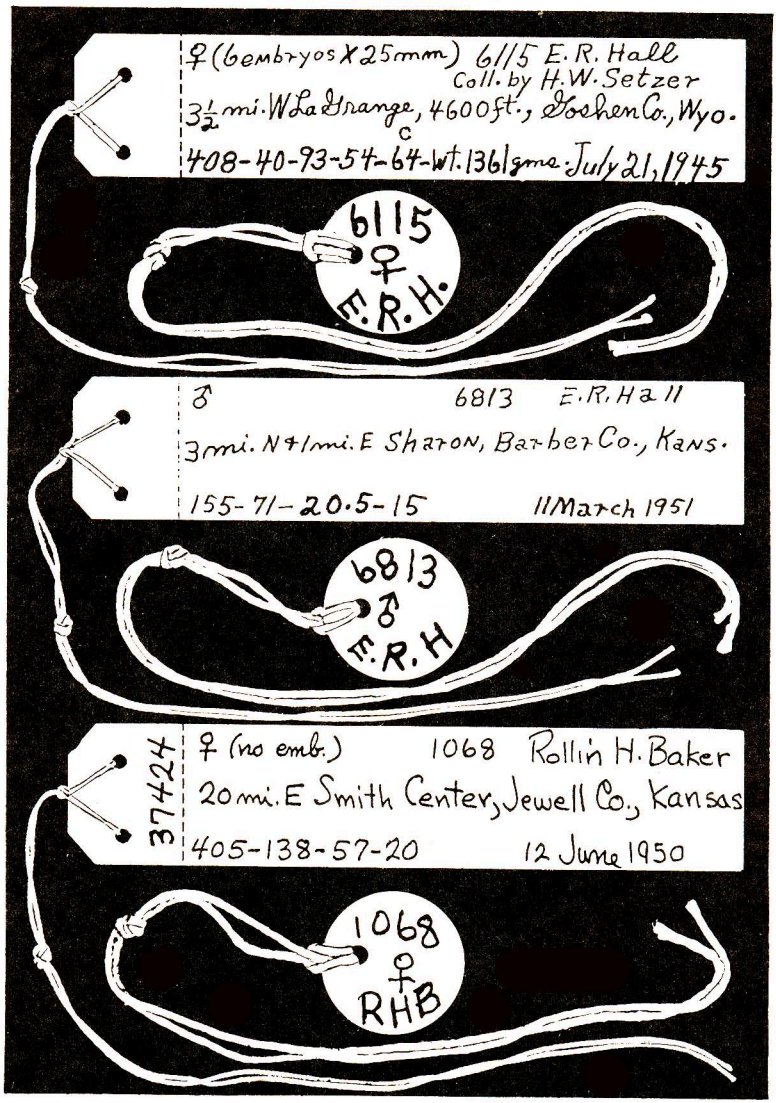


FIG. 4. Labels filled out. The rectangular labels are for stuffed skins; the round labels are for uncleaned skulls and skeletons. Actual size.

Record data on labels for skins on one side only (the opposite side is left blank for entering the name in eternal ink after laboratory studies have been completed). Enter data on three or four lines as may be necessary, and in the order indicated below.

On the first (top) line record sex (if female, record number and size of embryos or absence of embryos), collector's field number, and collector's name. Immediately following the field number record the name of the person to whom the number pertains, and preface the name of the second person with "Coll. by" or with "Prep. by" for the purpose of insuring that the field number will be associated only with the name to which it pertains and also to show which person was the collector and which one was the preparator. This information is important and especially so when necessity arises for tracing back through the field notes (catalogue, species account, or itinerary) to obtain supplementary information.

On the second line, or on the second and third lines, record the locality exactly as in the catalogue and other parts of the field notes—even to punctuation and abbreviation.

On the last line, record total length, length of tail, length of hind foot, height of ear from notch, weight in grams, and date. Use dashes (not commas, periods, colons, or semicolons) to separate the measurements. Use the abbreviation "gms." after the weight to show that the weight is recorded in grams instead of in grains or in ounces. Write out the names of months that are no longer than five letters; abbreviate the names of the others. Never use a numeral to represent the month, because doing so increases the chances of error in later transcriptions of the month and day. For example, depending on the country from which a person comes, the date of June 9, 1953, is written in at least the following forms: VI-9-1953, 6-IX-1953, 6-9-1953, VI-IX-1953, 9-6-1953; still other combinations are possible and may be used; even within different parts of one country (the United States) the form varies. Any one of the above combinations of numerals means Sept. 6, 1953, to some persons and June 9, 1953, to other persons; consequently it should be written "June 9, 1953" or "9 June 1953" in order to avoid error. Also use four numerals for the year (1953) and not an apostrophe and two numerals ('53) because the apostrophe can waste valuable time of the zoologist in ascertaining whether 1753, 1853, or 1953 is correct.

On a skull-tag enter field number, initials, and sex symbol with Higgins Eternal Ink; write *'large* and *heavy'* to prevent fading of the number and consequent loss of a specimen.

Attach tag to skull by running the string between the *lower jaws*. Tie with about ¼-in. slack in the string. Do not tie tightly around the lower jaw; there is danger of breaking the jaws of bats or shrews. Also, a loose string allows the larval dermestids to eat the meat directly between the string and jaw bone. Cut off the loose ends of the string.

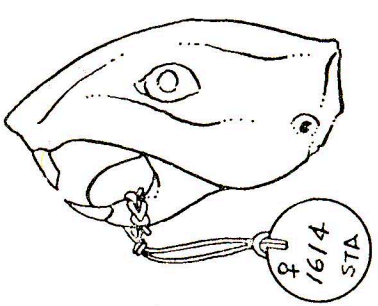


FIG. 5. Skull-label correctly tied to one ramus of the lower jaw of a skull freshly skinned out, immediately before skull is immersed in water. × ¾.

All miscellaneous material should bear labels with notebook references by specimen numbers, and initials of collector. Nests should be "threaded" and have labels attached to them

(not only to container). Folders for plants should each be inscribed with full data, according to usual botanical practice.

LABELS

Labels for skins. Paper used as labels should last for centuries, take ink well, hold ink well even when labels are immersed in liquids, and retain its strength in water or formalin or alcohol. At the Museum of Natural History of the University of Kansas we use, as best meeting the requirements mentioned above, "Resistall Index, Bristol 100 per cent rag." This paper has a weight of 110 lb. From sheets 25½ x 30½ in. we cut out the labels, after printing, that are to be attached to skins.

Stacks of 50 labels are firmly held in a metal frame of appropriate size, and two holes are drilled by means of a bit in a drill press near one end of the stack of labels. See figure 4 for exact position of the two holes.

For threading the labels we use Star Brand, white, 6-strand, mercerized, size-10 cotton thread manufactured by the American Thread Company. This thread comes in spools of 150 yd. to the spool. For stringing one label a piece of thread 330 mm. long is used. After the thread is strung through the two holes in the label, the loose ends of the thread are strung through a half-turn loop taken in the thread of the "backside" of the label. The threads are pulled taut, and a knot is tied in the two threads exactly one inch from the end of the label. This label and thread are recommended as satisfactory in all respects save one. The size of our label, in our opinion, is too large (see Figure 4). A width of 15 mm. and a length of 70 mm. would suffice. Predecessors established the size now used at the University of Kansas, and we continue to use it because the advantages of uniformity within a single collection outweigh the advantages that would be gained by changing to another size.

Threading of the labels is done by hand. A smooth flat board, say, 4 x 8 in., with the point of a finishing nail showing on one side at a distance of 1 in. from an ink mark facilitates tying the knot at the correct distance from the edge of the label. A skillful person can thread and tie 200 to 300 labels an hour.

Labels for skulls and skeletons are of a diameter (19 mm.) that fits loosely in the bottom of the smaller of the two sizes of glass vials used for housing skulls. These round labels are "Fiber Water Proof Stock, 10 pt." purchased from the Dennison Manufacturing Company of St. Louis, Missouri. The labels are perforated at one side and are strung with No. 5 linen twine, in which a knot is tied exactly 1 in. from edge of label (see Figures 4 and 5). If pressure is exerted when writing on these labels, the writing will be retained even though the labels are immersed in water, ammonia, or alcohol. This fiber stock yields labels that are resistant to dermestid beetles and their larvae—insects used to remove flesh from the osteological specimens to which these round labels are attached. Some other kinds of paper are eaten by dermestids if the paper becomes stained with blood.

Notebook paper that is high in rag content is used because its lasting qualities are thought to be superior to most other kinds of paper. Field notes containing observations of behavior of animals written "on the spot," and census counts of animals under natural conditions in areas that later are greatly modified by Man, have increasing value with the passage of time. Such records, therefore, should be on paper that will not deteriorate with age.

Before starting on a collecting trip, the collector makes certain that he has the best available topographic map for use in the field.

SKINNING AND STUFFING SMALL MAMMALS

Tools and supplies normally used are as follows:

Labels for skins
Labels for skulls
Higgins Eternal Ink (not Higgins Drawing Ink or Higgins India Ink)
Dip pen or fountain pen in which Higgins Eternal Ink can be used
30-cm. rule graduated in millimeters
Sewing needles
White (not colored) cotton thread, 2 sizes
Pliers with clean-cutting jaws and wire-gripping ends on jaws
Forceps with fine sharp points but having arms strong enough to permit of gripping solidly
Scalpel or razor-sharp knife blade
Carborundum sharpening stone
Scissors, surgical-type, with two sharp points
Cotton, long-fibered, resilient, in smooth bats
Arsenical powder or soap in wide-mouthed container
One shallow pie tin
White cornmeal or fine hardwood sawdust

Other supplies and equipment are optional and may include scraper for removing fat and a 3-cornered file for working metal.

Measure the mammal in millimeters and weigh it in grams. Experienced preparators take two measurements, write them on the label, take two more measurements, write them on the label, weigh the animal, and write the weight on the label.

The standard measurements for a study specimen are taken as follows:

Total length. Manipulate mammal so that it lies out straight (do not stretch it; guard against error that can result from a broken vertebral column), and measure distance from tip of nose-pad to tip of fleshy part of tail, excluding hairs that project beyond tip.

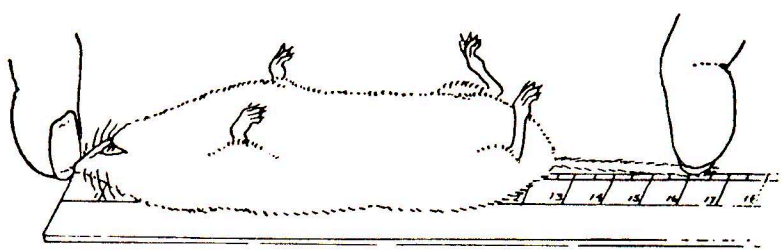


FIG. 6. Measuring total length of a small mammal. × ½.

Length of tail. Bend tail up at right-angle with body and measure from bend on back to tip of fleshy part of tail, excluding hairs that project beyond tip.

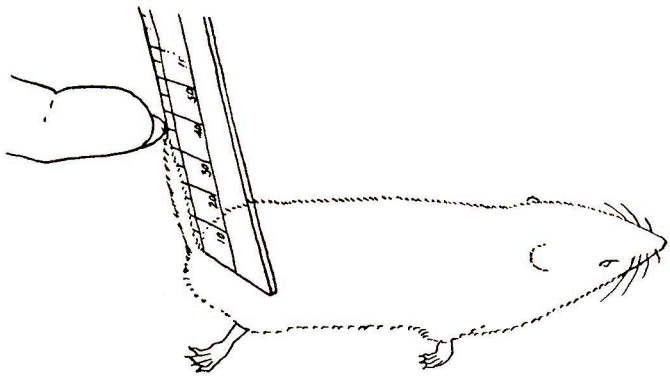


FIG. 7. Measuring length of tail of a small mammal. × ½.

Length of hind foot. With its toes out straight measure the distance from tip of longest claw to heel—in the same way that the over-all length of a person's foot would be measured. Outside of North America the claw is excluded from the measurement of the length of the hind foot, and only the fleshy part of the foot is measured in mammals from continents other than North America (Greenland, Panamá, and Central America are parts of North America).

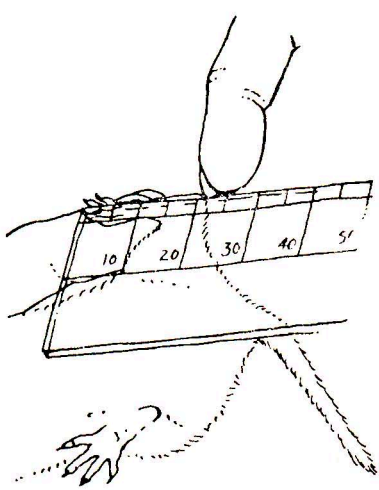


FIG. 8. Measuring length of hind foot of a small mammal by means of a transparent (plastic) rule. × ¾.

Height of ear from notch. Insert end of rule in notch at bottom of ear and measure to distalmost border of fleshy part of ear.

Next make out the labels (for skin and skull), and then make the entry in the field cataloue. It may be necessary to enter the sex (and certainly number and size of embryos if any) after the animal is skinned.

Fold a square piece of cotton or other stuffing to desired size and shape, and lay it to one side. A body too large or too small will cause trouble. A body wider than high and wider at the middle than at either end, to begin with, gives best results. Make the body one-fourth longer than the body of the animal (the extra fourth will be cut off later). The back and sides of the body should be smooth; small irregularities in the body make larger-appearing irregularities in the dried specimen. The outside edge of the cotton should be feathered; that is to say, enough of the fiber should be removed to make the cotton taper to a thin edge. When the last fold is made, drag the body across the skinning board or table top so as to cause the thin

edge of the cotton to adhere to the previous layer. So doing will prevent the body from unrolling while the skin is being turned over it; partial unrolling twists the skin, making it unsightly. The aim, whatever method is adopted for forming the body, is to obtain a symmetrical, firm, yet resilient body that will retain its shape while the skin is drying.

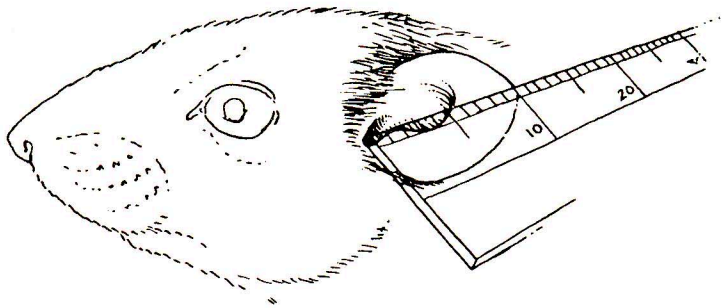


FIG. 9. Measuring height of ear from notch in a small mammal. × 2.

After the body is made, select monel metal wire of appropriate gauge; with pliers holding one end of the wire stretch a piece until it is perfectly straight. Cut and lay to one side five pieces, one piece for the tail and four pieces for the four legs. A leg-wire should be as long as the bony structure of the limb; wires for the two hind legs should be longer than those for the front legs. The tail-wire should be a half longer than the tail. For pocket gophers and wood rats use No. 20 wire; for a larger *Peromyscus* use No. 22; for small pocket mice use No. 24; for tails of the smallest bats use No. 24 or even No. 26 wire. Monel metal wire, or annealed tin wire, is to be used. Do not substitute other kinds of wire (not even copper, brass, or galvanized wire), because those eventually corrode or rust and destroy the specimen. If the correct kind of wire is not available, use split bamboo instead, and in any event use bamboo or other straight-grained, tough wood in place of wire in the legs of mammals larger than wood rats. Striped skunks and other mammals of equal and smaller size are to be stuffed; badgers, foxes, and larger animals are skinned so that the hides can be properly tanned and preserved unstuffed.

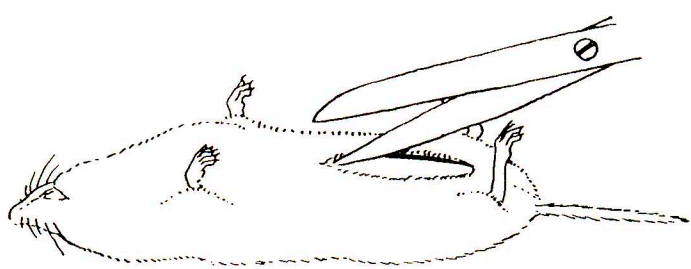


FIG. 10. Completing initial incision in order to allow skinning of a small mammal. × ¾.

Have ruler, threaded needle, scalpel, forceps, scissors, arsenic container, and pie tin containing a double handful of sawdust or cornmeal before you on a table or on a flat skinning board supported on the arms of a camp chair.

With the mammal held, back down, on the sawdust in the pie tin, use the scissors to cut the skin, and if possible not the body wall, on the midline of the belly from immediately in front of the anal opening forward one-fourth the distance (no more) toward the chest. Experience will enable you to make this cut by means of no more than two snips of the scissors, and to cut only the skin and not the body wall. Retain the scissors on the thumb and finger of one hand while proceeding so as not to waste time in laying down and picking up the instrument each time that it is needed.

With the free hand sweep sawdust onto the cut area. With the third and fourth fingers of the hand holding the mammal, thrust the knee toward the midline of the body, meantime pushing the skin of the belly and flank away from the midline by means of the thumb of the same hand. Grasp the exposed knee with the scissors hand, and with the forefinger and thumb of the other hand separate the leg from the skin and push the skin all of the way down to the ankle. Insert a blade of the scissors at the ankle in such a way that the bones of the lower leg are between the blades of the scissors, and in one motion by means of the blades of the scissors strip the flesh from the lower leg and free the lower leg by cutting it immediately below the knee joint. Repeat the process on the other hind leg.

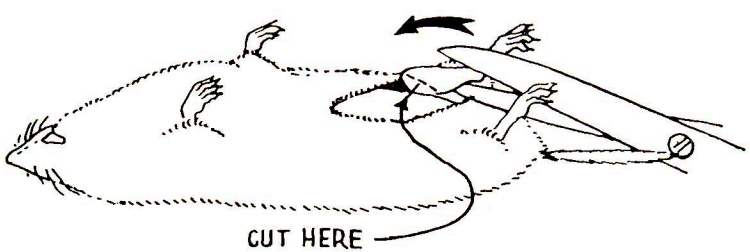


FIG. 11. Hind leg skinned out preparatory to severing leg immediately below knee. × ¾.

One reason for leaving the bones of the lower leg attached to the skin, instead of severing the hind leg by cutting through the ankle, is to meet the need that sometimes arises to measure the length of the dry hind foot. If the bones of the lower leg are present, the heel can quickly and certainly be located. If the bones of the lower leg are not present, there will be uncertainty concerning the heel: Was it cut away with the bones of the lower leg? If the heel is located, is all of it present? To answer such a question, it is necessary to relax the skin of the hind foot, cut the skin, and visually inspect the bones. These time-consuming operations can be avoided by leaving the bones of the leg in the skin.

Meanwhile, and throughout the whole of the skinning, keep the specimen buried as much as possible in sawdust, because the sawdust absorbs the fat and any body fluids, thus preventing them from getting on the fur or on the hands of the preparator. If the fat gets on the hands of the preparator, it

will be transferred to the fur. Fat on the fur makes the pelage unsightly and spreads eventually to the label and other specimens; fat anywhere on the preparation oxidizes and in time destroys the skin. To keep the specimen immersed in sawdust (or white corn meal) requires that the preparator learn to work as much as possible by touch instead of by sight. Beginners seldom use enough sawdust. The thought that "if some is good more is better" really applies to the use of sawdust in skinning mammals. After eight to ten small mammals that are exceptionally fat are skinned in a small quantity of sawdust, it becomes saturated with grease. Discard it and use fresh sawdust.

When the two hind legs have been freed and skinned out in the manner described above, separate the skin from the body wall by working a finger, or the handle of a scalpel, between the skin and the body. With the fingernails sever the gut and associated connections of the skin to the body. Scissors or scalpel can be used, but time is saved by using the fingernails. When the skin is free all around the base of the tail, place three fingernails behind the skin and push it off the tail. One motion will do the job. Take care to keep the nails against the tail vertebrae and behind the skin so as to avoid the misfortune of having the skin of the tail turn inside out; this misfortune slows down even the experienced preparator and is one that may be insurmountable for the beginner.

When the skin is free from the tail and hind legs, separate the skin from the body wall at the anterior end of the initial incision that was made on the belly. Then turn the skin down all around the body and push (don't pull) it off the body. Be sure that the skin is reflected (turned down) on the belly as well as elsewhere; otherwise the skin will gradually tear forward from the front end of the initial incision on the belly as you proceed with the skinning, and that misfortune causes the skin to fit improperly on the cotton body, with the result that the dried skin of the specimen will be misshapen. Push the skin down until the mammal's elbows are in sight. Tear or cut the thin skin-muscle that shows up. Push the skin down to the wrist. Straddle the forearm near the wrist with the blades of the scissors; in bringing the blades of the scissors up from the wrist almost to the elbow, strip the flesh from the lower leg and cut the bones immediately below the elbow joint. Do the same with the other foreleg. Drop the scissors, because you will not need them again in skinning this mammal. Push the skin farther until the bases of the ears come into view. By means of the fingernails securely grasp the ear tube on two sides where it emerges from the bone and pull the tube free. When the two ears are free, push the skin forward until the eyes are reached. Pick up the scalpel or knife and make two cuts on each eye: one cut straight down across the eye to sever most of the attachments of the skin to the skull, and a second cut on a transverse plane, with the blade of the scalpel against the bone so as to sever the lower (front) angle of the eye from the skull. Care has to be used in making the last cut, or the lids at the angle of the eye will be cut, with the result that the eye opening will be unnaturally large in the stuffed skin.

Push the skin to the tip of the lower jaws, sever the skin of each cheek, and then separate the skin from the front of the jaw by means of three slices of the scalpel or by means of three tears made with the fingernails. By means of the thumbnail push the skin on each side of the rostrum (forepart of the

skull) to the tip of the nose. Cut the skin free by a stroke of the scalpel, taking care to cut well ahead of the tips of the nasal bones. Beginners often cut off the ends of the nasal bones and are especially apt to do this if scissors are used instead of a scalpel.

With experience, less than a minute should be required to skin a mouse; that is to say, no more than a minute need elapse from the instant when the first incision (cut) is made on the venter until the skin is freed from the tip of the nose.

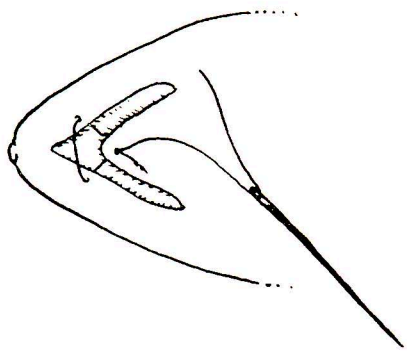


FIG. 12. Stitch used to close mouth of a skin. × 1.

Note the sex. If the specimen is female, note the absence or presence of embryos. If embryos are present, note the number and length from crown to rump. Complete the entries on labels and in catalogue. Attach the skull-label to the skull and drop it in water.

With scalpel in hand go over the skin, laid flat on the sawdust, to remove any fat. Remove it all. Fascia or small bits of red muscle are not worth removing. Grasp threaded needle; sew up mouth with a triangular stitch, and secure with a knot to prevent the stitch from coming loose. Cut the thread above the knot. Tie a knot with one hand at the end of the thread, and place threaded needle where you will reach for it the next time it is needed. To all parts of the flesh-side of the skin now apply arsenical soap by means of a brush, or apply powdered arsenic by means of a wad of cotton held in forceps.

In each foreleg thrust a wire along the bone of the foreleg into the palm and to the base of the nail of the middle finger without perforating the skin. Begin at the wrist with a thin wisp of cotton, and wrap the bone of the lower leg and wire firmly together. Moistened fingers will secure the cotton at the upper end of the wrapping. The foreleg shaped from cotton should be smaller than the original foreleg.

By means of the forceps pick up a cotton body. Place the outer seam down. By means of the closed forceps press down on the center of one end of the roll of cotton; with a finger and the thumb of the free hand press inward each side of the cotton at the same end; maintain pressure of the thumb and finger on the two sides of the end of the body; transfer the forceps, now opened, to the outside of the finger and thumb, and by means of the forceps constrict the cotton. Repetition of the maneuver forms a firm, sharp-pointed, symmetrical end, pointed downward. Holding this pointed end by means of the forceps, place the nose-pad of the skin (still flesh-side out) against the pointed end of the cotton body; turn the skin over the cotton body as far as the forelegs, meanwhile maintaining the grip with the forceps on the pointed end of the cotton; set in place the skin of the head and neck by tugging (not strongly enough to tear it) at the skin in the area of each eye, the skin of the throat, the skin around each ear, and the skin of the chest,

making certain that the hard pointed nose of cotton is all the way to the tip of the nose, that the two eye openings are symmetrically set, that the ears are exactly opposite each other, and that the skin of the head is fully stuffed. Then release the grip of the forceps. If the head end of the cotton body was correctly formed the cotton will expand and thus fill out the skin of the head and cause it to be bilaterally symmetrical.

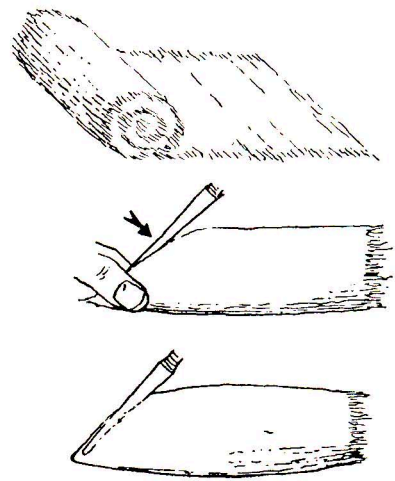


FIG. 13. Folding cotton to make a body, and shaping the end of the body by means of forceps and thumb and forefinger so that the body will fit properly in the nose of the skin. × ⅓.

Handling the body and skin as little as possible, turn the remaining part of the skin over the body, which should be slightly longer than the natural body. With scissors cut off the surplus end of the body but leave a thin extension on the back (top) side. See that the cut is exactly vertical and exactly transverse. Let the thin extension of cotton from the back cover the cut end.

Rotate each hind foot one-half turn outward. Then wire each hind leg in the fashion described above for the forelegs. Pull the hind feet out behind. The soles should be down. The skin of the hind leg should be stuffed so that the circumference of the lower leg and thigh is the same as it was in life. The wrapping that binds the wire and bone of the lower leg together should be long enough and frayed enough at the upper (proximal) end to make a gradual blend with the cotton body.

Pick up the tail-wire, moisten one end, twirl (by rotating the wire) on a thin strand of cotton, continue twirling so as to wrap a strand of cotton of gradually increasing diameter on the wire. The tail on the skinned body is a pattern for size. Remember that projecting ends of fibers cause the artificial tail to be functionally larger than it appears to be. Consequently, the wrapped tail-wire should seem to be of a slightly lesser diameter than the actual tail that has been slipped out of its skin. If the cotton is firmly anchored at each end of the tail-wire and if the diameter is exactly correct, all will go nicely. Hang the unstuffed tail down over the near edge of the skinning board (or table), dust some arsenic on the artificial tail, place the tip of the tail-wire into the open base of the tail, and then in one continuous movement thrust the tail-wire all the way to the tip of the skin of the tail—almost to the tip is not sufficient, because any unstuffed part will wither and be broken off.

With wire cutters snip off only as much of the free end of the wire as can not be got through the slit in the skin of the belly. The wire should lie on the midline of the underside of the cotton body between it and the skin.

Adjust the four legs so that the pairs are symmetrically placed and so that the leg-wires lie parallel to the midline and as close to it as tension on the

skin will permit. See that the tail-wire is lined up properly—parallel with the leg-wires and on the midline of the belly midway between the wires of the two hind legs. All of this should be done without picking up the stuffed skin; unnecessary handling at this stage makes the body misshapen. Next sew

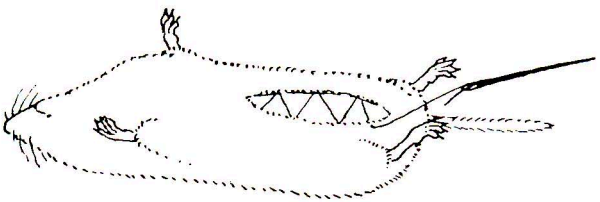


FIG. 14. Sewing together cut edges of a stuffed skin. × ½.

up the slit in the belly. This is to be done by first catching the very edge of the cut edge of the skin with the needle; three or four diagonal cross-stitches should suffice. After the last one is taken, pull the whole lot tight; throw a loop in the thread, and by means of the points (closed) of the scissors run the loop down to the fur side of the skin to form a knot that prevents the stitches from pulling out as the skin dries. Cut the thread close, say, 2 mm. above the knot. Before returning the needle to the place selected for it, tie a knot in the thread so that it will be ready for instant use to sew together the lips of the next specimen that will be stuffed.

Lay the stuffed skin belly-down with hind feet projecting over the near edge of the skinning board. Tie on the label above right heel; take double turn (on the thread, not the leg), pull the thread almost as tight as possible without breaking it, complete as a square knot or tie four alternate granny knots. Cut off the loose ends of the string. The aims are first to tie the knot so snug that it will not slip off after the diameter of the heel and foot has decreased owing to drying out, and, second, to tie the knot so secure that it will have to be cut to remove the label.

Use a toothbrush having soft bristles to comb the pelage.

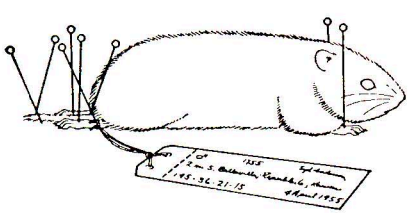


FIG. 15. Stuffed skin pinned down to dry. × ⅓.

Select 8 glass-headed pins no longer than the depth of the drying tray. Pin down the skin in the form shown in Figure 15. Pin down the forefeet first, seeing that each foot has the palm flat down on the board. The forefeet should be underneath the head well toward the midline of the body. Slant the pins outward so that they will not crease the skin or fur of the sides of the head. Next pin down the base of the tail by crossing two pins over it, in the fur at its base instead of over the bare part of the tail. Line up the tip of the nose, base of the tail, and tip of the tail; then pin down the tip by means of two crossed

pins. Finally pin down the two hind feet. Inspect the stuffed animal from the rear to see that the two hind feet are equidistant from the tail; inspect from the front to see that the two forefeet are equidistant from the nose, and inspect from each side to see that the tips of the toes of each pair of feet are correctly arranged in anterior to posterior position.

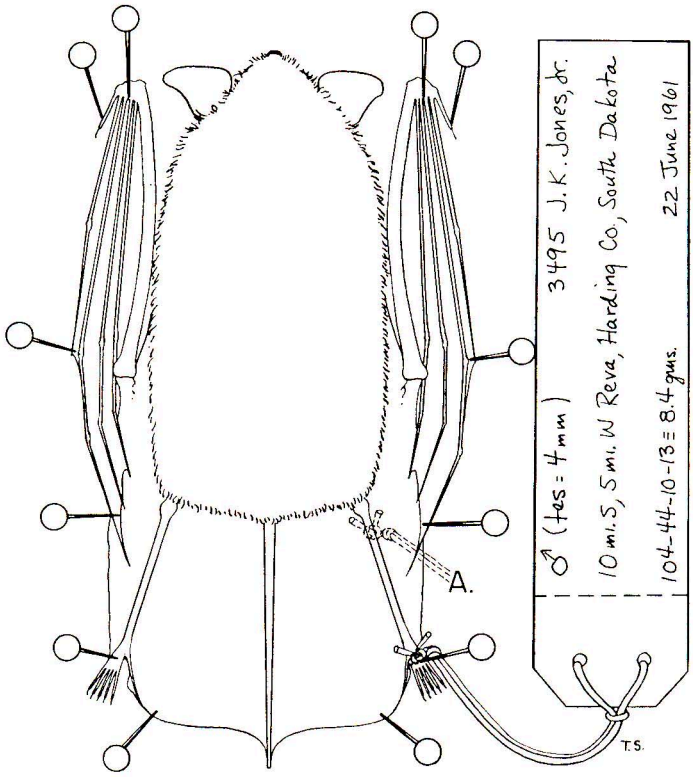


FIG. 16. Completed skin of a bat pinned down to dry. × 1.

By means of a pair of forceps, or by means of a thumb and forefinger, compress each external ear so that the two ears will be creased exactly alike. This helps in causing them to lie down flat as they dry, and if the treatment is repeated on the following day, the ears are more likely to be symmetrical when thoroughly dry.

Use a metal pin, the back of a scalpel, or the sharp edge of forceps to smooth the pelage. Set the tray where the skin can dry in a shady, airy place safe from animals and storms. Two days to two weeks later, whenever the skin is thoroughly dry, it can be unpinned. The amount of humidity has most to do with the time required for drying; in a hot, dry desert, rodent skins may dry in 24 hours, but in a humid, hot, tropical setting, the skins may never dry unless artificial heat is used to drive out the moisture.

With practice the average preparator can complete a specimen in twelve to fifteen minutes. The most rapid preparator that I know did the job in slightly less than five minutes. He, however, could not maintain that pace and actually turned out approximately eight specimens per hour. Self-analysis reveals to the beginner that he is making unnecessary movements. Attention to the elimination of superfluous movements probably is the best method of increasing the speed of preparation.

Bats can be prepared more quickly than other mammals because no wires have to be inserted in the limbs; the bones are left in place in order to provide the necessary stiffening. A wire is used in place of the tail-vertebrae. Pinning specimens in the fashion shown in figure 16 causes them to be of maximum usefulness. The fingers need to be spread enough to allow a mammalogist to measure each phalanx of each digit but should not be spread more than necessary. Note proper position of thumb. My colleague, J. Knox Jones, Jr., prefers to tie the thread of the label around the proximal part of the tibia (see A of Fig. 16) because tying the thread around the ankle distorts and partly conceals the calcar of the right foot on many specimens. More pins than are shown in figure 16, of course, can be used if necessary to fix the stuffed skin in the desired position.

Many persons have suggested means of saving the skins of small mammals without stuffing them, or means of partly stuffing them, as for example with only a piece of flat cardboard. Such skins are less useful for studying geographic variation and speciation than those prepared by the method described above, because such studies require comparisons of the new specimens with old specimens—specimens prepared in earlier years. Satisfactory comparisons are made only with specimens prepared in the same form. Since nearly all of the specimens from the past were prepared according to the method described above, specimens to be saved now are most useful if they also are prepared as described above.

An exception of a sort is made for rabbits in that the artificial bodies are prepared in a fashion different than that described above. The approved method is the following: Cut a piece of currugated cardboard for the center of the body; attach a straight stick to the cardboard at two places by means of wire or twine so that the stick strengthens the cardboard and projects far behind the cardboard to form a paddle; cover the cardboard with a thin (¼-in.) layer of smooth cotton bringing the two edges of the cotton together on the midline of the belly-side of the body along the stick; turn the skin, prepared in the usual way even to the legs, over the flattened body; with heavy shears cut off the posterior end of the cardboard to an appropriate shape; by means of monel metal wire or a large sacking needle and twine sew through each hind foot around the stick at two places so that the stick will support the two hind legs; with a single stitch secure each forefoot to the skin of the throat; sew up the slit in the belly; thrust a single pin (to be removed when the skin is dry) through the tip of each ear to secure the ears in the desired position; tie the label on the right hind leg; lay the skin away to dry. The skin need not be pinned down. Some advantages of this method are that it provides maximum support for the long hind legs which are wobbly and subject to breakage if otherwise prepared; a flattened body that is strong allows the specimen to be stored in less space than would be required

if the body were deeper; and the method requires a minimum of time for stuffing.

Flattening the bodies of all specimens is desirable, and the larger the specimen the thinner the body should be in relation to its width. Convenience in storing is one reason for flattening the bodies. In many collections of study specimens of mammals—for example, those in the University of Kansas Museum of Natural History—the storage cases have the runners so spaced that the distance between the topside of one tray bottom and the underside of the tray bottom next above is $1\frac{15}{16}$ in. Sectional cardboard trays are used for specimens of shrew size and mouse size and reduce the available vertical space to 1⅞ in. or slightly less. (The over-all depth of boxes to house skulls was the factor governing the vertical space between trays.) Because there is only 1⅞ in. of vertical space between trays, the artificial bodies of the smaller mammals, say, chipmunks, are made in such a size that the over-all height of a specimen is less than 1⅞ in. The pinning trays in the collecting-chests (part of the field equipment) have end pieces 1½ in. high. When the trays of freshly stuffed specimens are stacked in the chest, any specimen that is slightly more than the specified height is at once compressed to 1½ in. Once the skin has dried in that space the height will not increase much if any.

Specimens as large as jack rabbits and opossums may need to be slightly deeper than 1½ in. even if the artificial body is much flattened. The height of such a specimen should not exceed 2¾ in., because that height of body is almost the maximum that can be accommodated in a storage case by separating succeeding trays by one additional case-runner. The means of caring for these specimens in the trays of the collecting chest is to stack one empty pinning tray upside down on the pinning tray that contains the jack rabbits or opossums. In actual practice, however, some collectors keep the heights of even opossums and jack rabbits to 1½ in.

In preparing study specimens of mammals, just as in doing other work, different methods will be found for gaining the same result. By slightly altering their methods from year to year, two preparators who used the same methods to begin with will employ appreciably different methods after the lapse of several years. It is understandable therefore that no two preparators of experience use exactly the same methods—and this, I think, is as it should be, for each preparator should constantly strive to improve the quality of his product. The aim should be firm, symmetrical skins free of all fat.

It seems to me that every preparator takes pride in his specimens and derives genuine personal gratification from the contemplation of one of his mammal specimens if well prepared, firmly made, and indelibly and accurately labeled. At such moments he may even consider the possibility that one or another of several especially well-stuffed mice a century hence will be as deservingly spoken of and achieve more of favorable remembrance for him than some other accomplishment at the moment better appreciated by his associates.

A few collectors have immersed skins in a salt-alum bath or treated them with only salt in order to preserve the skins until it was covenient to stuff them. Salt, or salt-alum solution, does alter the color of the pelage. I recommend against using these preserving agents even at a sacrifice in quantity of specimens. Also, it seems to me, that the least that should be done for study skins subjected to the salt-alum treatment or to *any* treatment offering fair like-

lihood of resultant color change is to label the skins at the time of preparation with clear indication of departure from the conventional technique.

A departure that I regard as the lesser of several evils is the soaking of autumn-taken skins of ground squirrels in white gasoline in order to remove surplus fat that may have been released by scraping the flesh side of the skin. Twelve to eighteen hours in gasoline removes the fat. Longer immersion tends to dehydrate the skin, making it difficult to shape properly and making it so brittle after it is dried that it may break. For the skins of some ground squirrels almost ready for hibernation, I know of no substitute for gasoline, carbon tetrachloride, or other compound that removes fat. Such skins that I degreased only by scraping and applying cornmeal or fine sawdust in order to absorb the fat, although seemingly free of fat at the time of stuffing, later showed some greasiness that spread to several parts of the skin and down the thread of the label onto the label. Gross inspection of skins of mammals almost ready to hibernate suggests that there are fat cells *in* the skin of some as well as on the flesh side of the skin. Scraping and using an absorbent such as cornmeal removes most of the fat but not all of it. In spring, when the same kinds of mammals are lean, the soaking of the skin in gasoline or in some other liquid compound is unnecessary—undesirable, in fact.

When a skin has to be washed in soap and water for the purpose of removing dirt, bloodstains, and the like, it can be dried more quickly if its final bath is in white gasoline instead of in water. This is because the gasoline displaces the water and the more volatile gasoline is quickly removed by cornmeal or sawdust in which the skin is buried or with which the skin is repeatedly dusted. Such a skin must be thoroughly dried until the fur is everywhere fluffy before being stuffed; otherwise the fur will always cling together in patches and be unsightly.

Mammal skins to be tanned. Skins that are to be tanned or stuffed at a later date should be cased. Slit the skin from hind feet, down inside of hind legs to base of tail, and split tail full length. Do not open pads of feet on carnivores. In deer, open front legs from "elbow" to hoof.

Fat on skins should be scraped off before skins are stretched for drying. It is not necessary to soak such skins in gasoline.

Do not apply salt, alum, or formalin to skins that are to be relaxed later. Stretch skins that are to dry, flesh-side out, over a board, cardboard, frame of wire, or two poles. When nearly dry, skins as large as those of deer may be rolled up for packing; skins of carnivores should be packed flat, with the tail folded on the body if desired, with a wisp of excelsior between the skins. Be sure that skins dry and that no fly eggs are on the skins when they are packed. Label dried skins with skull tags only.

Preparation of skulls. Skulls should be severed from the vertebral column, using extreme care not to injure the skull. Skulls the size of those of *Spermophilus franklinii* or larger should have the major part of the masseter muscle snipped off to allow the skull to dry quickly.

As soon as possible, skulls should be put in a glass container of cold water to soak for 12 hours, to remove the blood and loosen the brain. In very hot weather it may be necessary to change the water to prevent fermentation.

After removing the skulls from the water, blow out the brains with the aid of a hypodermic fitted with a blunt needle, or with an atomizer bulb fitted with a short rubber tube and blunt hypodermic needle.

Large and small skulls should not be strung on the same wire to dry. If, for example, squirrel and mouse skulls are strung together, some of the smaller skulls certainly will be more or less broken.

Above all, do not allow skulls to become fly blown. This is apt to occur when they are hung up to dry and while soaking, as some will float and thus be exposed to flies. Maggots do much damage by discoloring the bone, loosening the sutures, and obliterating data on tags. Never hang skulls in the sun—always in the shade and, if possible, where there is a breeze. When skulls are quickly dried, any fly eggs deposited will not hatch. If, due to damp weather, the skulls are apt to remain soggy, protect them by cheesecloth (when hung up) to exclude flies. When packing skulls for shipment, or when moving camp, use a container with plenty of air holes. *Never* put damp or even dry skulls in air-tight containers; this causes sweating and maceration. For directions on cleaning mammal skulls, see Jour. Mammalogy, 14(4):372-374, 1933.

Preparation of skeletons. When preparing skeletons, skin the body completely, which means to the tip of the tail and to the claws of the feet. The pads of the feet of mammals and the skin on the tarsi of birds are nearly impervious to the dermestid beetles. Always "draw" the animal and cut off all large muscles. Tag skeletons (each separate piece) in the same way as skulls.

Take care to save baculum, hyoid bones, marsupial bones, patellas, tip of tail, pygostyle, and alula, as these are easily lost. Do not remove tongue or eyes; they contain important bones.

When a skeleton has been roughed out, wrap it with thread or string so that the head and extremities will not be broken off when they are dry and brittle. The legs are pulled up along the body and the head brought back. A few wrappings of thread will suffice for small skeletons. Do not use so much thread that the beetles have difficulty in getting to the meat in the cleaning process. Do not wrap too tightly, as fresh bones are easily bent.

The higher the humidity, the more thoroughly skeletons should be roughed out. Be sure to remove heart and lungs. A mammal skeleton the size of a squirrel's or larger should have its skull detached and its brains removed. Be sure to tie the skull to the body. A skeleton with its skull and leg bones packed in rib basket is slow in drying. Keep sawdust off skeletons. Tie an additional label on skeletons of extremely young animals calling attention to them, so that they will receive extra care in cleaning. See that each separate part has a tag.

Packing and shipping. Keep skins of mammals with you until thoroughly dry. In preparing for shipment, take special pains to pack specimens tight so that they will not move. Much of the smoothness and symmetry may be lost through loose packing.