

BIRTH, BEHAVIOUR
AND DEVELOPMENT OF
A HAND-REARED
TWO-TOED SLOTH

Choloepus didactylus

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AN exhibit of Two-toed sloths, *Choloepus didactylus*, at the National Zoological Park has maintained itself continuously for the past 13½ years. Four animals of undetermined sex were originally purchased in 1952 and

the group now consists of seven individuals: six adults and one juvenile born in August 1964. During the period between June 1952 and April 1965 a total of 21 births were recorded, in every month of the year except April, September and November (Table 1).

From the available records, at least five of the 21 infants born were rejected or fell from the mother shortly after birth. Human attempts to return the dropped young to the mothers were all unsuccessful. Also unsuccessful were efforts to hand-rear four of these five infants. The fifth, named 'Mary-Jane' before it was sexed correctly, was the first sloth to be successfully hand-reared at the National Zoo. At the time of writing (April 1965) the animal is eight months and one week old.

The birth of 'Mary-Jane' occurred during the afternoon of 31 July 1964 and was witnessed by the associate zoo director, Mr J. Lear Grimmer, by Dr Charles O. Handley, Jr, of the Smithsonian Institution Division of Mammals, and by students of Dr Handley's summer graduate course in Mammals of the

Breeding

Table 1. History of animals born* in the Two-toed sloth exhibit† at the National Zoological Park – 26 June 1952 to 8 April 1965.

Single young born	Sex	Disposition
31.8.1953		Stillborn
28.6.1954		Stillborn
21.10.1954		Died 7.12.1954
24.1.1955		Died 26.2.1955
18.2.1955		Died 18.2.1955
7.5.1956		Died 25.5.1956
10.1.1957		Still alive on exhibit
29.3.1958		Died 17.4.1958
28.5.1959		Died 15.6.1959
17.12.1959		Died 20.12.1959
15.5.1960		Still alive on exhibit
2.6.1960		Died 8.6.1960
26.3.1961		Stillborn
19.6.1961		Hand-reared. Died 23.6.1961
27.7.1961		Still alive on exhibit
8.7.1962	Female	Hand-reared. Died 16.8.1962
17.6.1963		Hand-reared. Died 18.6.1963
29.7.1963		Hand-reared. Died 4.8.1963
2.5.1964		Appeared premature. Died 2.5.1964
31.7.1964	Male	'Mary Jane'. Hand-reared. Still with author.
?8.1964		Still alive on exhibit. Still with mother.

* We were unable to determine the gestation period of *C. didactylus*. Copulation was never observed here despite 21 births.

† Animals in this exhibit have never been tagged, but the number of surviving young plus the total number now in the exhibit group indicate that three of the original four purchased adults are still alive and are at least 13½ years of age.

World (University of Virginia, Mountain Lake Biological Station). The following impressions and recollections of the parturition were asked for eight months after the birth and were generously given to the author (personal communication).

All observers agree that when the birth process was first noticed, the baby's head had emerged from the vagina, was free of membranes and was facing upwards (anti-gravity) towards the mother's abdomen.

Report No. 1 – J. L. Grimmer (NZP). The infant emerged head-first, facing upwards. The embryonic membranes were torn early in the birth process. The mother was in the normal adult (upside-down) hanging position and made attempts with one fore-leg to pull the infant between her hind-legs on to her abdomen. The infant hooked on to the mother with its fore-legs as soon as these were free and wriggled extensively to free the rest of

its body from the birth canal. Other sloths (number not determined) assisted by preventing the infant from falling and by cleaning the mother and infant by licking.

Report No. 2 – C. O. Handley (SI). Parturition generally seemed slow and difficult. The infant was precocious, struggled and helped free itself when only half emerged by reaching out, trying to hook and pull itself on to the mother. A number of other sloths were close together during parturition and appeared to assist the infant by blocking its fall with their bodies. They did not actively assist the infant with their fore-limbs.

Report No. 3 – Mrs E. Shetler. Parturition seemed difficult, both for the mother and the infant. The female's nostrils were expanded in laboured breathing and muscular contractions were noticed. The mother helped to pull the struggling infant up on to her abdomen using

one fore-leg. Duration of parturition (including the time required for the young to reach the abdomen successfully) seemed to be from 15 to 30 minutes. Other sloths helped clean the mother and infant by licking and also assisted the young to reach the mother's abdomen by using their fore-legs.

Report No. 4 - Mr Lloyd H. McFarland (San Antonio College). 'Delivery was head-first and lasted for about two to three minutes. The mother remained in the same position on the limb of a tree and did not appear to give herself external help. She underwent a few rather violent respiratory-abdominal contractions and did make one ineffective effort with a fore-limb to 'catch' the baby when presumably she sensed it slipping. She made no sound. No real assistance was given by the other sloths, although one did appear to act as 'nurse' and briefly sniffed or licked the mother's genital area. It was largely up to the new-born animal to grasp the mother's hair and retain its position (which it did very efficiently, in spite of considerable crawling about). Although 8 or 9 in. of umbilical cord were exposed, no blood of any consequence was observed. No extra-embryonic membranes, etc., had been discharged when the class departed - probably 15 or 20 minutes after arrival.'

Despite the infant's success in reaching the mother's abdomen, it was found and retrieved from the floor at approximately 2300 hours the same day. It was then taken to the hospital for hand-rearing where it thrived on a mixture (1:1) of evaporated milk and water for the first three weeks of life. No reason was found for discontinuing the hospital care except that the author found the little sloth quite irresistible.

The gross error in sexing was not discovered until the young animal was well-established and it was discovered that it was definitely a male. Sexing of sloths is usually difficult in the living animals for two reasons: the external genitalia are small, inconspicuous and of similar form in both the male and the female; and the normal position (upside-down and curved) and untame disposition of adult sloths preclude easy examination.

Slight spreading of the skin in the anal-genital area reveals an appendage resembling a penis. This is the urogenital-cloacal opening (*Figure 1*). It is roughly the same size in both male and female and is found in exactly the same position relative to the anus in both sexes. In males, however, the cloacal opening is a small, more or less circular hole. In females, the opening is a longer, elongated slit. Normally this appendage is held 'folded'

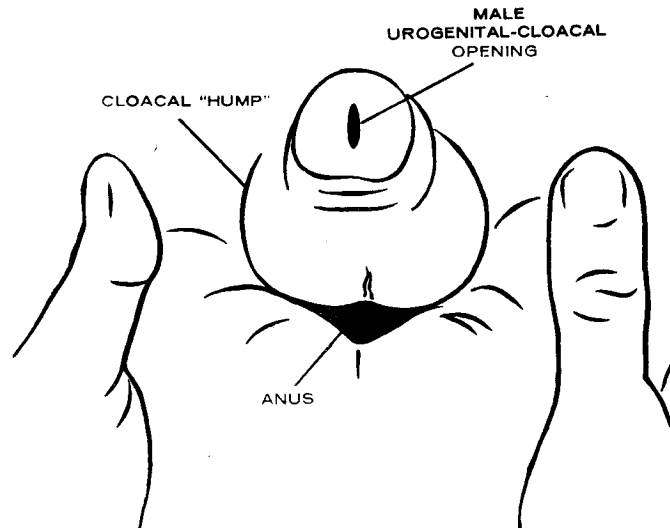


Figure 1. Anal-urogenital region of a male Two-toed sloth, *Choloepus didactylus*.

Breeding

into the abdominal skin by what appears to be muscular contraction. Thus contracted and partially hidden by fur the 'hump' is seldom prominently visible. Even in the hand-reared infant it is only clearly seen when the animal is fully relaxed and the surrounding skin is spread manually.

Another sloth, born shortly after the hand-reared infant, was concealed by the mother and was not observed until 24 August 1964. This accepted young afforded an opportunity to observe normal positions of infant sloths

before the age of three weeks but at that time all the molars had erupted.

The tongue and inside of the mouth are pink with a sharply defined dark brown area on the roof of the mouth, just under the nose. It is thought that pigmentation in the mouth varies among individuals (Handley, 1964).

Pronounced eyelids are lacking. On closing, the surrounding skin simply meets horizontally at the centre of the eye (Figure 2).

The pinnae are small, circular in shape and concealed by hair. (Figure 2.)



Figure 2. Head of an infant Two-toed sloth, *Choloepus didactylus*, showing external ear and simple eyelids.

as well as a comparison of behaviour and development with the hand-reared animal.

PHYSICAL CHARACTERISTICS OF THE HAND-REARED INFANT

At birth the hair was velvety dark brown but it gradually lengthened, becoming coarser in texture and lightening to blonde (particularly along the back crest) as the animal developed. Adults in the exhibit show considerable colour variation, ranging from dark brown grizzled with blonde to an almost uniform 'champagne' blonde and 'strawberry' blonde.

Observations on the teeth were not made

The claws were well developed at birth, as was the animal's gripping power in both front and hind feet. The typical grasp of the infant, as opposed to frantic 'hooking' when insecure or frightened, was tested on the author's scalp. The dorsal surfaces of the claws were run along until a 'fistful' of hair was gathered. The animal then 'clenched its palms', forming a painless, lock-tight grip.

DIET AND FEEDING

Milk. The infant was started on a 1:1 formula of evaporated milk and water containing two drops of a multivitamin mixture¹ per

¹ ViDaylin-T, Abbott Laboratories, Chicago, Ill., USA.

21 cc feeding bottle. During the 13th week, the animal's weight, appetite and activity decreased and the concentration was increased to 3:2 evaporated milk and water, three drops of multivitamins and approximately 0.1 to 0.3 grams of C-1 mineral mixture¹.

The quantity of milk intake was always erratic and varied from 2.6 cc to 5.2 cc per feeding in the third week, to 21 cc per feeding in the sixth week. From the sixth to the 19th week, milk intake gradually decreased as more solid foods were consumed. The bottle was discontinued at 19 weeks of age after the animal choked and bubbled milk from the nose during three successive feeding attempts. From that time to the present at least 21 cc of milk formula has been given daily in two feeds, each poured on to a quarter slice of protein bread.

Initially the infant was fed every three to four hours until it began refusing milk during the fifth week. Food was then offered every six hours and this schedule was adhered to until the 24th week when the animal began sleeping through the mid-day feeding period.

Solid Food. Baby sloths, as reported in the literature, are able to take solids at four to five weeks of age. This infant began mouthing and gumming solids at four weeks but did not actually chew and swallow until six weeks old. At that time slivers of soft fruits (peach, cantaloupe, mealy apple, banana, etc.) were introduced, as well as green foods (kale, celery leaves, spinach, etc.). Parsley was the first green food the animal ate.

Pablum² was offered at four weeks but was not accepted. Although sloths use the tongue to gather food into the mouth, at the time of writing this animal had never fully learned to lap liquids and semi-solids from a dish without submerging the nose, resulting (except in the case of fruit yoghurt) in trauma and loss of interest in the food.

The infant has always displayed specific likes and dislikes in food, as well as intermittent or irregular acceptance of some foods (Table 2). Young sloths start eating solids by reaching out and stealing bits of food from the mother as she eats. This technique of

holding the infant and eating a non-preferred food (such as bananas) failed to interest him more than temporarily.

In the eighth week, solids were substituted for one milk feeding in a 24-hour period, but at no time during the eight months was milk given less than twice a day.

At 11 weeks the hand-reared sloth was discovered to be extremely interested in meat. Since that time, cooked chicken, turkey or beef has been given once a day.

Starting during the 11th week, solids were given after the milk and this regimen has been continued. Solid foods are also offered in all miscellaneous periods of wakefulness and activity. At 11 weeks of age the animal began holding its own greens and at seven to eight months, leafy greens and fruit wedges were left in the cage food tray for consumption during the night. At eight months of age the animal showed a decided preference for eating upside-down, in the manner of adult sloths. However, the three major meals of the day were at this time still fed by hand to ensure adequate intake. Raw carrot is fed steamed until it is soft.

The development of the hand-reared sloth was characterised from the beginning by alternating cycles of activity and lethargy of varying duration with a corresponding effect on appetite and food intake. Even in periods of high activity and obvious hunger, feeding the sloth is time-consuming. In the more lethargic periods (particularly when the animal was very young), feeding required much patience and coaxing. Encouraging the animal to nuzzle on the author's cheek or chin or press his nose against warm flesh often seems to stimulate the feeding response. *Water.* Water was first provided when milk from the bottle was discontinued. Before that time, drops lapped from freshly washed spinach leaves seemed to provide enough moisture. A drip bottle (of a design used for laboratory cages) was installed in the cage when the animal was 20 weeks old. It was used immediately. At eight months, up to three ounces of water were consumed during a 24-hour period.

¹50 per cent steamed bone meal, 25 per cent Ledinac (Lederle Laboratories, Pearl River, New York, USA), 20 per cent dried skimmed milk and 5 per cent iodised salt.

²Pablum is a proprietary baby food.

Breeding

Table 2. Food preferences of a hand-reared Two-toed sloth, *Choloepus didactylus*, during first eight months of life.

<i>Routinely offered Readily accepted</i>	<i>Frequently offered Occasionally accepted</i>	<i>Occasionally offered Occasionally accepted</i>	<i>Refused</i>	<i>Actively reached for while being held</i>
*Milk	Orange	Pablum	Sweet potato, boiled and strained	Hamburger, cooked
*Cantaloupe	Grapes	Parsley	Carrot, strained	Maple syrup
*Apple	Carrot, raw	Monkey biscuit, milk-soaked	Kale, raw	Ice cream
Peach	Tomato, ripe	Apple-sauce	Banana, ripe or green	Cake
Nectarine		String beans, cooked	Celery	Chocolate, any form
*Carrot, steamed		Peaches, strained	Watercress	Oyster stew
*Spinach		Grass, hydroponic	Apple-sauce, strained	Creamed cheese
*Pear		Kale, cooked	Egg yolk, hard- boiled and strained	Candy
Bread, protein		Broccoli, cooked	Hamburger, raw	Chestnuts, boiled
*Chicken, cooked		Asparagus, cooked	Avocado	
*Turkey, cooked			Dog food, prepared	
*Beef, cooked			Collards, raw	
*Yoghourt, any fruit			Honey	
*Egg, scrambled with evaporated milk			Chicken, strained	
			Diet A	

*Favourite foods

GROWTH AND PHYSIOLOGY

Figure 3 shows the rate of growth from 15.5 oz at two weeks of age to 71.3 oz at 34 weeks.

Periods between defaecation in sloths have been reported as varying from two to six-day intervals and observations made on the hand-reared infant show a similar trend of time lapse between defaecation. For the first five months of life, defaecation and urination occurred at from one- to seven-day intervals. In one instance, the time interval was eight days. From the sixth to the end of the eighth month, a period of both high activity and high food intake, defaecation and urination occurred either nightly or every other night.

Except on one occasion (urine only), defaecation and urination have always occurred simultaneously. Sloth droppings are in the form of round, more or less individual

pellets and the amount of urine voided has always been surprisingly large in proportion to the size of the hand-reared animal. From birth, the infant backed off any surrogate mother to defaecate and urinate and by its 22nd week it was depositing droppings in a specific corner of the cage.

Periods of lethargy were originally thought to coincide with increasing accumulation of body waste but this theory was not supported by observations made on the hand-reared sloth between the age of six and eight months.

HOUSING AND TRANSPORTATION

A fur muff or rolled turkish towels of increasing size were always provided as a surrogate mother for the baby to lie on and cling to (Figure 4). Up until the age of 19 weeks the animal was kept in a large wicker basket amply lined with towels. Except in very

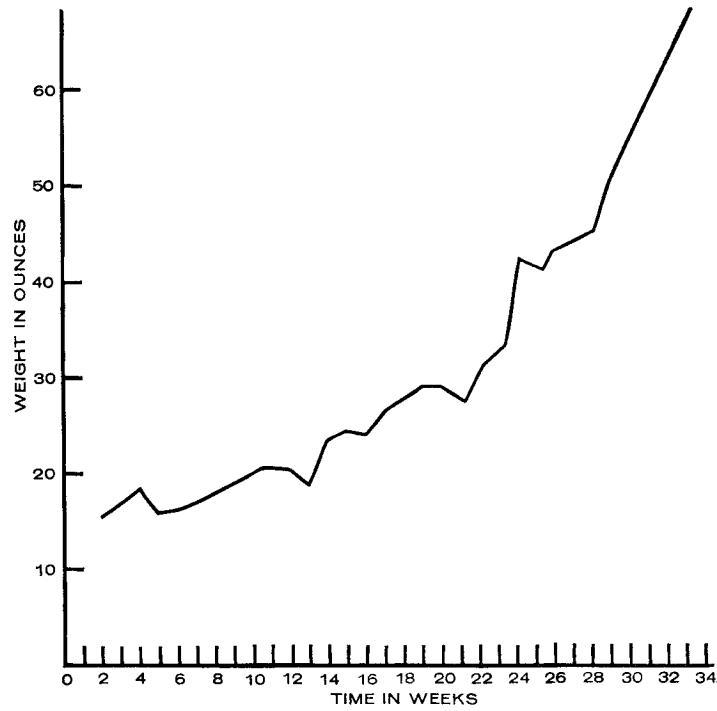


Figure 3. Growth rate of a male hand-reared Two-toed sloth, *Choloepus didactylus*, during the first 34 weeks of life.



Figure 4. Right-side-up position of infant sloth on a rolled towel, simulating the mother's abdomen.

Breeding

warm weather, a towel-wrapped hot-water-bottle was provided for the infant to lean against.

Vinyl-coated wire with a mesh of 1 in. \times 2 in. was used to cover the top of the basket when the animal was nine weeks old and beginning to move about. At 19 weeks it was necessary to replace the basket with a cage, 30 in. \times 16 in. \times 20 in., made of the same vinyl-coated wire and containing firmly supported tree branches of appropriate diameter. This cage was also padded with towels and the usual hot-water-bottle was propped up at one end.

transported inside a coat, close to the body until it grew too large to be accommodated. After this, a fur-lined sleeping-bag (zipper jacket) was provided.

POSITION AND REVERSION

New-born sloths lie right-side-up or 'face down' on their mothers' chests and abdomens (*Figure 4*) and do not learn to hang upside-down until later in their development. The infants suckle against gravity. In the past, inverted bottles with a nipple on the end of a U-tube were tried unsuccessfully on hand-reared infants. With this sloth, a compromise

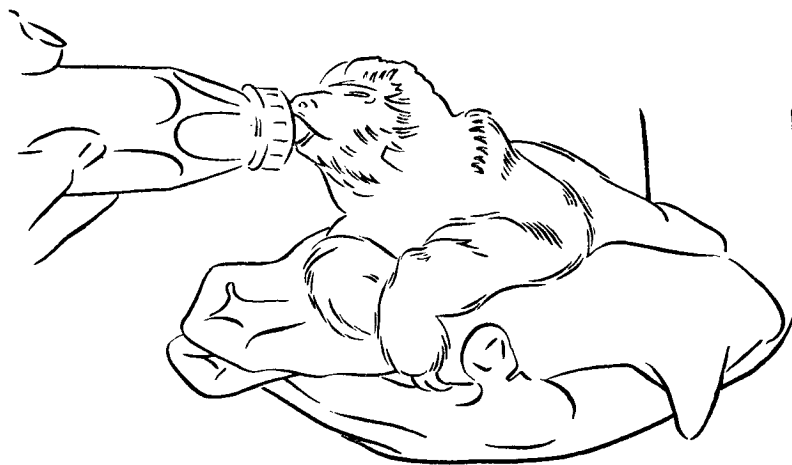


Figure 5. Feeding position used for hand-reared sloth. At no time was the animal tilted more than an angle of 45 degrees.

The animal was always covered with a wool or flannel blanket when inactive, as much for security as for warmth, for infant sloths are usually well-hidden and wrapped by their mother's arms and legs. Depending on the temperature, the young sloth covered itself or kicked off the blanket voluntarily.

Sloths are so adapted for clinging that attempts to pick up the youngster without the surrogate mother resulted in panic after the third week. Thereafter the sloth was always handled on the muff or rolled towels. Transferring from one 'mother' to another was effected by allowing a slow crawling movement, one leg at a time.

In cold weather the young sloth was

position was used. With one arm, the muff was tilted just enough to permit filling of the nipple (*Figure 5*). Because some of the infants hand-reared previously had succumbed to inhalation pneumonia, it seems imperative that the angle of tilt when feeding should be no greater than 45 degrees.

When very young, sloth infants sleep 'spread-eagled' or on their sides in a position that resembles a lima bean. The hand-reared infant also slept flat on its back propped up by rolled towels used to steady the muff or the surrogate mother.

It was of interest to learn at what age reversion takes place, but this, typical of most development is a gradual phenomenon.

During the first six weeks, the animal moved little except to change position, groom clumsily and catch onto proffered fingers with its front feet. At $1\frac{1}{2}$ months it began crawling around the basket and reaching and pulling itself up to the wire top or branches overhead, using only the front legs (*Figure 6*).

first in being unable to climb down to the muff on the floor. Twice the animal fell before anyone could reach it but within one week it had learned to back down the cage sides when tired. At eight months the animal was adept at climbing, not only in the cage, using the once-distrusted branches (*Figure 7*)

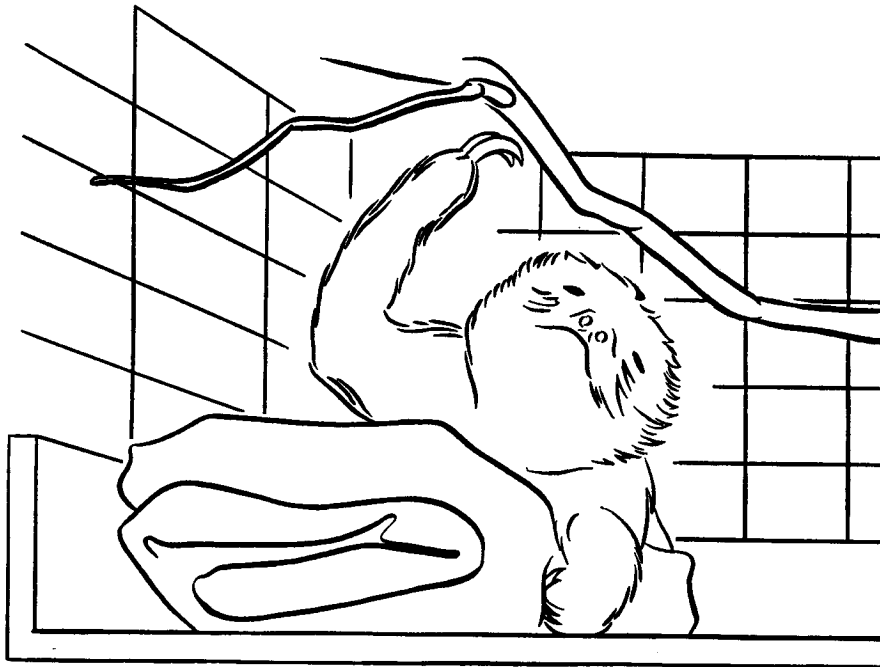


Figure 6. Infant sloth learning to climb by reaching out with fore-limbs.

In its tenth week, three feet were up on the wire but it was not until the 12th week that it fully reverted, briefly, for the first time using all four feet.

When a sloth begins its first exploration of nearby branches, the mother climbs with the baby, her body supporting it from underneath so that the youngster can sink down when fatigued. With practice and development, the young can climb for progressively longer periods. Human hands obviously can serve as a similar support, although perhaps not always readily available. Conditioned to hanging upside-down on wire, the hand-reared sloth immediately climbed to the top of the new cage, ignoring the unfamiliar branches. Some difficulty was experienced at

but also cautiously on runged furniture placed within reach. However, as soon as the author went out of sight, it usually returned immediately to the muff.

The animal still slept on the surrogate mother or propped against it, gripping the wire of the side of the cage, and always rushed to it or the author (whichever was closer) when frightened.

BEHAVIOUR

Activity and Lethargy. The previously mentioned periods of inactivity and sleepiness were first viewed with alarm but keepers reported similar periods of 'regression' in the young sloth reared by the mother in the exhibit.

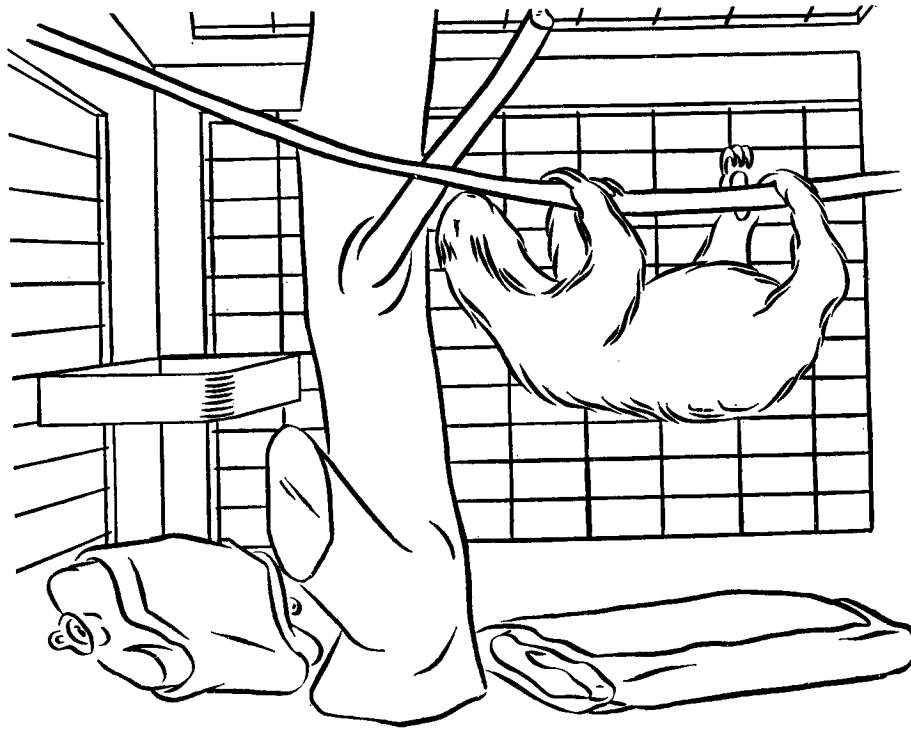


Figure 7. Eight-month-old sloth in its cage, fully able to climb and hang upside down.

Curiosity, Play and Tameness. The animal began showing an interest in its surroundings at the age of five weeks. From that time on, new objects were sniffed, licked and tested with the teeth.

First attempts at play were noted at the same age. This began with a flailing of the arms to catch proffered fingers and pull them into the mouth. Later, at the age of six to eight months, this turned into 'attacking'—grabbing with the arms, 'hooking' roughly, biting, chewing and snorting during times of greatest activity. This same play behaviour was observed once in the young reared by the mother and throughout the approximately five-minute onslaught witnessed, the mother subjected to the 'attack' appeared oblivious to it.

Despite the occasional rough play, the animal was exceptionally tame and responsive to any person, reaching out with the arms for attention. Occasionally, it would leave

the muff and crawl several feet across a carpeted floor to reach familiar persons and at times voluntarily climbed up on a bare arm to be held. As already mentioned, sucking, nuzzling and being held seem vitally important to the well-being of sloths in that they are very strong 'contact' infants, and throughout the hand-reared sloth's development it was held as often as possible and for as long as possible at every opportunity. In most instances the animal would voluntarily leave the muff in order to cling directly to the author.

Vision. By the age of eight months the young sloth seemed to be able to perceive humans easily at a distance of 3 to 4 ft but whether by sight, sound, smell or a combination of senses was impossible to determine. The animal appeared uncomfortable in bright light and blinked and turned away from the source of light. Although apt to be awake at any hour of the day (especially during the

first six months) the hand-reared sloth was always most active at night.

Hearing. In sloths, hearing appears to be acute, at least when the animals are awake. From three weeks of age, it was startled by loud noises and would react by jumping, tensing and clutching tightly. When frightened by a strange sound while climbing, the hair over the entire body erects or 'puffs' so that the animal appears almost double its body size. When startled during a meal, all chewing stops for several moments.

Vocalisation. Expulsion of air through the nose ('snorting') is not uncommon during active play and a similar sound is often heard when a new object is sniffed, but true vocalisation appears to be extremely rare in sloths. In eight months the animal was heard to produce a sound only five times, very briefly on each occasion. This was a soft squeaking bark, seemingly a distress call. It was heard when the animal was cold and wet, after being alone for longer than usual.

Grooming and Cleanliness. Grooming with the claws of both fore- and hind-feet was first observed in the fourth week. Earliest attempts at grooming were clumsy but noticeable improvement in co-ordination was noted by the eighth week. The animal kept itself extremely clean with little or no human aid. A bath was required only once after crawling through a dish of yoghurt. The animal showed no alarm when soaked with tepid water.

HEALTH

The most serious set-back suffered in eight months was the decrease in weight, remedied by the change of the feeding formula. The animal choked badly once on the membrane of an orange section. Hiccoughs were not uncommon but were seldom of long duration. Slightly dry skin at the age of six weeks was quickly alleviated by a few applications of baby oil. Some excess ear wax was removed once during the eighth week and for a period of about one month there was some minor difficulty with eye filming but a few washings with water and a mild boric acid solution cleared this condition completely. Generally, the over-all development of the hand-reared sloth was free from any major or serious illness.

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