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Species Identification of Commercial Crocodilian Skins

F. Wayne King[1] and Peter Brazaitis[2]

(Figures 1-41)

Gross similarities in the morphology of crocodilian skins has made specific identification of individual commercial hides extremely difficult. Qualitative and quantitative differences between the hides of various species are defined and form the basis of a key to commercial crocodilian hides. The distribution, common, and commercial names, distinguishing characteristics of the hides, and the status of the wild populations of each of the 27 species and subspecies is given.

Introduction

To the layman most crocodilians look similar – all have relatively long toothy snouts, scaly backs, flattened oar-like tails, large webbed hindfeet, and most have crossbanded color patterns. As a consequence, most Americans mentally lump all crocodilians under the collective heading "alligator." Profound differences exist between the species of crocodilians, but the untrained eye notices the gross similarities rather than the less obvious differences. When it comes to identifying a species of crocodilian from a commercial hide, however, even a trained herpetologist faces serious difficulty. All commercial skins are grossly alike. All crocodilian leather is retailed throughout the United States as "alligator," while in Europe, Africa, and Asia the same hides are sold as "crocodile."

In this paper, we attempt to provide means to identify commercial crocodilian hides. Since the paper will be read by layman, trained herpetologist, government inspector, and commercial dealer alike, we have endeavored to use terminology comprehensible to all. Where there is a chance of confusion, we have provided photographs and line drawings for clarification.

Materials and Methods

Comparisons were made between the skins of live specimens in zoos and private collections, preserved specimens and dried skins in museum collections, and tanned and finished commercial skins supplied by the Reptile Products Association of the United States. A total of over 350 specimens were examined. Museum specimens of every species and subspecies were studied. Living specimens of every form, except *Caiman crocodilus apaporiensis* and *Crocodylus siamensis,* were seen. Commercial hides of most species were examined. The notable exceptions were *Gavialis gangeticus, Alligator sinensis, Paleosuchus palpebrosus, Paleosuchus trigonatus, Crocodylus palustris,* and *Crocodylus rhombifer.* The raw data are on deposit at the New York Zoological Park. The characters and terms used in this study are defined below.

COMMERCIAL HIDES. Hides used in the crocodilian hide trade for the manufacture of leather goods are termed commercial hides, whether they are raw skins or are in the process of being tanned and finished.

HORNBACK HIDES. Rough dorsal (back) skins obtained by skinning the animals beginning from an incision made along the midventral (belly) line. Large bony dorsal scales, usually with raised keels, occupy the center of the hide. Smooth squarish scales from the ventral surface are located along the lateral edges of the hide. Hornback hides usually are skinned from relatively small specimens since the heavily ossified dorsal scales of adults make their hides stiff and limits its use for leather. Skin from the tail and proximal portion of the legs is attached to the hide (figure 1).

BELLY HIDES. Smooth ventral (belly) skins obtained by skinning the animal beginning at an incision just below the large bony dorsal scales high on one side and continuing down the side, under the body, and up the other side to the

[1] Curator of Herpetology, New York Zoological Park, Bronx, New York 10460.

[2] Assistant Animal Manager, Department of Herpetology, New York Zoological Park, Bronx, New York 10460.

posterior portion of the scar remains as an area of soft skin lacking scales, and because of the profusion of creases and lines it has a distinctly spider-web appearance (figure 7).

VENTRAL COLLAR. Most crocodilians have a prominent row of enlarged scales, called a ventral collar, across the throat just anterior to the front legs (figure 1). A few species lack an enlarged row of scales, so the collar is not conspicuous. One species has a double collar, two enlarged rows of scales.

TRANSVERSE VENTRAL SCALE ROWS. Ventral scales are arranged in transverse rows in all crocodilians, but the number of rows found between the neck and vent differs between species. The transverse rows of ventral scales are counted from the first row posterior to the ventral collar to, but not including, the row of scales encircling the vent (figure 1). The row of scales around the vent may be missing from a commercial hide because the hide-hunter was careless when skinning the animal. In that event the position of the missing rows must be estimated. Only rows which cross the midline are counted. Incomplete or missing rows will add confusing variation to the count, so to eliminate doubt, the count first should be made only to the right of the midline and then repeated on the left side, and the two counts compared.

LARGE-SCALE AND SMALL-SCALE HIDES. Soft-belly crocodilians which have 26 to 35 transverse ventral scale rows are called small-scale hides by the hide trade. Soft-belly species with 20 to 25 transverse ventral scale rows are called large-scale hides (see the key that follows and figure 26).

TAIL WHORLS. The transverse rows of scales under the tail are the ventral portions of the whorls of scales that completely encircle the tail. The ventral portion of these whorls, like the rows of ventral scales on the body, are usually complete and evenly arranged (figure 28). Morelet's crocodile (*Crocodylus moreletii*), however, possesses irregular or incomplete whorls 66 percent of the time (figure 30). No other species shows as high an incidence of irregularity in this character.

Identification of Crocodilian Hides

The following keys can be used to identify the species, or species groups, of commercial belly skins, hornbacks, and sides. The keys are of limited use in identifying throats and girdles, and are useless for flippers. They may be useless in identifying skins already manufactured into finished products.

Keys are identification tools which employ a series of alternative choices. To use the keys, first decide whether or not the hide you wish to identify is a side, belly, or hornback. Once this determination has been made, proceed to the appropriate key. Each set of alternative choices, or couplets, is numbered. Starting with couplet 1, decide which of the two choices, "a" or "b," best describes the hide to be identified. The number that follows the correct choice indicates the next couplet. By moving from couplet to couplet following the numbers shown after each correct choice, you will arrive at a final choice which indicates the species, or species group, of crocodilian from which the hide was taken. Once the identification has been made, you should turn to the text that follows the keys for information on the distribution of the species, the commercial names under which it is sold, additional distinguishing characteristics, and status of the wild populations.

Species identifications supplied by manufacturers are not to be relied on until verified by means of the keys. In the past two years, the authors have seen live African slender-snouted crocodiles and South American caimans shipped into the United States from Bangkok, Thailand, as Siamese crocodiles; finished African dwarf crocodile hides enter from a tanner in France who labelled them gavial; and wallets made from South American caimans arrive from an Italian manufacturer who declared they were Nile crocodile.

A KEY TO COMMERCIAL CAIMAN SIDES

The key to sides is based on the assumption that the sides being identified are from caimans (*Caiman, Melanosuchus,* or *Paleosuchus*), and not from other species. At the present time, caimans are the only crocodilians being skinned in this manner. This may not be the case at some future date. In addition, small finished products such as belts may be pieced together from scrap left over from the manufacture of large belly hide products. These small pieces may come from any species, therefore, the key is of little use in identifying pieced items.

1. a) Rows of large oval scales alternating with rows of small scales (figure 21) . . . *Melanosuchus niger.*
   b) Rows of large scales alternating with network of creases and small irregular scales (figure 16) . . . 2

2. a) Large oval scales, usually smooth, and arranged in distinct rows . . . *Caiman crocodilus* (four subspecies), *Caiman latirostris.*

b) Large oval scales usually keeled, and usually not arranged in distinct rows . . . *Paleosuchus palpebrosus, Paleosuchus trigonatus.*

A KEY TO CROCODILIAN BELLY SKINS AND HORNBACK SKINS

This key is for use with belly skins. Hornback hides can be identified if you limit your attention to the belly scales found along the lateral edges of the hide. Surface pitting is not evident in untanned hides.

1. a) Ventral (belly) scales with follicle glands (figures 22 and 24) . . . 2
   b) Ventral (belly) scales without follicle glands (figures 4, 11, and 18) . . . 4
2. a) Osteoderm buttons present (figures 34 through 37) . . . *Crocodylus cataphractus, Crocodylus niloticus, Osteolaemus tetraspis* (two subspecies).
   b) Osteoderm buttons not present (figure 27) . . . 3
3. a) Transverse rows of ventral scales 20 to 25 . . . *Crocodylus acutus* (south of Panama), *Crocodylus intermedius, Crocodylus johnsoni, Crocodylus novaeguineae* (two subspecies), *Tomistoma schlegelii.*
   b) Transverse rows of ventral scales 26 to 35 . . . *Crocodylus acutus* (north of Panama), *Crocodylus moreletii, Crocodylus niloticus, Crocodylus palustris* (two subspecies), *Crocodylus porosus, Crocodylus rhombifer, Crocodylus siamensis, Gavialis gangeticus.*
4. a) No osteoderm buttons present in midbelly (figure 6), or single buttons present (figure 8) . . . 5
   b) Double osteoderm buttons present in midbelly (figures 14 and 19) . . . 6
5. a) Umbilicus scar has spider-web appearance (figure 7); transverse rows of ventral scales 29 or more . . . *Alligator mississippiensis.*
   b) Umbilicus scar not evident or lacks spider-web appearance; transverse rows of ventral scales 28 or fewer . . . *Alligator sinensis.*
6. a) Large osteoderm buttons present medially only, not over pelvic girdle (figure 19); surface pitting slight; transverse rows of ventral scales 25 or more . . . *Melanosuchus niger.*
   b) Large osteoderm buttons in all large ventral scales, throat to pelvis (figure 13); surface pitting slight to pronounced; transverse rows of ventral scales 18 to 30 . . . 7
7. a) Surface pitting pronounced; transverse rows of ventral scales 20 to 30 . . . 8
   b) Surface pitting slight or absent; transverse rows of ventral scales 18 to 22 . . . *Paleosuchus palpebrosus, Paleosuchus trigonatus.*
8. a) Transverse rows of ventral scales 26 to 30; double ventral collar . . . *Caiman latirostris.*
   b) Transverse rows of ventral scales 20 to 27; single ventral collar . . . *Caiman crocodilus* (four subspecies).

In the text that follows, the species and subspecies are listed alphabetically by scientific name within each family. The systematic arrangement follows Wermuth and Mertens (1961).

Family ALLIGATORIDAE

AMERICAN ALLIGATOR

Alligator mississippiensis (Daudin)

DISTRIBUTION. Southeastern United States – the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, and Texas. This species does not occur outside the United States (Schmidt, 1953; U.S. Department of Interior, 1968; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is also called the Florida and the Mississippi alligator, or gator. Hides are marketed as American, Florida, or Louisiana alligator or soft-belly.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* No follicle glands. No osteoderm buttons (large specimens from Florida have single osteoderm buttons on the throat). Transverse ventral scale rows 29 or more. Umbilicus scar prominent and with spider-web appearance. Maximum length of live specimen is 18 feet.

STATUS OF WILD POPULATIONS. Endangered (Honegger, 1968; Pan American Union, 1967; U.S. Department of Interior, 1968). Now protected by state law in every state in which it occurs; by federal prohibition on interstate traffic in illegal hides; and by local and state prohibitions on sales of live specimens, hides, and hide products.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* No follicle glands. Full double osteoderm buttons, at least medially. Lateral scales may lack osteoderms or possess small osteoderms in center of scales. Surface pitting slight. Transverse ventral scale rows 25 to 28. *Sides:* Parallel rows of large oval scales alternating with rows of small oval scales. Maximum length of live specimen is 16 feet.

STATUS OF WILD POPULATIONS. Endangered (Honegger, 1968; Pan American Union, 1967). Rapidly declining everywhere, and exterminated in many areas. South American countries prohibit the export of untanned hides. Peru prohibits the killing of specimens less than 2 meters in length (Honegger, 1968).

DWARF CAIMAN

Paleosuchus palpebrosus (Cuvier)

DISTRIBUTION. Northern and central South America – Amazon and Orinoco river drainages of Colombia, Venezuela, Guyana, Brazil, Peru, Ecuador, and Bolivia (Carvalho, 1955; Medem, 1967, 1968; Schmidt, 1928b; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is also called musky caiman and Cuvier's smooth-fronted caiman. In South America it is called *cachirré, jacaré coroá,* and *yacaré coroá.* Hides are marketed under these names.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* No follicle glands. Full double osteoderm buttons on all large ventral scales. Surface pitting slight or absent. Transverse ventral scale rows 18 to 22. Single prominent ventral collar. *Sides:* Large scales scattered, not in well-defined rows, and separated by wide areas of soft skin. Maximum length of live specimen is 5½ feet.

STATUS OF WILD POPULATIONS. Declining in numbers (Pan American Union, 1967). *Paleosuchus* is possibly the least persecuted of the crocodilians at the present time. Its small size and heavy osteoderm buttons make the skins less desirable than skins from the larger caimans and crocodiles of South America. South American countries prohibit the export of untanned hides.

SMOOTH-FRONTED CAIMAN

Paleosuchus trigonatus (Schneider)

DISTRIBUTION. Northern and central South America – the Amazon and Orinoco river drainages of Colombia, Venezuela, Guyana, Brazil, Ecuador, Peru, and Bolivia (Carvalho, 1955; Medem, 1967, 1968; Schmidt, 1928b; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is also called Schneider's smooth-fronted caiman. In South America it is called *cachirré, jacaré coroá, jacaré curuá,* and *yacaré coroá.* Hides are marketed under these names.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* No follicle glands. Full double osteoderm buttons on all large ventral scales. Surface pitting slight or absent. Transverse ventral scale rows 18 to 22. Single prominent ventral collar. *Sides:* Scattered large keeled oval scales, not in well-defined rows, and separated by wide areas of soft skin. Maximum length of live specimen is 7 feet.

STATUS OF WILD POPULATIONS. Declining in numbers (Pan American Union, 1967). *Paleosuchus* is possibly the least persecuted of the crocodilians. Its small size and heavy ossification of the osteoderms makes the skins less desirable than skins from the larger caimans and crocodiles of South America. South American countries prohibit the export of untanned hides.

Family CROCODYLIDAE

AMERICAN CROCODILE

Crocodylus acutus Cuvier

DISTRIBUTION. Florida, West Indies, Central and northern South America – southern Florida, Cuba, Hispaniola (Haiti and Dominican Republic), Jamaica, Mexico south to Colombia and Venezuela, exclusive of the Orinoco river drainage system (Cochran, 1941; Medem, 1968; Smith and Taylor, 1950; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. In Central America and Cuba it is called *caimán,* and in South America it is known as *caimán* and *caimán de aguja.* Hides may be marketed under these names, or simply as Central or South American "alligator," crocodile, soft-belly, small scale (north of Panama) or large scale (south of Panama).

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 25 to 35. Tail whorls regular ventrally. Maximum length of live specimen is 23 feet.

STATUS OF WILD POPULATIONS. Declining everywhere due to excessive hide-hunting (Pan American Union, 1967). The species is considered endangered by some experts (Honegger, 1968). Many populations in Central and South America have been totally exterminated. The species is protected by state law in Florida, and South American countries prohibit the export of untanned hides. Mexico regulates the hunting of the species, as does Nicaragua. Jamaica prohibits the export of crocodiles, their eggs, or skins (K.C. Hall, 1970, in *litt.*). The species is protected in Cuba and Colombia, although the law is not enforced in the latter (Honegger, 1968).

AFRICAN SLENDER-SNOUTED CROCODILE

Crocodylus cataphractus Cuvier

DISTRIBUTION. Western and central Africa – the Congo, Niger, and Volta river drainages, and the coastal rivers from Senegal south to northern Angola. Only once recorded from East Africa at Ujiji, Tanzania, on Lake Tanganyika (Schmidt, 1919; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is sometimes called the West African crocodile, African long-nosed crocodile, African gavial, or sub-water crocodile. Hides are sold under these names or as Nigerian, Congo, or Cabinde "alligator," crocodile, or button hides.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. Round or elliptical single osteoderm buttons present. Surface pitting may or may not be present. Transverse ventral scale rows 25 to 29. Hides from Nigeria usually are missing the tip of the tail, due to local hunting practices. Skins from other parts of Africa usually have complete tails. Maximum length of live specimen is 13 feet.

STATUS OF WILD POPULATIONS. Critically endangered (A. C. Pooley, 1971, personal communication). This species is limited to large rivers, and is rarely abundant anywhere. Populations are declining everywhere due to hide hunting and the spread of human population (Lowes, 1970).

ORINOCO CROCODILE

Crocodylus intermedius Graves

DISTRIBUTION. Northern South America – the Orinoco river drainage of Colombia (east of the Andes), Venezuela, and possibly Guyana (Medem, 1968; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is called *caimán* in South America. It is marketed under this name, or as Colombian, Venezuelan, or Venezuelan delta "alligator," crocodile, large scale, or soft-belly.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 20 to 25. Tail whorls usually regular. Maximum length of live specimen is 23 feet.

STATUS OF WILD POPULATIONS. Endangered (Pan American Union, 1967; U.S. Department of Interior, 1970). Because of excessive hide hunting the species is now rare in Venezuela, and apparently exterminated in Colombia (Honegger, 1968). South American countries prohibit the export of untanned hides. Colombia has legislation prohibiting the hunting of crocodiles, but it is not enforced (Honegger, 1968). Import is prohibited under provision of the Endangered Species Conservation Act (U.S. Department of Interior, 1970).

JOHNSON'S CROCODILE

Crocodylus johnsoni Krefft

DISTRIBUTION. Northern Australia—from the Fitzroy River in northern Western Australia to Mackay in eastern Queensland (Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933; Worrell, 1963).

OTHER COMMON NAMES. In Australia it is called the freshwater crocodile, Johnson's river crocodile, Johnstone's crocodile, and fish crocodile. It may be marketed under these names, or as Australian or Singapore "alligator," gator, crocodile, soft-belly, or large scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 22 to 24. Tail whorls usually regular. Maximum length of live specimen is 9½ feet.

STATUS OF WILD POPULATIONS. Rare (Honegger, 1968). The species is completely protected by law in Western Australia and Northern Territories, but skins are still shipped from Queensland (Fauna Preservation Society, 1970b; Green, 1969; Honegger, 1968).

MORELET'S CROCODILE

Crocodylus moreletii Duméril, Bibron and Duméril

DISTRIBUTION. Northern Central America – Atlantic and Pacific coasts of Mexico, British Honduras, and Guatemala (Smith and Taylor,

1950; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is sometimes called Belize crocodile or Central American crocodile. In Central America it is called "alligator," *caimán*, and *lagarto de El Petén*. Hides are marketed under these names, or as Mexican "alligator," crocodile, small scale, or soft-belly.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 27 to 32. Tail whorls irregular (66 percent of the time). Maximum length is 8 feet.

STATUS OF WILD POPULATIONS. Endangered (Honegger, 1968; Pan American Union, 1967; U.S. Department of Interior, 1970). This species has all but been eliminated from British Honduras and parts of Guatemala (Charnock-Wilson, 1970). It is still locally abundant in parts of Mexico (Fauna Preservation Society, 1969b). Mexico has protective laws but they are unenforced (Honegger, 1968). Guatemala began enforcing its protective legislation in 1970. Importation is prohibited under provision of the Endangered Species Conservation Act (U.S. Department of Interior, 1970).

NILE CROCODILE

Crocodylus niloticus Laurenti

DISTRIBUTION. Africa (all of Africa except the northwest corner and central Sahara); east along the Mediterranean coast to Syria; Malagasy Republic (Madagascar); and Seychelles, Comoros, and Mauritius (Schmidt, 1919; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is also called the Nilotic crocodile. Hides are marketed as African, Ethiopian, Kenya, Madagascan, or Nile "alligator," "caiman," crocodile, small scale, button-belly, or soft-belly.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. Usually no buttons, but occasionally single buttons may be present in the midbelly and collar area. Transverse ventral scale rows 26 to 32. Tail whorls usually regular. Hides from Nigeria have the tip of the tail missing due to local hunting practices. The tails are complete on hides from elsewhere. Maximum length of live specimen is probably 18 feet.

STATUS OF WILD POPULATIONS. Endangered (Cott, 1961; Honegger, 1968; Pooley, 1969; U.S. Department of Interior, 1970). This species has been exterminated over large areas of Africa by hide hunters (Fauna Preservation Society, 1969c, 1969d, 1970a; Lowes, 1970; Pooley, 1970, in *litt.*). It can be found in numbers only in small local populations. It is extinct in the Seychelles and Mauritius. It is protected by law in most East African countries and in national parks and game preserves (Cott, 1969). Hunting of this species is to be regulated throughout all of Africa by the African Convention for the Conservation of Nature and Natural Resources (Burhenne, 1970; Honegger, 1968). South Africa has set up a research program in hopes of saving the species and restocking it in areas where it has been exterminated (Pooley, 1970). Importation is prohibited under provision of the Endangered Species Conservation Act (U.S. Department of Interior, 1970).

NEW GUINEA CROCODILE

Crocodylus novaeguineae novaeguineae Schmidt

DISTRIBUTION. New Guinea (Schmidt, 1928a, 1932; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is also called the New Guinea freshwater crocodile. Hides may be marketed as Australia, New Guinea, or Singapore "alligator," crocodile, soft-belly, or large scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 24 to 25. Tail whorls usually regular. Maximum length of live specimen is 9½ feet.

STATUS OF WILD POPULATIONS. Rare (Honegger, 1968). Populations are declining rapidly due to hide hunting. Specimens over 20 inches in belly width are protected by laws in most of Papua and Northeast New Guinea (Bustard, 1970; Fauna Preservation Society, 1969a; Honegger, 1968).

PHILIPPINE CROCODILE

Crocodylus novaeguineae mindorensis Schmidt

DISTRIBUTION. Philippine Islands—Luzon, Mindoro, and Mindanao Islands (Schmidt, 1935; Wermuth, 1953; Wermuth and Mertens, 1961).

OTHER COMMON NAMES. Also called the Mindoro crocodile and Philippine freshwater crocodile. Hides may be marketed under the name Philippine or Singapore "alligator," crocodile, soft-belly, or large scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 24 to 26. Tail whorls usually regular. Maximum length of live specimen is 8 feet.

STATUS OF WILD POPULATIONS. Rare, possibly endangered. Hide hunting is eliminating the species from parts of its former range.

MUGGER CROCODILE

Crocodylus palustris palustris Lesson

DISTRIBUTION. India and Pakistan – from the Dasht River in West Pakistan through all the river systems of India to the Brahmaputra River drainage in the east (De Rooij, 1915; Schmidt, 1935; Smith, 1931; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. Also called the marsh crocodile, broad-snouted crocodile, swamp crocodile, and Indian freshwater crocodile. Hides may be marketed as Indian "alligator," crocodile, soft-belly, or small scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 26 to 32. Ventral collar not distinct (no enlarged scales). Tail whorls usually regular. Maximum length of live specimen is 13 feet.

STATUS OF WILD POPULATIONS. Endangered. The species is protected in India by a ban on the export of crocodile hides, and in Pakistan by a ban on the export of all wild animal hides (Fauna Preservation Society, 1967, 1970c; Mountfort, 1969).

CEYLON MUGGER CROCODILE

Crocodylus palustris kimbula Deraniyagala

DISTRIBUTION. Ceylon (Deraniyagala, 1936, 1939, 1953; Wermuth, 1953; Wermuth and Mertens, 1961).

OTHER COMMON NAMES. It is also called the Ceylon swamp crocodile, Ceylon marsh crocodile, and lake crocodile. In Ceylon it is known as *hale kimbula, ala kimbula,* and *kulathi muthele.* It may be marketed as Ceylon "alligator," crocodile, soft-belly, or small scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 26 to 32. Ventral collar present and distinct. Tail whorls regular. Maximum length of live specimen is 18 feet.

STATUS OF WILD POPULATIONS. Declining in numbers. Hunting is regulated by the Ceylon government (Fauna Preservation Society, 1970e).

SALTWATER CROCODILE

Crocodylus porosus Schneider

DISTRIBUTION. India and Ceylon east to Australia and New Guinea – the coastal rivers, lagoons, and marshes from Cochin in extreme southwestern India east to Ceylon, Burma, Malaysia, Thailand, Cambodia, Vietnam, Indonesia, the Philippines, Palau Islands, northern Australia, New Guinea, Solomon Islands, New Hebrides, and Fiji (Deraniyagala, 1939, 1953; De Rooij, 1915; Schmidt, 1932; Taylor, 1970; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933; Worrell, 1963).

OTHER COMMON NAMES. It is also called the estuarine crocodile, gator (in Australia), and sea-going crocodile. In Ceylon it is known as *pita gatteya, gatte kimbula, gorekeya,* and *semmukhan;* in Indonesia, *buaja;* in Malaysia, *buaja, buaya, baya,* and *rawing.* Hides may be marketed under these names, or as Indian, Javan, Philippine, Singapore, Sumatran, or Thailand "alligator," crocodile, soft-belly, or small scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 30 to 35. Tail whorls regular. Maximum length of live specimen is probably 25 feet.

STATUS OF WILD POPULATIONS. Most populations are declining rapidly due to hide hunting, and the species is non-existent in some parts of its former range where it was once abundant (Fauna Preservation Society, 1970d; Honegger, 1968). It is partially protected in most of Papua and North East New Guinea, where specimens over 20 inches belly width may not be killed (Fauna Preservation Society, 1969a; Bustard, 1970). The species is completely protected in Western Australia until 1980 (Fauna Preservation Society, 1970b; Honegger, 1968). Indonesia has imposed size limits. Ceylon, India, and Pakistan protect the species completely by banning the export of all crocodile skins or the skins of all wild animals (Fauna Preservation Society, 1967; Honegger, 1968; Mountfort, 1969). Singapore requires export licenses. Deraniyagala (1939, 1953) mistakenly listed this species as occurring on the Seychelles and Mauritius where *Crocodylus niloticus* was known to occur in the past.

CUBAN CROCODILE

Crocodylus rhombifer Cuvier

DISTRIBUTION. Cuba and the Isle of Pines (Barbour and Ramsden, 1919; Varona, 1966; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. In Cuba it is called *cocodrilo, cocodrilo perla, cocodrilo criollo, cocodrilo legitimo, caimán,* and occasionally *zaquendo.*

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 32 to 33. Tail whorls regular. Maximum length of live specimen is 16 feet.

STATUS OF WILD POPULATIONS. Endangered (Honegger, 1968; U.S. Department of Interior, 1970). The species once occurred on the Isle of Pines from which it has been exterminated. Today it only occurs in remnants of the Zapata Swamp on the south coast of Cuba, but hide hunting and land drainage has made it very nearly extinct even there. The Cuban government protects this species rigidly and has established a captive breeding facility in the Zapata Peninsula National Park in an attempt to save it from extinction (Honegger, 1968). Importation is prohibited under provision of the Endangered Species Conservation Act (U.S. Department of Interior, 1970).

SIAMESE CROCODILE

Crocodylus siamensis Schneider

DISTRIBUTION. Southeast Asia—Thailand, Cambodia, Vietnam, and Java (De Rooij, 1915; Smith, 1931; Taylor, 1970; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It may also be called the Siamese freshwater crocodile. In Indonesia it is called *buaja.* Hides may be sold as Java, Singapore, or Thailand "alligator," crocodile, soft-belly or small scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 30 to 34. Tail whorls regular. Maximum length of live specimen is 13 feet.

STATUS OF WILD POPULATIONS. Endangered. It has always been a rare animal in Indonesia, and became scarce in Thailand 30 years ago due to hide hunting. Today fewer than 200 remain in the wild in Thailand, but approximately 9,000 specimens are protected in the Sumatprakan Crocodile Farm in Bangkok (U. Youngparpakorn, 1971, personal communication).

WEST AFRICAN DWARF CROCODILE

Osteolaemus tetraspis tetraspis Cope

DISTRIBUTION. West Africa – the Niger and Senegal river drainages and other rivers south of the Sahara and north of the Congo River drainage (Schmidt, 1919; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is also called the broad-snouted crocodile. Hides may be marketed as African "caiman," button-belly, bony crocodile, black crocodile, or rough-back crocodile.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. Large single osteoderm buttons present. Surface pitting usually evident. Transverse ventral scale rows 21 to 27. Maximum length of live specimen is 6½ feet.

STATUS OF WILD POPULATIONS. Endangered (A. C. Pooley, 1971, personal communication). Populations declining due to hide hunting, destruction of habitat, and live animal collecting (Lowes, 1970). This species has never been as abundant as the other African species.

CONGO DWARF CROCODILE

Osteolaemus tetraspis osborni (Schmidt)

DISTRIBUTION. Central Africa—the Congo River drainage (Schmidt, 1919; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. Also called the Central African dwarf crocodile, Osborn's dwarf crocodile, and African broad-snouted crocodile. Hides may be marketed as African "caiman," button-belly, bony crocodile, black crocodile, or rough-back crocodile.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. Large single osteoderm buttons present. Surface pitting usually evident. Transverse ventral scale rows 21 to 27. Maximum length of live specimen is 5 feet.

STATUS OF WILD POPULATIONS. Endangered (A. C. Pooley, 1971, personal communication). This species does not occur in large populations. Its numbers are declining due to hide hunting.

FALSE GAVIAL

Tomistoma schlegelii (Muller)

DISTRIBUTION. Southeast Asia – Indonesia (Kalimantan and Sumatra) and Malaysia

(De Rooij, 1915; Taylor, 1970; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. It is also called the Malay gavial, Malayan gharial, and Malayan fish crocodile. In Indonesia it is called *bediai sampit* and *buaja sapit;* in Malaya, *buaya senjulong;* in Sarawak, *baya kanulong.* Hides may be sold under these names, or as Singapore "alligator," crocodile, soft-belly, or large scale.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 22 to 24. Tail whorls usually regular. Maximum length of live specimen is 16 feet.

STATUS OF WILD POPULATIONS. Declining in numbers, soon to be endangered. Hide hunters have so decimated the populations of this animal in Malaysia that protective legislation is being considered (Lucas Chin, 1970, personal communication).

Family GAVIALIDAE

GAVIAL

Gavialis gangeticus (Gmelin)

DISTRIBUTION. India, Pakistan, and Burma – specifically the Indus, Mahandi, Ganges, Brahmaputra, and Kaladan river drainage systems, and possibly parts of the Irawaddy system in northwestern Burma (Smith, 1931; Wermuth, 1953; Wermuth and Mertens, 1961; Werner, 1933).

OTHER COMMON NAMES. In India it is called *gharial.* Hides may be sold as Indian soft-belly, small scale, "alligator," "crocodile," or gavial.

DISTINGUISHING CHARACTERISTICS OF COMMERCIAL HIDES. *Belly skins:* Follicle glands present. No osteoderm buttons. Transverse ventral scale rows 30 to 31. Ventral collar not prominent. Maximum length of live specimen is 21½ feet.

STATUS OF WILD POPULATIONS. Endangered (U.S. Department of Interior, 1970). Protected in India by a ban on the export of all crocodilian hides, and in Pakistan by a ban on the export of all wild animal hides (Fauna Preservation Society, 1967, 1970c; Mountfort, 1969). Importation is prohibited under provisions of the Endangered Species Conservation Act (U.S. Department of Interior, 1970).

ACKNOWLEDGMENTS

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LITERATURE CITED

BARBOUR, T., AND C. T. RAMSDEN

1919. The herpetology of Cuba. Mem. Mus. Comp. Zool., 47(2): 73-213.

BURHENNE, W. E.

1970. The African Convention for the Conservation of Nature and Natural Resources. Biol. Conservation, 2(2): 105-114.

BUSTARD, H. R.

1970. A future for crocodiles. Oryx, 10(4): 249-255.

CARVALHO, A. L. DE

1955. Os jacarés do Brasil. Arquivos Mus. Nac., 42(1): 127-139.

CHARNOCK-WILSON, J.

1970. Manatees and crocodiles. Oryx, 10(4): 236-238.

COCHRAN, D. M.

1941. The herpetology of Hispaniola. U.S. Nat. Mus. Bull. 177: 1-398.

COTT, H. B.

1961. Scientific results of an inquiry into the ecology and economic status of the Nile crocodile (*Crocodilus niloticus*) in Uganda and Northern Rhodesia. Trans. Zool. Soc. London, 29(4): 211-356.

1969. Tourists and crocodiles in Uganda. Oryx, 10(3): 153-160.

CROWE, P. K.

1965. What is happening to the wildlife of South America. Oryx, 8(1): 28-37.

DERANIYAGALA, P. E. P.

1936. A new crocodile from Ceylon. Ceylon J. Sci. (B) 19: 279-286.

1939. The tetrapod reptiles of Ceylon. Vol. 1, Testudinates and Crocodilians. Colombo Mus. Nat. Hist. Ser. xxxii + 412 pp.

1953. A colored atlas of some vertebrates from Ceylon. Vol. 2, Tetrapod Reptilia. Ceylon Nat. Mus. Publ. vii + 101 pp.

DE ROOIJ, N.

1915. The reptiles of the Indo-Australian archipelago. Vol. 1, Lacertilia, Chelonia, Emydosauria. E. J. Brill Ltd., Leiden. xiv + 384 pp.

FAUNA PRESERVATION SOCIETY

1967. No crocodiles from India. Oryx, 9(3): 184.

1969a. Protection for Papua's crocodiles. Oryx, 10(2): 81.

1969b. Morelet's crocodile near extinction. Oryx, 10(2): 88.

1969c. Crocodiles decrease in Natal. Oryx, 10(3): 144.

1969d. Crocodiles in Blue Nile gorge. Oryx, 10(3): 144.

1970a. Crocodiles going in Uganda. Oryx, 10(4): 208-209.

1970b. Crocodiles in Australia. Oryx, 10(4): 213.

1970c. Two crocodiles in trouble. Oryx, 10(5): 287.

1970d. Sarawak crocodiles. Oryx, 10(5): 295.

1970e. Poaching in Ceylon. Oryx, 10(5): 295.

GREEN, K.

1969. Rare fauna. Walkabout, 35(4): 6.

HONEGGER, R.

1968. Red Data Book. Volume 3 – Amphibia and Reptilia. International Union for the Conservation of Nature and Natural Resources, Survival Service Commission, Morges, Switzerland. Loose leaf n.p.

LOWES, R. H. G.

1970. Destruction in Sierra Leone. Oryx, 10(5): 309-310.

MEDEM, F.

1955. A new subspecies of *Caiman sclerops* from Colombia. Fieldiana: Zool., 37: 339-344.

1963. Osteologia craneal, distribucion geografica y ecologia de *Melanosuchus niger* (Spix) (Crocodylia, Alligatoridae). Revista Acad. Colombiana Cien. Exactas, Fis. y Nat., 12(45): 5-19.

1967. El genero *Paleosuchus* en Amazonia. Simposio Biota Amazonica, 3: 141-162.

1968. El desarrollo de la herpetologia en Colombia. Revista Acad. Colombiana Cien. Exactas, Fis. y Nat., 13(50): 149-199.

MOUNTFORT, G.

1969. Pakistan's progress. Oryx, 10(1): 39-43.

PAN AMERICAN UNION

1967. Listas de especies de fauna y flora en vias de extincion en los estados miembros. La Convencion para la Proteccion de la Flora, de las Fauna y de las Bellezas Escienças Naturales de los Estados Americanos. Organization of American States. ii + 48 pp.

POOLEY, A. C.

1969. Rearing crocodiles in Zululand. African Wildlife, 23(4): 314-320.

1970. Crocodile rearing in Zululand. Animals, 13(2): 76-79.

POPE, C.

1935. The reptiles of China. Nat. Hist. Central Asia. Vol. 10. Amer. Mus. Nat. Hist. lii + 604 pp.

SCHMIDT, K. P.

1919. Contributions to the herpetology of the Belgian Congo based on the collection of the American Congo Expedition, 1909-1915. Bull. Amer. Mus. Nat. Hist., 39(2): 385-624.

1928a. A new crocodile from New Guinea. Field Mus. Nat. Hist. Zool. Ser., Publ. 247, 12(14): 177-181.

1928b. Notes on South American caimans. Field Mus. Nat. Hist. Zool. Ser., Publ. 252, 12(17): 205-231.

1932. Notes on New Guinea crocodiles. Field Mus. Nat. Hist. Zool. Ser., Publ. 310, 18(8): 167-172.

1935. A new crocodile from the Philippine Islands. Field Mus. Nat. Hist. Zool. Ser., 20(8): 67-70.

1953. A checklist of North American amphibians and reptiles. 6th ed. Univ. Chicago Press. vii + 280 pp.

SMITH, M.

1931. The fauna of British India. Reptilia and Amphibia. Vol. 1, Loricata, Testudines. Taylor and Francis, London. xxviii + 185 pp.

SMITH, H. M., AND E. H. TAYLOR

1950. An annotated checklist and key to the reptiles of Mexico exclusive of the snakes. U.S. Nat. Mus. Bull. 199: 1-253.

TAYLOR, E. H.

1970. The turtles and crocodiles of Thailand and adjacent waters. Univ. Kansas Sci. Bull., 49(3): 87-179.

U.S. DEPARTMENT OF INTERIOR

1968. American alligator. Rare and endangered fish and wildlife of the United States. U.S. Dept. Interior, Bur. Sport Fish. Wildlife, Washington, D.C., Sheet RA-2.

1970. List of endangered foreign fish and wildlife. Title 50—Wildlife and Fisheries. Federal Register, 35(233): 18319-19322.

VARONA, L. S.

1966. Notas sobre los crocodilidos de Cuba y descripcion de una nueva especie del Pleistocene. Poeyana Inst. Biol., Ser. A, No. 16: 1-34.

WERMUTH, H.

1953. Systematik der Rezenten Krokodile. Mitteil. Zool. Mus. Berlin, 29(2): 375-514.

WERMUTH, H., AND R. MERTENS

1961. Schildkroten, Krokodile, Bruckenechsen. Veb Gustav Fischer Verlag, Jena. xxvi + 422 pp.

WERNER, F.

1933. Reptilia, Loricata. Das Tierreich. Gruyter and Co., Berlin. xiii + 40 pp.

WORRELL, E.

1963. Reptiles of Australia. Angus and Robertson, Sydney. xv + 207 pp.

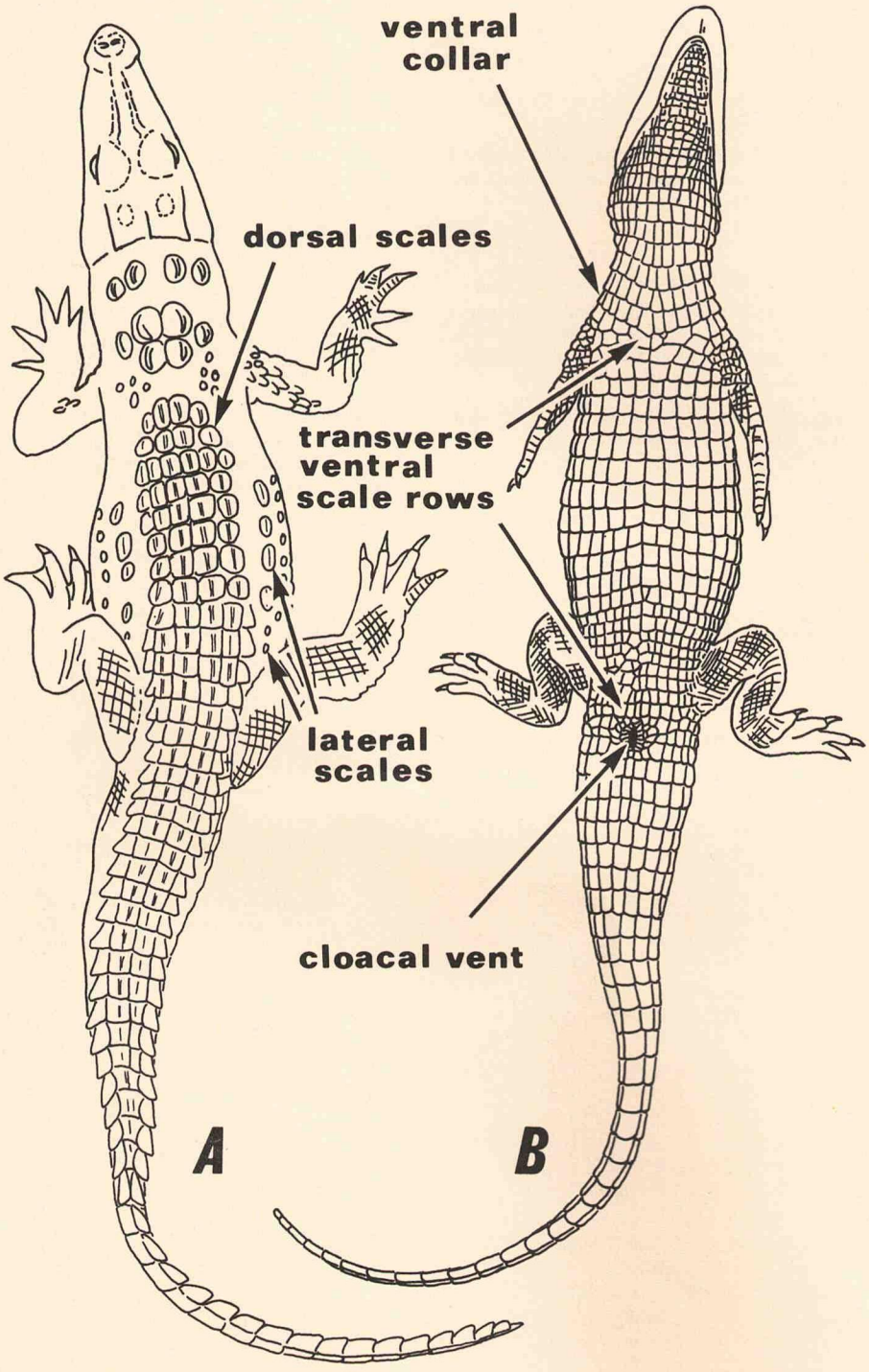

FIGURE 1. Diagrammatic dorsal (A) and ventral (B) views of a crocodilian. Hornback hides consist of most of the skin seen in A (skull and feet are absent). Belly hides consist of most of the skin seen in B (skull and feet are absent and the lateral [side] skin is attached). Transverse scale rows are counted by beginning and ending with the rows indicated by the arrows.

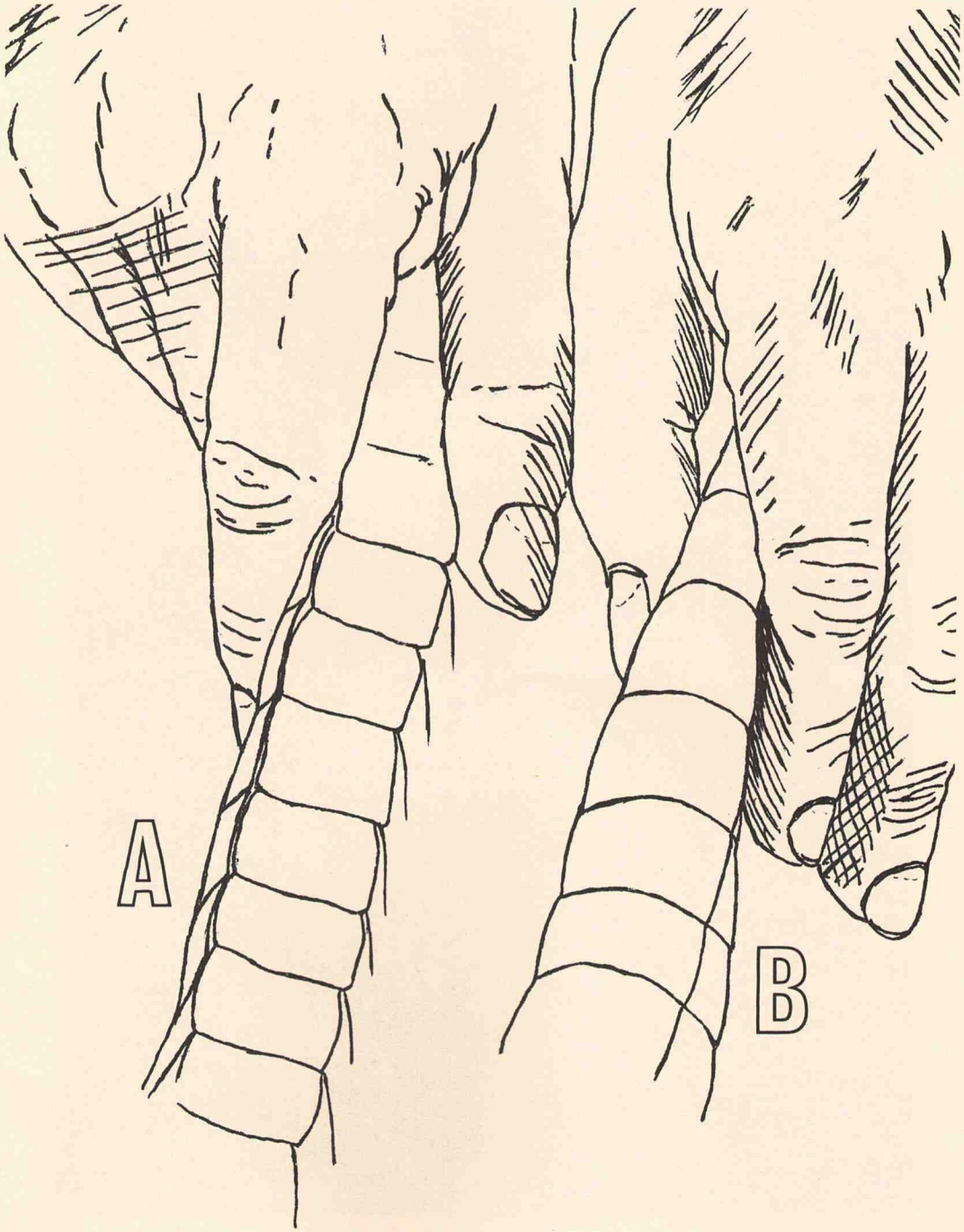

FIGURE 2. Comparative flexibility of a button-belly (A) and a soft-belly (B) hide. The hard osteoderms in the scales permit the button-belly hide to flex only between the scales, while the soft-belly hide will also flex through the scales.

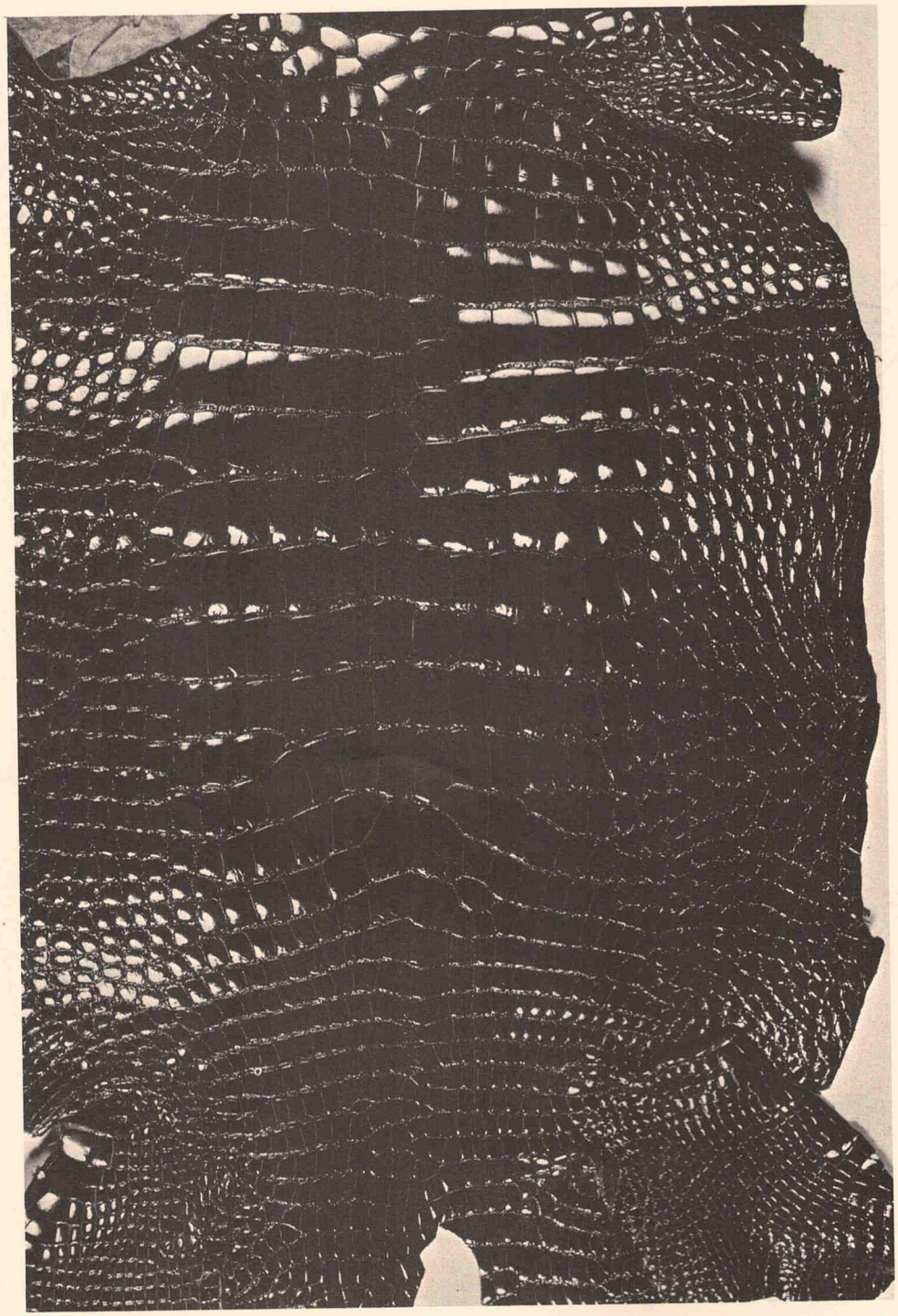

FIGURE 3. Outside surface of a finished American alligator (*Alligator mississippiensis*) belly hide. Closer views of the ventral scales and spider-web umbilicus are provided in figures 5 and 7.

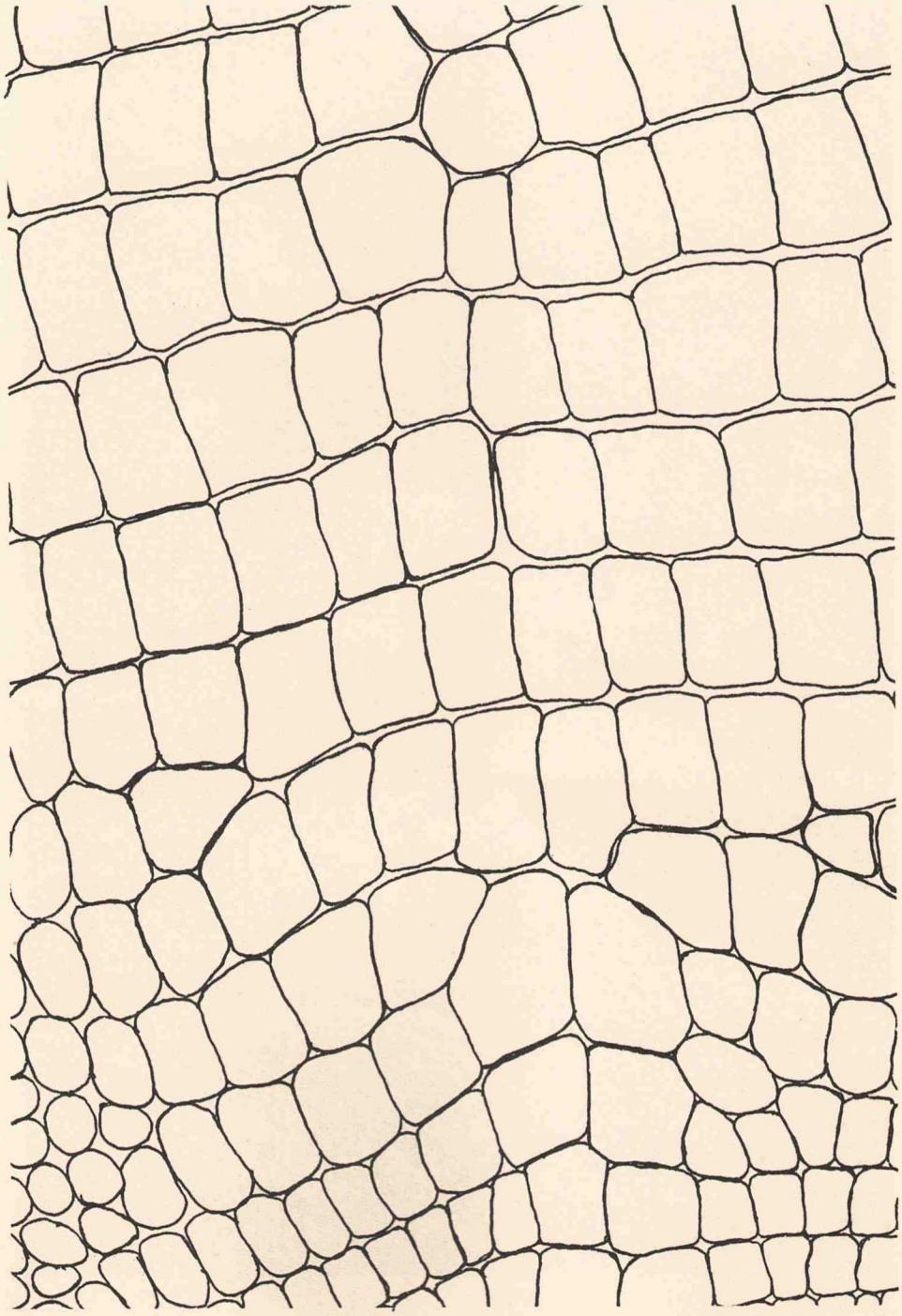

FIGURE 4. Diagrammatic illustration of the American alligator ventral scales shown in figure 5. Note the lack of both surface pitting and follicle glands.

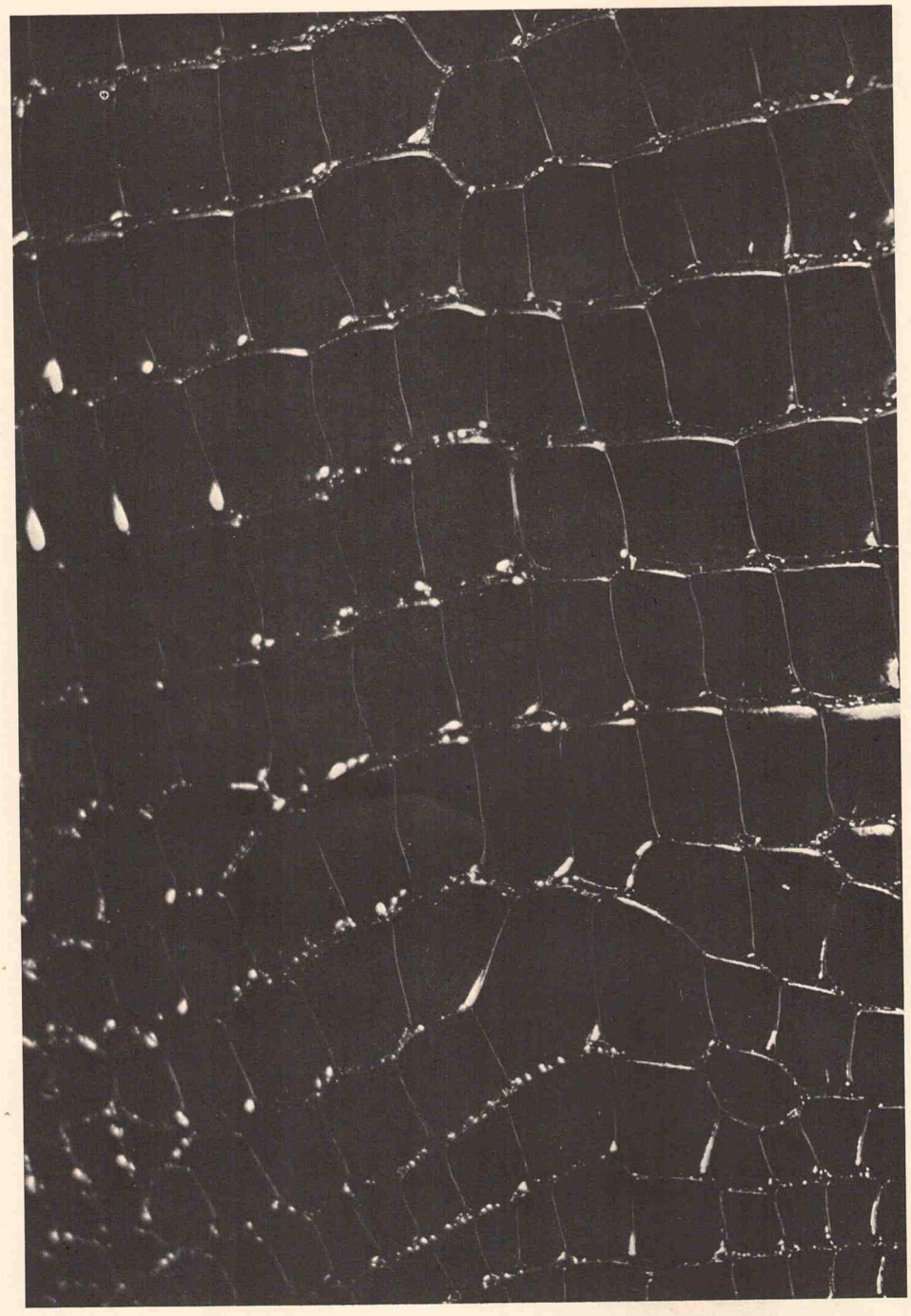

FIGURE 5. Ventral scales of a finished American alligator (*Alligator mississippiensis*) belly hide. Compare it with figure 4.

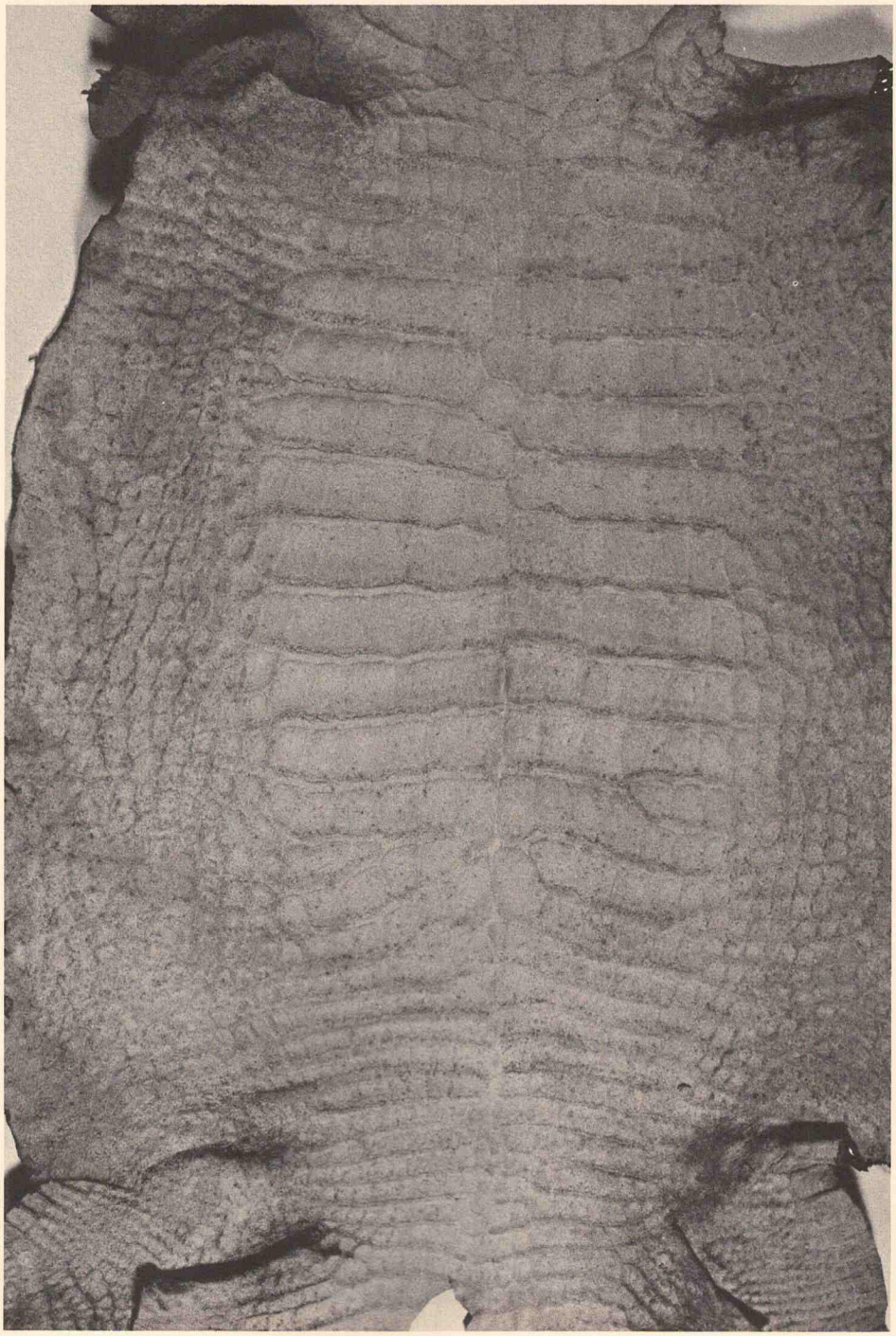

FIGURE 6. Inside surface of a finished adult American alligator (*Alligator mississippiensis*) belly hide. Note the total absence of osteoderm buttons, which indicates the specimen probably came from Louisiana. Compare the inside of the ventral collar, just visible at the top of the photograph, with figure 8.

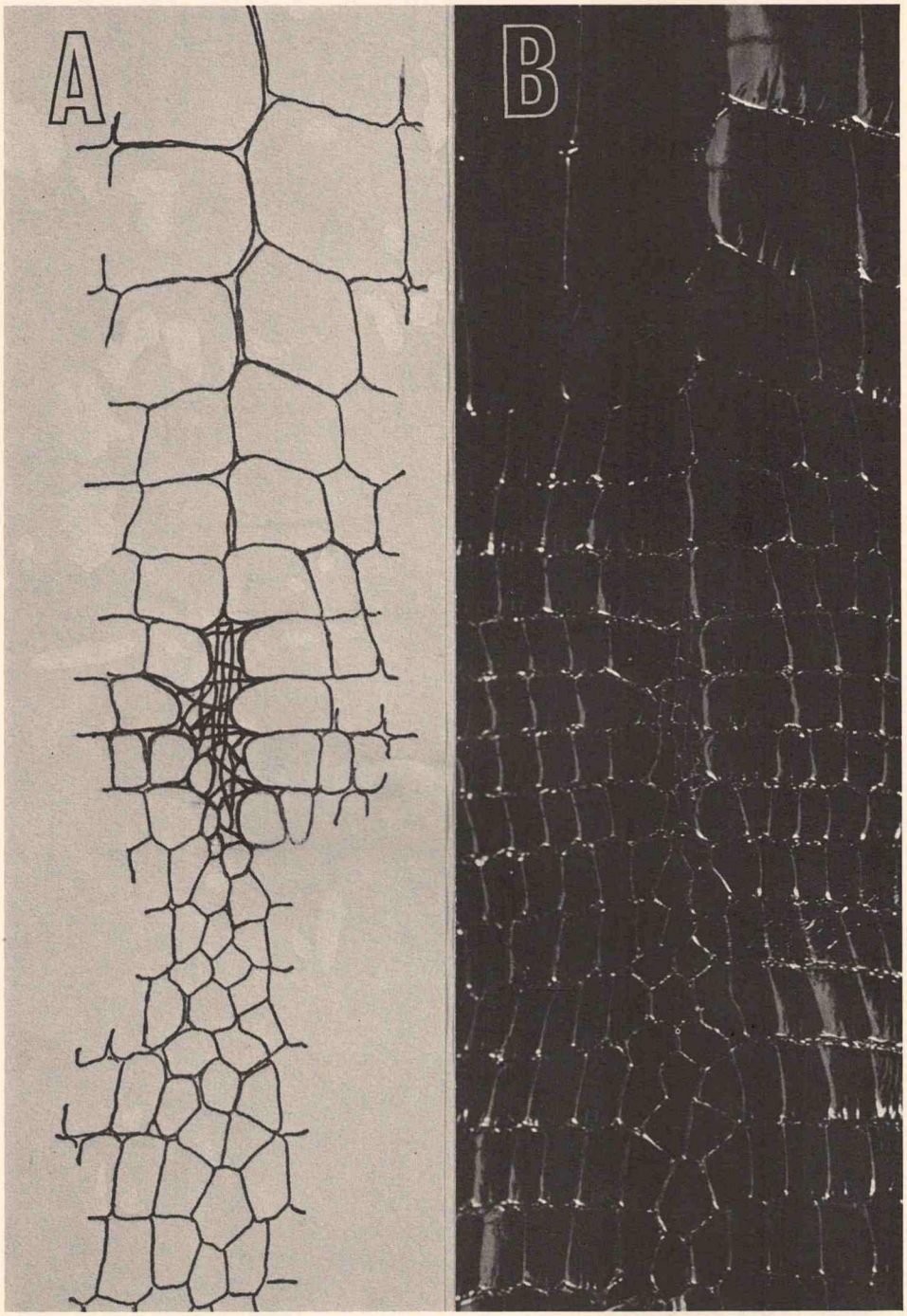

FIGURE 7. The spider-web umbilicus typical of American alligator (*Alligator mississippiensis*) belly hides – A is a diagrammatic illustration of the photograph B. Also note the absence of both surface pitting and follicle glands on the ventral scales.

FIGURE 8. Inside surface of a finished American alligator (*Alligator mississippiensis*) hide from Florida. The portion shown is from the throat area as evidenced by the ventral collar. The dark round blotches in the center of the scales are single osteoderm buttons.

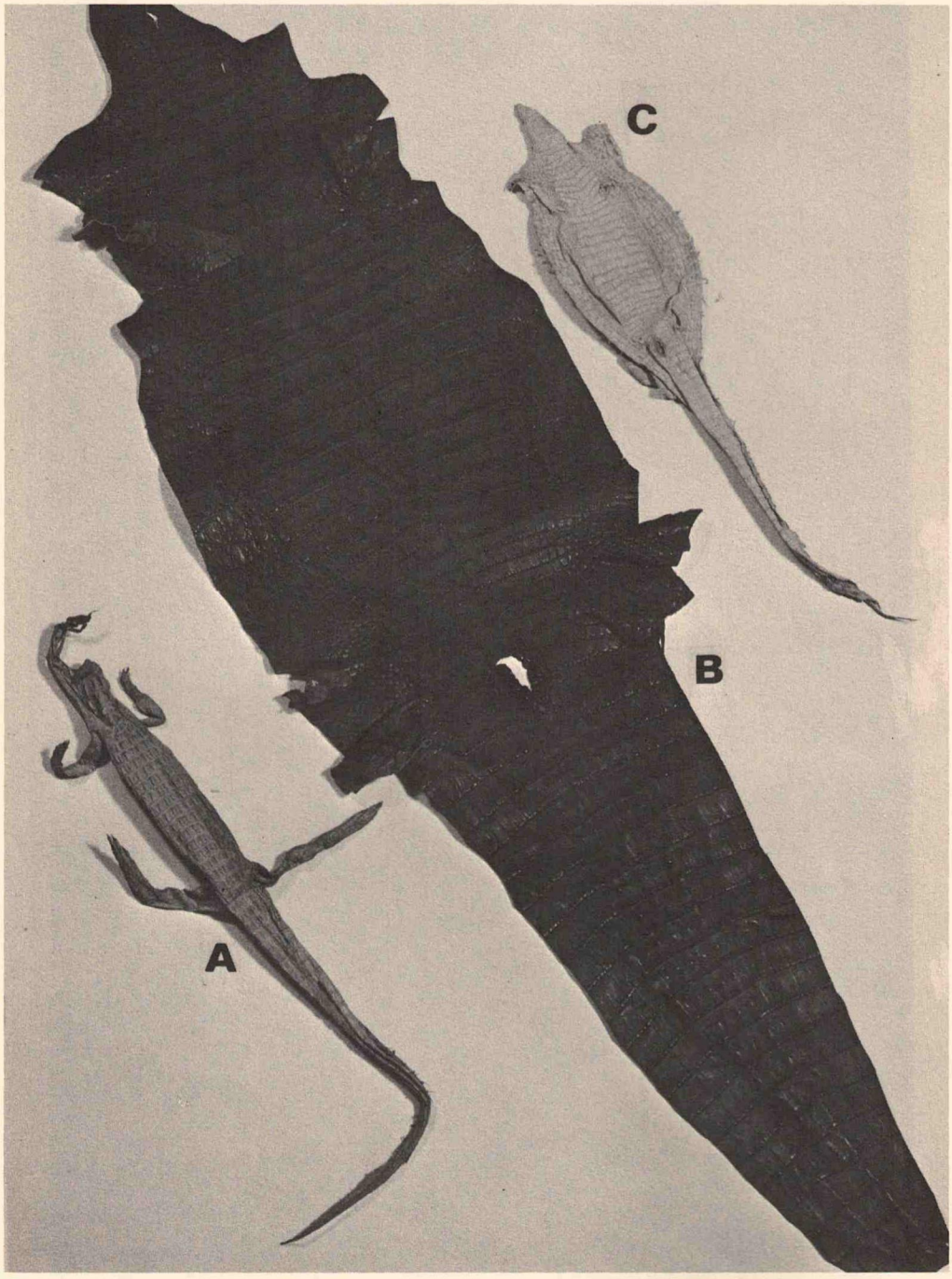

FIGURE 9. Hornback (A) and belly hides (B and C) of a South American caiman (*Caiman crocodilus*). Note the presence of the vent in both belly hides. A and C are crusts. B is a hide with *sauvage* finish.

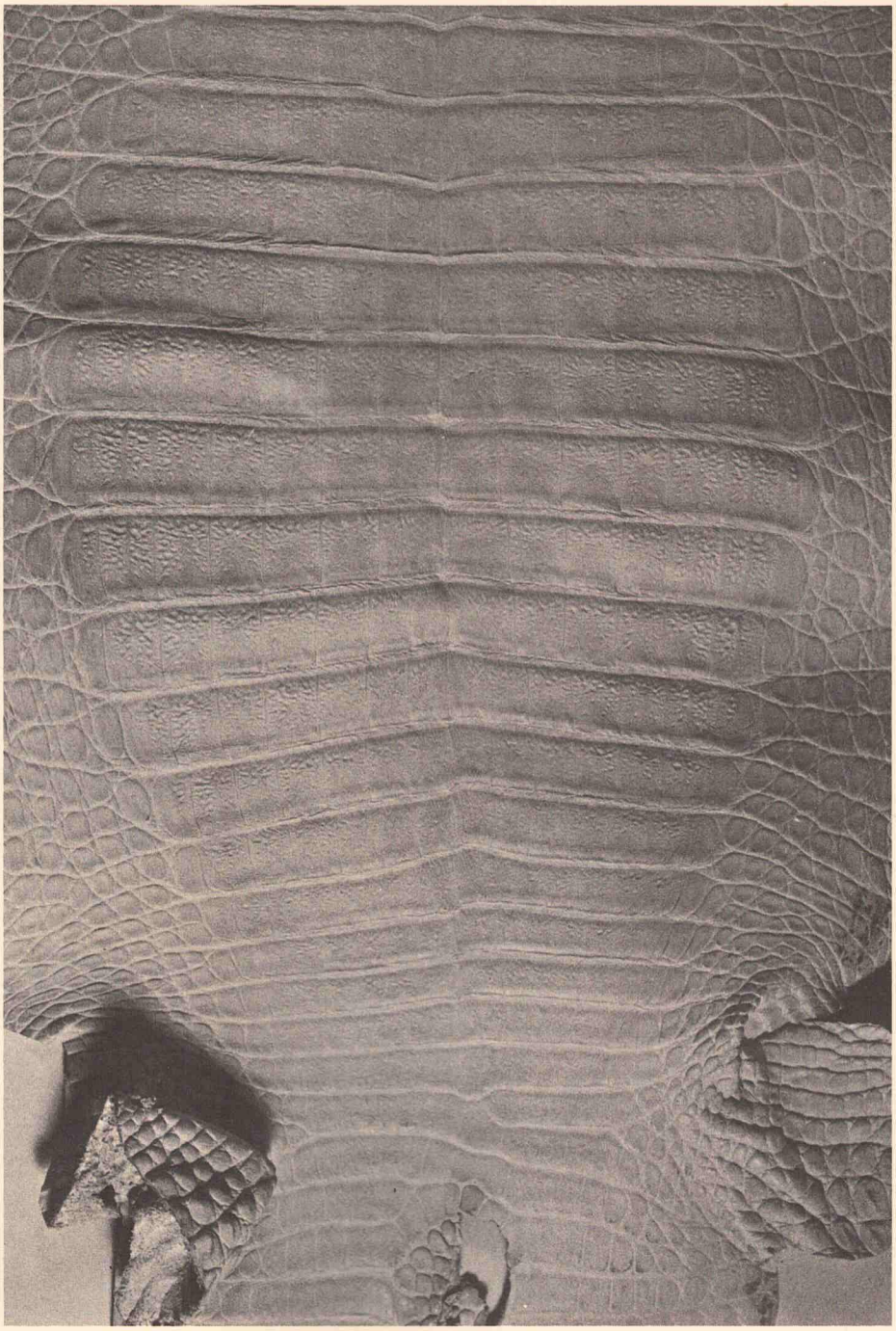

FIGURE 10. Outside surface of a crust belly hide of a South American caiman (*Caiman crocodilus*). Note the surface pitting which is indicative of underlying osteoderm buttons.

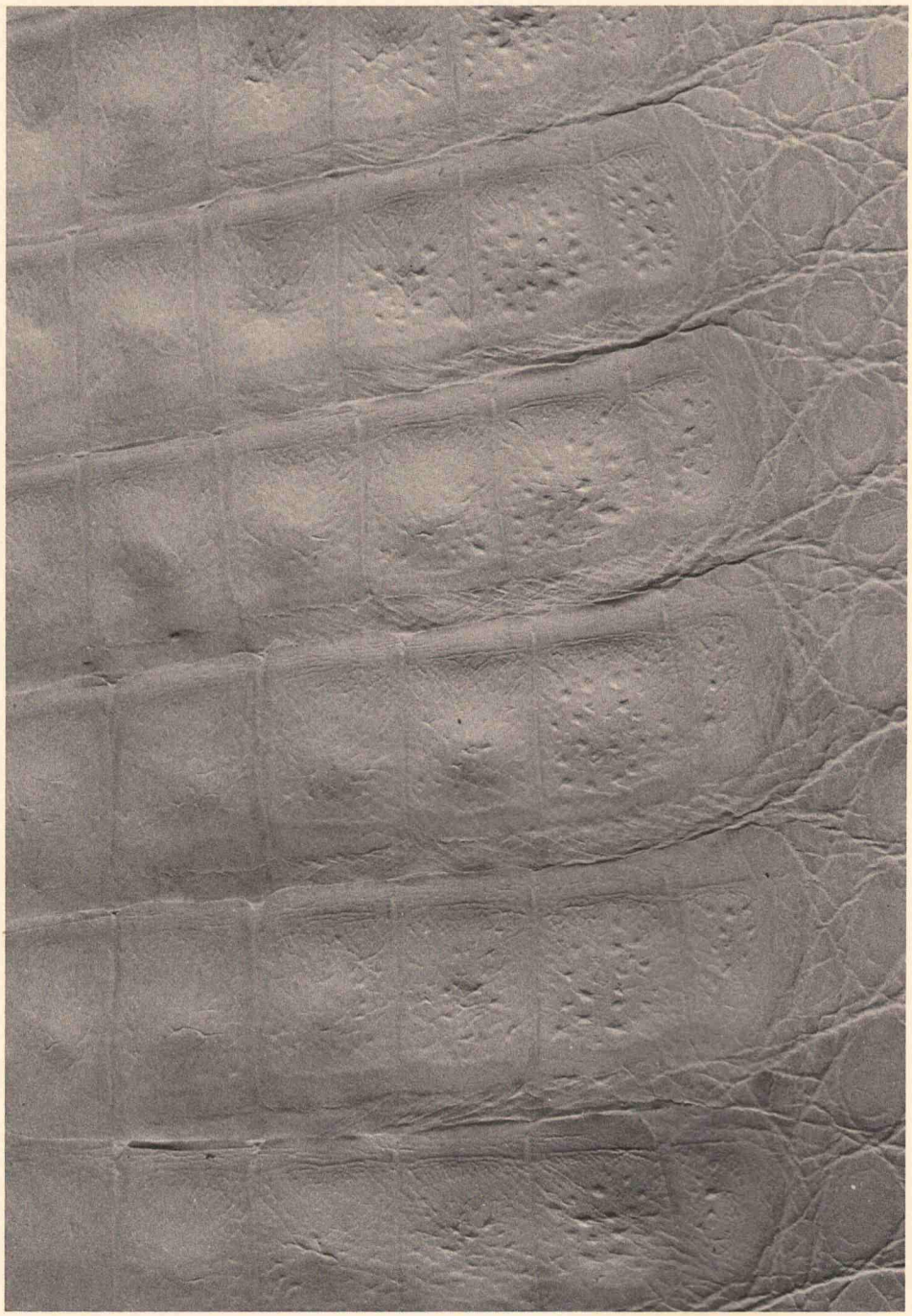

FIGURE 11. Ventral scales of a South American caiman (*Caiman crocodilus*) crust. Note the surface pitting. Lateral scales are just visible on the right side of the photograph.

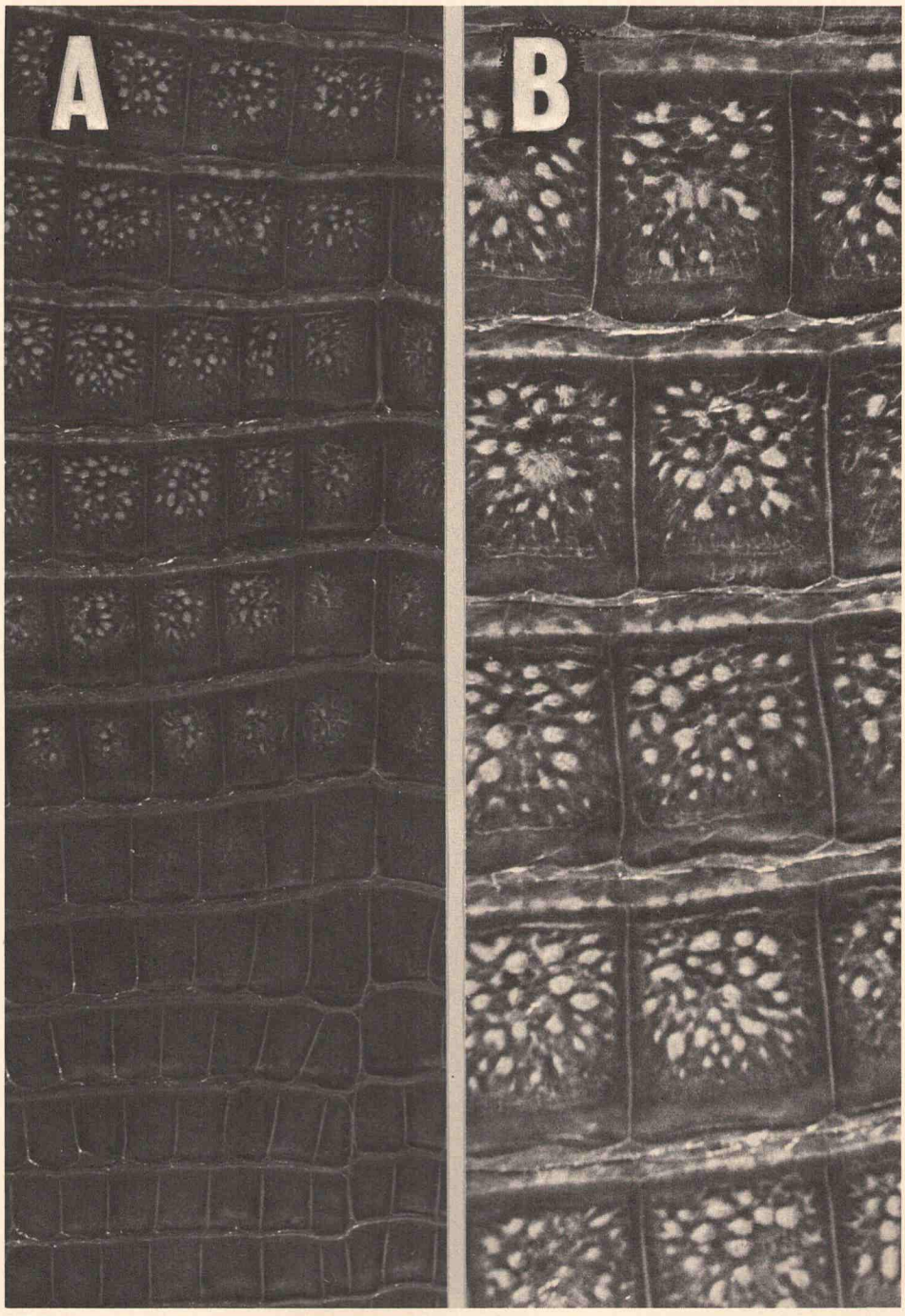

FIGURE 12. Ventral scales of a finished South American caiman (*Caiman crocodilus*) belly hide. Photograph B is a close view of the scales seen in A. Because of the technique used to dye this hide, the surface pits are white against a dark background. Note that the pitting is not as pronounced near the vent (lower half of A) as near midbelly (upper half of A).

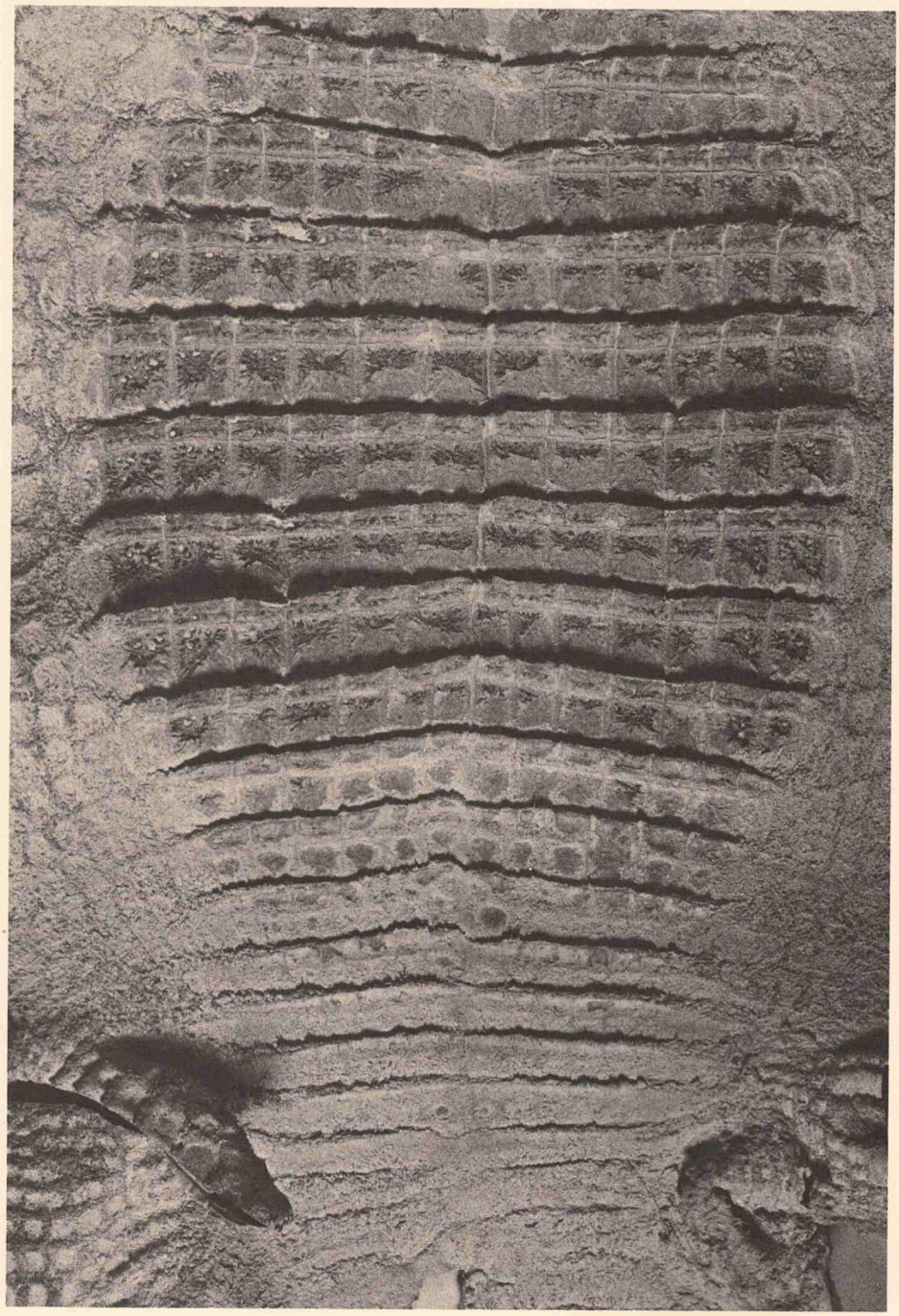

FIGURE 13. Inside surface of a South American caiman (*Caiman crocodilus*) crust. Note the presence of double osteoderm buttons in the ventral scales. Closer views are provided in figure 14.

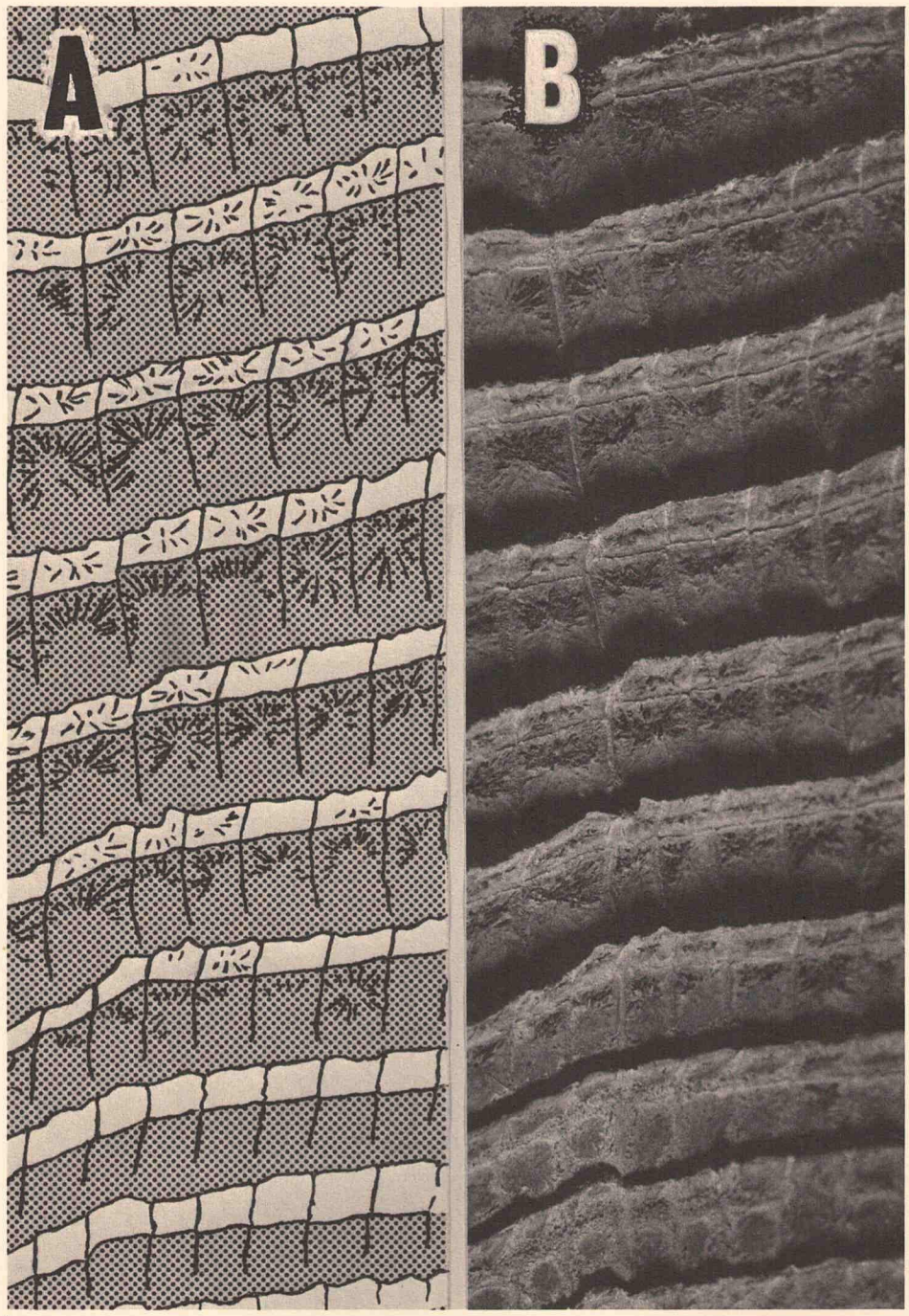

FIGURE 14. Double osteoderm buttons on the inside surface of a South American caiman (*Caiman crocodilus*) belly crust. A is a diagrammatic illustration of the photograph B. Each ventral scale contains two osteoderms, double buttons. The larger posterior button is shaded in A, while the smaller inward-curving anterior button is unshaded. Most of the anterior button is removed when the hide is shaved. Compare this figure with the shaved hide in figure 19.

FIGURE 15. Sides of South American caiman (*Caiman crocodilus*). The center hide is a crust. The other two are finished hides. The arrow indicates the anterior (cephalic) end of the hide.

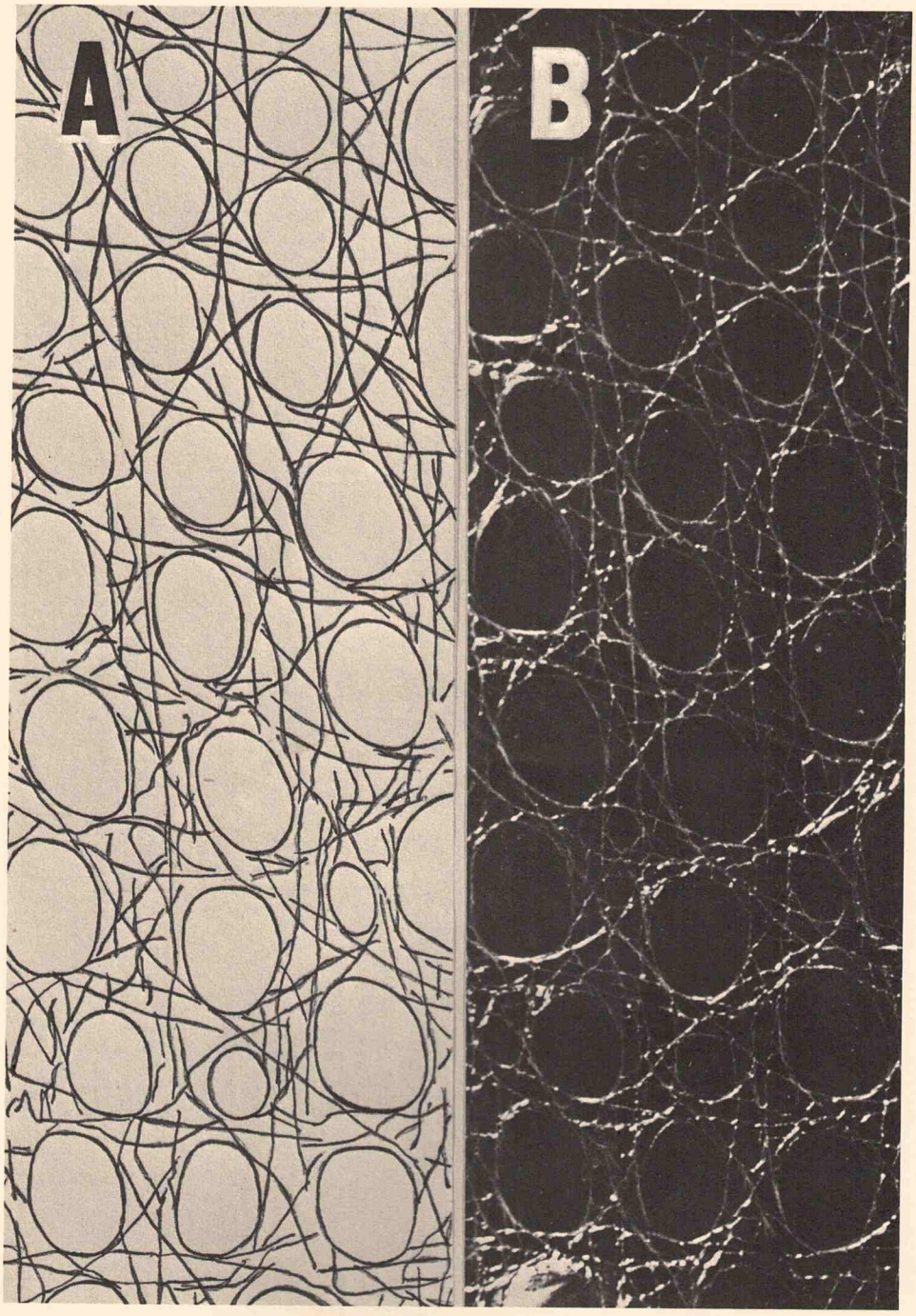

FIGURE 16. Scales of finished South American caiman (*Caiman crocodilus*) sides. A is a diagrammatic illustration of photograph B. Note that the rows of large oval scales alternate with strips of soft skin with a network of creases. Compare this with figure 21.

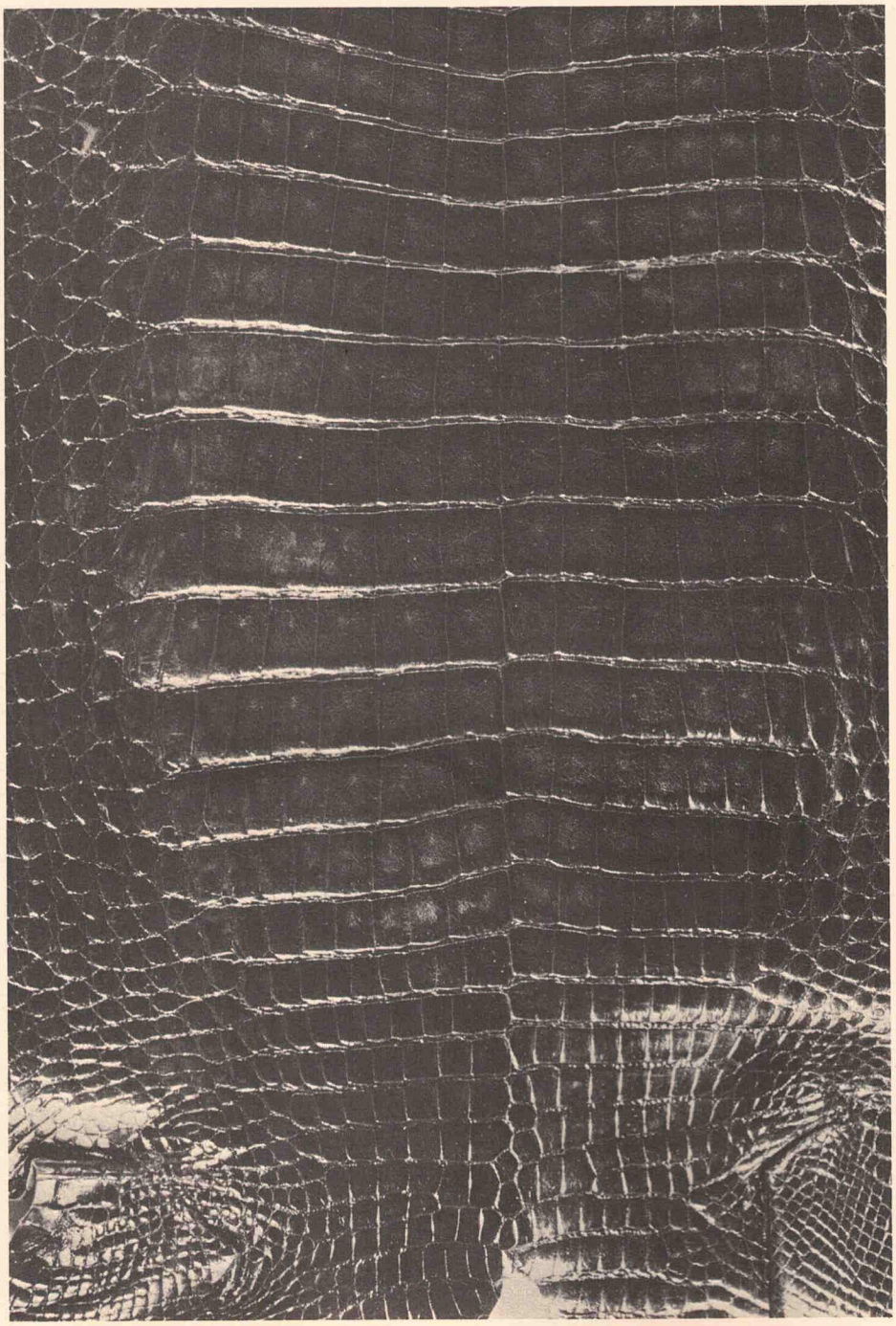

FIGURE 17. Outside surface of a finished black caiman (*Melanosuchus niger*) belly hide. A closer view of the ventral scales is provided in figure 18.

FIGURE 18. Ventral scales of a finished black caiman (*Melanosuchus niger*) belly hide. A is a diagrammatic illustration of the photograph B. Note the wrinkles and fine surface pitting, as well as the lighter color in the centers of the scales. Both conditions are indicative of underlying osteoderm buttons.

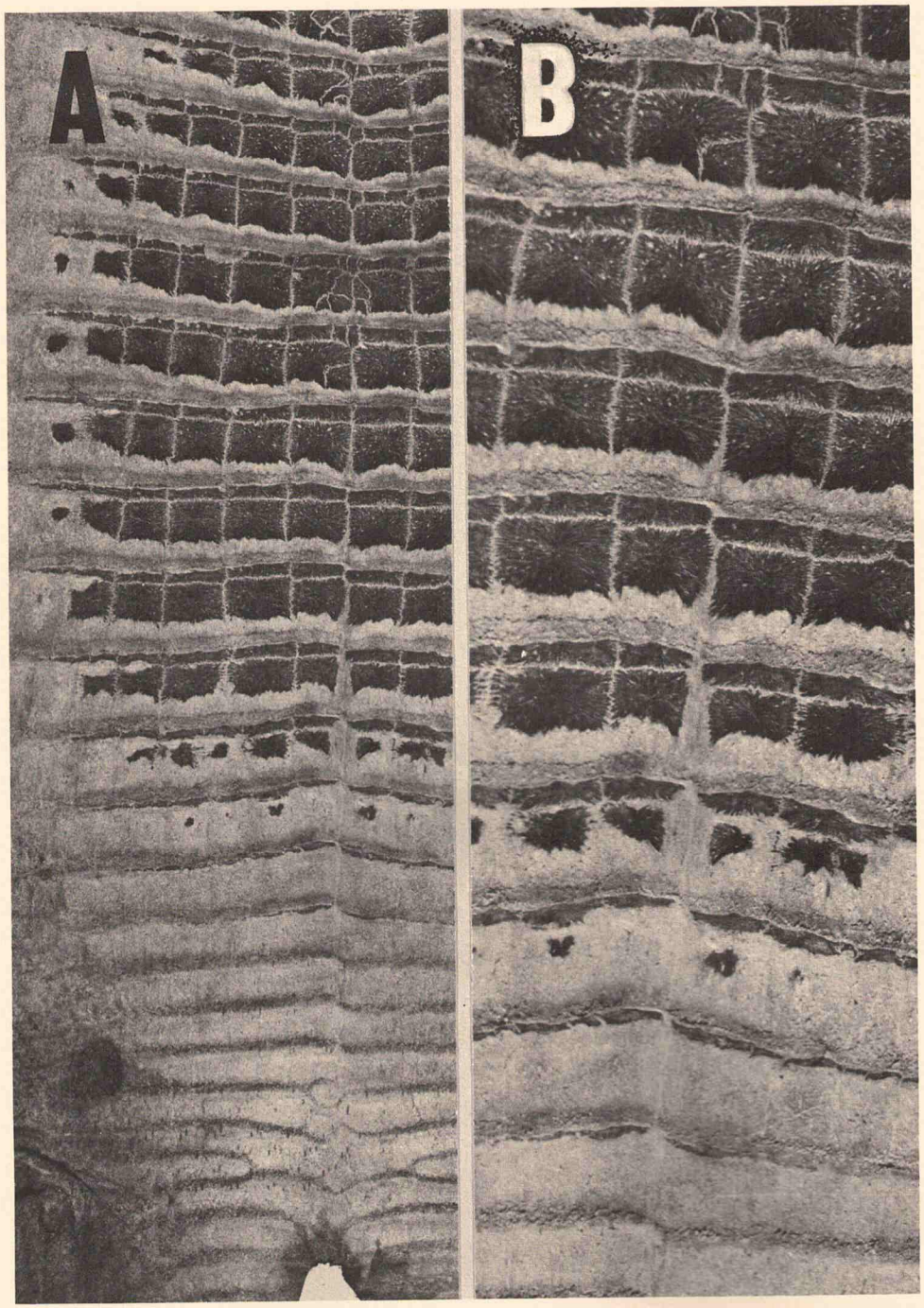

FIGURE 19. Inside surface of a finished black caiman (*Melanosuchus niger*) belly hide. Note the dark double osteoderm buttons in each scale. Photograph B is a close view of the buttons seen in A. This hide has been shaved so most of the anterior button has been removed. Compare it with figures 13 and 14.

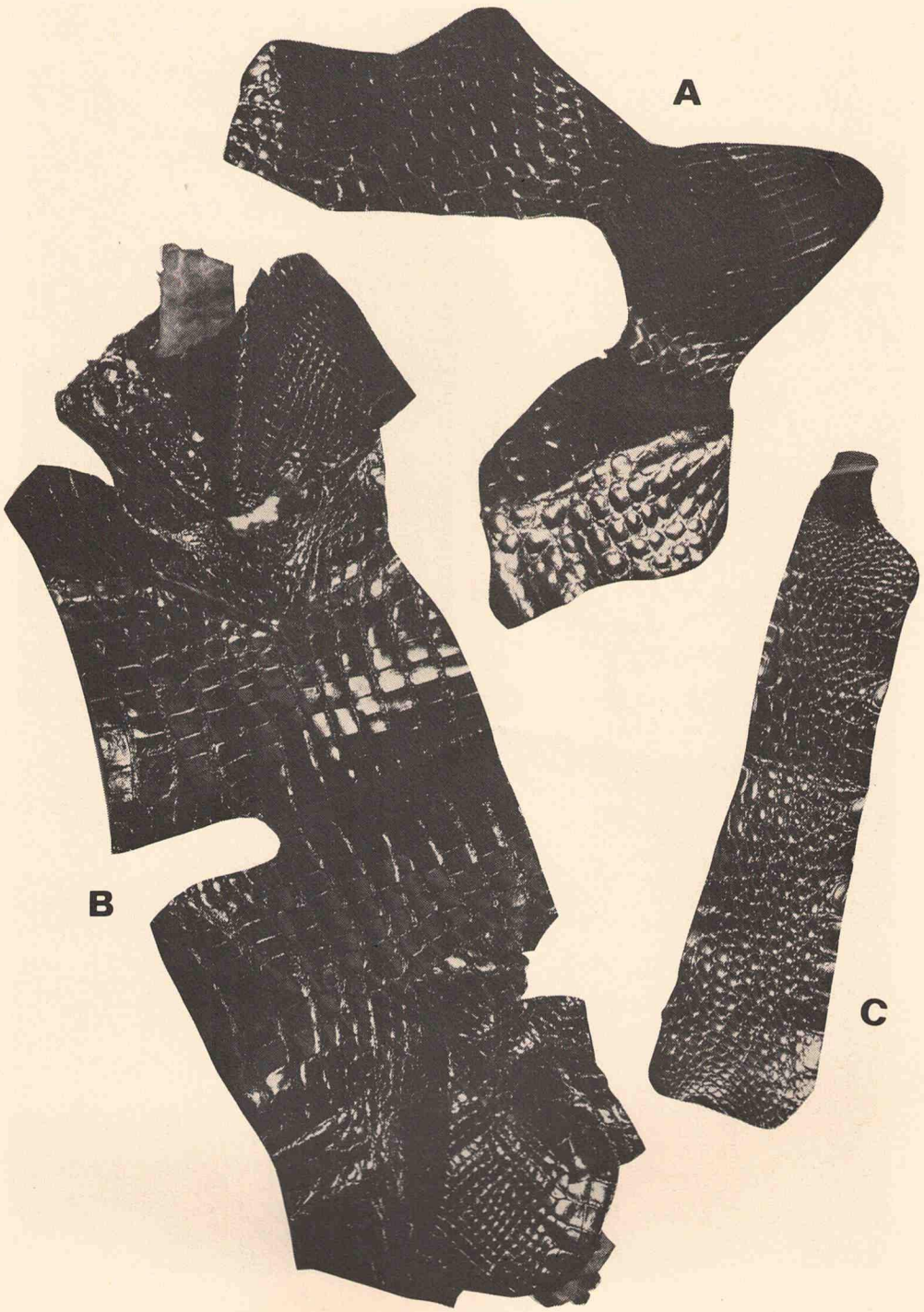

FIGURE 20. Outside surface of finished black caiman (*Melanosuchus niger*) throat (A), girdle (B), and side (C). The scales of the side are shown in figure 21.

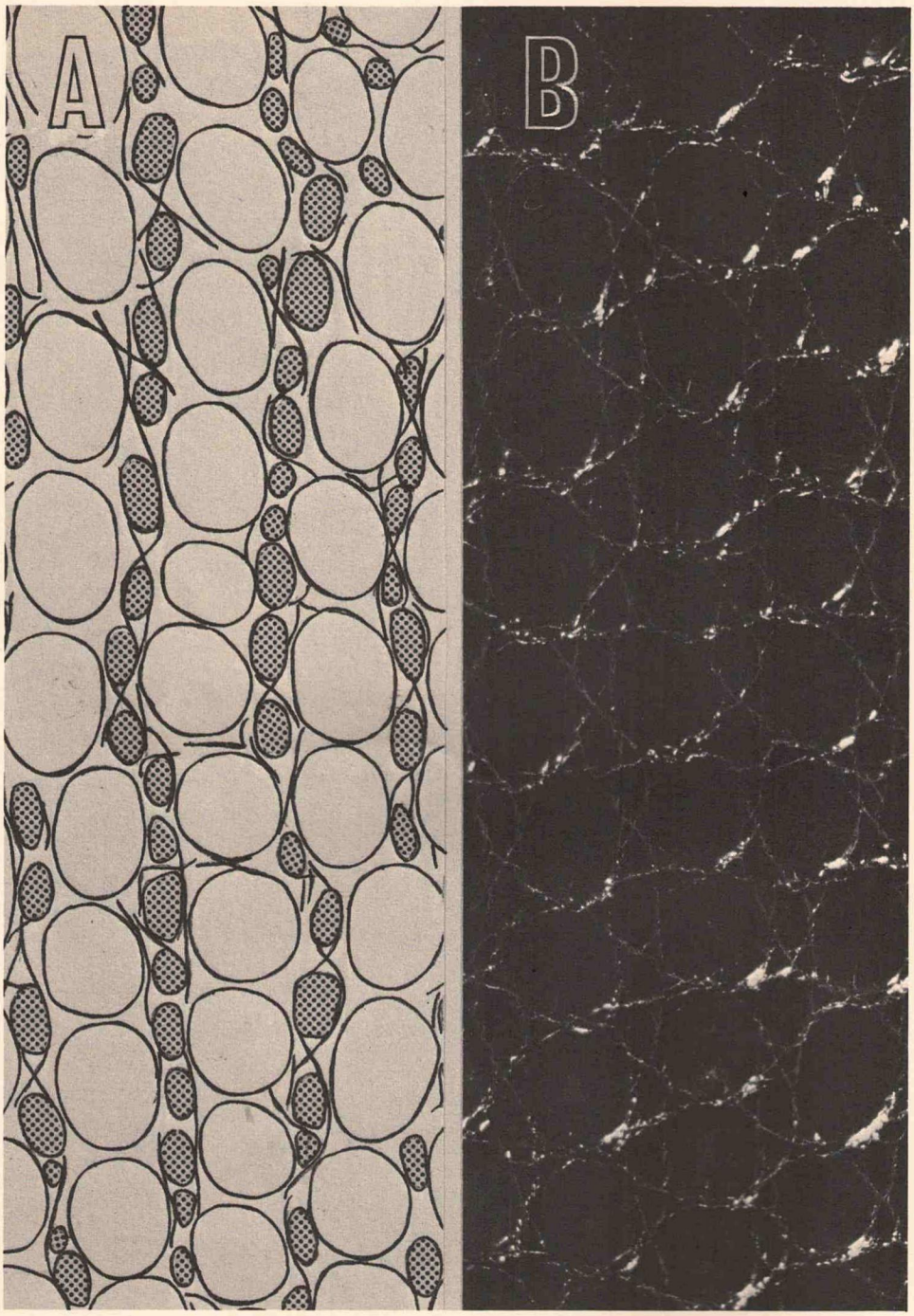

FIGURE 21. Scales of finished black caiman (*Melanosuchus niger*) side. A is a diagrammatic illustration of photograph B. Note that the large oval scales alternate with rows of small scales. Compare this with figure 16.

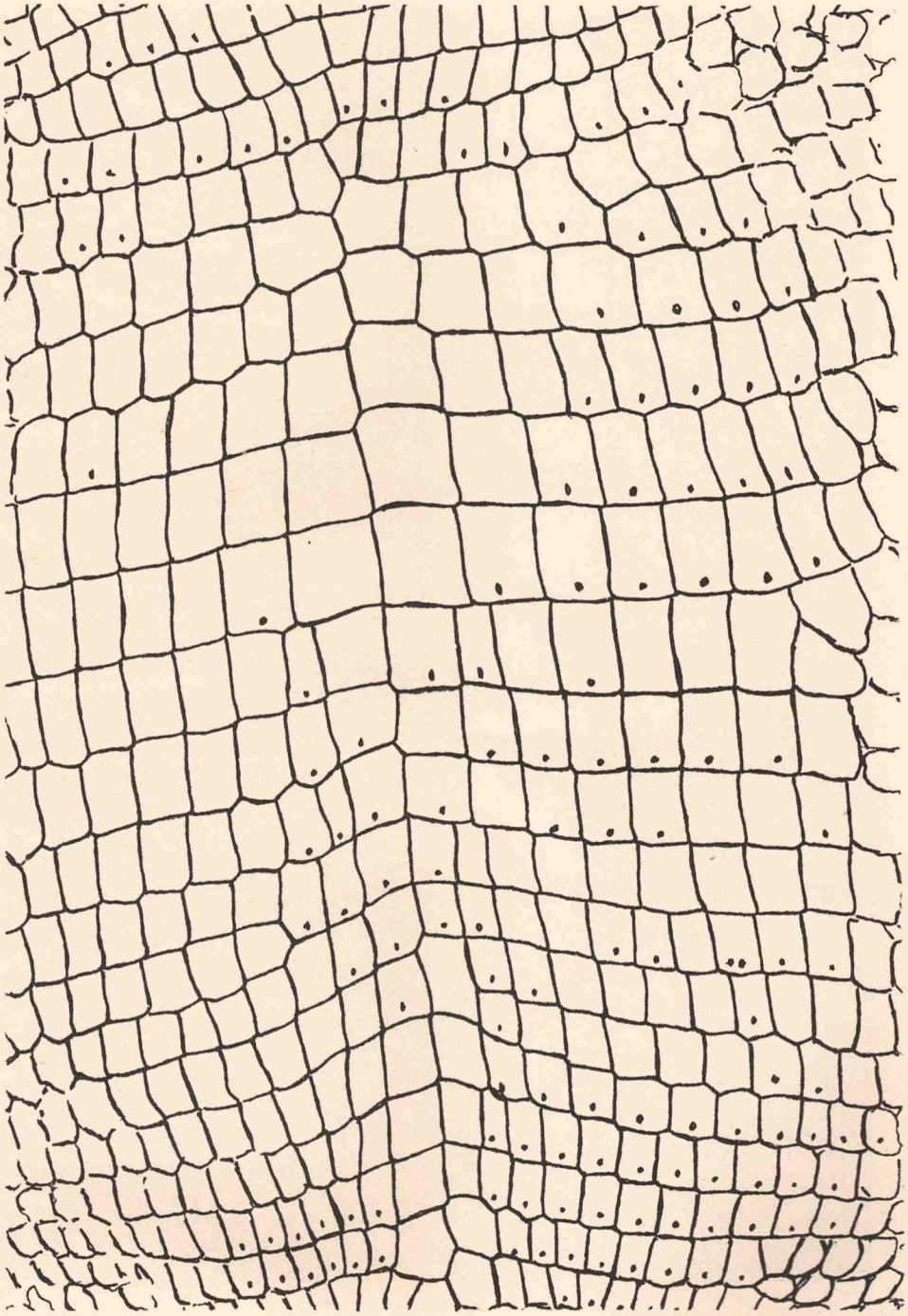

FIGURE 22. Diagrammatic illustration of the Nile crocodile belly hide shown in figure 23. Note the presence of follicle glands (only those visible in figure 23 are illustrated).

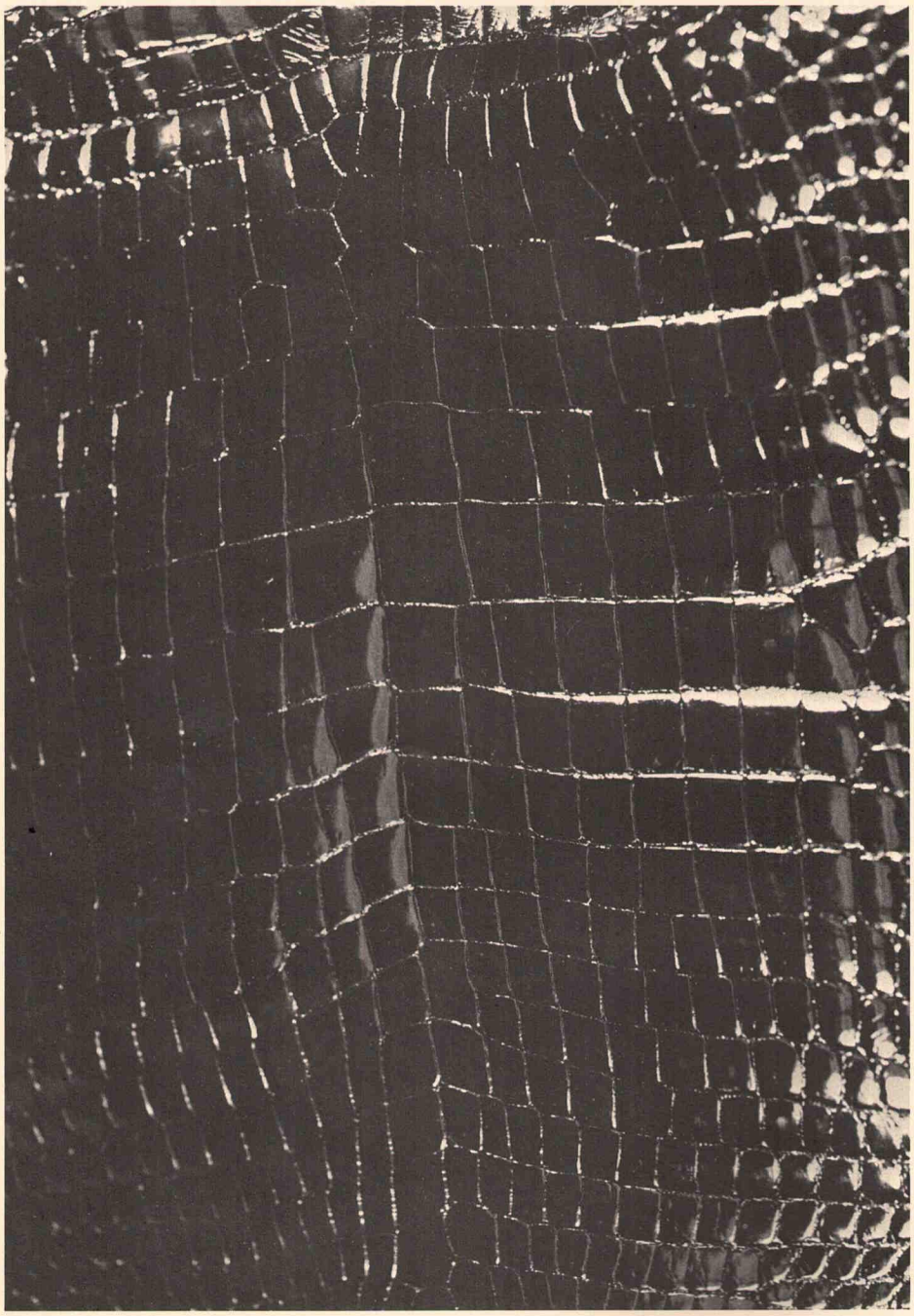

FIGURE 23. Outside surface of a finished Nile crocodile (*Crocodylus niloticus*) belly hide. Compare it with figure 22.

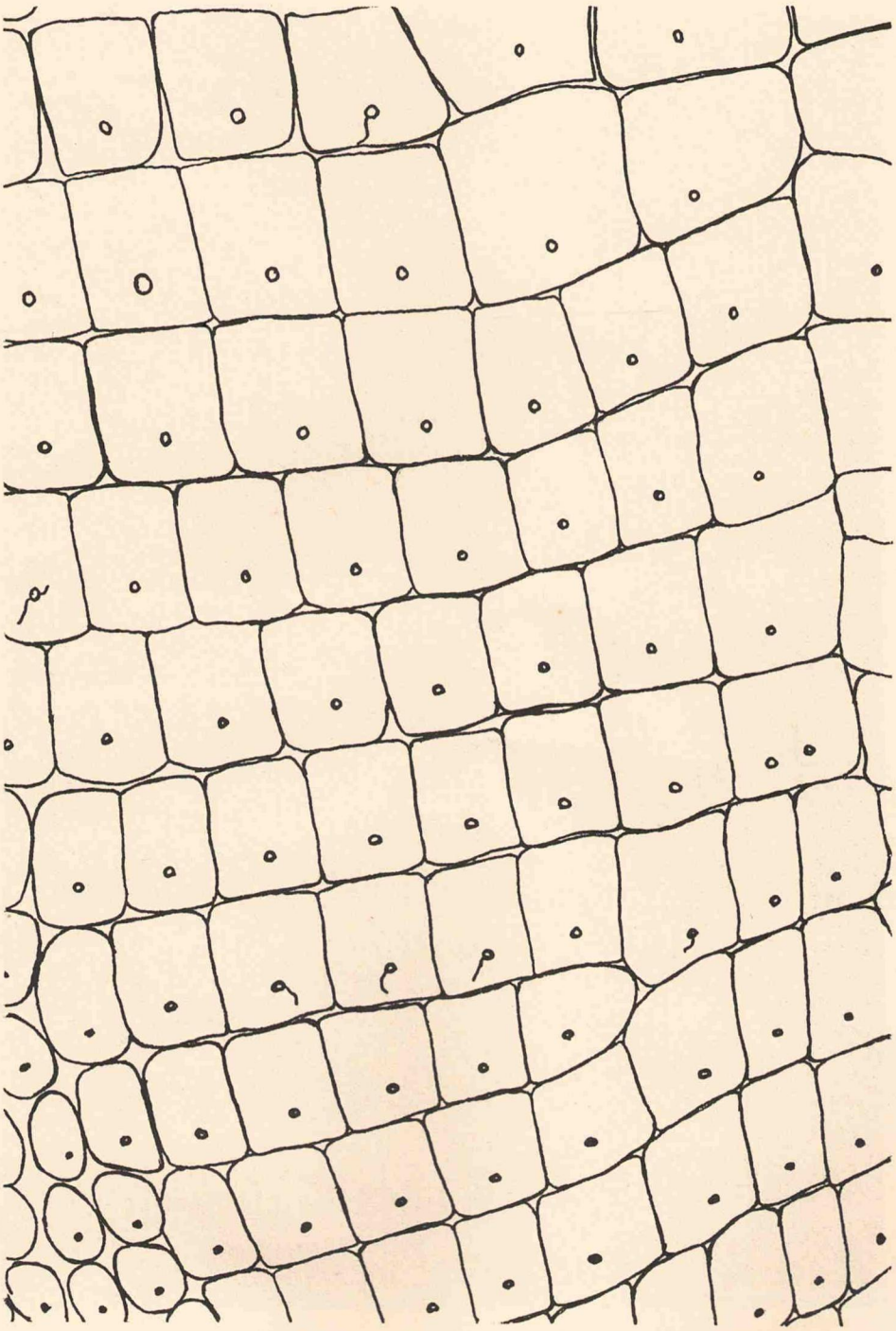

FIGURE 24. Diagrammatic illustration of the ventral scales of the Morelet's crocodile hide shown in figure 25. Note the prominent follicle glands.

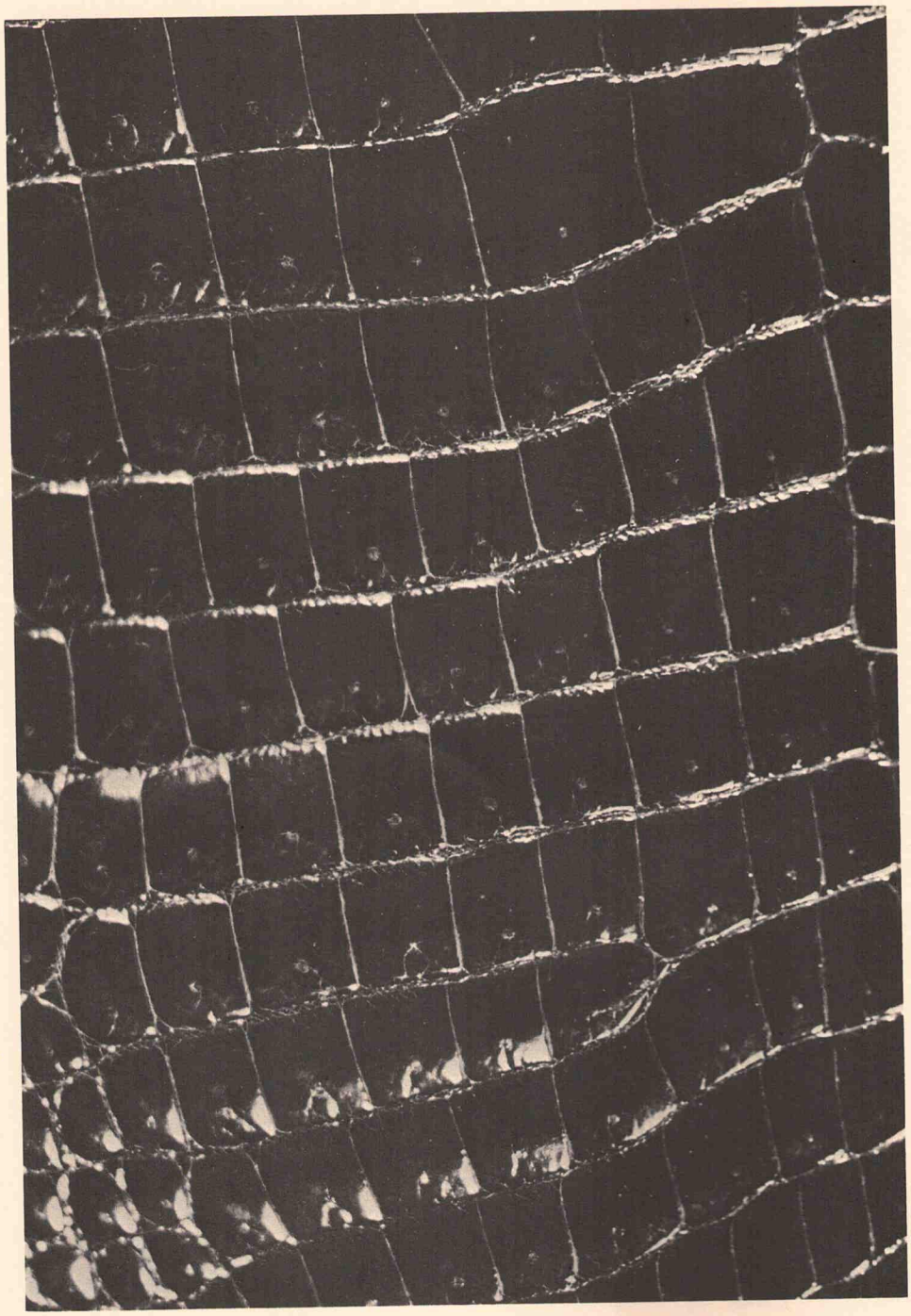

FIGURE 25. Ventral scales of a finished Morelet's crocodile (*Crocodylus moreletii*) belly hide. Compare it with figure 24.

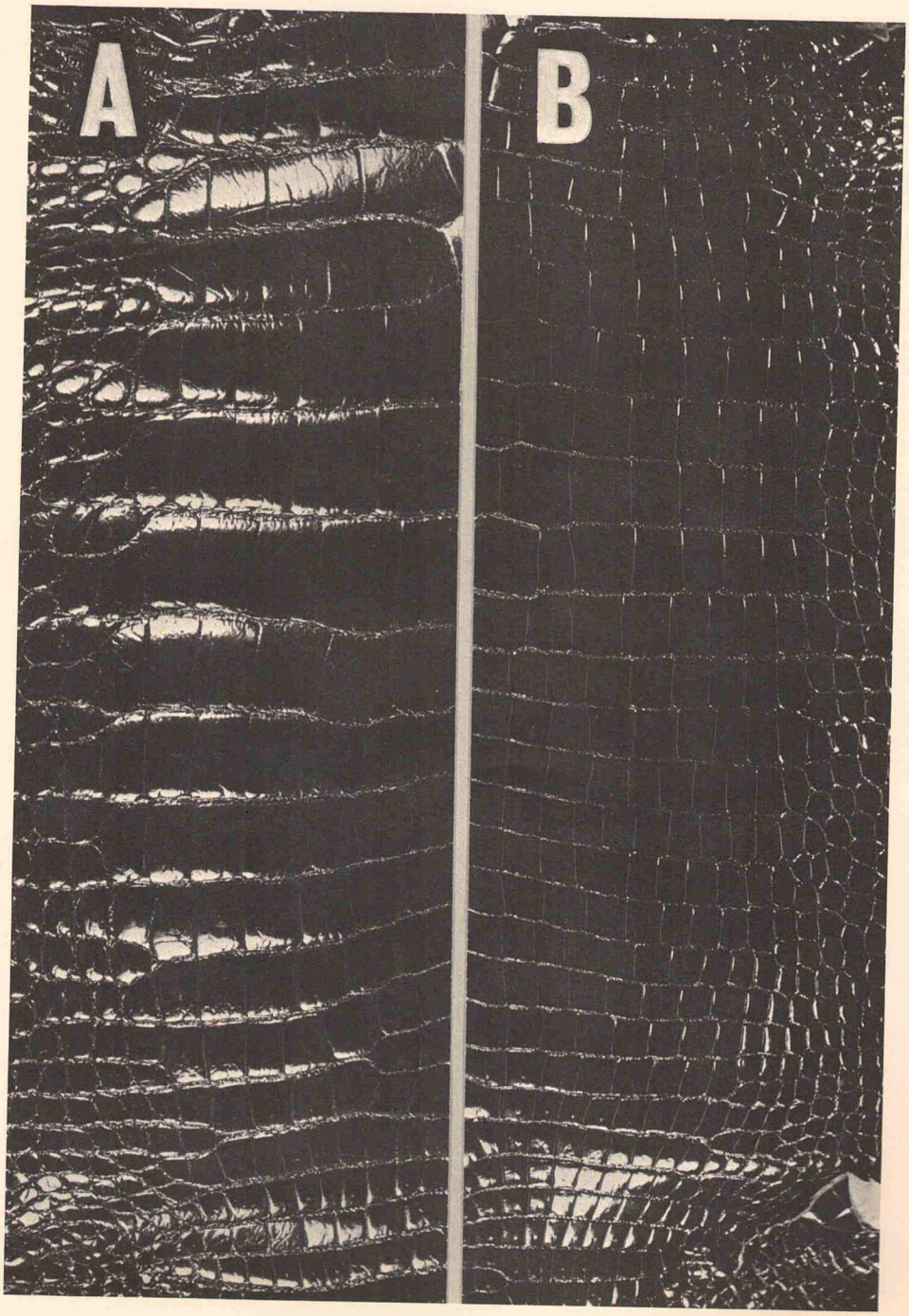

FIGURE 26. Comparison of scale size on (A) large scale false gavial (*Tomistoma schlegelii*) and (B) small scale saltwater crocodile (*Crocodylus porosus*) belly hides.

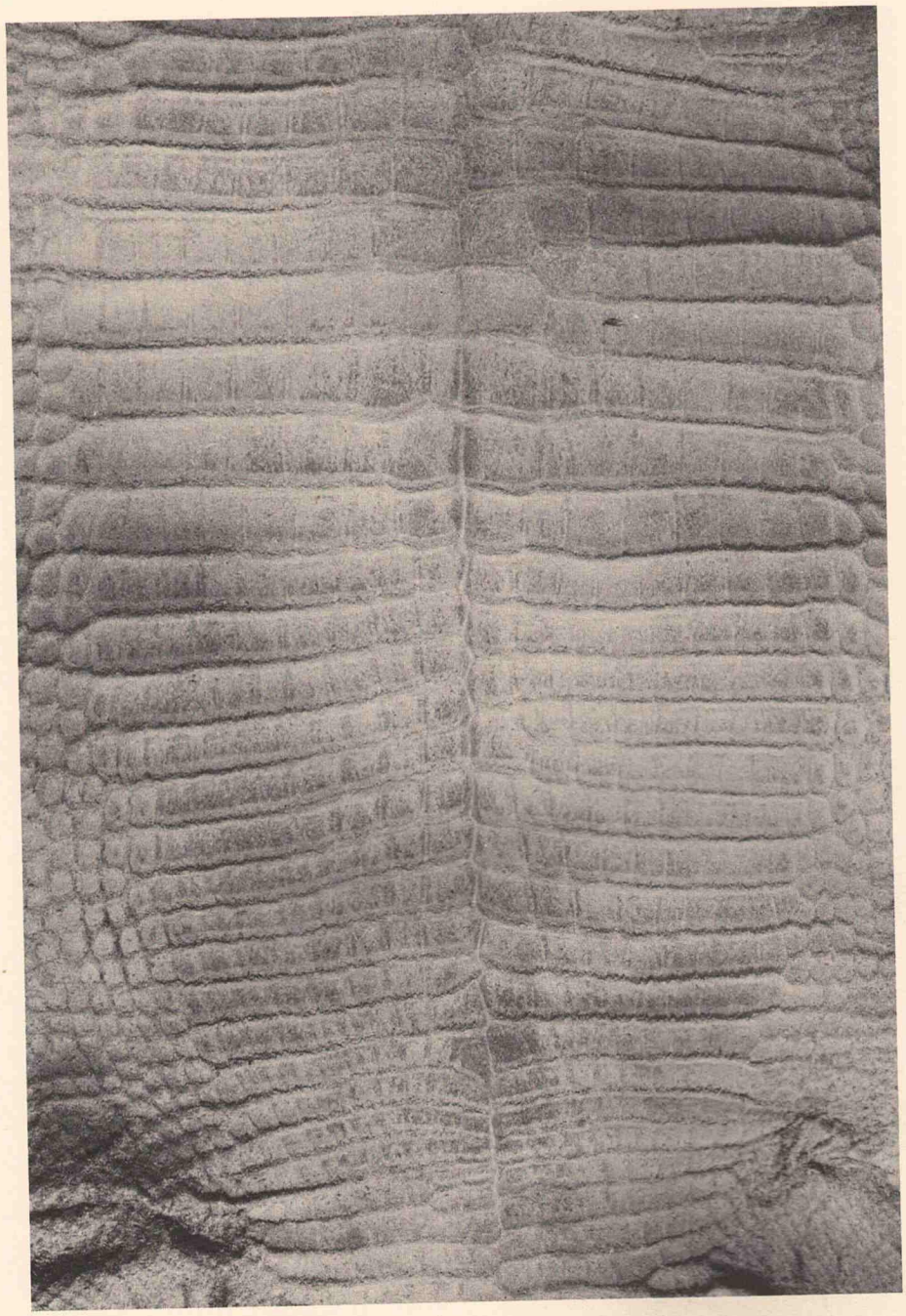

FIGURE 27. Inside surface of a finished saltwater crocodile (*Crocodylus porosus*) belly hide. Note the total absence of osteoderm buttons.

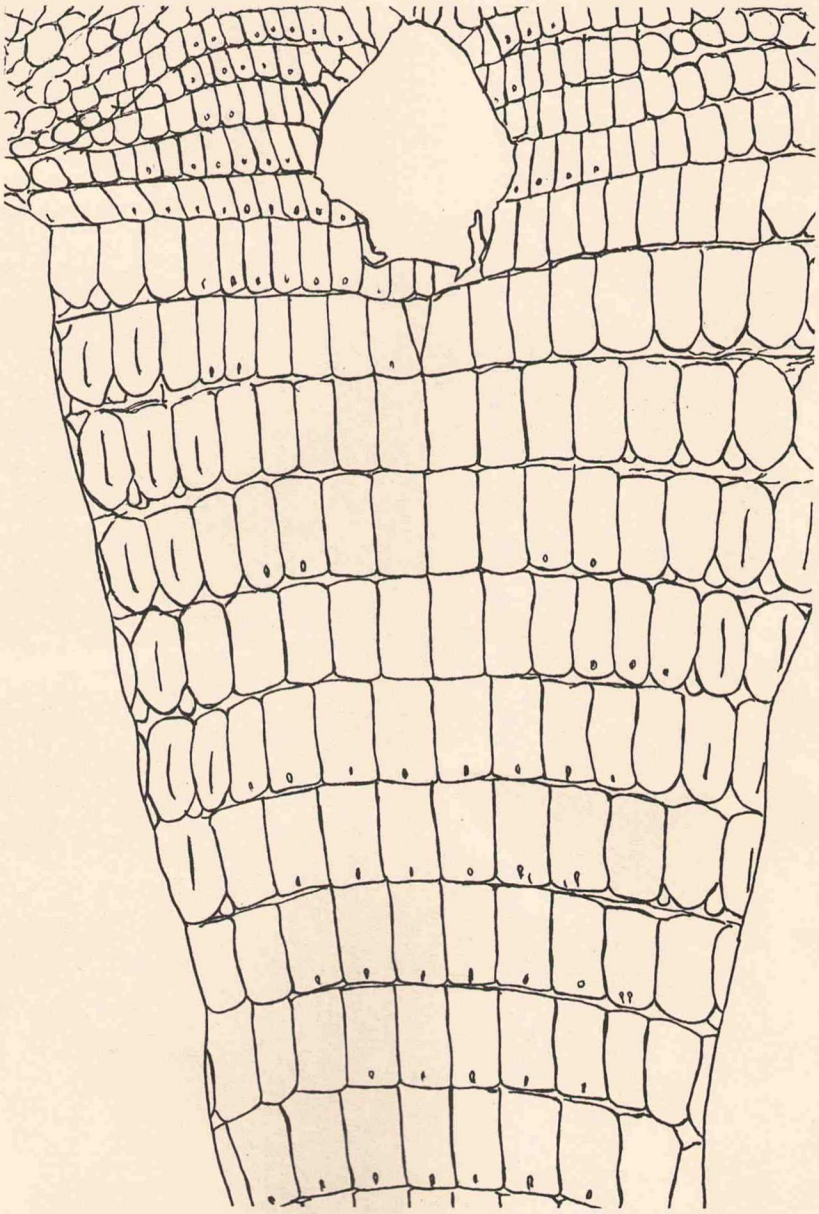

FIGURE 28. Diagrammatic illustration of the Nile crocodile tail whorls shown in figure 29. Note both the presence of follicle glands (only the ones visible in figure 29 are illustrated) and the regular arrangement of the whorls. Compare it with figure 30.

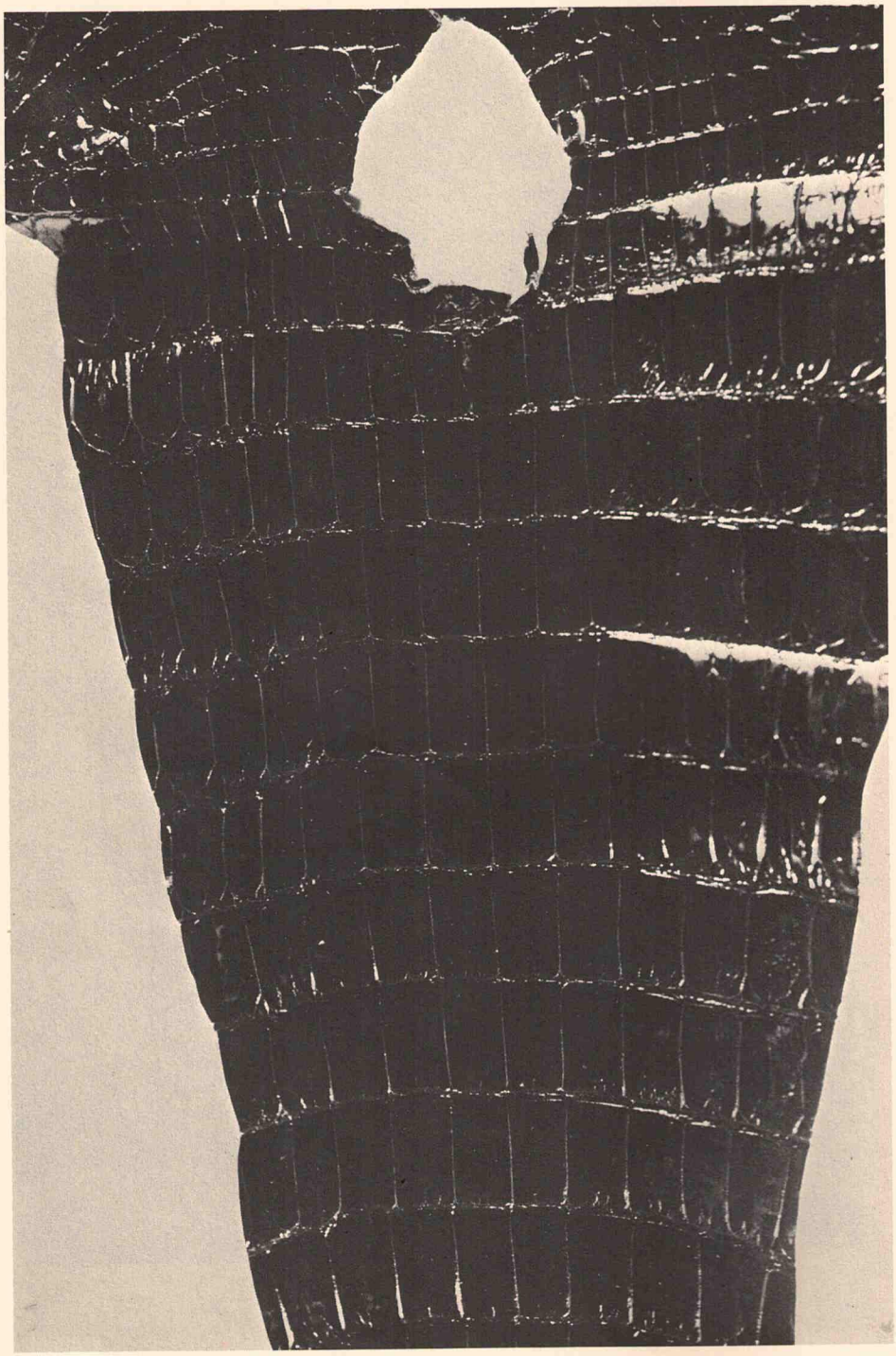

FIGURE 29. Tail whorls of a finished Nile crocodile (*Crocodylus niloticus*) belly hide. Compare it with figure 28.

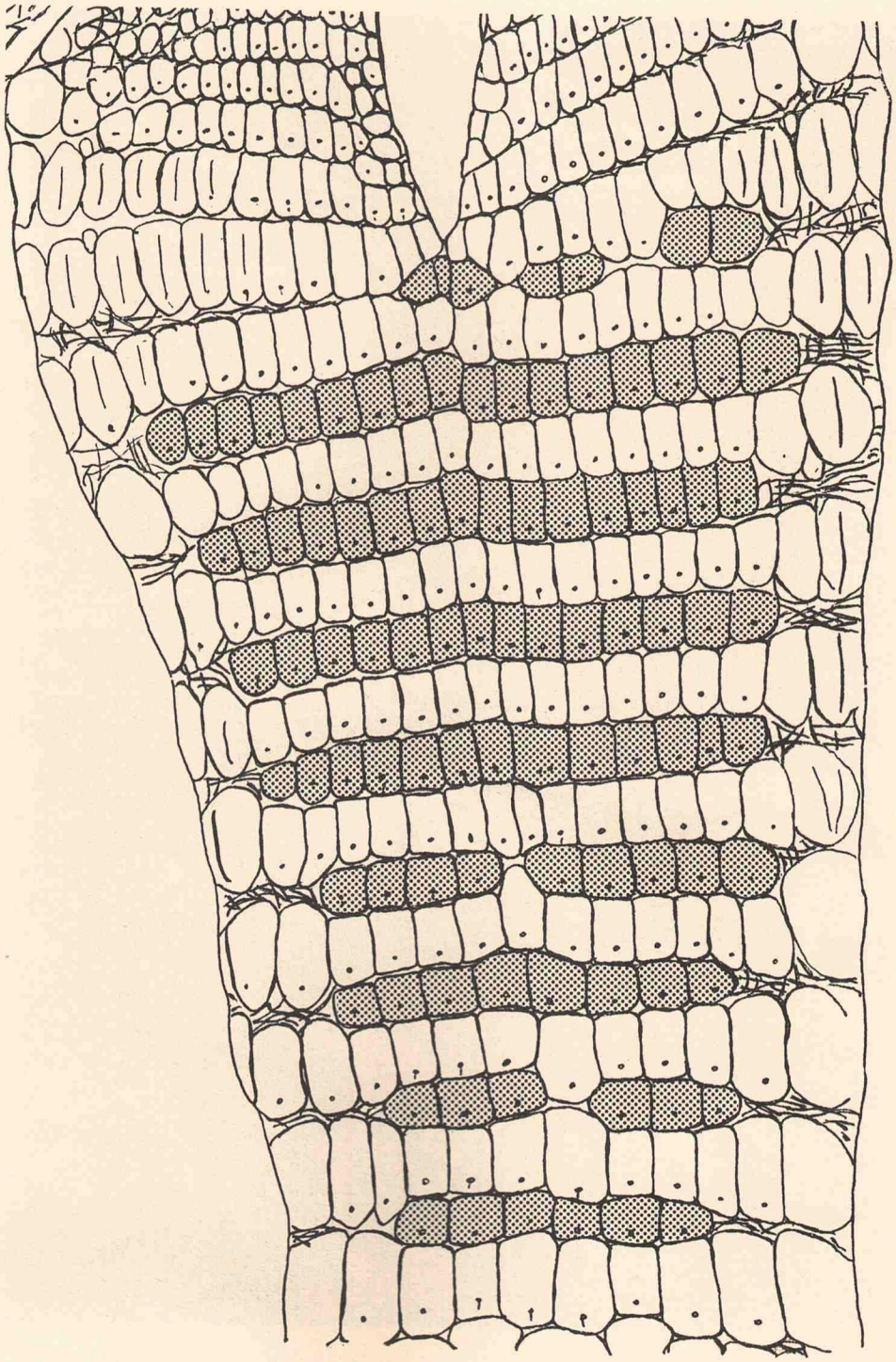

FIGURE 30. Diagrammatic illustration of the Morelet's crocodile tail whorls shown in figure 31. Note the presence of both follicle glands and irregular and incomplete (shaded) whorls. Compare it with figure 28.

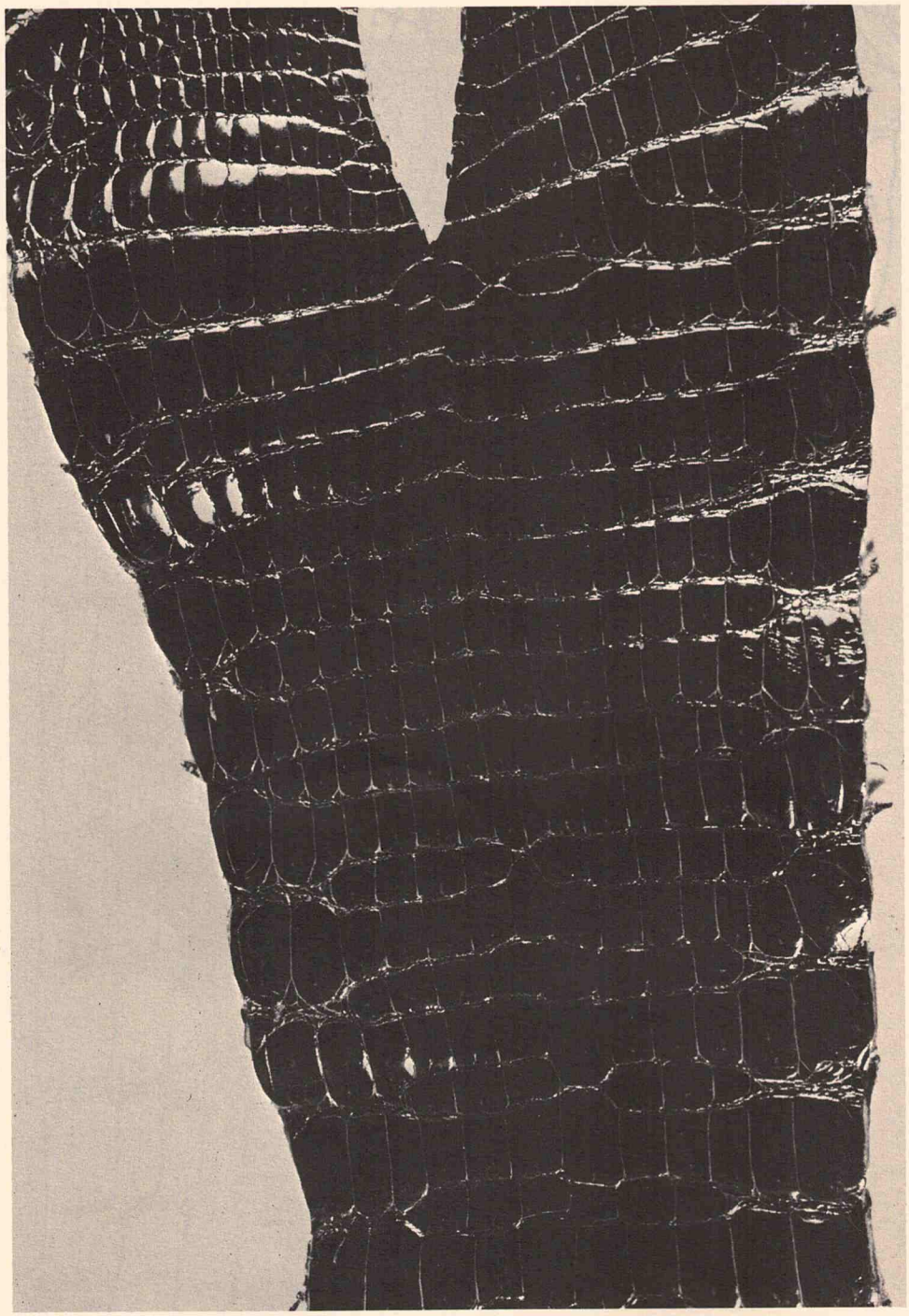

FIGURE 31. Tail whorls of a finished Morelet's crocodile (*Crocodylus moreletii*) belly hide. Compare it with figure 30.

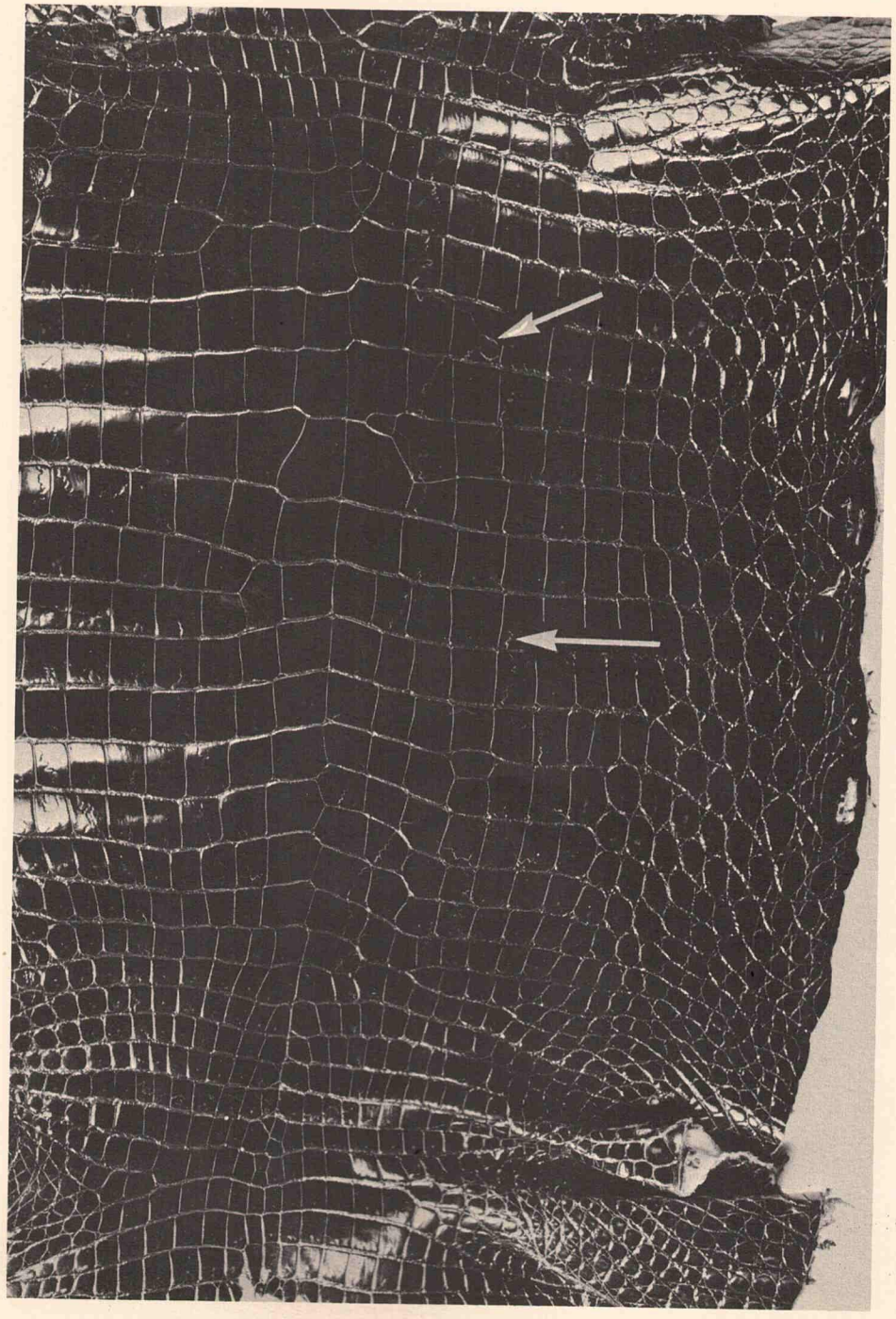

FIGURE 32. Outside surface of a finished Orinoco crocodile (*Crocodylus intermedius*) hide. The arrows indicate the location of parasitic "worm trails." Close views of these trails are shown in figure 33.

FIGURE 33. Undulating "worm trails" on the ventral scales of an Orinoco crocodile (*Crocodylus intermedius*) belly hide. Similar trails have been seen on Johnson's crocodiles (*C. johnsoni*), Morelet's crocodiles (*C. moreletii*), Nile crocodiles (*C. niloticus*), and saltwater crocodiles (*C. porosus*). They probably occur on other species as well.

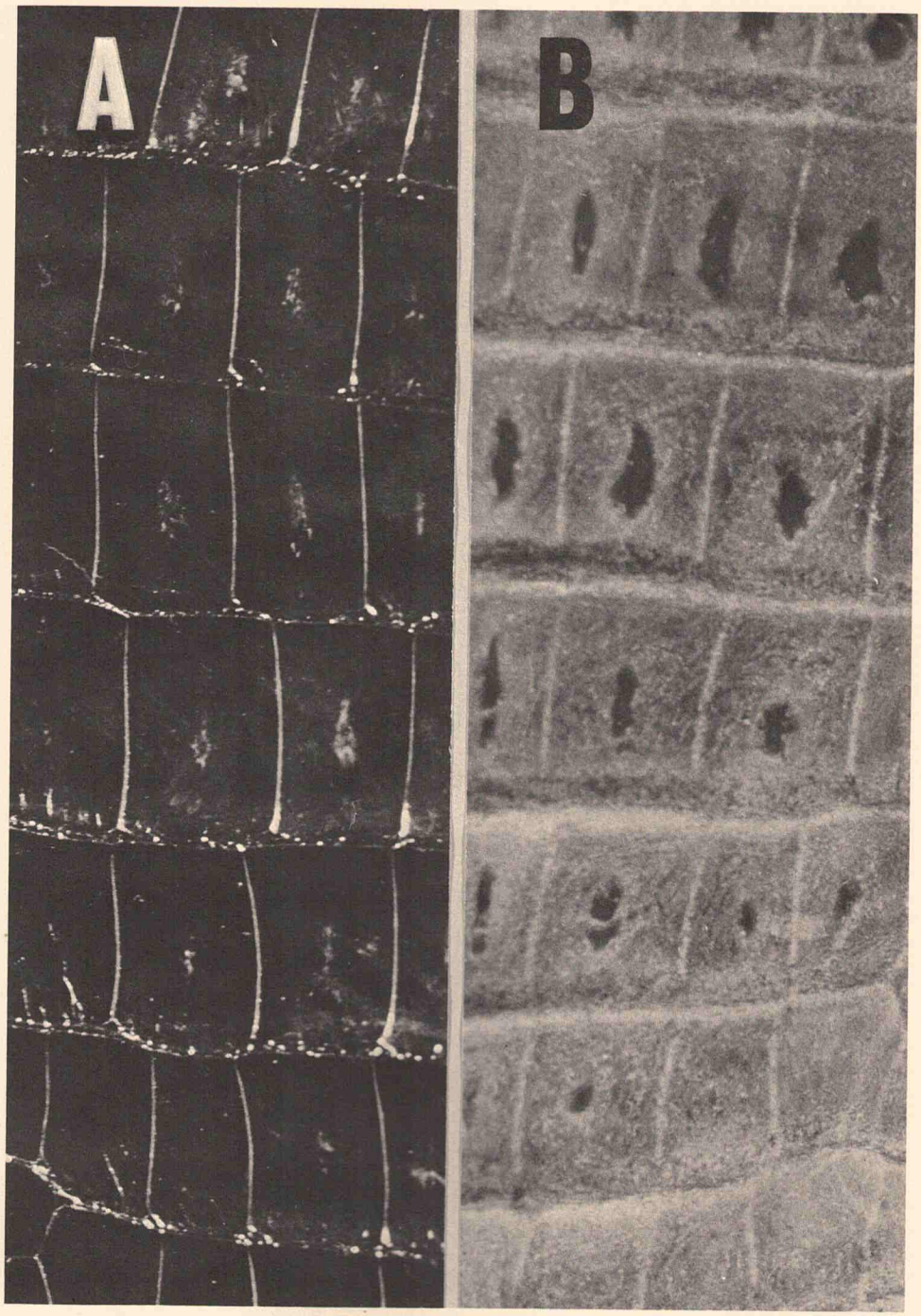

FIGURE 34. Outside (A) and inside (B) surfaces of finished ventral scales of either the African slender-snouted crocodile (*Crocodylus cataphractus*), Nile crocodile (*Crocodylus niloticus*), or dwarf crocodile (*Osteolaemus tetraspis*). Note the lighter color in the center of the scales (A), which are indicative of the underlying dark single osteoderm buttons (B).

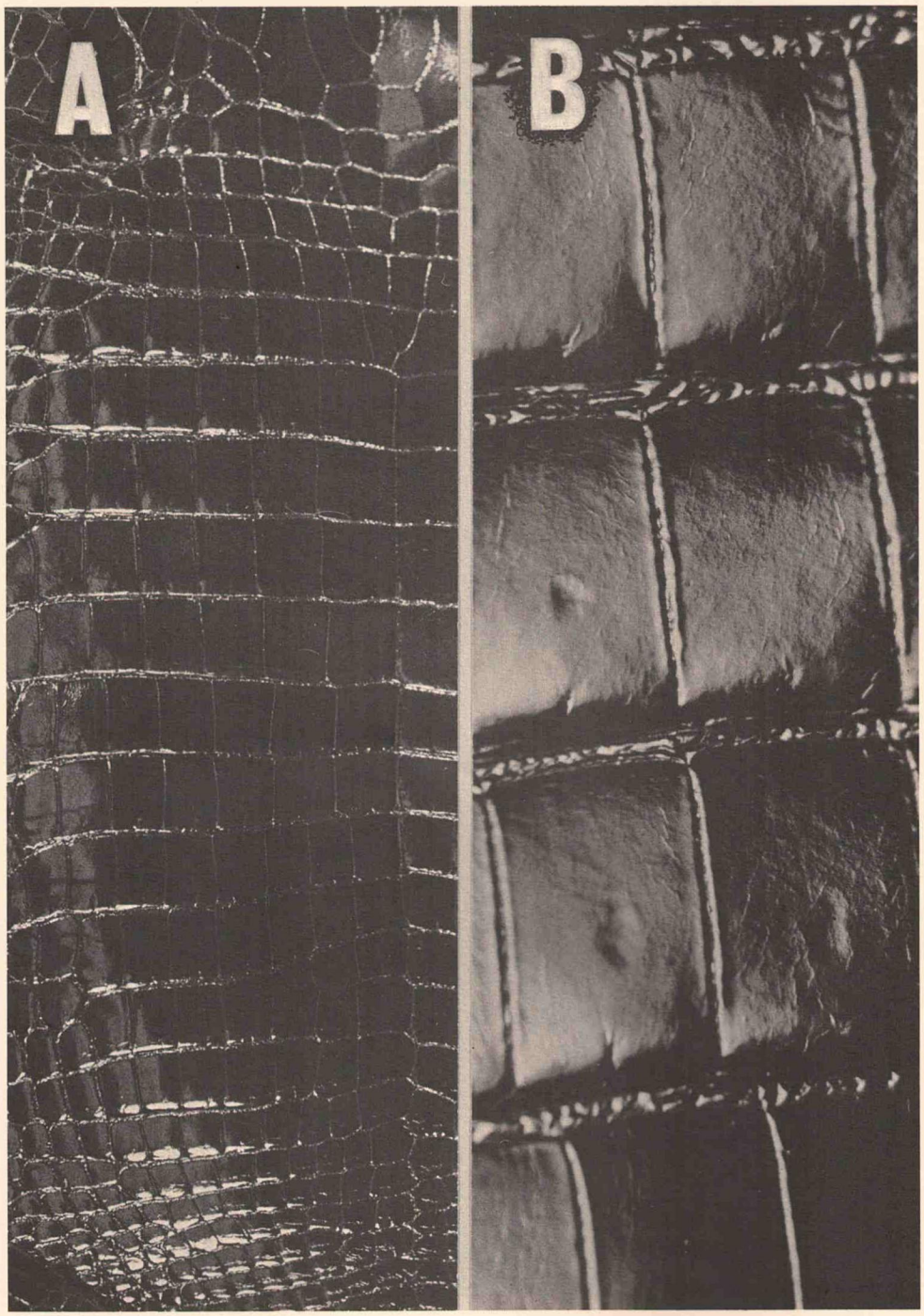

FIGURE 35. Outside surface of a finished belly skin (A) and ventral scales (B) of either an African slender-snouted crocodile *(Crocodylus cataphractus)*, Nile crocodile *(Crocodylus niloticus)* or dwarf crocodile *(Osteolaemus tetraspis)*. Note the shallow indentations, surface pits, indicative of underlying single buttons. Also note that follicle glands are reduced to deep wrinkles by polishing process.

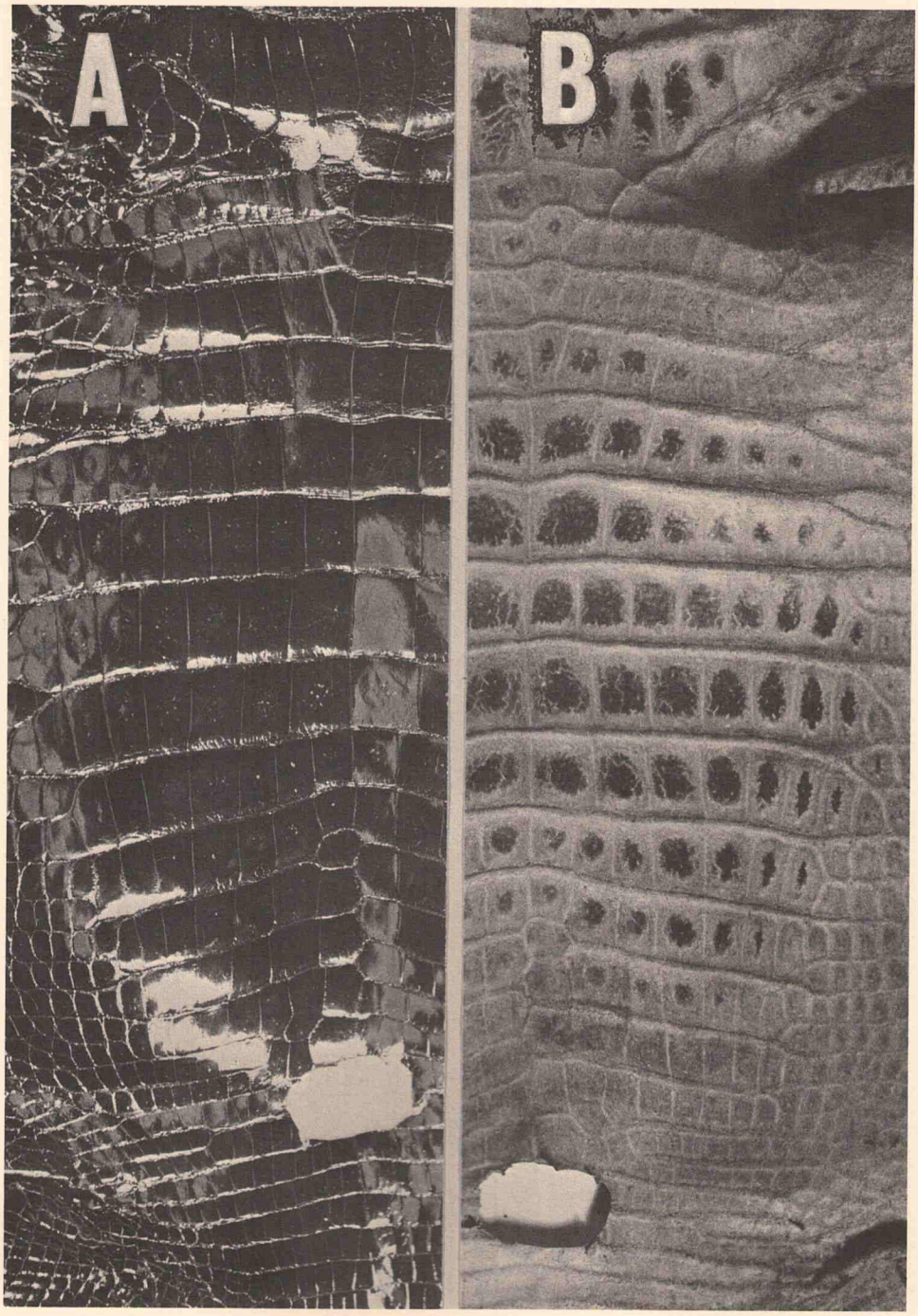

FIGURE 36. Outside (A) and inside (B) surfaces of finished African slender-snouted crocodile *(Crocodylus cataphractus)*, Nile crocodile *(Crocodylus niloticus)*, or dwarf crocodile *(Osteolaemus tetraspis)* belly hides. Note the surface pitting (A) and dark single osteoderm buttons (B). Close views of the ventral scales are shown in figure 37.

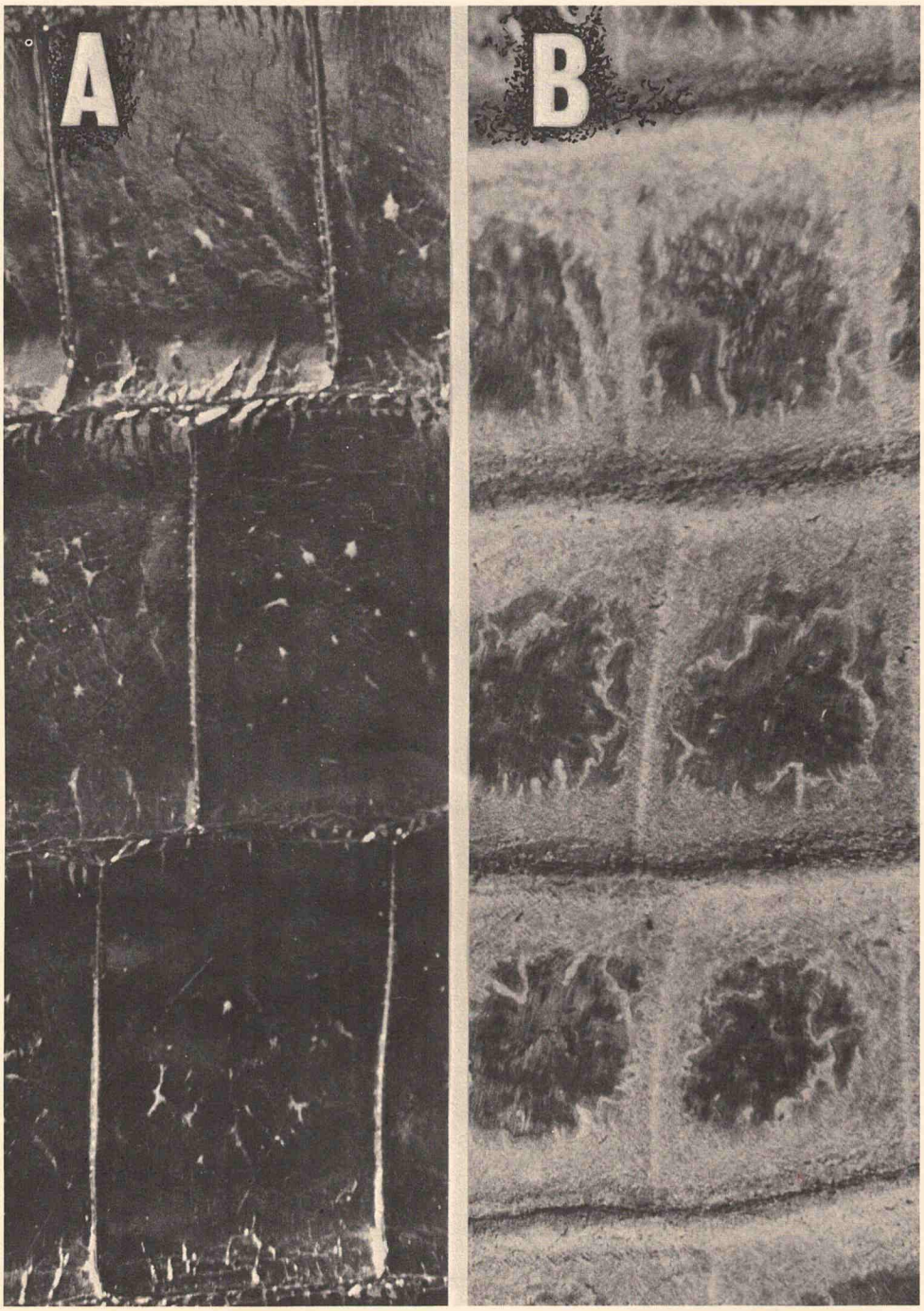

FIGURE 37. Ventral scales (A) and single osteoderm buttons (B) of finished African slender-snouted crocodile *(Crocodylus cataphractus)*, Nile crocodile *(Crocodylus niloticus)*, or dwarf crocodile *(Osteolaemus tetraspis)* hides. Because of the technique used to dye this hide, the surface pitting is white against the dark scales.

FIGURE 38. Lady's purse made from narrow South American caiman *(Caiman crocodilus)* sides. Seams where the sides are glued together are difficult to locate. Arrows indicate seams.

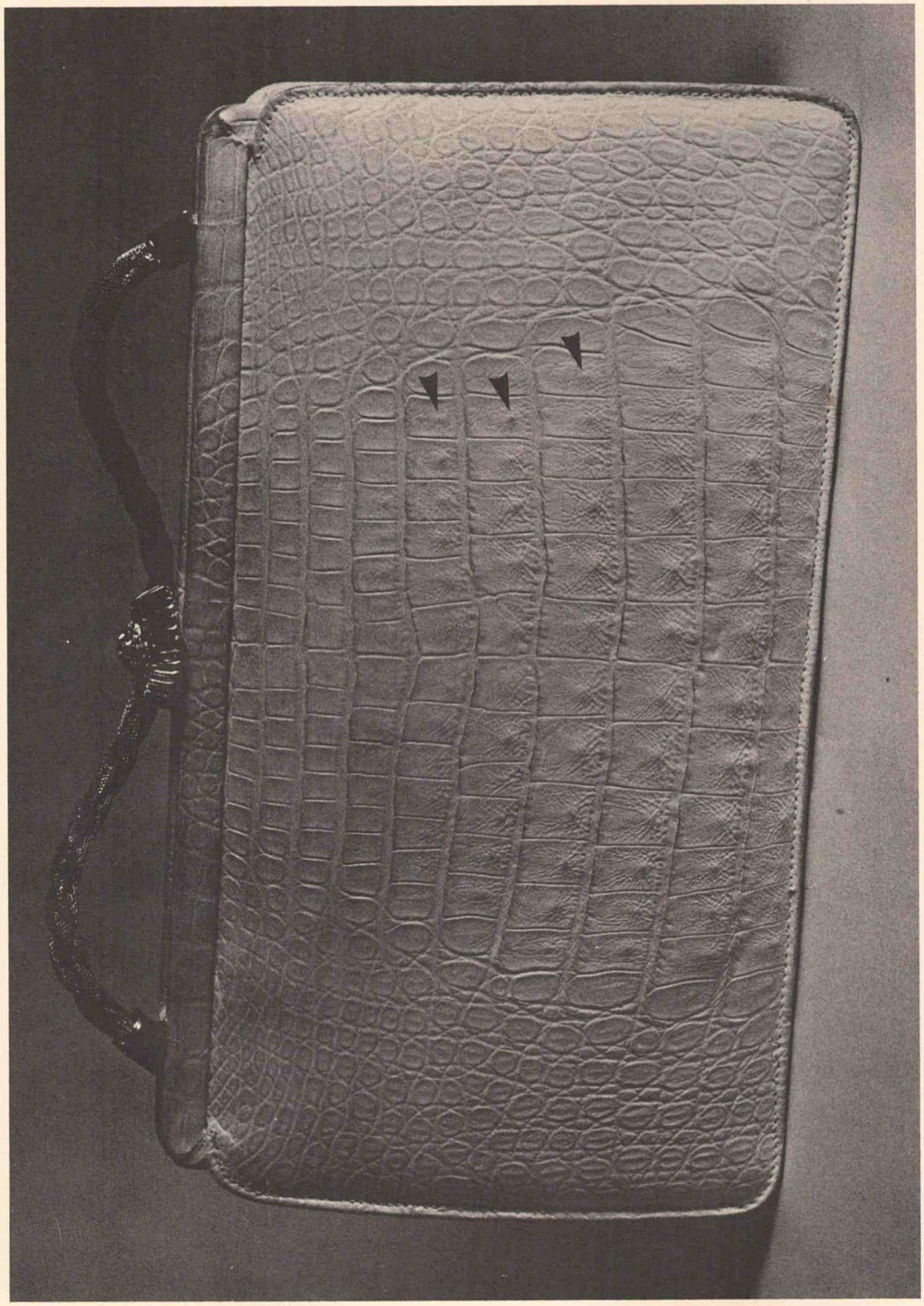

FIGURE 39. Lady's purse made from a South American caiman *(Caiman crocodilus)* belly. Note the wrinkles and surface pitting. Arrows indicate the high points of the scales. In this species the high point is just anterior to the center of the scale (the anterior end of this hide is touching the table, the posterior end is up).

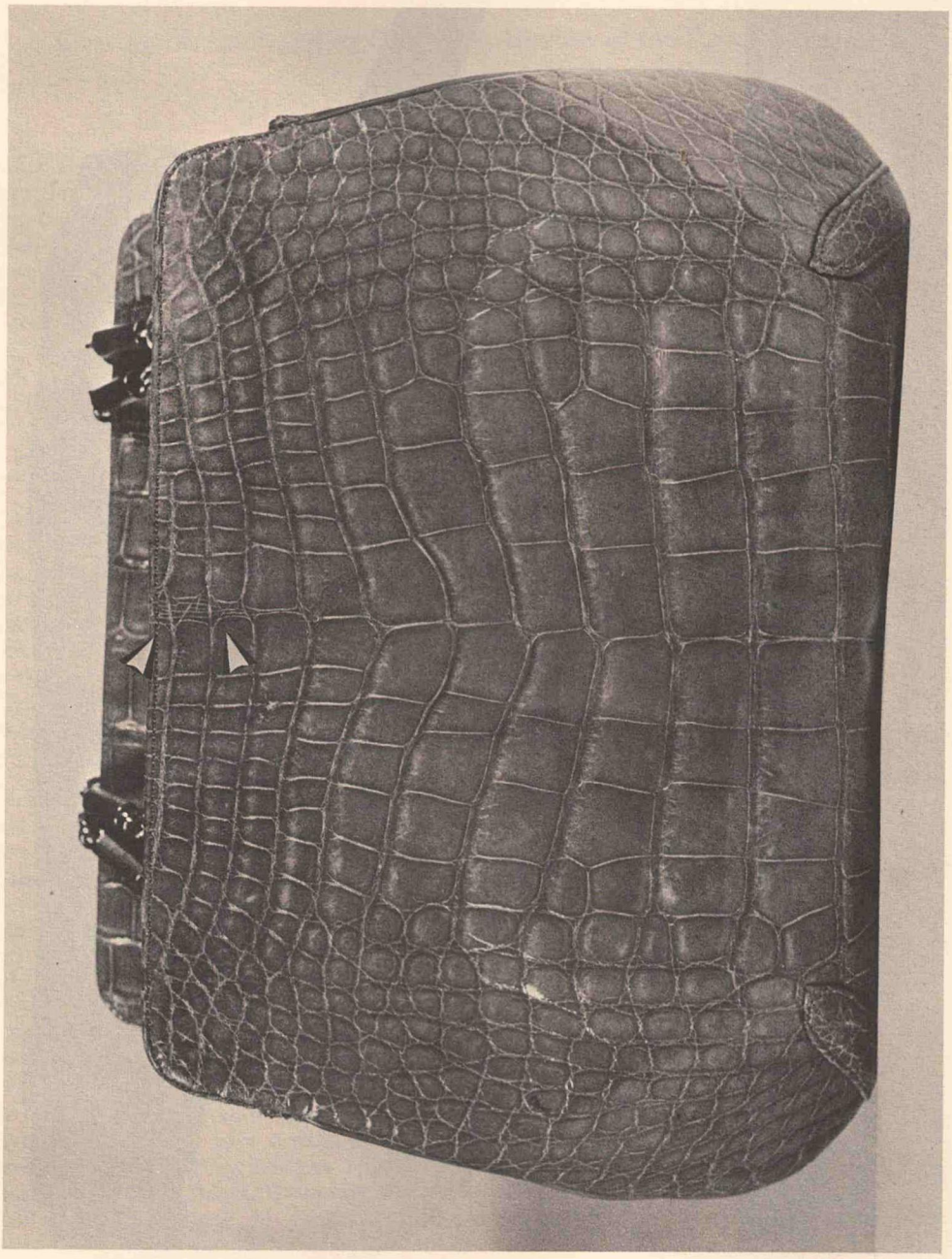

FIGURE 40. Lady's purse made from American alligator *(Alligator mississippiensis)* belly. Note the absence of both surface pitting and follicle glands. Also note the spider-web umbilicus indicated by the arrows.

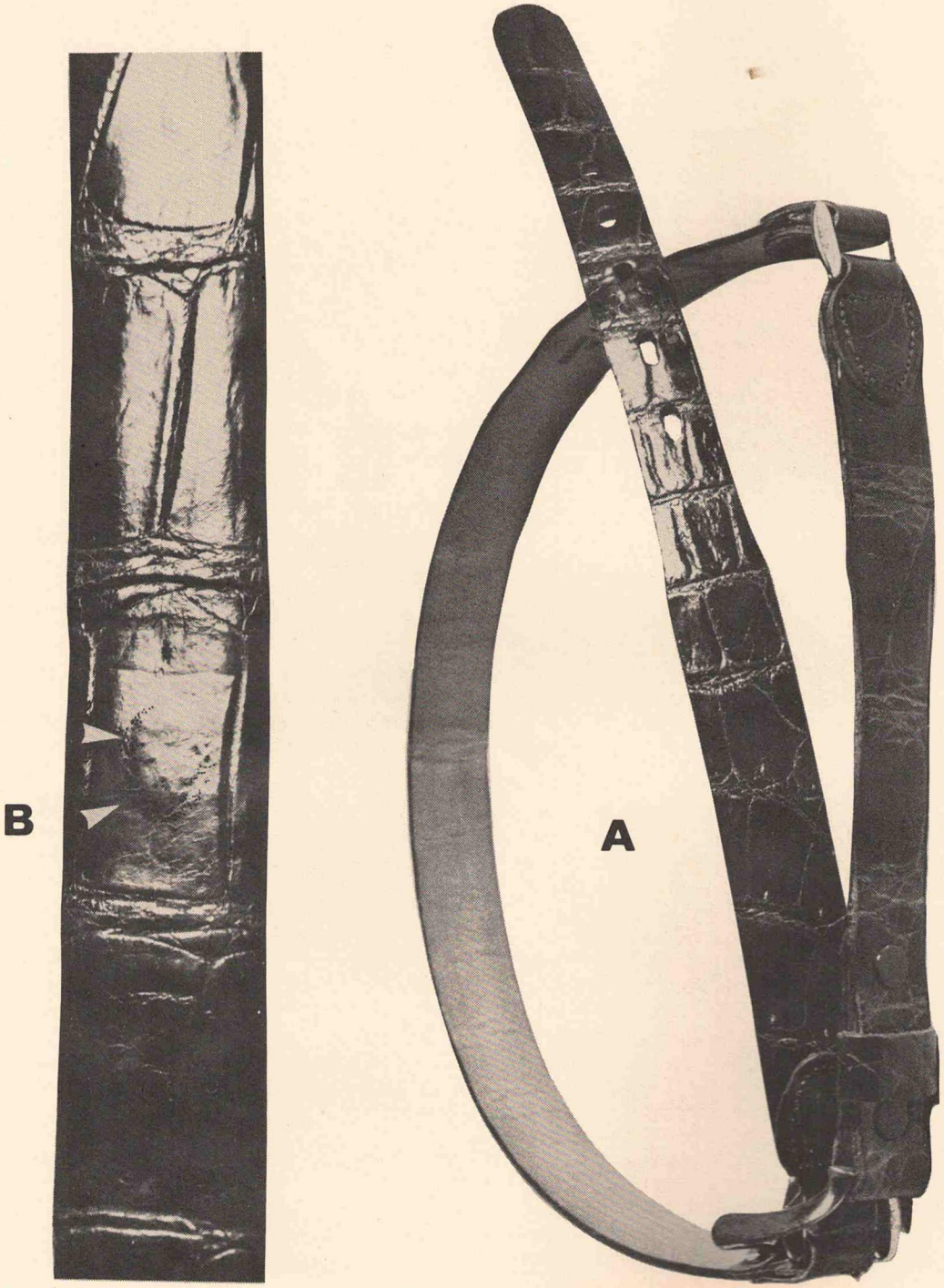

FIGURE 41. Man's belt made from either African slender-snouted crocodile *(Crocodylus cataphractus)*, Nile crocodile *(Crocodylus niloticus)*, or dwarf crocodile *(Osteolaemus tetraspis)* belly hide. Photograph B is a close view of some scales from A. Note follicle glands and also slight hump (arrows) indicating underlying single osteoderm buttons.

NEWS AND NOTES

Crocodylus intermedius Graves, A Review of the Recent Literature

(Figures 1-3)

Studies evaluating the definitive morphological characters of living crocodilians have disclosed some confusion in the recent literature on the Orinoco crocodile *Crocodylus intermedius* Graves (Mook, 1921, Bull. Amer. Mus. Nat. Hist., 44(13):165-173; Wermuth, 1953, Sonderdruck aus: Mitteilungen aus dem Zoologischen Museum in Berlin, 29(2):493-495; Wermuth and Mertens, 1961 Schildkröten, Krokodile, Brückenechsen, Veb Gustav Fischer, Jena: 359 and 361). A complete biological profile of the species is given by Medem (1958, Caldasia, 8(37):175-215) and need not be repeated here.

I thank Dr. F. Wayne King and the New York Zoological Society (= NYZS); Federico Medem; the American Museum of Natural History, New York (= AMNH), and its Herpetological Information Search System; and the Field Museum of Natural History, Chicago (= FMNH) for their assistance in making specimens and difficult-to-obtain literature available for study and for reviewing the manuscript.

Discussion

Before Medem presented his collection to the Field Museum of Natural History in 1958, *Crocodylus intermedius* was poorly represented in zoological and museum collections. Those specimens which were available were supported by little or no collecting data. Consequently, one skull (AMNH 8790), bearing the data "Venezuela, South America, via the New York Zoological Society," was described in detail and figured by Mook (1921), and subsequently figured by Wermuth (1953), and Wermuth and Mertens (1961). Unfortunately, the skull was not available for re-examination until recently. Comparison of AMNH 8790 to a female *Crocodylus intermedius* collected by Medem on the Rio Ariari, Territory of Meta, Colombia (FMNH 75658); and individuals of *Crocodylus cataphractus* from K. P. Schmidt's Congo Expedition (AMNH 10075), and from Liberia, West Africa (NYZS 610716 and 610504) discloses AMNH 8790 to be an example of *Crocodylus cataphractus*, the West African slender-snouted crocodile, erroneously identified as *Crocodylus intermedius*.[1, 2]

Medem (1958:184) pointed out that Mook described and figured AMNH 8790 with nasal bones not entering the external narial opening while those *Crocodylus intermedius* he had examined from Colombia showed the nasals to enter the external narial opening. However, he did not realize Mook had incorrectly identified the specimen as *C. intermedius*.

In addition, AMNH 8790 differs from *Crocodylus intermedius* (FMNH 75658) and agrees with *Crocodylus cataphractus* (AMNH 10075), in the following aspects:

The pre-maxillary/maxillary suture extends caudad to slightly beyond the level of the first maxillary teeth in AMNH 8790, while in FMNH 75658 the suture nearly reaches the level of the third maxillary teeth.

The mandibular symphysis of AMNH 8790 and AMNH 10075 extends to the level of the eighth mandibular teeth, while in FMNH 75658 the symphysis barely reaches the level of the seventh mandibular teeth.

The palatine/maxillary suture in AMNH 8790 is triangular, anteriorly pointed at its junction with the median palatine suture, and occupies a space approximately equal to that of three adjacent maxillary teeth. FMNH 75658 has an elongated parallel-sided palatine/maxillary suture, square at its anterior face which is at right angles to the median palatine suture. Its length coincides to the space occupied by four maxillary teeth.

The ninth maxillary teeth are largest in AMNH 8790 while the tenth are the largest in FMNH 75658.

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[1] While comparing plate figures, it was noted that the skull figure for *Tomistoma schlegelii* (S. Müller) shown in Wermuth and Mertens, 1961, page 376, was duplicated in error on page 360 as the skull figure for *Crocodylus cataphractus* Cuvier.

[2] De Rochebrune, 1883 (Faune de la Senegambie, J. Durand, Imprimeur de la Societe Linneenne, Bordeau, p. 47), includes *Temsacus intermedius* Gray (= *Crocodylus intermedius* Graves) in the fauna of Senegambi (= Senegal and Gambia) although the species is unknown in Africa. The specimen he figures most closely resembles *C. intermedius*.

The conformation of AMNH 8790 is suggestive of *C. cataphractus* in the relatively high, square profile of the cranial table, the concave dorsal aspect of the snout, and the proportionately narrow frontal between the orbits. FMNH 75658 differs in having a relatively low cranial table, a slightly elevated or "swollen" snout immediately anterior to the orbits, and a frontal region which is wide in proportion to the overall length of the skull.

It should be noted that AMNH 8790 is the skull of a deformed specimen, probably resulting from confined captive conditions over a prolonged period of time during shipment. Many of the maxillary and mandibular teeth are broken or twisted in their sockets. The mandible itself is broken, perhaps during preparation or damaged in life. Portions of the anterior mandible and the pre-maxillaries are also damaged or worn away, a condition often seen in captive specimens poorly crated for shipment, in cramped quarters.

Only two "Orinoco crocodiles" appear in the New York Zoological Society's annual reports between the years 1900 and 1922. These coincide to the receipt of AMNH 8790 and another preserved juvenile specimen (AMNH 2206) bearing "Colombia, South America," data, also "via the New York Zoological Society." The latter preserved specimen is also an example of *Crocodylus cataphractus.* One of these is reported to have been secured by the zoological park from a donor recently returned from a tour aboard a merchant vessel.

One of these specimens was photographed in life while at the zoological park. The plates, misidentified as *Crocodylus intermedius,* were reproduced in subsequent literature (Ditmars, 1913, Bull. Zool. Soc., 16(58):1005; DeSola, 1933, Bull. Zool. Soc., 36(1):14, Wermuth, 1953, 29(2):493). These photographs are preserved in the NYZS photographic archives.

The identification of living crocodilians without the availability of accurate collecting data has been a problem for scientific staffs of zoological parks and museums, particularly during earlier years when the classic works of Boulenger, Cuvier, and Gray represented the only comprehensive literature on crocodilians. These publications, which stress osteological materials rather than living specimens, obviously were of little help in the identification of a rare species perhaps never seen before and seldom encountered since.

PETER BRAZAITIS, Department of Herpetology, New York Zoological Park, Bronx, New York 10460.

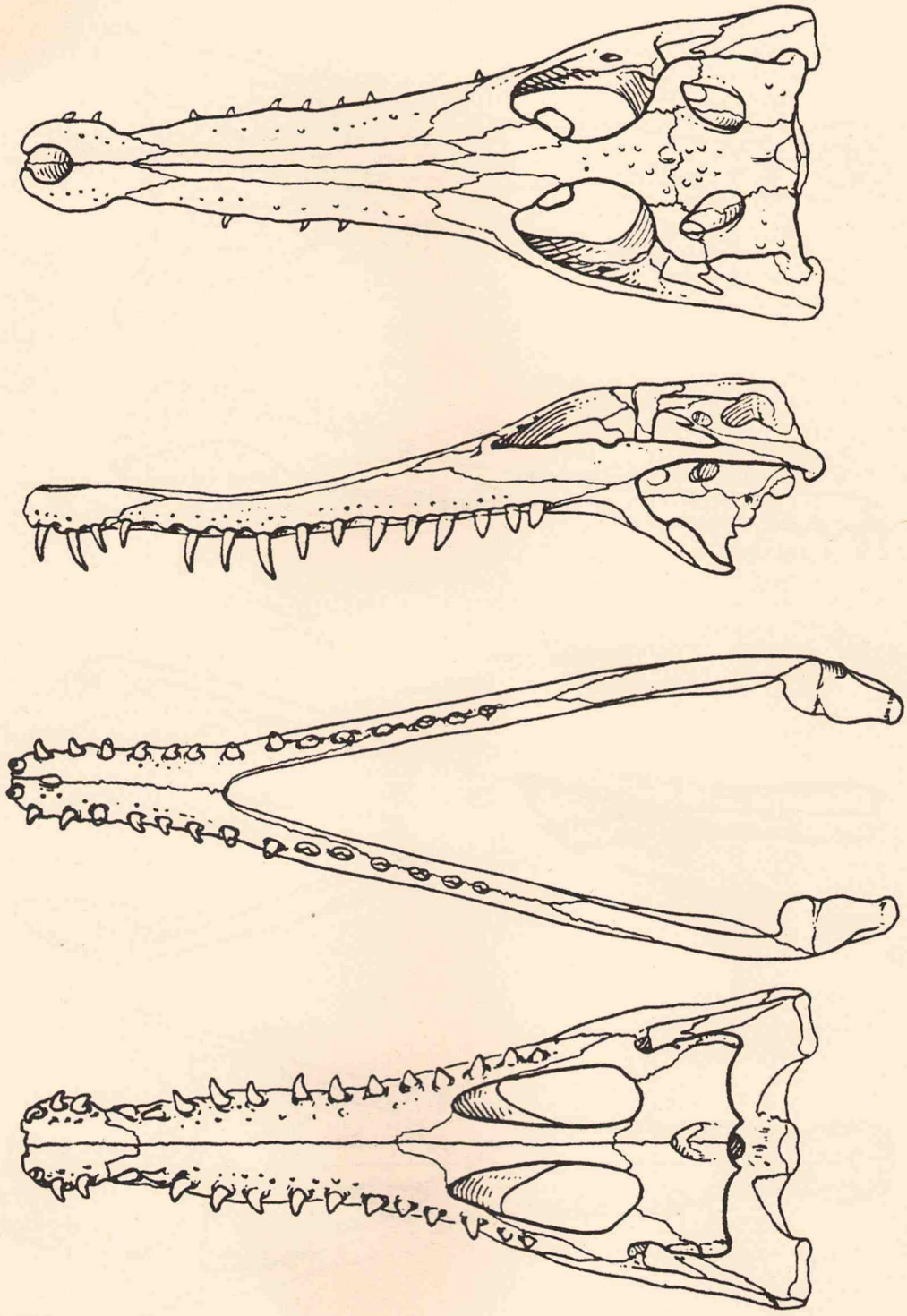

FIGURE 1. *Crocodylus cataphractus* Cuvier (AMNH 8790), misidentified and described in Mook (1921) as *Crocodylus intermedius* Graves. Figure adapted from Mook.

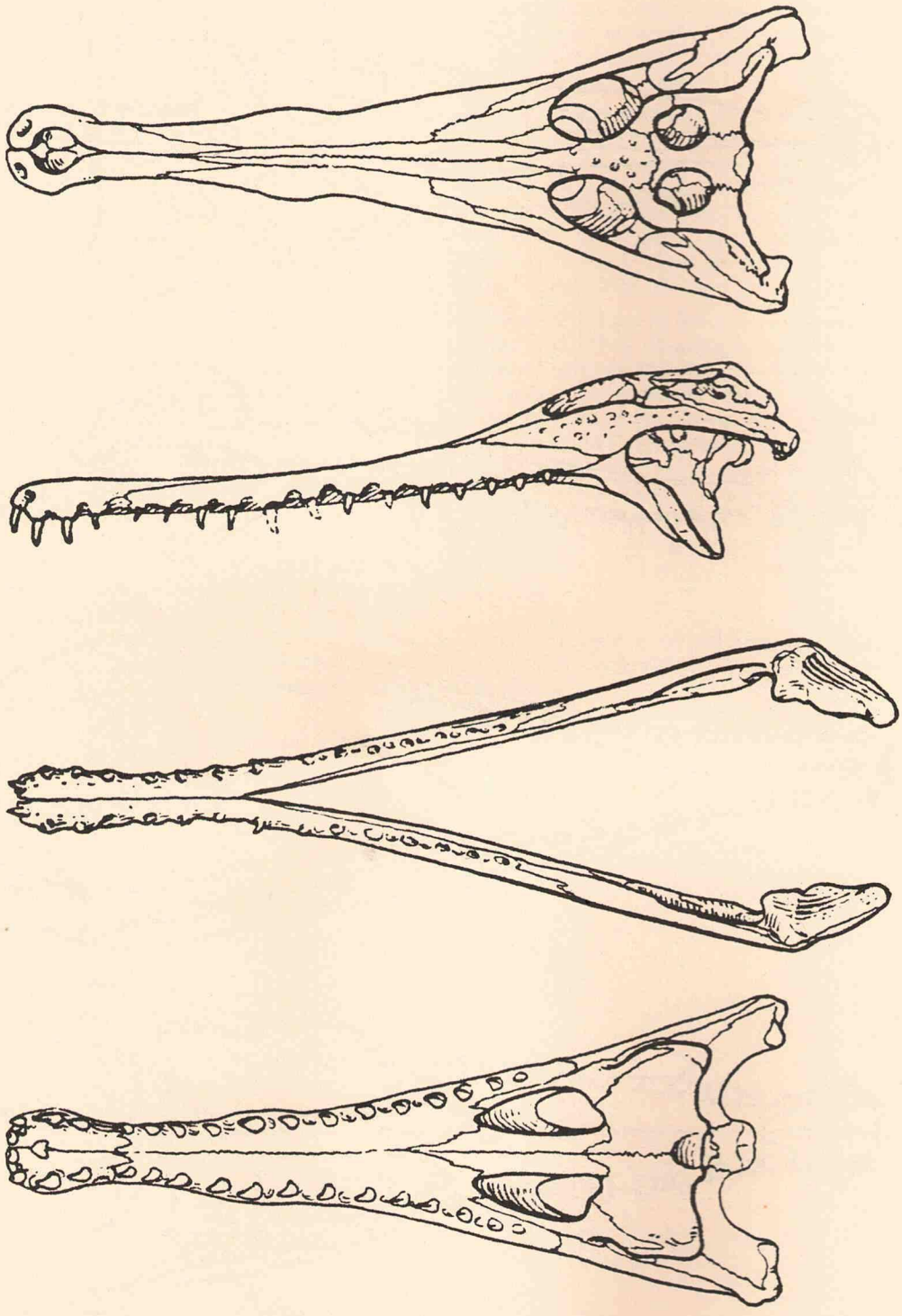

FIGURE 2. *Crocodylus cataphractus* Cuvier (AMNH 10075), described in Mook (1921). Figure adapted from Mook.

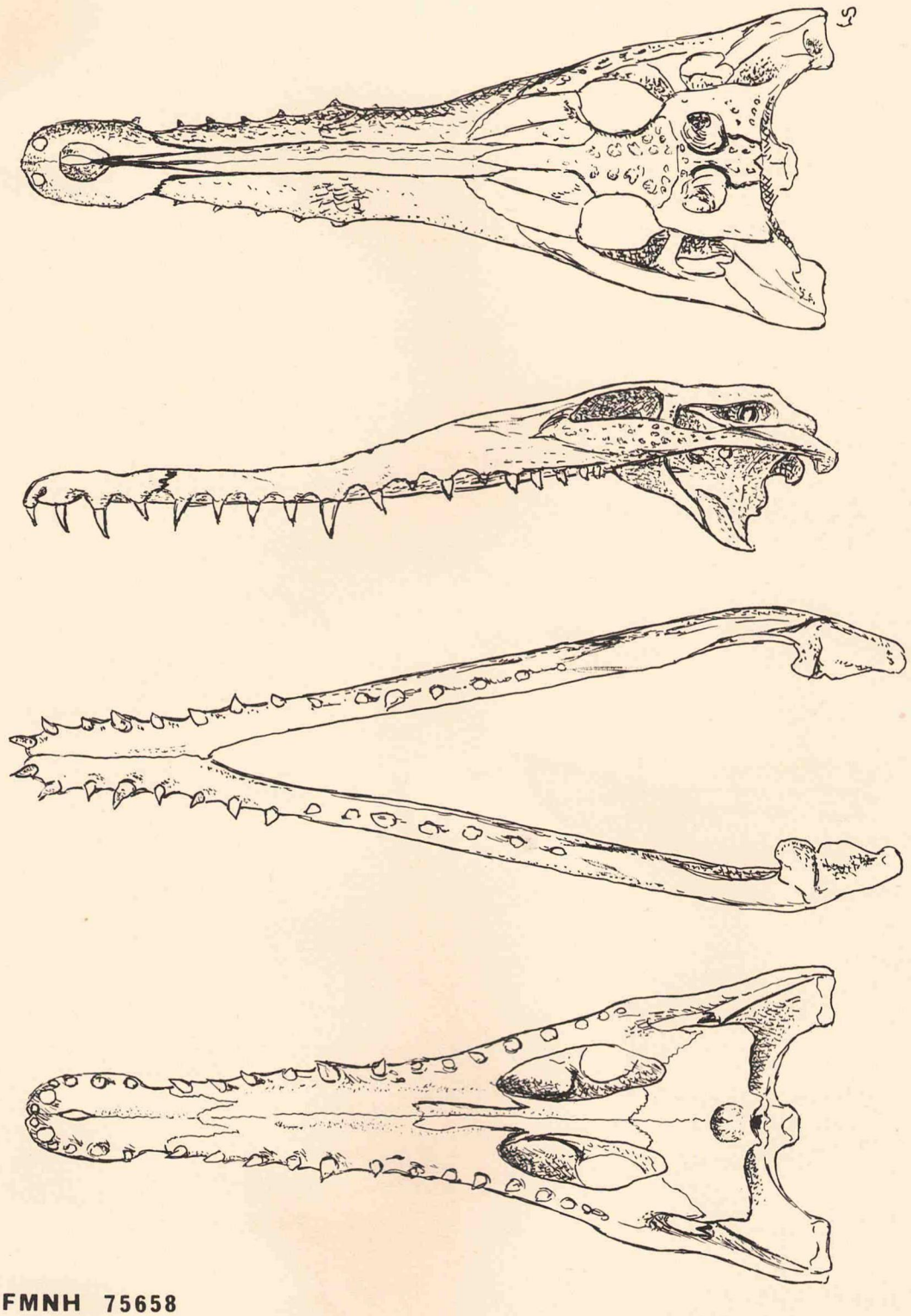

FIGURE 3. *Crocodylus intermedius* Graves (FMNH 75658), a juvenile female from Rio Ariari, Territory of Meta, Colombia, collected by Federico Medem. Illustration by Lloyd Sandford, NYZS.

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