LEATHERS EMPLOYED IN THE TEACHING OF LEATHERCRAFT

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CHAPTER I

PRELIMINARY STATEMENTS

The fact that leathercraft is as old as history itself, reveals very little as to the educational potentialities involved in the word. Of the many subjects taught in industrial arts, including those which lead to either an avocation or a vocation, none integrates the interests of all ages and sexes any more than does leathercraft. Teachers of industrial arts, who have become leaders in the community, have found that a knowledge of leathercraft is beneficial as an individual organized project, or co-ordinated with others.

During the recent crises of World War II, and since, the Veterans Administration has recognized the importance of leathercraft as an aid in the rehabilitation program. Realizing, through experimentation, the advantages derived from placing leathercraft facilities at the disposal of veterans, the above organization has done much to awaken the public to possibilities found in leathercraft. One shoe-leather supply house in Dallas, Texas, has been compelled, by public demand, to construct a brick building and maintain a payroll of ten persons to handle the leathercraft supplies. In a greater number of colleges and smaller schools, leathercraft, which was formerly considered a by-product of Boy Scout work, is now included in their curricula as an industrial arts subject.

Purpose of the Study: The purpose of this study is to

study and describe those leathers adaptable for various uses in the teaching of leathercraft. By investigating the tanning processes, finishes, physical structures, and through the classification of the individual leathers, an endeavor is made to supply sufficient data which would ascertain or justify the uses of certain leathers for specific purposes.

The Importance of the Study: Only when characteristics and classifications are known and considered, can a quality product be constructed. Much has been written regarding the leathers used in the shoe industry, but investigations, with reference to the properties required for leathers used in the teaching of leathercraft, so far as the writer has been able to find, are yet to be written. The designer or leathercraft artist may possess a great amount of artistic ability, but due to lack of knowledge in selecting materials, a potential success will terminate in failure. To excel, it is imperative for the instructor of industrial arts leathercraft to understand the limitation of the materials used. There is no substitute for knowledge, for without it much time, money, and energy are utilized in a gamble for success.

Delimitations: Methods, processes, and practices included in this study pertain to those used within the continental limits of the United States. All books employed in securing information were written by American authors, with the exception of a small book by K. J. Adcock.

Since information concerning findings, tools, and dressings,

is given in leathercraft supply catalogues, textbooks, and previous studies on the methods of teaching leathercraft, this study has been confined solely to those leathers used in the teaching of leathercraft.

Definition of Terms: Those terms used in the following chapters have been defined in a glossary taken from the Leather Dictionary, published by the Tanners' Council of America, One Hundred Gold Street, New York City; and in a glossary of terms listed on page 705 in Modern Practice of Leather Manufacture, by John A. Wilson.

Collagen Fibers: The protein material of the hide fibers.

Crocking: The rubbing off of coloring materials from leather onto other materials.

De-liming: Soaking skins in a weak acid or other solution to remove lime.

Depilation: A process of immersing hides in an infusion of lime which loosens the hair without injury to the skin.

Dry Hide: Those hides stretched on a board and placed in the sun to dry.

Fatliquoring: Applying oils to leather in the form of dilute oil-in-water emulsions.

Flesher: Sheepskin after the removal of the grain layer or skiver.

Grain Layer: The layer of the derma of hides, skins, and leather that includes the hair follicles; the thermostat layer.

Green Hides: A hide fresh from the animal.

Liming: The method of applying hydrated lime and water to skins for removal of the hair.

Mordant: A material that will combine chemically with leather and then combine with a dye to bring about a combination of the dye with leather.

Pickling: Saturating unhaired hides and skins with a solution, usually sulfuric acid and common salt, to preserve them.

Reticular Layer: The fibrous portion of a hide or skin between the grain layer and the flesh.

Scudding: Removing the remnants of epithelial tissues and hair pigment from unhaired hides and skins, by the scraping action of a knife or blades by hand or machine.

Sulphonated Oils: Oil rendered soluble in water by chemical treatment with sulfuric acid.

Sweating: An old method of loosening the hair on skins by allowing controlled putrefaction to take place in warm rooms.

Thermostat Layer: The layer of hide or skin that contains the mechanism for controlling body temperature; the grain layer of the leather.

A Preview of Organization: The plan of presentation will include five other chapters. Chapter II will record the historical developments of leathercraft from the beginning of civilization to the present. After consulting leathercraft supply catalogues to determine the leathers most universally listed, Chapter III was prepared to present eighteen major leathers, as to their origin, physical structure, and classification. The fourth chapter includes processes necessary in the conversion of the green pelts into the finished product of leather. Those processes will comprise soaking, depilation, de-liming, tannage, fatliquoring, and finishing. A discussion of area measurements and thicknesses, as to units by which each is sold or tabulated, comprises Chapter V. The last chapter is a summary and conclusion.

CHAPTER II

HISTORICAL STUDY OF LEATHER

The animal skins which mankind has used for centuries in one form or another, to protect his body from the elements, have continued to increase in importance. Especially is this true with the discovery of newer methods of tanning and the invention of modern machinery. Tanneries throughout the United States are continuously processing skins into fancy leathers, which are being manufactured into quality products.

The Raw Material: From the beginning of creation, before man learned the tanning processes known today, the animal skin has been useful. Genesis 3:21 reads:

> Unto Adam and also his wife did the Lord God make clothes of skin and clothed them.

Moses required the Israelites to bring an offering of rams' and badgers' skins to aid in the building of the tabernacle.

> And rams' skins dyed red, and badgers' skins and shittim wood, oil for the light, spices for anointing oil, and for sweet incense,... (Exodus 25:5-6)

> And thou shalt make a covering for the tent of rams' skins dyed red, and a covering above of badgers' skins. (Exodus 26:14)

Furs and skins have been used in all ages to serve mankind. In addition to his clothing, the Eskimo developed a kayak, a small canoe covered with sealskin, to provide a suitable method of transportation for hunting expeditions in the Arctic. Materials for this small craft consisted of bone and the raw skins

chewed until pliable, by the Eskimo women.

The American Indian woman turned bird skins inside out, chewed them into pliability, sewed them with sinew threads with the feather side in, producing a warm suit for the papoose. Thus the skin once pulsating with millions of blood cells, which is no longer a part of the carcass upon which it was created, continues to serve humanity in hundreds of ways. (12, page 7)

By the discovery that water is kept fresh and cool in bags made of skins, the Ancients were freed from returning to rivers and springs for a longer period of time. This made it possible for him to increase his travel.

The beginnings of recorded history were found on parchments of skin which existed fifteen hundred years before the birth of Christ. The Jews used skin-rolls for their sacred books, and it may be assumed for other literature, also. This practice is still maintained today. Synagogue rolls are inscribed on this time-honored material. The "sheepskin" which is awarded to a person graduating from a college is in some cases an actual piece of sheep skin. (16, page 1)

The Evolution of Leather: It is not known when leather was first made, but earliest historical records date back to the building of the great pyramids of Egypt. When memorialists succeeded in deciphering the strange hieroglyphics, carved on tables of stone, numerous allusions to leather were found. Leather, thirty-three centuries old, unearthed in the Egyptian

tombs, may be found today in the British Museum in a perfect state of preservation. (15, page 10)

Perhaps man learned, by hanging wet skins before the fire to dry, that smoke caused a reaction which gave the skins a better wearing quality. By accident, it was learned that a skin carelessly dropped into a forest pool, littered with barks from various trees, tended to preserve the skin. (20, Volume 18, page 6441)

The Egyptian Leather: Vegetable tannins were used by the Egyptians in the tanning of hides and skins. The resulting leather was dyed, painted, embossed, and ornamented with gold and silver threads. King Solomon's famous exclamation:

> How beautiful are thy feet with shoes,
> O prince's daughter!
> (Songs of Solomon 7:1)

describes the splendid attire of princesses and sultans. The prominence and ostentatiousness of leather shoes was signified in the court ceremonials when princes appeared before Pharaoh barefooted. Monarchs, alone, were entitled to wear shoes on such occasions. (16, page 3)

Leather was considered a highly precious material. Articles made from it were presented in tribute to kings and gods. Conquered nations were required to pay many hundreds of hides as tribute. (17, Volume 8, page 32)

Early Arabian Leather: Saddle making was a specialty of the Arabians, and much leather was used for this purpose. The use of flour and salt were employed in the tanning process.

The integument remained in this solution for days to be cleansed of all fats and impurities. The stalks of the Chulga plant were pulverized between large stones, placed in the water, and applied to the flesh side of the skin for one day. Repeating the process many times was required to produce a finer grade of leather. (16, page 2)

The Jewish Babylonian Leather: From the Hebrew Talmud it is learned that leather-making was common to the Jewish Babylonians. The Hebrews were the first to discover the value of oak-bark tanning, and that of "Shamoying," a process described in Homer's Iliad (11, page 420). The pores of the hide are opened by repeated washings, and cod-liver oil is forced into the pores by beating and rubbing, while the hide is stretched on a frame. Much of the leather for clothing was made by this process.

Grecian Leather: The Greeks placed their tanneries outside the city walls. Wet skins were often spread on the ground to be softened by the tread of many feet passing to and from the city. Lime water was universal in the removing of hair. The oak-bark method was most commonly preferred in the actual tanning process. Roots and berries were also placed between the stacked hides along with ground bark. Several months elapsed between the "pickling process," and the time the hides were hung on poles to dry.

A legend of ancient Greeks describes Zeus, the great god,

wearing the aegis (shield), a covering which was supposed to have been the hide of the goat that suckled him.

From the founding of Carthage comes the legend that Queen Dido was promised the land which could be covered by a bull's hide. She cut it into thin strips and encircled the land on which the city was built. (16, page 3)

Roman Leather: The word "tan" is derived from the Latin word "tanare," meaning "oak-bark." Tanning was done by the use of oak-bark and roots. Leather was valued so highly that for a time it was used as a basis for money. It originates from the Latin word "pecus," meaning "hide," from which the English word "pecuniary" is derived.

Ancient Roman shoes denoted the rank of the owner. The senators of Caesar's time wore the "calceus" with straps wound around the ankle, and laced down the front over the tongue of the shoe. Roman soldiers wore heavy hobnailed sandals and boots with numerous straps wound around the lower part of the leg. The noble-blooded patricians wore a red leather shoe. The early leather workers were slaves, but during the Middle Ages they formed one of the strongest guilds. (19, page 4)

European Leather of the Middle Ages: Cardovan, Spanish and Morocco leathers became famous throughout Europe as a direct result of the Moorish invasion into Spain in the eighth century. They brought with them the "sumac" process of tanning, and their elaborate geometric methods of decorating leather,

which contributed to the beginning of a renaissance that spread far beyond the continent of Europe. Some of the most elaborately decorated leather work of all times, was produced in southern Spain and Morocco.

Cardova was one of the great Spanish leather centers, thus the name Cardovan was given to the leather made from horsehide. The French word "cardwainer" comes from the word meaning "cardovan."

Records of the French Revolution indicate that each day's horrible crop from the guillotine was taken to the town of Mendon where the skins were transformed into leather. World War II is marked by similar incidents when, it is claimed, American service men, with numerous tattoos, were skinned, the hide was tanned, and the finished product became shawls for the German women. (10, page 203)

Leather workers of the Middle Ages were the first to form a guild. In France, a fraternity of leather workers was established by Charles the Sage, and was controlled by the church. The right to become a tanner was bought from the king. Each member was required to observe the morals of the trade.

Throughout Europe, monks wrote on parchment leather pages decorated with gold, silver, and every color known to the artist. These illuminated scriptures may be found in both public and private libraries, the world over. A Bible of purple-dyed vellum, with all the text letters in gold, was given to Henry VIII by the Pope as a coronation present. (19, page 5)

Leather from chicken skin became famous during the Elizabethan period. It was used for gloves and beauty masks to remove wrinkles and reduce double chins. (10, page 204)

Leather of the Far East: Marco Polo gives an account of the great monarch of the Tartars, Kublai Kahn, who wore a leather armor made of thick buffalo hides, which were hardened by the fire. The Tartar soldiers made and carried rations of dried milk with them in a leathern bottle. A noon ration consisted of one-half pound of the dried milk placed in the leathern bottle and the bottle filled with water. The contents were shaken violently by the constant motion of the moving soldiers.

The war tents of Kublai Kahn were made of lion skins which were lined with the most costly of all furs, the sable and ermine. The palace of this Chinese emperor was decorated elaborately. Courtiers, upon reaching the court, would slip on white leather buskins to keep from soiling the beautiful carpets, which were curiously wrought with silk and gold.

The visit of Marco Polo into India found much of the coverlets for beds made of extremely delicate, soft, tanned leather, stitched with silver and gold thread. (21, pages 48 to 52)

American Leather: Guild Craftsmen, who first came to America, were surprised to learn that the Indians were well versed in the art of tanning leather. Their method of removing the hair with wood ashes, rubbing it with liver and brains, and impregnating the skin with smoke, was unknown to the rest of the

world. Where the method originated is not known, but the Crow Indians were considered to have the best tanning methods. (6, page 31)

The famous buckskin tan would stand any amount of wetting, and would remain soft and pliable when dry. This quality of leather proved valuable to the post riders, who used saddle bags to protect the mail from rain and snow.

Many original designs and decorations on leather came to America through the Spanish. In the north, designs and decorations were European, while in the south, the Spanish design was predominant.

Other than the introduction of European methods, little progress was made in the development of the leather industry until about the eighteenth century. Humphrey Davy, a noted English scientist, began to deviate from the Ancients by the use of tannins from trees found in American forests. Changes were made in industry through scientific knowledge and experimentation, during the Industrial Revolution. The small hand craft began to disappear with the introduction of larger equipment. With the aid of new discoveries, tanners began to produce a greater variety of improved leathers.

The most revolutionary discovery came in the nineteenth century with the introduction of chrome tanning, which will be discussed more extensively in another chapter. Robert Foerderer, a young Philadelphia tanner who became interested in better methods of tanning, performed a long series of experiments. By

the use of soap and oil, the stiff, hard, chrome leather became soft and pliable. A new era dawned for the leather industry in America. Today, the finest leathers in the world are made in American tanneries, from hides which come from all parts of the Western Hemisphere, Europe, Australia, Africa, and China. (16, page 10)

CHAPTER III

PRINCIPAL TYPES OF LEATHERCRAFT MATERIALS

The leathers considered in this chapter include those most commonly used in the teaching of leathercraft in industrial arts courses and classes. Major supply catalogues were consulted by the writer to determine which leathers should be included in this study. Leathers, which are a by-product of another leather, have been included only when used extensively for leathercraft purposes. When the physical structures are examined in the original leather, the same are not repeated in the study of the by-product.

Each leather has been studied as to its origin, usefulness, and physical structure. The classification given for each leather refers to the finished product as it is purchased from the supply house for leathercraft use. Since the grading of leather varies with each tannery, it has been eliminated from the classification list. One tannery may grade A, B, and C, while another may use 1, 2, and 3, or x, y, and z, to determine the various qualities of leather. Costs listed here can only be tentative as there is a constant fluctuation from month to month. The prices listed include those for April, 1949, and represent the retail price for a square foot of leather of average thickness.

ALLIGATOR

The production of alligator leather has never been large,

and precise quantities are uncertain. Between seven hundred and seven hundred and fifty thousand hides are used each year. Half of this number are imported, a greater percentage coming from Latin America. Stocks in the United States are being depleted, even though alligator farming has been encouraged.

Alligator skins have been tanned longer than any other of reptile origin. The process originated when the species was copious in the state of Florida, from where the United States' domestic supply is obtained today. The long-wearing quality paralleled with its admirability, gives alligator leather a place in the manufacture of fancy leathers. (3, page 527)

Physical Structure: Leathers from the alligator skins have a highly distinctive appearance, assuming a scaly pattern. The horny upper layer of the epidermis is removed by a lengthy liming process. Scales appearing on small articles are rudimentary since the leathers, from which they are made, come from the sides and bellies of the skins. Due to slow penetration of the tanning agents, leather-making involves much expense and hard work. All species are not equally adapted for leather-making as some are too cartilaginous.

From ten to fifteen years are required to mature an alligator. At birth, the young alligator is eighteen inches in length, and it grows one-half inch per day until a length of five feet is attained. The growth rate between five and eight feet is one-third inch per month; then it is one-quarter inch per month until the reptile is mature.

Classification:

Size . . . . . Nine inches to thirty inches across belly.

Weight . . . . Never sold thus.

Sold . . . . . By the skin.

Approximate Cost . . . Twenty cents per inch across the belly.

Uses . . . . . Billfolds, coin cases, and ladies' handbags, belts, and shoes.

CABRETTA

The word "cabretta" when spoken of in general may have various interpretations, but it is universally referred to as the hair sheep and their products. The French word "chevette" means a half-grown goat, while the Portuguese applied the word "cabretta" when speaking of the hair sheep of Brazil. The latter more nearly approaches the classification given the word in the United States which refers to the raw sheepskins from Brazil, and the leathers made from them. A definition of cabretta is:

> The skin of a hybrid cross between a sheep and a goat; a straight-haired sheepskin. (22, page 707)

Interbreeding resulted when the Chinese used the male goat to guard the sheep; the progenies being straight-haired.

Physical Structure: Pelts from this species are of the finest of quality, the thermostat layer being twice that of the reticular layer. The skins are somewhat small, but their texture is fine, close-grained, and substantial, qualities which

are not sacrificed though the skins are thin and light. (3, page 352)

Classification:

Size . . . . . Three to four square feet per skin.

Weight . . . . One to two ounces per square foot.

Sold . . . . . Skins are sold by the square foot.

Approximate Cost . . . Thirty-two cents per square foot.

Uses . . . . . Bookmarks, pen wipers, and linings.

CALFSKIN

This leather is made from the skins of young cattle, which are from a few days to a few weeks old. The quality and substance of calfskin leather vary much less, due to locality, than that of goat or sheep, but a definite mutation takes place when a calf begins to eat grass. Until then, the skin is distinctly immature, soft, fine-grained and supple, yet possessing strength of substance. Fat wrinkles often appear in the finished product, which are a hall-mark of quality, since they are most pronounced in skins of the healthiest animals. (16, page 29)

The grain of the leather has a distinctive pattern which is much finer than that found in sheep or goat skins. The eccentricity of calfskin appears in the weights of the red, white, and black-haired skins; the latter being lighter. Skins of the female have greater solidity and firmness than found in the male, consequently, the former is preferred for leather-making.

The thermostat layer is relatively thick and uniform throughout, which are qualities of the utmost importance where fineness of appearance is at a premium in leathercraft. Noticeable variations in thickness are due to divergencies in the reticular layer. (23, page 50)

The fine, closely knit fibers of calfskin are adaptable to all types of leathercraft. When properly tanned and finished, it is a delicate, rich leather, which may be produced in a variety of weights and colors.

Tooling Calf: Often, this type of calfskin is referred to as "Russian Calf," a leather suitable for tooling only when vegetable-tanned. The finest of calfskins are selected for this class of leather, and they should be free of butcher cuts and other imperfections. It is imperative to inspect each skin very carefully for any defects which would disqualify it for fancy leathercraft. When wet, this vegetable-tanned calfskin readily takes and retains an imprint, a quality denoted in the name given to this type of leather. Many colors may be obtained, but the natural or unfinished skin is more compliant for tooling, embossing or modeling.

Lining Calfskin: Being somewhat thinner than the regular tooling calf, this grade of calfskin is used on the inside of leathercraft articles for compartments, linings, pockets, and reinforcements. Due to the thinness of the material, very little is used for exterior purposes. The chrome-tanned process gives suppleness and toughness to the skin without looseness of

texture, making it more desirable for its intended use. When vegetable-tanned, these qualities are lacking, even though the leather is heavier. (15, page 34)

Classification:

Size . . . . . Ten to thirteen square feet per skin.

Weight . . . . One to four ounces per square foot.

Sold . . . . . By the square foot.

Approximate Cost . . . One dollar and twenty-five cents per square foot.

Uses . . . . . Coin cases, wallets, purses, key cases, belts, bookends, notebook covers.

CARDOVAN

Since the hide of the horse is not essentially a by-product of horse meat, and only a small part of a hide is used in the manufacture of cardovan leather, the supply is somewhat limited. About one-third of the hides from horses, which die in service, are recovered.

Cardovan leather is made from the butt of a horsehide, a section cut from the hind quarters. It is defined as:

> Leather made from the butt or shell of a horsehide. (22, page 707)

Physical Structure: The eccentricity of the horsehide is the dense mass of collagen fibers in the butt area, which are almost air-tight and water-proof when made into leather. This portion is extremely hard and fine-grained, while the remainder of the hide is of a loose texture. This area contains a section

known as the glassy layer through which the shell is split, and the split or glassy layer is finished. Though split, the two pieces have a fair degree of thickness, with a high resistance to abrasion and moisture. (23, page 58)

Classification:

Size . . . . . Six to eight square feet per shell.

Weight . . . . Two to three ounces per square foot.

Sold . . . . . By square foot.

Approximate Cost . . . Ninety cents per square foot.

Uses . . . . . Billfolds, key cases, coin cases, luggage, notebook covers, and brief cases.

CHAMOIS LEATHER

This leather is not usually made from the skin of the mountain antelope of Europe and Asia bearing that name, but from the reticular layer of domestic sheepskins. It is split from the grain or thermostat layer, the two being tanned separately by different methods, and for very different purposes. Skins are received at the tannery in casks holding a thousand pounds of pickled skins. Water is run over the skins for twenty minutes, causing them to swell, before the stock is passed through a splitting machine which separates the flesh and grain side. These flesh splits are soaked with cod-liver oil and pummeled in especially designed machines, to assist in the penetration of the oil. A combining of oil with the skin protein takes place with the evolution of acrylic aldehyde and

other pungent products, developing a considerable amount of heat. The pummeling is stopped frequently and the skins allowed to cool, after which the process is continued. (22, page 431)

Upon removal, the flesh splits are soaked a few hours in warm water, and pressed so as to remove the uncombined oil. The remaining oil is removed by washing with a solution of sodium carbonate, and the bleaching process is accomplished by strong sunlight.

The process of oil tanning sheepskins is known as chamoising. Two definitions of chamois leather are:

> Leather produced from pickled sheepskin fleshers, by tanning with cod-liver oil. (22, page 707)

> Leather produced by the incorporation of an oxidizable oil, such as cod-liver oil. (3, page 684)

Chamois is the most difficult leather to dye, as the oil-tanned fibers do not take up the dyes readily. This necessitates mordanting the leather by the use of chrome alum and potassium dichromate after the hide has had some of the oil removed. After the mordant penetrates the thickest part of the hide, which takes about thirty or forty minutes, it may then be dyed.

Classification:

Size . . . . . Five to six square feet per skin.

Weight . . . . One to three ounces per square foot.

Sold . . . . . By square foot.

Approximate
Cost . . . One dollar and five cents per square foot.

Uses . . . . . Bookmarks, book covers, coats, and linings for purses.

The physical qualities of the untanned chamois are the same as those of the flesh split of the sheepskin. Those of the genuine chamois made from the antelope, are almost identical to the deerskin.

COWHIDE

The thick leather made from cowhide may be split several times, and the splits tanned by various methods. Those most commonly used for leathercraft being ooze, moccasin, grained, tooling, and morocco cowhide. Each has been defined as:

> Ooze Cowhide is a heavy leather with a velvety finish instead of a full grain; used mostly where a heavier leather with a suede finish is desired.
>
> Moccasin Cowhide is an especially strong, durable leather, tanned and finished especially for outdoor moccasin use. It is practically waterproof and heatproof, containing a substantial amount of those greases which insure greatest protection.
>
> Grained Cowhide is a leather that is grained to imitate pinseal, ostrich, alligator and numerous other types of skins.
>
> Tooling Cowhide is a leather developed especially for leathercraft work, which has an unexcelled tooling surface.
>
> Morocco Cowhide is a very light-weight leather on which a pinseal morocco grain has been impressed. (15, page 36)

Leather produced from the skin of a cow is thirty per cent lighter than steerhide and has a grain that is coarse. Cows are

usually kept until older, causing formations of depressed patches commonly called "old grain."

Physical Structure: Eighty per cent of the total thickness of the hide is made up of heavy bundles of fibers which are the chief leather-forming constituents. This portion of the skin contains very few of the fat cells that tend to make the leather spongy. The thermostat layer occupies the top fifth of the skin, while the reticular layer is composed of the remaining four-fifths. The latter determines the physical structure of the hide and the former determines the appearance of the leather. (23, page 39)

Classification:

Size	Eighteen to twenty-six square feet per one-half hide.
Weight	Two to thirteen ounces per square foot.
Sold	By the square foot.
Approximate Cost . . .	Eighty cents per square foot.
Uses	Belts, brief cases, handbags, notebooks, moccasins, basketball covers, baseball covers, volley ball covers, and golf grips.

GOATSKIN

Variations in quality from country to country are a direct result of climatic conditions existing in each locality. The heavy hair growth in colder climates tends to reduce the quality of goat pelts for leather purposes. In respect to skin, the goat structure is between the calf and the sheep, being superior

to the latter. Glands and fat cells responsible for sponginess in sheepskin are less abundant, feeding conditions being equal. Surface coarseness makes the goat inferior to calfskin. (23, page 56)

Commercially, the sixty-eight varieties of goatskins are divided into three types: (1) fine; (2) medium; and (3) coarse-grained. The differentiation is based on the spacing of the pores. In the fine skins, they are small and close together, while in the coarse, they are large and more widely spaced.

Seldom are goatskins thick enough to split overall, and those splits that are taken from the heaviest skins are of little commercial value. Table I gives relative weights of pelts from various countries.

TABLE I

CLASSIFICATION OF DRIED GOATSKINS
FROM VARIOUS LOCALITIES

Place	Weight in Pounds				Quality
	Light	Medium	Heavy	Bulls	
China	1.25	2.00	2.50	3.00	High
India	.75	1.00	1.50	2.00	High
Argentina	.75	1.15	1.50	2.50	Medium
Brazilian	.75	1.00	1.50	2.00	High
Spanish	1.25	2.25	2.50	3.00	High
Italian	2.50			3.00	High
Austrian	3.25			3.50	High
Turkish	3.30			3.66	Poor
Russian	1.00	1.75		2.00	High
Algiers	1.50	1.75		2.00	High
Egyptian	1.00	1.25	1.60	2.30	Poor
Arabian	1.00	1.25	2.25		High

(13, pages 22 to 29)

The fact that ninety-eight per cent of all skins tanned in

United States are imported, is perhaps due to the lack of popularity of goat meat in the American diet.

Morocco Leather: As the name implies, this class of leather reached the modern Occident from North Africa where the mature goatskin was tanned with vegetable agents. Today, most of the leather made of goatskin is classified as morocco. It has been defined as follows:

> Term applied to distinctive natural grain of vegetable-tanned fancy goatskin, to which the name is properly restricted. The name originally indicated leather from Morocco, and later was applied to all goatskin leather. (9, page 8)

The increased demand for fancy goods has called for cheaper grades. Some sheepskins are described as "imitation morocco," while that of goatskin is defined as "genuine."

Classification:

Size	Four to nine square feet per skin.
Weight	One to four ounces per square foot.
Sold	By the square foot.
Approximate Cost . . .	Forty-five cents per square foot.
Uses	Coin cases, comb cases, pen wipers, linings, and bookbinding.

KANGAROO

Until about fifty years ago, the kangaroo skin was considered as valueless. After American tanners discovered its usefulness, large quantities of dry skins were imported from Aus-

tralia. Today, more than a million skins are taken annually from the one hundred and seventeen species found on that continent where the supply is diminishing. (16, page 31)

Physical Structure: This supple, tough, thick-grained material is classified in a grade by itself, which is recognized by a symmetrical pattern with hair cells evenly spaced. It differs from other types of leathers in having a particularly tightly woven skin structure, the closely entwined fibers running in all directions, making it the strongest leather known for its weight and thickness.

Skins vary in texture seasonally, due to variation in rainfall rather than temperature, the correlation being between texture and hair growth. (3, page 513)

Classification:

Size	Four to ten square feet per back.
Weight	One to four ounces per square foot.
Sold	By the square foot.
Approximate Cost . . .	One dollar and twenty-five cents per square foot.
Uses	Suspenders, scissor cases, wallets, brief cases, and luggage.

KIDSKIN

Kid leather is produced from the skin of a goat, which is almost mature. The many varieties are classified into three types; fine, medium, and coarse; the differentiation being based on the spacing of the pores. The identification of kid is the

same as that previously given for goat. Genuine kid skins are in many cases too small and light for conversion into good leathers. As a result, much of the kid is used for the manufacture of gloves where strength and suppleness is at a premium.

Skins from one section of the country differ from those of another. The thermostat layer is usually one-half the total thickness of the skin, and the fat cells are less numerous between the two layers (reticular and thermostat) than found in the larger skins. (2, page 77; 1, page 16)

Classification:

Size . . . . . Four to eight square feet per skin.

Weight . . . . One to four ounces per square foot.

Sold . . . . . By the square foot.

Approximate Cost . . . One dollar and ninety cents per square foot.

Uses . . . . . Gloves.

KIP LEATHER

In most continental languages, no word is recorded corresponding to kip. Most statistics of hide and skin production class kips with either cowhide or calfskins. The same classification is given at many tanneries where small kips are tanned with the calfskins, and the large ones with the cowhides. By weight, the line of demarcation between a calfskin and a kipskin is fifteen pounds; and between a kipskin and a cowhide is twenty-five pounds. It is difficult to distinguish kip side leather from regular sides, the only difference being in the grain, which

is finer than cowhide and coarser than calfskin.

(13, pages 18, 19)

The American Tanner's Association has defined kip as follows:

> Skin from an animal of bovine species, in size between a calf and a matured cow, weighing in a green-salted condition from sixteen to twenty-five pounds. This term includes skins from calves which have grown larger than the size usually slaughtered for veal, and from certain breeds of undersized cattle which may have reached maturity.

Classification:

Size . . . . . Twenty square feet per skin.

Weight . . . . Three to five ounces per square foot.

Sold . . . . . By the square foot.

Approximate Cost . . . One dollar and two cents per square foot.

Uses . . . . . Knife sheaths, gun holsters, belts, baseball gloves, baseball covers, basketball covers, and volley ball covers.

LIZARD

Distinctive grain and a limited supply induces most of the genuine lizard to be used for fancy leathers. The law of supply and demand compels prices to remain high, inflicted by small quantities and spasmodic imports. Being very small, only a small article may be made from a single skin. The following definition is quoted from Webster's Dictionary:

> The skin of a saurian reptile having a scaly body.

Physical Structure: It is a leather which neither stretches, cracks, or shrinks. Nature has hardened these skins against abrasion or scuffing. Being hard and firm, the skin needs little attention to be kept neat. (1, page 94)

Classification:

Size	Four to sixteen inches across the belly.
Weight	Never sold by weight.
Sold	By number of inches across the belly.
Approximate Cost . . .	Twenty cents per inch across the belly.
Uses	Coin cases, purses, billfolds, belts, and key cases.

PIGSKIN

Of the sixty-six million pigs killed in this country each year, only a small percentage of the skins are available for tanning, as it is a common practice to leave the skin on the meat, except for pigskin strips. A pigskin strip is defined as:

> A rectangular piece of pigskin from over the lard areas of the animal sold to the tanneries by the packer; the rest of the skin is usually left on the meat. (22, page 717)

When properly tanned, pigskin is as durable as goatskin, as pliable as calfskin, and is characterized by holes in groups of three that go through the skin. The smoothest and best skins are imported from Europe where the animals are as carefully tended as pure bred cattle in the United States.

Physical Structure: Pigskin leather may be classified as

fancy leather, luggage leather, or as a glove leather. Resistance and durability are qualities in which it excels all other leathers, though its tensile strength is low. Being attractive, paralleled with toughness, it lends itself to the manufacture of leathercraft articles. It can be tooled successfully with straight line and stippled designs. (3, page 498)

Classification:

Size . . . . . Ten to twenty-two square feet per skin.

Weight . . . . One and one-half to four ounces per square foot.

Sold . . . . . By the square foot.

Approximate Cost . . . Thirty-nine cents per square foot.

Uses . . . . . Purses, wallets, coin cases, and book covers.

SHEEPSKINS

No other skins are used so extensively as those of the sheep. This fact is largely due to the inexpensiveness of leather made from it, rather than the quality of the product. In reality, the leather is inferior in various respects to many others. Being of a loose and spongy nature disqualifies it for some purposes. Despite these qualities, however, it is suitable for the making of many other leathers, such as; suede, cape, degrain, doeskin, and chamois. (2, page 87)

Physical Structure: The leather-forming fibers are extensively thin, and loosely interwoven, which tend to run parallel to the surface of the skin and contribute to its loose texture.

In the thermostat layer there are numerous sweat glands and fat cells which leave empty spaces in the finished leather, a factor conducive to low quality. Quite often a layer of fat cells separate the thermostat and reticular layers, necessitating a splitting process. Feeding practices often govern this condition. Generally, the more wooly the skin, the more fat on the pelt and the softer the wool, the finer the grain. (13, page 30; 23, page 50)

Sheep pelts may be vegetable-tanned for tooling leather as a substitute for calf, provided the heavier ones are used. Though inferior, it may be used where less expensive articles are desired. (15, page 39)

Classification:

Size . . . . . Seven to ten square feet per skin.

Weight . . . . One to four ounces per square foot.

Sold . . . . . By the square foot.

Approximate Cost . . . Forty-five cents per square foot.

Uses . . . . . Bookmarks, pen wipers, book covers, and linings.

SKIVER

This portion of a sheepskin is cut from the grain or hair side of the skin. Very few domestic skins in the United States are used to make skivers, as only the larger skins are thick enough for commercial splitting. Those meeting this specification are taken from English and Scotch breeds which are the open and luster-wooled type, and having grown much larger than

their progenitors. The Argentine sheep yields a very strong skiver, while those from New Zealand produce a much finer quality. A skiver is defined as:

> The grain side of a split sheepskin. (13, page 686)

Great care must be taken in the selection of pelts, due to the thinness to which the skivers are cut. The thinness, in many instances, regulates its commercial value. After splitting, the tenuous skiver stretches fifteen per cent larger than the flesher from which it is taken.

Due to softness and weakness of grain, it often becomes imperative to stiffen and strengthen the material with an artificial layer of paste finishes. Equal parts of Irish moss and water are boiled for two hours to produce this mucilaginous substance. The grain surface is particularly suitable for embossing. All types of imitation skins and designs may be reproduced. (1, page 157)

Classification:

Size	Seven to ten square feet per skin.
Weight	One to two ounces per square foot.
Sold	By the square foot.
Approximate Cost . . .	Twenty-five cents per square foot.
Uses	Linings for wallets, purses, and luggage.

SLUNK

The production of slunk being wholly a matter of accident,

the supply is relatively small and subject to fluctuation. Areas sparsely populated and less advanced economically tend to produce larger quantities. Very little care is given against climatic conditions to cattle in these areas. The supply varies with the extent of recovery in each locality. A greater percentage of skins imported come from slaughter houses in the River Plate countries of Central and South America.

The word "slunk" is usually known by provincial terms, but is quite common in English-speaking countries. It is defined as:

> The skin of an unborn or prematurely born animal. (22, page 719)

Deacons, which are very small calfskins, are often classed as slunks, but may be distinguished by the length of hair, the former being much longer. Raccoon skins are sometimes used as a substitute for slunk by dyeing them black, with a solution of copper and iron sulphate. (13, page 521)

Physical Structure: The skins from these prematurely-born animals are composed of very fine fibers and blood vessels, which are less highly developed. When manufactured, a leather is produced with a velvety finish. By buffing on the flesh side, a delicate suede is produced with a very fine nap, that may be dyed in various colors. (22, page 551)

Classification:

Size . . . . . Three to five square feet per skin.

Weight . . . . Never sold thus.

Sold . . . . . By the square foot.

Approximate Cost . . . Two dollars and seventy-five cents per square foot.

Uses . . . . . Handbags, billfolds, key cases, coin cases, belts, and jackets.

SPLITS

Due to certain requirements to meet specification on various articles, some hides are not adaptable because of thickness. In order to compensate, the stock is run through a splitting machine which is set to cut the desired thickness. The inner, or flesh cut is usually referred to as a split. Hides may be run through the splitting machine either before or after the liming process. If the latter procedure is followed, the splits may be tanned in various ways, but splits taken from the lime are drenched with lactic acid and tanned wholly by suspension. (13, page 132)

Technically, any skin that can be tanned can be split, but it is not always practical. The tensile strength of leather is not uniform throughout its thickness. Most of the strength is found in the reticular layer. Since this is true, any reduction in thickness tends to weaken the skin. The sum of the strength of the two splits is less than the unsplit hide or skin. Usually, a split is taken off as a by-product of a better grade of leather. A split is defined as:

> A term to describe the portion of a hide or skin after splitting; other than the grain or hair side. (16, page 23)

The Commercial Classes of Splits and Their Uses:

Wax splits	Shoe uppers
Vamp splits	Shoe uppers
Flexible splits . . .	Leathercraft linings
Glove splits	Cheap grade gloves
Butt splits	Men's belts
Dope splits	Upholstery

(3, page 256)

Classification:

Size	Varies with the kind of hide.
Weight	From three to four ounces per square foot.
Sold	By square foot in the half or whole hide or skin.
Approximate Cost . . .	Forty-four cents per square foot.
Uses	Purses, wallets, brief cases, vests, banners, pillows, and moccasins.

STEERHIDE

The effects of castration develop a much better quality of hide, in that it becomes smoother and more uniform in thickness and structure. Preference is given the fine grades of leather produced from it. The denseness and tightness of structure gives it a higher quality than cowhide. A steerhide is defined as:

> The hide of a male of the ox kind that was castrated when a calf several months old; it is finer, tighter in structure, and more uniform in thickness than a bull hide. (22, page 721)

Several minor classifications have been given various physical qualities of steerhide:

Colorado Steerhide: A term given to a hide which has been branded on the side of the butt area.

Butt-branded Steerhide: Hides branded on the butt area back of the break in the flank.

Texas Steerhide: A Colorado hide which is compact, narrow, plump, and close-patterned.

Pacific Coast Steerhide: A hide slaughtered and flayed in one of the known packing plants in the trade of the West Coast plants.

Spready Steerhide: Hides which are unusually wide, whose surface area is large in proportion to their weights.

Plump Steerhides: Hides having a dense and uniform structure and surface area but small in proportion to their weights. (13, page 16)

Hides taken off during the months of July, August, and September, produce a better grade of leather. Winter hides contain less hide substance and more hair. This is an important factor when hides are split as many as three times. The thickest part of the hide is over the rump and the thickness decreases toward the shoulder and belly. (4, page 17)

Due to the structure of the grained surface, the steerhide is especially desirable for carving and tooling. The natural finish and the pebbled grain appearance produce a beautiful effect. (15, page 38)

Classification:

Size . . . . . Twenty-four to thirty square feet per half side.

Weight . . . . Two to thirteen ounces per square foot.

Sold . . . . . By the square foot in the whole or half hide.

Approximate Cost . . . Seventy-six cents per square foot.

Uses . . . . . Belts, notebooks, handbags, picture frames, brief cases, moccasins, basketball covers, and football covers.

SUEDE

In producing suede, a soft, even nap must be raised on the surface of the skin. Small skins are finished on the flesh side, with a novelty nap which is quite thin. The strength of the skin is not lowered as the full substance of the skin remains. However, there is a definite correlation between small fibers and fine nap.

After fatliquoring, the stock is dried and wet back to a thirty-four per cent water content and stalked. While still damp, it is buffed on the flesh side with an emery wheel. Suede leather is defined as:

> Very small skins finished on the flesh side by buffing to produce a fine and soft nap. (22, page 721)

Raw Product: Various skins are used in the production of suede, including calf, sheep, slunk, and kangaroo. Perhaps the most important is calfskin, which produces an extra fine leather with a velvety finish. Sheepskin takes a very good finish, but the leather is loose-textured and not very strong. Kangaroo skins produce an attractive leather with a uniform nap over the entire area of the skin. Buffing results in a nap which appears much deeper than it really is. Slunk suede is the finest quality of suede that can be purchased, but the supply is very small. (2, page 53)

Dyeing of Suede: Much difficulty is encountered in the processing, as rich uniform colors have to be dyed which do not easily crock. In some cases, as many as eight or ten dyestuffs must be used in the coloring drums in order to produce matched colors. Matching is done while the skins are still saturated with wet liquors. Black is the most difficult to dye. By washing in a solution of carbonate of ammonia to remove uncombined dressing, the skin is prepared for dyeing. Chrome tanning does not require this preparation. (13, page 392)

Care of Suede: Brush in a circular motion with a fine, stiff brush to remove dust from nap and then smooth in one direction. A cleaning solution containing a small amount of aniline dye, which matches the leather, should be applied.

Characteristics of a Quality Suede:

Suede that has a very fine silken nap without a suggestion of greasiness.

Suede which has a rich uniform color.

Suede that will show only a faint color on a white handkerchief that is rubbed lightly over it.

A suede that is always finished on the flesh side.

The livest blacks have a faint color cast of blue or red to make them rich and bright. This cast should be uniform. (2, page 55)

Classification:

Size . . . . . Varies with size of animal skin used.

Weight . . . . One to three and one-half ounces per square foot.

Sold . . . . . By the square foot.

Approximate Cost . . . Fifty-five cents per square foot for sheep; one dollar and ten cents for calf per square foot.

Uses . . . . . Linings, jackets, cut-work, and applique.

Summary: The ability to discern is acquired by the study of characteristics. Often it becomes necessary to make a comparison to obtain quality where two or more materials may be used for the same purpose. The information about the eighteen leathers, as presented in this chapter, should provide the necessary knowledge for such a selection.

The chemical content of a hide or skin is very complex and of this relatively little is known. Qualities which have made hides and skins so valuable are found in their physical structure. Hides and skins are composed of a great number of minute fibers intricately interlaced, which gives the skins their flexibility and strength, and yet remain porous enough to admit air.

CHAPTER IV

TANNING PROCESSES AND FINISHES

When skins and hides are removed from the carcass, they are potentially in a state of decay until arrested by some preserving agent. Realizing this fact, the Ancients devised ways of treating which transformed the green hide into a substance that the centuries have been unable to efface. Museums have many of these century-old relics on display. Man's ceaseless effort to improve the methods of preservation has brought to this civilization many beautifully finished leathers.

The writer realizes the multiplicity of operations involved in the tanning industry, which cannot be included in this study. If a clearer understanding of the material, which makes leathercraft possible, can be achieved by those interested, this survey will have accomplished its purpose.

The tanning process involves a number of definite steps which are defined according to procedure, as follows:

> Soaking: The washing of hides and skins with water to remove dirt, blood, and salt, previous to liming. (13, page 686)
>
> Depilation: The process of immersing hides in an infusion of lime, which loosens the hair without injury to the skin. (13, page 684)
>
> De-liming: Soaking skins in a weak acid or other solution to remove lime. (13, page 684)
>
> Tannage: A process of converting hide substance into leather. (13, page 687)

Fatliquoring: Applying oils to leather in the form of dilute oil-in-water emulsions. (22, page 710)

Finishing: Treating leather so as to make it more pleasing to the eye and more serviceable in use; applying a plastic coating to the grain surface of leather to give it a finished appearance. (22, page 711)

Each process must be carefully performed if best results are obtained in the finished product. This makes it imperative to maintain close supervision over each division of the overall tanning process. Constant research is contributing to an ever increasing quality of hides and skins used for fancy leathercraft. Each of the processes just defined will be described in some detail in this chapter.

SOAKING

Two purposes are involved in the soaking process. First, is the cleaning of foreign matter, and second, to restore the fibers to normal size. Hides and skins are cured in various ways and must be treated accordingly. Due to the presence of an excessive amount of bacteria found in stocks, it often becomes imperative to deviate from the regular procedures. Bacteria tend to multiply faster in the thicker hides, causing an extremely careful check to be made on them. (22, page 178; 13, page 57)

Green Hides and Skins: The condition of the hide governs the length of time hides are to be soaked in water. If extremely dirty, seventy-two hours are required, changing the

water every twenty-four hours. A hide that is not dirty may be soaked only twenty-four hours. If hard water is used, a pound of borax for each one hundred gallons of water should be added. A supply of water should be plentiful which does not contain impurities that are injurious to the skins. For this reason, water used in the process should be analyzed at intervals. Skins and hides soaked for three days at a temperature of fifty-two degrees is considered an ideal situation. (22, page 184)

Dry Hides and Skins: Being in a flint condition, more work is required to restore a dry hide or skin to its original state. Milling, by placing the skins in a revolving drum, is used to assist in this process. Chemicals are employed to aid in the softening of the hardened fibers. After two days in a plain water soak, one pound of formic acid is added for each hundred gallons of water. (13, page 58)

DEPILATION

The many processes used in depilation basically react the same, that of causing the fibers to separate. A swelling action takes place, and the hair-cementing material is dissolved. Great care should be taken not to damage the thermostat layer, which gives leather its beauty.

Sweating: The oldest method of depilation was that of incipient putrification. By placing the hides in a damp room, the mucous between the epidermis and the dermis decomposes causing a loosening of the hair. Due to excess damage to the hide, this

process has become somewhat obsolete. (16, page 22)

Liming: This first chemical method is still used extensively for depilation. Hydrated lime, which is a mixture of calcium oxide and water to form calcium hydroxide, may be used without fear of damage to the stock. Liming tends to swell and plump the hide, making them more susceptible to the tanning liquors. From three to nine days must elapse before stocks are ready to be removed from the liming vats. The time element is governed by the thickness and texture of the material. The liming period has a marked influence on the quality of the finished product. Long liming periods produce a loose open grain, while short liming results in a tight grain which is excellent for leathercraft. (16, page 23)

Numerous other chemicals are employed in conjunction with lime to speed up the depilation process. The addition of these chemicals is known as "sharpening" the lime. Those chemicals used in reducing the time element are arsenic sulphide, arsenic, dimethylamine, and sodium cyanide.

Scudding: After removing the hair, the hair follicles still contain lime soaps, epithelial tissues, and hair pigments, which must be removed before the tanning process begins. Both the hand and machine methods are employed in the removal of these substances. The former is the most efficient method, but involves much difficult labor with a scudding knife. Strokes should be made in the direction of hair growth to prevent trapping dirt in the follicles. Though only partially efficient,

the skins are run through the scudding machine and individually inspected for those needing further attention. (22, page 217)

DE-LIMING

A prerequisite to tanning is a process of removing all depilating agents from the hide, since these are a hindrance to tanning. If present, the skins' fibers are weakened, and the grain has a harsh feeling.

The alkaline nature of lime creates somewhat of a problem when in contact with the hide fibers. Merely washing in clear water does not free the fibers of this dehairing agent. Only with the aid of certain chemicals such as sulphuric acid, hydrochloric acid, boracic acid, sulphurous acid, lactic acid, carbonic acids, ammonium chloride, and ammonium butyrate, the alkaline is removed from the fibers.

Testing of the skin or hide to determine whether they are properly delimed, is done by the use of phenolphthalein solution. If lime is present, a violet coloration is produced, but no color appears if the pelt is entirely delimed. (23, page 199)

TANNAGE

In the selection of raw stocks for various types of leather, it becomes necessary to consider the suitability of the stock for a certain leather, and if possible, the purpose for which a particular leather is being manufactured. The raw stock for one type of leather may not be at all suitable for another. Thus, it becomes necessary for a tanner to have in

mind the stocks most commonly used for each type of leather. Table II gives a list of raw stocks used for various leathers. (22, page 169)

TABLE II

LEATHERS, AND RAW MATERIALS USED

Leathers	Raw Materials
Alligator	Real alligator skin or embossed light cow and calf skins.
Cabretta	Straight-haired Chinese sheepskin.
Cardovan	Horse butts.
Chamois	Pickled sheepskins.
Splits	Cow, sheep, calf, and goat skins.
Kangaroo	Australian kangaroo skins.
Kip	Small cowskins.
Lining	Goatskin, cabretta skins, pickled sheepskin, calfskin, and pigskin.
Lizard	Real lizard skins, or light-weight cowhide, kipskins, calfskins, and goatskins embossed.
Morocco	Goatskins and sometimes sheepskins.
Moccasin	Pickled sheepskin, shearlings, deerskins, light cowhides, and calfskin.
Steerhide	Steer and bull hides.
Pigskin	Hogskins, peccary skins and light cowhides, and calfskins (embossed).
Skiver	Sheepskins.
Slunk	Skin of the unborn calf.
Suede	Best from calfskins, kangaroo, sheep, and slunk calf. Low grade from light native cow, kipskins, and goatskins.

TABLE II (continued)

LEATHERS, AND RAW MATERIALS USED

Leathers	Raw Materials
Calfskin	Calfskin.
Cowhide	Cowhide.
Sheepskin	Sheepskin.

Three major methods, vegetable, chrome, and combination, are employed to transform the raw hides and skins into a product that will meet the needs of a scientific world. Each method has a characteristic affect as a tanning agent, and is discussed under a separate heading in this chapter. The tannage method may often be recognized by the smell, feel, color, flexibility, and appearance, as indicated in Table III. (2, page 31)

TABLE III

PHYSICAL CHARACTERISTICS OF MAJOR TANNING PROCESSES

	Vegetable	Chrome	Combination
Smell	Pungent	Faintly lardy	None
Feel	Silky-smooth	Silky-smooth	Smooth
Color	Russett or creamy tan	Greenish grey to grey	Golden brown
Edge	Firm	Soft	Smooth
Flexibility	High	Usually high	Very high

Table V gives the most common methods of tanning the leathers given in Table II.

Vegetable Tannage: This process is an actual combination of the hide substance with an astringent agent called tannic acid, that is obtained from vegetable growth. Vegetable tanning materials have been classified as to natural and tanning extracts, in the following paragraphs:

Natural Tanning Materials:

Barks: Oak, Hemlock, Pine, Fir, Khaki, Alder, Willow, Cork, Wattle, Babool, Larch, Mangrove, Spruce, Elm, Birch, Pomegranate, and Cebil.

Leaves and Twigs: Sumac, Mangrove, Mango, Eucalyptus, Pistacia, Lentiscus.

Roots: Canaigre, and Palmetto.

Fruits: Myrobalans, Valonia, Divi-Divi, Cascalote, Mangosteen, Pomegranate, Celavinia, Bablah, Algarobilla.

Excrescences: Gall Nuts, Chinese Galls, Pistacia Galls, Tamarisk Galls.

Tanning Extracts:

Woods: Oak, Quebracho, Hemlock, Chestnut, Mimosa, Mangrove, Spruce.

Barks: Oak, Wattle, Larch.

Shrubs and Leaves: Gambier, Cutch, Catechu, Kino, Sumac.

Fruits: Myrobalans, Valonia.

Roots: Palmetto.

(1, page 33)

Raw materials containing the active tanning agents are seldom used as formerly, but are produced by being ground into

small chips and are extracted by leaching, a process similar to percolation. Hot water is continuously circulated through the ground wood dissolving the tannins, which are poured off in the form of tanning liquor. In some cases, the water is evaporated leaving the dry extract, making it much easier to ship. Comparatively speaking, a small percentage of the tannins known, are of importance commercially. Of these, only those most extensively used are presented here. (16, page 18)

Chestnut: Known to the botanist as "Castanea Vesca," this tree provides a tannin which ranks second as a tanning agent. Nuts from the tree are used as a food in France, Italy, and United States, where the major supply is grown for the extraction of tannins. By decolorising the tannin, a light brown color is produced when applied to leather. It is rarely used alone, but in conjunction with quebracho, valonia, or myrobalan.

Hemlock: Both the bark and wood are used extensively in the production of tannins. Leather made by the application of this extract is strong and durable. The quality is reduced by the addition of artificial materials, such as glucose, epsom salts, the latter taking the place of tanning materials.

Mangrove: Several tropical countries have coast lines dotted with the mangrove, whose great orchid roots are exposed when the tide is low. The ceriops species produces a bark containing nearly forty per cent of tannin, which may be made into solid extracts containing sixty per cent of tannin. It is adapt-

able for blending with other extracts, but when used alone imparts a reddish color to leather.

Myrobalans: The unripe fruit of this tree has the appearance of shrivelled nutmegs, with the exception of a yellowish color. Being very hard, a special machine is required to grind them into powder. The addition of this extract, with other tannins, contributes a brightening affect to dark colors. It is also satisfactory when used alone; producing a very light-colored leather.

Oak: Due to the weakness of tannins produced from the oak bark, the tanning process is very slow. As a result, the extracts are usually mixed with other tanning materials to produce leather which is firmer. The wood contains a greater percentage of tannin than found in the bark. It is used in the tannage of heavy leathers resulting in a fine quality.

Quebracho: Very little of the natural material, which is used as tannin, is extracted without difficulty. By treating the extract with sulphites, it becomes soluble and the percentage of tannin is raised from twenty-two to seventy per cent. The wood is so very hard and dense that it sinks in water. Such characteristics gave the tree its name, which is derived from two Portuguese words meaning "axe-breaker."

Sumac: This small bush furnishes tanning materials used largely on hides and skins made into fancy leathers. It is one

of the few plants grown extensively for the production of tanning extracts. After drying, the leaves are ventilated to remove all traces of iron which would cause dark blue spots on leather.

The male sumac produces a stronger tannin than that from the female, but the former is rarely sold alone. Sicilian sumac gives a lighter colored leather than that grown in other countries, thus it is used to lighten darker tannins. When used alone, the leather is almost white.

Valonia: Acorn cups of an oak tree which is grown abundantly in Asia Minor, are used in the making of this tannin extract. The first drying process takes place in the sun after the acorns have fallen from the tree, and is completed in large warehouses. After being dried, the acorns have shrunken enough to be removed from the shell.

The beard of the acorn cup contains more tannin than the shell, having a ratio of thirty to forty-two per cent. In conjunction with oak bark extracts, the valonia produces a leather which is very solid and resistant to moisture.

Wattle: The wattle, a tree of the acacia species, which is also known as mimosa, produces a bark rich in tannin. That found in South Africa contains as much as sixty per cent. The industry is adaptable to almost any area, as the tree will grow on soil unsuitable for agriculture. By grinding the bark before shipping, it may be easily transported to tanneries.
(1, pages 34 to 44)

Recent Findings on Latin American Tannins: A beautiful finish on purses and other leathercraft articles is obtained by the use of a tannin from Latin America. Besides the quebracho and mangrove, varieties of the caesalpinia used in the United States, another species, known as the divi-divi, is a most promising source of tannins. The tree of twenty to thirty feet produces a pod one and one-half to two and one-half inches in diameter, which contains from forty to fifty per cent tannin. By soaking in water, the tannin is readily extracted from the pods. Leathers tanned by this method have a yellowish tint. (5, page 154)

Characteristics of Vegetable-tanned Leather: The vegetable-tanned leather has a much larger sized fiber than that of the chrome. The fibers are so large that they almost completely fill the interfibrillary spaces. It has greater weight and solidity as a greater amount of tannin is combined with the skin protein. Such qualities make the hide or skin adaptable for tooling, carving, or embossing. It may be made tough, however, by the use of a sufficient amount of oil. It is capable of absorbing quite a lot of oil without becoming raggy. Treated thus, the leather may be used for the making of plain articles in leathercraft. (23, page 300)

Table IV includes data concerning the more important shrubs, roots, and trees, from which tannins are obtained.

Chrome Tannage: Within the last century, a mineral process for tanning has been discovered and developed, which has revolu-

TABLE IV

SOURCES OF TANNINS

Plant or Tree	Where Grown	Pounds of True Tannin in 100 lbs. of Official Tannin Stock	Price Per lb. of Official Tannin in 1940	Price Per lb. of True Tannins	Equal Amounts of Tannin ——— Days to Penetrate	Stability After Standing For: % Loss 4 Weeks	% Loss 8 Weeks	% Loss 12 Weeks
Chestnut Wood	France	55	$1.75	$12.73	14	7.80	15.00	17.00
Hemlock Bark	U. S.	61	3.00	19.67	19	.40	11.11	14.88
Mangrove	Tropical Forests	83	4.50	9.86	16	.00	1.45	
Myrobalans	India	49	6.25	21.26	33	25.78	54.22	60.24
Oak Bark	U. S.	53	2.75	20.75	30	8.32	17.51	21.44
Quebracho Wood Bark	Argentina	72	4.83	10.65	18	.72	1.29	4.32
Sumac Bark	Sicily	38	4.15	43.68				
Valonia	Asia Minor	57	6.25	17.45	20	15.38	23.54	27.51
Wattle Bark	South Africa	72	4.95	11.46	11	.81	2.75	2.91

(2, page 15; 22, pages 294-98)

tionized the leather industry. Augustus Schultz (1884) patented a "two-bath" process in which skins and hides are treated with a solution of chromic acid, and afterward, with a solution of sodium thiosulphate and hydrochloric acid. Later, (1893) Martin Dennis perfected a "one-bath" method by the use of sodium dichromate, syrup glucose, and concentrated sulphuric acid. All basic materials from which chrome-tanning materials are made, are from an ore known as chromite that comes from Africa, Greece, Brazil, and western United States. Since the chrome ores cannot be used in their rough state, they are chemically treated and refined. The chemical industries furnish chrome salts to the tanneries.

After the preparatory steps, the hides or skins are placed in revolving drums filled with the chrome chemicals, sodium and potassium bichromate. The agitation brings each fiber into contact with the transforming chemical. The time element of tanning has been greatly reduced by the introduction of these chemicals. Small skins are churned into leather within five or six hours after being immersed in the chrome liquors.

There are many variations in both the "one-bath" and "two-bath" processes, but each causes a variation in the kinds and amounts of organic compound produced, and causes a marked change in the tanning properties. Some changes are beneficial, while others are harmful. For this reason, great care is taken in preparation of the liquors. Many tanners experiment until the desired results are obtained for a particular kind of leather, and then makes sure there are no deviations.

The writer does not include the many chemical equations involved in the making of chrome liquors, as each tannery makes use of a different group for each hide or skin, which are considered a secret. (22, page 363)

Characteristics of Chrome-tanned Leather: The fibers are thin as in a dry, raw skin. Compared to the vegetable-tanned leather, chrome leather feels empty, and the fibers are much smaller. The leather may be toughened or softened as desired by the introduction of a sufficient amount of oil. Chrome leather has a relatively high sulphuric acid content, and any attempt to reduce this acid content tends to cause brittleness. When completely tanned, however, the leather is unaffected by boiling water. (23, page 300)

Combination Tanning: The use of two or more tannins in various combinations have proved successful as a tanning process. Individual characteristics are retained when tannins are mixed or used successively. By the combination of tannins possessing certain qualities, a desired result may be obtained, which is seldom possible when one tannin is used alone. The combining of alum with chrome produces a white leather.

Darker leather produced by certain tannins are lightened when used in conjunction with myrobalans. This is also true when other characteristics, such as toughness, suppleness, and firmness are desired. (2, page 18)

Miscellaneous Tannings: Perhaps ninety per cent of all

tanning is done by the vegetable or chrome process, or a combination of the two. Though there are many other substances capable of changing raw hides and skins into leather, their use is restricted by either cost or undesirable qualities. When used in conjunction with other processing methods, they are often very effective. Being of little importance in the processing of fancy leathers, they are briefly mentioned here. (22, page 418)

Alum Tanning: Aluminum salts do not combine with the fibers as readily as vegetable or chrome tannins, and the properties of the leather are inferior. However, it is important as a tanning agent for furs, as it will not discolor the hair as done by chrome and vegetable processes. This ancient method is being replaced by the aldehyde method.

Formaldehyde Tanning: The treatment of skins with formaldehyde produces a white leather which is water resistant. It has been defined as:

> A method of mineral tanning of the same type as alum, and used for approximately the same classes of leather. (9, page 21)

Leathers produced in this manner are not affected by sweat or hot water. They are very tough and resistant to tension, making them especially adaptable for belts, linings, and gloves. (13, page 156)

Oil Tanning: Skins have been tanned by the application of oils upon the raw skin, for many centuries. It is identified

by the open texture and softness. Oil tanning has been defined as:

> The process of tanning with animal oil, which is used in the manufacture of certain soft leathers, particularly chamois and certain kinds of buckskin. (9, page 22)

The skins are thoroughly beaten by a machine and sprinkled with cod-liver oil. A second beating tends to drive the oil into the leather.

TABLE V

METHODS OF TANNING LEATHERCRAFT MATERIALS

Leather	Most Common Method of Tanning
Alligator	Alum, chrome
Cabretta	Chrome, vegetable
Tooling Calf	Vegetable
Lining Calf	Combination, chrome, vegetable
Cardovan	Chrome, vegetable
Chamois	Oil tanning
Cowhide	Combination, chrome, vegetable
Goatskin	Combination, chrome, vegetable
Kangaroo	Vegetable, chrome
Kidskin	Chrome
Kip	Chrome, vegetable
Lizard	Chrome
Pigskin	Vegetable
Sheepskin	Vegetable, alum, chrome

TABLE V (continued)

METHODS OF TANNING LEATHERCRAFT MATERIALS

Leather	Most Common Method of Tanning
Skiver	Chrome, vegetable
Slunk	Chrome
Splits	Alum, chrome, combination, and vegetable
Steerhide	Chrome, vegetable
Suede	Vegetable

FATLIQUORING

During the tanning process, most of the natural oil of the hide or skin is removed and must be replaced to insure beauty and long life to the finished leather. Regardless of how well a pelt has been tanned, it will lack the necessary fullness and softness unless properly fatliquored. (16, page 20)

The newly tanned leather is placed in a drum of hot emulsion of soap, oil, and other ingredients which are absorbed by the leather. Great accuracy is required in the mixture of this solution. Too much oil will result in a leather which will not finish satisfactorily, while not enough oil results in a dryness in the leather. The oil provides a lubricant for the many millions of fibers. Oils used in the fatliquoring process are sulphonated, olive, castor, and Neat's foot oil. The following procedure is only one of many which may be followed:

> For each dozen skins to be fatliquored, use one pint of egg-yolk, one-half pint of olive oil, four ounces of castile soap, and six

> gallons of water. Chip the soap into the water and boil until it is dissolved; then stir in the oil. Boil the mixture of soap and oil; cool down to 100° Fahrenheit and add the egg-yolk. The skins are then milled in this liquid for one-half hour. (13, page 422)

The fatliquoring process of each leather will deviate from this procedure, somewhat, but basically the same ingredients are employed.

After being removed from the fatliquor drums, the leather is hung to drain for several hours. The water is pressed out, after which the leather is oiled. By penetration of one of the oils just mentioned into the body of the skin, strength is added to the fiber.

FINISHES

The application of a finish on leather has two purposes, that of preserving the leather, and adding beauty, which is essential for leathers used in leathercraft. For some leathers, a finish is used only as a preservant, since the fine texture of the grain has a beauty which is not improved by a finish. Others are finished with the aid of machinery, dyes, and plastic substances that increase both the quality and beauty.

Due to the great variety of solutions involving pigments, casein, and shellac for finishing, the writer deems it unnecessary to list them here. Most tanneries prepare the simplier finishing solution, and purchase the more complex ones from finish manufacturers, who specialize in new formulae which are kept secret. For this reason it would be impossible to give all

of them. Each leather may be finished in a number of different ways. Only those exterior finishes, resulting by the use of machines, dyes, and waxes, are given.

Suede Finish: The finish is obtained by buffing the flesh side of the leather against a rounded emery wheel. The characteristic appearance of suede appears in the form of a silky nap which may be dyed almost any color. Articles made from suede-finished materials are becoming more popular. (16, page 29)

Dyeing Leather: Leather may be dyed either before or after it is fatliquored. If before, the skins are thoroughly soaked and washed in lukewarm water to remove all excess tannin which makes dyeing difficult. Some tanneries pour off the fatliquors and pour in the dyestuff, while others never bother to remove the fatliquor from the drums before the addition of the dye.

Dyestuffs have been classified into two groups, "substantive" and "adjective." Those dyes capable of producing a fully developed color on textile material are the substantive, while the adjective are those requiring an intermediate combining substance called a "mordant." This classification does not always hold true, as some dyes require a "mordant" on some fibers and not on others. (13, page 356)

Dyes of importance are obtained from two major sources; natural organic materials, and artificial organic materials. Sources of dyestuffs are given in Table VI.

TABLE VI

DYESTUFF, AND MAJOR SOURCES OF SUPPLY

Dyestuff	Source of Supply
Natural Organic	Indigo, logwood, Brazil wood, peach wood, Japan wood, osage, orange, cutch.
Artificial Organic	Basic colors, acid colors, direct colors, alizarine colors, developed colors.

The application of the dye may be done by brush, drum, paddle, or the tray method. The choice of method is usually determined by the type of hide or skin to be dyed.

TABLE VII

METHODS OF APPLYING DYES TO HIDES AND SKINS

Method	Weight and Size	Type of Hide or Skin	Time to Dye
Brush	Large, heavy	Cowhide, steerhide	
Tray	Light, small		Five to ten minutes
Drum	Light	Kip, horsehide, calf, sheep, and goatskin	Thirty to forty-five minutes
Paddle	Very light	Skivers or light sheepskin	Thirty minutes

(13, page 364)

Glazed Finish: Preceding the actual glazing process, the leather is "seasoned" by the application of a solution of Irish

moss, flaxseed, mucilage, blood albumen, and a coloring. By the application of this paste solution to the grain side of the skin, a fullness of color is obtained. When the process is repeated for a better or brighter finish, a greater quantity of blood albumen is used. After drying, the leather is ready for glazing.

Machines with large glass cylinders, and known as glazing jacks, are utilized in the glazing procedure. Pressure is applied to the glass cylinders which do not roll, thus causing a friction. Friction, produced while the cylinders are operating on the leather, generates a heat so great that the carnauba wax softens so as to produce a luster on the grain surface. The glazing operation brings about a cohesion of the fibers, which must be broken up by slightly staking. If re-glazing is required, all moisture must be removed after each "seasoning" by passing the leather through the tunnel dryers.
(18, pages 51 and 52)

Wax Finish: Although all leather-finishing waxes are insoluble in water, a watery emulsion can readily be made by melting the wax and pouring it into a boiling soap solution. Waxes used in leather finishes are listed in Table VIII. It is then applied to the leather as a dispersion in soap and water, which gives a shine to leathers when brushed. Glazing sometimes causes the soft wax finishes to dull, as the melting point of the wax is much lower than the temperature generated by the glazing machine. The harder waxes produce a finer luster.

TABLE VIII

CLASSIFICATION OF FINISHING WAXES

Wax	Soluble in	Texture	Obtained from
Carnauba	Boiling soapy water	Hard	Leaves of the Carnauba palm of Brazil
Beeswax	Boiling soap solution	Soft	Honey-comb
Japan	Benzene-Naphtha	Soft	Berries from the Rhus in Japan.
Candelilla	Alcohol, ether, acetone, chloroform	Hard	Desert plant in Arizona
Montan		Hard	Saxony

(22, page 589)

Embossed Finish: Leather made from skins which are scarce and expensive, have been counterfeited on goat, sheep, pig, and calfskin. Embossing machines are equipped with plates, which will make an imprint on smooth leathers resembling almost any skin that can be tanned. Seldom is the quality of the embossed leather equal to that of the genuine, but many substitutes are meeting requirements which could never be met otherwise.

The temperature of the machine used for embossing is regulated by a heating chest. Pressures up to five hundred tons may be exerted on the plates. By increasing the thickness of the matrix paper on the plates, the imprint can be deepened. Machines may be set for instant release after each imprint, or

made to run continuously.

Summary: Modern tanneries are equipped to complete only a portion of the processes described in the foregoing pages of this chapter. The multiple and careful operations to be performed in changing a green or dry skin into a beautiful piece of leather, require the aid of many skilled workmen and the best of materials.

Although the United States has a large number of the necessary materials, imports are received from many countries to assist in such a transformation.

CHAPTER V

MEASUREMENTS OF LEATHER

As the thicknesses and areas of leathers are as numerous as the types of hides and skins sold, a standard of measure has been set as a guide. Leather is sold per unit by the square foot, and each unit is gauged in thickness as to the number of ounces a unit will weigh. Although these are not one hundred per cent accurate due to physical structure of the raw material used in manufacture, such a standard has proven satisfactory.

AREA MEASUREMENTS

Since most leathers are sold by the area, it is imperative to determine how many square feet are in each hide or skin before they leave the tannery. The obsolete method of using a planimeter was too slow to keep apace with modern methods of converting skins into leather, thus, inventions of new machines came about. The first machines invented were very inaccurate, due to mechanical defects, which have largely been overcome. To check the accuracy of various machines, the United States Bureau of Standards made a comparative test on five different machines, by the use of five calfskins on each. After actual areas were determined by careful planimetric measurements, a comparison with machine measurements was made. The average error extended from four and four-tenths per cent in excess to one-tenth in deficiency. Though all machines are different, they operate on the same principle.

The Hand Frame: This measuring device is a screen divided into squares comprising one-fourth square foot each. Being superposed upon the hide, the squares may be counted and divided by four to give the total number of square feet. The accuracy of the machine depends upon the skill of the user, and this machine is somewhat obsolete. (14, page 8)

The Pin Machine: The operation of a pin machine is dependent upon the weighing of a number of vertical pins. The interposition of the hide relieves the pins in contact with it, while the remaining pins are in contact with the weighing mechanism. Perforations are so arranged in the table to allow the pins to pass through. A spring balance, which is in equilibrium under the load, indicates any change on a dial and is graduated in area units. The degree of accuracy is dependent upon the closeness of the pins. This construction of machine is simple, and is easy to manufacture, but a major handicap is the slowness of operation. (14, page 9)

The Wheel Machine: Comparatively speaking, the wheel machine is much more accurate and is used almost exclusively today. Its construction is a bank of uniformly spaced wheels whose rotation is dependent upon the passage of the hide under them, by the aid of feed rolls. Each wheel rotates through an angle, which is proportional to the length of the middle line. By totaling the rotations of the various wheels and multiplying the sum by a constant, a result is obtained representing the area measurement of the irregular figure measured. Its accuracy

is within one-tenth of a square foot. (14, page 13)

The Planimeter: At present, the planimeter is obsolete, with the exception of a few cases where absolute accurate checks are desired. As it gives a reading of the area by manually tracing the outline or perimeter of the hide, a time element is involved which is difficult to overcome.

It is beneficial, however, in standardization work such as checking other machines. Its usefulness in the measurement of high priced leathers is dependent upon the cost of operation as compared to the degree of error of competing machines.

When hides have been measured, the area is marked on the flesh side. From the time the hide leaves the tannery until it is consumed, all transactions are made on the number of square feet marked on the skin. (14, page 9)

THICKNESSES OF LEATHER

The unit of thickness is measured in ounces and, theoretically, is equivalent to a square foot of leather that is one sixty-fourth of an inch thick. The inaccuracy of this is due to the variations in specific gravity of individual leathers. Those used for leathercraft range in thickness from one to twelve ounces. The thicker leathers are not adaptable in many cases, until they are run through a splitting machine. Very thick hides may be split a number of times.

Splitting Machine: A flexible belt knife moves over two large pulleys at a very high speed. The leather, to be split,

is placed on the bed of the machine where two rollers pull it into the knife that cuts the skin or hide in layers. It is possible to split even the thinnest skins, but not always practical.

TABLE IX

STRENGTH AND STRETCH OF VARIOUS LEATHERS USED IN LEATHERCRAFT

Kind of Leather	Av. Thickness (oz.)	Lbs. to break 1 inch width	Tensile strength (lbs. per sq. in.)	% Stretch at 1000 lbs. per sq. in.	% Stretch when leather broke
Cow (veg. tan)	7.64	530	4699	15	38
Steer (veg. tan)	4.28	179	2679	24	41
Sheep (chrome tan)	2.72	96	2491	36	57
Cow (chrome tan)	2.32	103	2854	11	29
Calf (chrome tan)	2.39	163	4358	8	36
Calf (veg. tan)	3.15	240	6096	5	29
Cardovan (veg. tan)	2.82	71	1803	22	28
Elk (chrome cow)	4.49	419	5768	10	42
Horse front (chrome tan)	3.53	336	6093	14	60
Cow belly (chrome tan)	3.55	117	2175	29	49
Kangaroo (chrome tan)	1.31	147	7214	15	40
Kid (glazed chrome)	1.86	139	5075	19	59
Pigskin (veg. tan)	6.48	221	2184	12	21
Sheepskin lining (veg. tan)	2.19	97	2840	14	31
Calf slunk (chrome tan)	1.59	55	2215	18	28
Split (chrome-tanned cow)	3.15	168	3422	23	49

Machines are equipped with a micrometer hand gauge which measures both in millimeter and in ounces. The operator checks several samples of leather to assure accuracy. As a result of a knife grinder attachment that operates during the splitting

process, a more uniform thickness is obtained. (22, page 443)

Precision becomes a necessity when sheepskin skivers are split to seven or eight thousandths of an inch, to be used for valve covers on player pianos. Uniformness in thickness maintains uniformity of strength proportionately throughout the entire pelt. Table IX (22, page 643) gives various thicknesses and strengths of the more popular leathers used in leathercraft.

Before splitting, pelts vary in thickness over an individual hide or skin, resulting in a difference in quality. The thinner parts comprise the head, belly, and shoulders, while the thicker leathers are obtained from the back and butt. The chart which is included as page 69 of this report, shows the various parts of a hide, which are defined as follows:

Back: Formed by first cutting the hide longitudinally along the backbone, then trimming off head and belly.

Belly: That part of hide from under side of animal, usually less valuable than other portions.

Bend: A "back" with shoulder trimmed off.

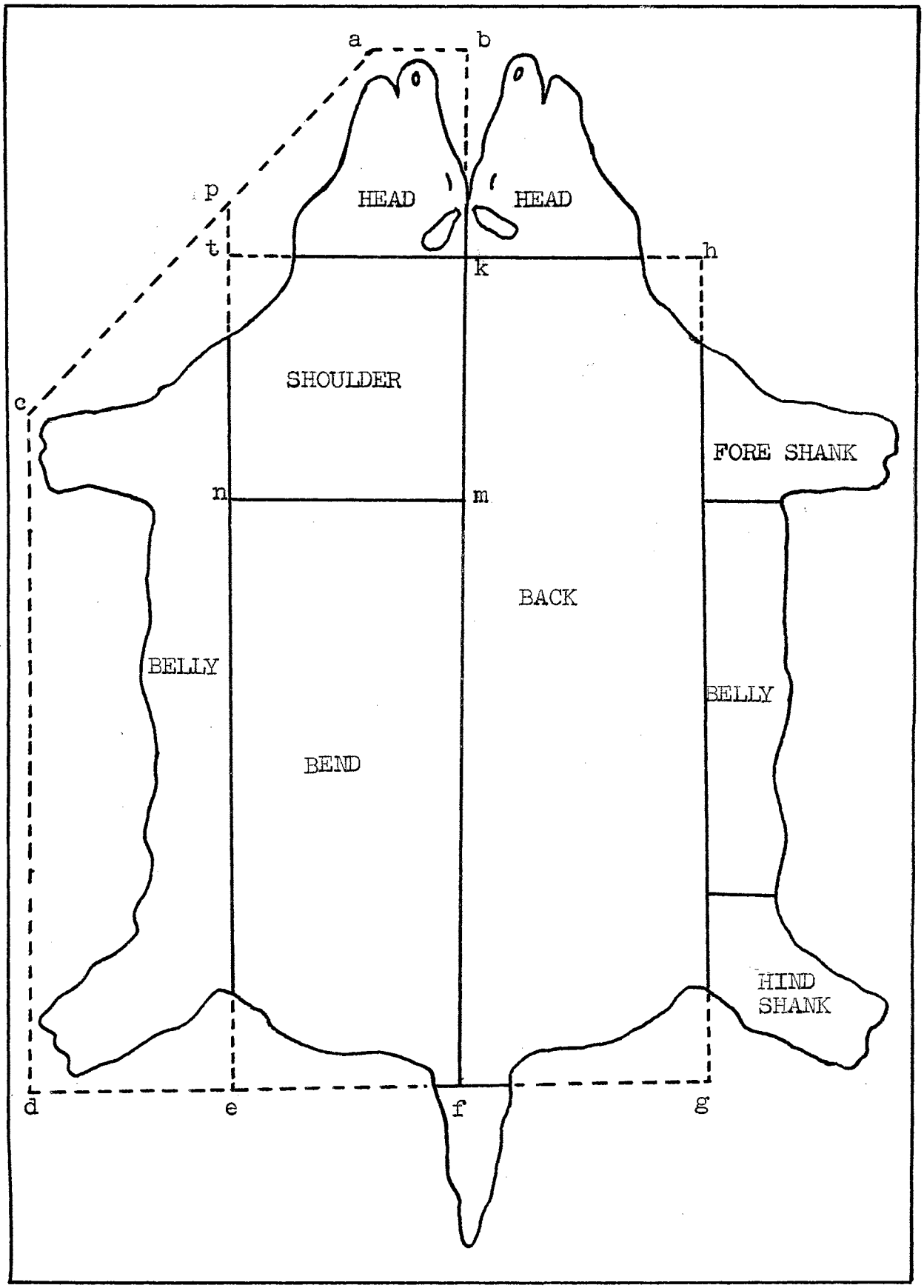
Crop: A "side" of leather with belly cut off, retaining both head and shoulder.

Front: Term usually applied to horse hides to distinguish the forepart of hide from the butt or hind portion. A half front is about a third of the entire area of the hide and whole front is about two-thirds of the area.

Head: That part of the hide which is cut off at the flare into the shoulder.

Hide: When used to describe tanned leather, it refers to a pelt from one of the larger animals (cattle, horse, etc.) in its entirety, containing the whole superficial area of the covering of the animal from which it was taken.

Shank: That portion of the hide which covers the leg of an animal.


a
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SHANK
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Shoulder: That part of the hide between the neck and a line cut across the hide from the center of the front flanks, about fifty inches from the butt of the tail in cattlehides.

Side: Half of a whole hide, cut longitudinally along the backbone, with offal (head, belly and shoulder) attached.

Skin: Pelt from the smaller animals (sheep, calf, goat, etc.); when applied to finished leather, indicates the whole skin. (9, pages 18 and 19)

Substance, thickness, weight, and plumpness are qualities which are closely linked. Weight and thickness are usually correlated with size, while raw stock is said to have substance when the fibers are tough, solid, and firmly interlaced. When a pelt has all the qualities of substance in balanced proportion, and evenly distributed throughout the hide or skin, it is said to be plump. Although a hide or skin possessing the two latter qualities are likely to be relatively heavy and thick, this is not necessarily true.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The findings of this study are presented relative to values given to those leathers which are listed in the preceding chapters. The definite relationship is given between the characteristics of individual leathers and their adaptation for a particular use.

Summary: The usable conclusions resulting from this study are given in Tables X and XI. Table X is concerned with methods of tanning, and the characteristics of each leather that governs its adaptability for the various projects. Table XI gives a list of those leathers, with their thicknesses, which are suitable for each project.

TABLE X

LEATHERS, TANNING METHODS AND CHARACTERISTICS INCLUDED IN THIS STUDY

Leather	Most Common Tanning Method	Characteristics Governing the Adaptableness for Leathercraft Projects
Alligator	Alum, chrome	Long-wearing quality, distinctive appearance, and admirability.
Cabretta	Vegetable, chrome	Fine texture, close-grained, substantial, light and thin.
Calfskin	Vegetable	Toolable (for making of beautiful designs), fullness of body. If chrome-tanned, it becomes very tough but no longer toolable.

TABLE X (continued)

LEATHERS, TANNING METHODS AND CHARACTERISTICS INCLUDED IN THIS STUDY

Leather	Most Common Tanning Method	Characteristics Governing the Adaptableness for Leathercraft Projects
Cardovan	Vegetable, chrome	Extremely hard, fine-grained, high resistance to abrasion and moisture.
Chamois	Oil tanning	Softness of grain, tensile strength not uniform, and loose textured.
Cowhide	Chrome, combination, vegetable	Made of heavy bundles of fibers, no fat cells which make for sponginess, and thermostat layer occupies one-fifth of layer to give fine appearance. Can be carved, stamped, or embossed.
Goatskin	Combination, vegetable, chrome	Fibers are firm, coarser than calfskin, less spongy than sheepskin.
Kangaroo	Vegetable, chrome	Tough, supple, thick-grained, symmetrical pattern, tightly woven skin structures, intertwined fibers, strongest leather known for its weight and thickness.
Kip	Vegetable, chrome	An intermediate grain which is finer than cowhide and tougher than calfskin.
Lizard	Chrome	Neither stretches nor shrinks. Resistant to abrasion and scuffing.
Pigskin	Vegetable	Resistant to wear, tensile strength is low, but is tough.
Sheepskin	Alum, chrome, vegetable	Leather-forming fibers very thin, loosely interwoven, may be tooled or stamped.

TABLE X (continued)

LEATHERS, TANNING METHODS AND CHARACTERISTICS INCLUDED IN THIS STUDY

Leather	Most Common Tanning Method	Characteristics Governing the Adaptableness for Leathercraft Projects
Skivers	Vegetable, chrome	Soft, weak grain, stretches.
Slunk	Chrome	Very fine grain, velvety finish, suede with fine nap, distinctive color.
Splits	Alum, chrome, vegetable, combination	Characteristics vary as to kind of hide.
Steerhide	Vegetable, chrome	Close-grained, tough, supple, may be carved, tooled or embossed, and stamped.
Suede	Vegetable	Silken nap, uniform color.

Although the tanning processes may vary as the tanner desires, the physical structures which are developed during the lifetime of the animal will characterize each leather.

TABLE XI

PROJECTS, AND LEATHERS USED FOR EACH

Projects	Leathers to be Used	Thickness of Each in Ounces
Baseball covers	Split (cowhide)	Two or three ounces
	Kip	Two or three ounces
Banners	Splits	Two to four ounces
	Kip	Three ounces

TABLE XI (continued)

PROJECTS, AND LEATHERS USED FOR EACH

Projects	Leathers to be Used	Thickness of Each in Ounces
Basketball covers	Cowhide	Four ounces
	Kip	Four ounces
	Steerhide	Four ounces
Belts	Alligator (ladies')	Not measured as to thickness
	Calfskin (ladies')	Four ounces
	Cowhide (men's)	Nine or ten ounces
	Lizard (ladies')	Not measured as to thickness
	Kip (ladies')	Four ounces
	Slunk (ladies')	Not measured as to thickness
	Steerhide (men's)	Nine to twelve ounces
Billfolds	Alligator	Not measured as to thickness
	Calfskin (tooling)	Two or three ounces
	Cardovan	Two or three ounces
	Goatskin	Two or three ounces
	Kangaroo	Two ounces
	Lizard	Not measured as to thickness
	Pigskin	Two or three ounces
	Slunk	Not measured as to thickness
	Splits (steerhide)	Two or three ounces
Bookcovers	Calfskin	Three ounces
	Cabretta	One ounce
	Chamois	Two or three ounces
	Goatskin	Three ounces
	Pigskin	Three or four ounces
	Sheepskin	Three or four ounces
Bookmarks	Calfskin	One or two ounces
	Chamois	One or two ounces
	Sheepskin	Two ounces
	Suede	Two ounces
Bookends	Calfskin (tooling)	Two or three ounces

TABLE XI (continued)

PROJECTS, AND LEATHERS USED FOR EACH

Projects	Leathers to be Used	Thickness of Each in Ounces
Brief cases	Cardovan	Three ounces
	Cowhide	Seven ounces
	Kangaroo	Four ounces
	Kip	Five ounces
	Steerhide	Seven ounces
Cartridge belts	Kip	Four or five ounces
Coin cases	Alligator	Not measured as to thickness
	Calfskin	Two or three ounces
	Cardovan	Two ounces
	Goatskin	Two or three ounces
	Lizard	Not measured as to thickness
	Pigskin	Three ounces
	Slunk	Not measured as to thickness
Cushions	Cabretta	Two ounces
	Goatskin	Two ounces
	Kangaroo	Two ounces
	Skivers	Two ounces
	Splits (cowhide)	Two ounces
Dog collars and harnesses	Cardovan	Three ounces
	Cowhide (split)	Four ounces
	Splits (steerhide)	Four ounces
Football covers	Steerhide	Three or four ounces
Gloves	Kidskin	One ounce
	Sheepskin	One ounce
	Pigskin	Two ounces
	Suede	One ounce
Handbags or purses	Alligator	Not measured as to thickness
	Calfskin	Four ounces
	Cowhide	Seven ounces
	Lizard	Not measured as to thickness
	Pigskin	Four ounces

TABLE XI (continued)

PROJECTS, AND LEATHERS USED FOR EACH

Projects	Leathers to be Used	Thickness of Each in Ounces
	Slunk	Not measured as to thickness
	Steerhide	Seven ounces
Jackets	Splits (steerhide)	Four ounces
	Suede	Three ounces
Jewelry boxes	Skivers	One or two ounces
	Goatskin	One ounce
Knife sheaths	Kip	Three to five ounces
	Splits (cow or steer)	Three to five ounces
Luggage	Cardovan	Three ounces
	Kangaroo	Three or four ounces
	Pigskin	Three or four ounces
	Splits (cow or steer)	Three to five ounces
Linings	Cabretta	One or two ounces
	Chamois	One to three ounces
	Skivers	One or two ounces
	Splits	One to three ounces
	Suede	One to three ounces
	Calfskin	One to two ounces
Letter cases	Calfskin	Two or three ounces
	Goatskin	Two or three ounces
	Kangaroo	Two or three ounces
Moccasins	Cowhide	Three to five ounces
	Steerhide	Three to five ounces
	Sheepskin (wooled)	Four ounces
Notebooks	Calfskin	Three or four ounces
	Cardovan	Three ounces
	Kangaroo	Three ounces
	Splits (cow and steer)	Three or four ounces
	Kip	Four ounces
Pencil cases	Calfskin	Three ounces
	Goatskin	Three ounces
	Kip	Three ounces
	Sheepskin	Three ounces

TABLE XI (continued)

PROJECTS, AND LEATHERS USED FOR EACH

Projects	Leathers to be Used	Thickness for Each in Ounces
Pen wipers	Cabretta	One or two ounces
	Chamois	One or two ounces
	Goatskin	One or two ounces
	Sheepskin	One or two ounces
Pillow tops	Calfskin (tooling)	Two ounces
	Sheepskin (tooling)	Two ounces
	Goatskin (stamped)	Two ounces
Picture frames	Cowhide	Seven to nine ounces
	Steerhide	Seven to nine ounces
Picture albums	Calfskin	Three or four ounces
	Cardovan	Three ounces
	Goatskin	Three ounces
	Sheepskin	Three ounces
	Splits (cow and steer)	Three or four ounces
	Suede	Three ounces
Scuffies	Cowhide	Five to nine ounces
	Steerhide	Five to nine ounces
Volley ball Covers	Cowhide	Two to four ounces
	Kip	Three ounces
	Steerhide	Two to four ounces
Wrist bands	Alligator	Not measured as to thickness
	Calfskin	Three or four ounces
	Cardovan	Three ounces
	Kangaroo	Four ounces
	Kip	Four ounces
	Splits (cow and steer)	Three to five ounces

Those leathers described in Table XI may be secured in many colors, thus giving the leathercraftsman a variety from which to choose.

Conclusions: There are many significant differences in

the characteristics of leathers, as to area measurements, physical properties, and tanning processes, which affect their adaptability for leathercraft purposes. Those leathers that are commonly found in the industrial arts shop are those which should be characterized by definite qualities.

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A P P E N D I X B

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE OF THE LEATHERS INCLUDED IN THIS STUDY

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE OF THE LEATHERS INCLUDED IN THIS STUDY

Splits:

Acme Leather Company, Chicago Illinois.

Hartland Tanning Company, Hartland, Maine.

Russell - Sims Tanning Company, Salem, Massachusetts.

Eagle - Ottawa Leather Company, 305 Ellis Street, Grand Haven, Michigan.

Good Brothers Leather Company, 142 Frelinghuysen, Newark, New Jersey.

Raser Tanning Company, Ashtabula, Ohio.

Merserburg Tannery, Mersersburg, Pennsylvania.

E. Hubschman and Sons, 415 North Fourth Street, Philadelphia, Pennsylvania.

Midwest Tanning Company, South Milwaukee, Wisconsin.

Sawyer Tanning Company, Napa, California.

Manasse - Black Tanning Company, Berkeley, California.

Mellen and Gebhardt, 1775 Egbert, San Francisco, California.

A. K. Salz Company, Santa Cruz, California.

Poetsch and Peterson, 300 Huntington Avenue, South San Francisco, California.

Chicago Tanning Company, 1500 West Cortland, Chicago, Illinois.

Gutmann and Company, Inc., 1511 West Webster Avenue, Chicago, Illinois.

Guiess - Pfleger Tanning Company, Waukegan, Illinois.

August Barth Leather Company, New Albany, Indiana.

Agoos Leather Company, 146 South Street, Boston, Massachusetts.

American Hide and Leather Company, 17 East Street, Boston, Massachusetts.

Beggs and Cobb, Inc., 76 South Street, Boston, Massachusetts.

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

Bernard Company, Inc., 109 South Street, Boston, Massachusetts.

N. Brezner and Company, 121 Beach Street, Boston, Massachusetts.

Gutterman Selverite Company, 212 Summer Avenue, Boston, Massachusetts.

Koran Leather Company, Peabody, Massachusetts.

A. C. Lawrence Leather Company, Peabody, Massachusetts.

Cardovan:

Huch Leather Company, 1525 West Homer, Chicago, Illinois.

M. Foulds and Son, Inc., Hudson, Massachusetts.

S. B. Foot Tanning Company, Red Wing, Minnesota.

John R. Evans Company, Camden New Jersey.

Midwest Tanning Company, South Milwaukee, Wisconsin.

Peter Baran and Sons, Inc., Harrison, New Jersey.

W. B. Place, Seattle, Washington.

Horween Leather Company, 2015 North Elston Avenue, Chicago, Illinois.

Hermann Loewenstein, 26 Ferry Avenue, New York City, New York.

Elkskin:

Berg and Cobb, Inc., 76 South Street, Boston, Massachusetts.

S. B. Foot Tanning Company, Red Wing, Minnesota.

Granite State Tanning Company, Nashua, New Hampshire.

Badger State Tanning Company, Sheboygan, Wisconsin.

N. Brezner and Company, 121 Beach Street, Boston, Massachusetts.

Griess - Pfleger Tanning Company, Waukegan, Illinois

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

Warner Miller and Sons, Johnstown, New York.

Colonial Tanning Company, 207 South Street, Boston, Massachusetts.

Richard and Meyer, North Bergen, New Jersey.

Alliance Leather Company, Inc., 20 Spruce, New York City.

Kips:

Kepner Leather Company, 179 South Street, Boston, Massachusetts.

John R. Evans and Company, Camden, New Jersey.

Monarch Leather Company, 1127 West Davidson, Chicago, Illinois.

Otto Salomon, 20 Spruce Street, New York City.

Badger State Tanning Company, Sheboygan, Wisconsin.

N. Berzner and Company, 121 Beach Street, Boston, Massachusetts.

Mart Waterman Leather Corporation, 20 Spruce, New York City.

Leton Leather Company, 62 Verona Avenue, Newark, New Jersey.

Alliance Leather Company, Inc., 20 Spruce Street, New York City, New York.

Cowhides:

Northwestern Leather Company, 93 Lincoln Avenue,

Sidney Tanning Company, Sidney, Ohio.

Midwest Tanning Company, South Milwaukee, Wisconsin.

California Chemical Tanning Company, Upland, California.

Mart Waterman Leather Company, 20 Spruce Street, New York City.

Legallet Tanning Company, 1099 Quesada Avenue, San Francisco, California.

Staffor Hoffmann Tanning Company, 1001 West Davidson, Chicago, Illinois.

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

The Schratter Company, 204 Franklin Street, New York City.

Pigskin:

U. S. Rawkins Corporation, 7 West 30th Street, New York City.

Charles King Company, Johnstown, New York.

Lewis Meyers and Sons, Inc., 1 Park Avenue, New York City.

Herman Roser and Sons, Glastonbury, Connecticut.

Edgar S. Kiefer Tanning Company, 223 West Lake Street, Chicago, Illinois.

Superior Tanning Company, Inc., 1254 W. Davidson, Chicago, Illinois

Brooks Brothers Leather Company, Amesbury, Massachusetts.

Federal Leather Company, 630 Main Street, Belleville, New Jersey.

John Evans Company, Camden, New Jersey.

Ocean Leather Corporation, 42 Garden Street, Newark, New Jersey.

Karb Brothers, Inc., Johnston, New York.

Salomon and Phillips, 460 Fourth Avenue, New York City.

Bache Brothers, 2002 Central Parkway, Cincinnati, Ohio.

Fred E. Toebe, Department 205-C, 4901-3-5 Spruce Street, Philadelphia, Pennsylvania.

Western Leather Company, 904 E. Pearson, Milwaukee, Wisconsin.

Skivers:

Western Leather Company, 904 E. Pearson Street, Milwaukee, Wisconsin.

Wittman - Morarty Company, Inc., 3227 B. Street, Philadelphia, Pennsylvania.

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

Fred E. Toebe, Department 205 - C, 4901-3-5 Spruce Street, Philadelphia, Pennsylvania.

Drueding Brothers Company, Fifth and Master Street, Philadelphia, Pennsylvania.

Crystal Tanning Company, Zanesville, Ohio.

Salomon and Phillips, 460 Fourth Avenue, New York City.

Bruno Leather Company, Inc., 78 Gold Street New York City.

P. Joyce Company, 47 Garden Street, Newark, New Jersey.

R. Newman and Company, Hoboken, New Jersey.

Morits Eichner, 184 William Street, New York City.

Blodget Tanning Company, Bucksport, Maine.

Barrett and Company, 49 Vesey, Newark, New Jersey.

Otto H. Oppenheimer Company, 382 Frelinghuysen Avenue, Newark, New Jersey.

Steinhardt Leather Company, 199 McWhorter, Newark, New Jersey.

Brightman Leather Company, Inc., 300 Butler, Brooklyn, New York.

Chamois:

P. Joyce Company, 47 Garden Street, Newark, New Jersey.

Salomon and Phillips, 400 Fourth Avenue, New York City.

California Chemical Tanning Company, Upland, California.

Charles King Company, Johnstown, New York.

Cabretta:

Amalgamated Leather Companies, Wilmington, Delaware.

Agoos Leather Company, Inc., 145 South Street, Boston, Massachusetts.

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

G. Lever and Company, 100 Gold Street, New York City.

Salomon and Phillips, 460 Fourth Avenue, New York City.

Hess and Drucker, 468 Fourth Avenue, New York City.

Goat:

Agoos Leather Company, Inc., 145 South Street, Boston, Massachusetts.

Allied Kid Company, 209 South Street, Boston, Massachusetts.

N. C. Lyons Company, Inc., 179 Lincoln Street, Boston, Massachusetts.

Boston Hide and Leather Company, Brookline, Massachusetts.

Willard Helburn, Inc., Peabody, Massachusetts.

Helburn and Thompson Company, Salem, Massachusetts.

Charles King Company, Johnstown, New York.

I. Friedman Leather Company, 32 Spruce Street, New York City.

The Schratter Company, 204 Franklin Street, New York City.

U. S. Rawskin Corporation, 7 West 30th Street, New York City.

Burk Brothers, 925 North Third, Philadelphia, Pennsylvania.

Kid:

Brandenkopf Leather Company, Wilmington, Delaware.

James B. Stewart, Wilmington, Delaware.

Premier Leather Company, 64 South Street, Boston, Massachusetts.

L. H. Hamel Leather Company, Haverhill, Massachusetts.

Benz Kid Company, Lynn, Massachusetts.

Salomon and Phillips Company, 460 Fourth Avenue, New York City.

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

William Amer, 215 Willow Avenue, Philadelphia, Pennsylvania.

Philip C. Schaefer and Son, 2327 North 7th, Philadelphia, Pennsylvania.

Robert D. Smith and Company, 325 Arch Avenue, Philadelphia, Pennsylvania.

Surpass Leather Company, 9th and Westmorland Street, Philadelphia, Pennsylvania.

Fear and White, Gloversville, New York.

Calf:

R. Neumann and Company, Hoboken, New Jersey.

I. Friedman Leather Company, 32 Spruce, New York City.

U. S. Rawskin Corporation, 7 West 30th Street, New York City.

Hiteman Leather Company, West Winfield, New Jersey.

E. Hubschman and Sons, 415 North 4th Street, Philadelphia, Pennsylvania.

Herman Loewenstein, 26 Ferry Street, New York City.

California Chemical Tanning Company, Upland, California.

Wilder and Company, 1038 Crosby, Chicago, Illinois.

Agoos Leather Company, Inc., 148 South Street, Boston, Massachusetts.

A. C. Lawrence Leather Company, Peabody, Massachusetts.

Brightman Leather Company, 300 Butler, Brooklyn, New York.

Salomon and Phillips, 460 Fourth Avenue, New York City.

Philip C. Schaefer and Son, 2327 North 7th, Philadelphia, Pennsylvania.

Barrett and Company, 49 Vesey, Newark, New Jersey.

John Nieder Company, Inc., 247 Emmett, Newark, New Jersey.

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

Ostrich:

R. Newmann and Company, Hoboken, New Jersey.

John Nieder Company, Inc., 247 Emmett, Newark, New Jersey.

Suede:

Brandt Leather Corporation, Norwood, Massachusetts.

U. S. Rawskin Corporation, 7 West 30th Street, New York City.

Amalgamated Leather Companies, Wilmington, Delaware.

James B. Stewart, Wilmington, Delaware.

Hunt - Rankin Leather Company, 106 Beach Street, Boston Massachusetts.

L. H. Hamel Leather Company, Haverhill, Massachusetts.

John R. Evans Company, Camden, New Jersey.

Alliance Leather Company, 20 Spruce Street, New York City.

J. Lichtman and Sons, 241 Frelinghuysen, Newark, New Jersey.

Federal Leather Company, 680 Main Street, Belleville, New Jersey.

John J. Riley Company, Woburn, Massachusetts.

Helburn Thompson Company, Salem, Massachusetts.

Mart Watterman Leather Company, 20 Spruce Street, New York City.

William Amer Company, 215 Willow, Philadelphia, Pennsylvania.

Edward Blank, Son and Company, 110 North 5th Street, Philadelphia, Pennsylvania.

Hood Dungan and Company, Inc., 240 West Susquehanna Avenue, Philadelphia, Pennsylvania.

Surpass Leather Company, 9th and Westmorland Street, Philadelphia, Pennsylvania.

Badger State Tanning Company, Sheboygan, Wisconsin.

COMPANIES THAT SPECIALIZE IN THE MANUFACTURE
OF THE LEATHERS INCLUDED IN THIS STUDY
(continued)

N. Brezner and Company, 121 Beach Street, Boston, Massachusetts.

Hess and Drucker, 468 Fourth Avenue, New York City.

George A. Shepard and Sons Company, Bethel, Connecticut.

Alliance Leather Company, Inc., 20 Spruce Street, New York City.

B. E. Cox Leather Company, Peabody, Massachusetts.

Willard Helburn, Inc., Peabody, Massachusetts.

Kirstein Leather Company, Peabody, Massachusetts.

A. C. Lawrence Leather Company, Peabody, Massachusetts.

Alligator:

Baran Leather Company, Harrison, New Jersey.

Peter Baran and Sons, Inc., Harrison, New Jersey.

Bayer Brothers Leather Company, Inc., 47 West 34th Street, New York City.

Lizard:

Acme Leather Company, 1700 West 13th, Chicago, Illinois.

Gullmann and Company, Inc., 1511 W. Webster Avenue, Chicago, Illinois.

Edgar S. Kiefer Tanning Company, 223 West Lake Street, Chicago, Illinois.

W. D. Byron and Sons of Maryland, Inc., Williamsport, Maryland.

Sheepskin:

Helburn Thompson Company, Salem, Massachusetts.

N. C. Lyons Company, Inc., 179 Lincoln, Boston, Massachusetts.

Donnel and Mudge, Inc., Salem, Massachusetts.

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Legallet Tanning Company, 1099 Quesada Avenue, San Francisco, California.

Otto H. Oppenheimer, 382 Frelinghuysen Avenue, Newark, New Jersey.

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The Schratter Company, 204 Franklin Street, New York City.

Brightman Leather Company, Inc., 300 Butler, Brooklyn, New York.

Morits Eichner, 184 Williams Street, New York City.

Fear and White, Gloversville, New York.

Blodget Tanning Company, Bucksport, Maine.

Leon, Inc., 276 Summer Street, Boston, Massachusetts.

Brandt Leather Corporation, Norwood, Massachusetts.

L. H. Hammel Leather Company, Haverville, Massachusetts.

B. E. Cox Leather Company, Peabody, Massachusetts.

Paul Gallagher and Company, Peabody, Massachusetts.

A. C. Lawrence Leather Company, Peabody, Massachusetts.

Master Industries, Inc., 287 East 6th Street, St. Paul, Minnesota.

Barrett and Company, 49 Vesey, Newark, New Jersey.

Brightman Leather Company, 300 Butler Street, Johnstown, New York.

Kangaroo:

Ersman Ziegel and Company, 99 Frelinghuysen Avenue, Newark, New Jersey.

Surpass Leather Company, 9th and Westmorland Street, Philadelphia, Pennsylvania.

Typist: Eunice B. Smith