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ABSTRACT

This teacher's guide suggests activities that provide opportunities for students in grades 4-6 to study animal tracks. Methods are explained for using sets of 52 Track Cards which show life-size drawings of tracks made by 14 animals; sets of 10 large Mystery Track Cards with life-size drawings of the prints of large mammals; and a Track Picture Book which shows many kinds of tracks, including tracks made by wind, waves, wheels, and tires. Activities are explained for exploring animal tracks out-of-doors, making casts of animal tracks, and interpreting track pictures. (CS)

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Elementary Science Study

TEACHER'S GUIDE FOR

# Tracks

Webster Division, McGraw-Hill Book Company

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# Acknowledgments

## The Tracks Unit

*Teacher's Guide for Tracks*

*Track Picture Book*

*Track Cards*

*Mystery Track Cards*

*Film Loop - The Horse: Walk, Trot, and Gallop*

## Related Units

*Bones*

*Animals in the Classroom*

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The idea for TRACKS was conceived by David Webster during his work with DESERT ANIMALS (now part of ANIMALS IN THE CLASSROOM) in the Wellesley, Massachusetts, Public Schools.

The trial teaching edition of TRACKS was prepared by David Webster, Robert Stinson, Dorothy Curtis, Cynthia Gilles, and myself.

TRACKS was trial taught during the winter and spring of 1969 in about 30 schools across the country. Suggestions from the trial teachers led to changes for this edition.

I would especially like to thank Dorothy Welch, who trial taught TRACKS in her science classes in Hollis, New Hampshire. Her suggestions for activities were extremely helpful.

I am particularly grateful to Robert Stinson for the endless encouragement and useful insights into the science of animals that he offered throughout the course of my work on the *Guide*.

The manuscript was edited by Adeline Naiman. Nancy Weston oversaw the production of this edition. Photographs, except as otherwise noted, are by Victor Stokes.

## Preface

The Elementary Science Study is one of many curriculum development programs in the fields of science, social studies, and mathematics under preparation at Education Development Center, Inc. EDC (a private nonprofit organization, incorporating the Institute for Educational Innovation and Educational Services Incorporated) began in 1958 to develop new ideas and methods for improving the content and process of education.

ESS has been supported primarily by grants from the National Science Foundation. Development of materials for teaching science from kindergarten through eighth grade started on a small scale in 1960. The work of the project has since involved more than a hundred educators in the conception and design of its units of study. Among the staff have been scientists, engineers, mathematicians, and teachers experienced in working with students of all ages, from kindergarten through college.

Equipment, films, and printed materials are produced with the help of staff specialists, as well as of the film and photography studios, the design laboratory, and the production shops of EDC. At every stage of development, ideas and materials are taken into actual classrooms, where children help shape the form and content of each unit before it is released to schools everywhere.

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## Introduction

The world is full of the traces of events that happened—sometimes a moment ago, sometimes a million years ago.

Every animal track is a record of a particular creature's activity at a particular time. For the finder, there is the reward of unraveling the events that shaped the track. A track can indicate many things about the animal that made it: its identity, the direction in which it was going, whether it was moving quickly or slowly, if it was pursuing a victim or being pursued, how long ago it lived, its mood, its size, and in some cases even its sex, its method of finding food, the food it ate, and the environment it needed in order to survive.

In the wild, we can rarely see an animal close by for more than a few seconds, but its tracks can tell us many things we could not otherwise learn. A track tells much about the physical structure of an animal and what it can do. A series of widely spaced, small, delicate footprints might indicate a slender-legged animal, probably capable of great speed and agility. A track of large spread-out prints might indicate a thick-legged, probably thick-bodied animal lumbering along. A track also tells much about the structure and function of the feet that made the prints. A print of an opossum's foot, showing the opposing fifth toe (which is positioned like the thumb of a human being) might lead the finder to



conclude correctly that the animal did these things.

Machines, too, make many of the tracks we find upon the earth. These tracks can tell about man and his way of life.

Tracks, then, offer children an opportunity to learn to use their eyes and ears to learn about the world in which they live.

## Possible Ways to Start

A good way to begin TRACKS is to take the class out to look at a set of tracks or show the students a photograph of tracks and ask questions, such as:

*What can you tell me about these tracks?  
What animal made them?  
How were they made?*

Several trial teachers began with a discussion of what "track" means. Children disagreed on whether a track is a single footprint or a whole series. Each class eventually decided how the group would use the word.

Another beginning is to ask the children to go on a track hunt on their way home from school:

*Did anyone see any tracks this morning?  
Are they where we could all see them?  
What were they tracks of?*

One trial teacher began by inviting the class to bring small pets to school in suitable cages. The children helped the animals to step on tempera paint and then make tracks on white paper. (See pages 10-11.)

## How to Continue: A Suggestion

Many teachers have found that children are led into other areas of inquiry as they work on TRACKS outdoors or indoors at various seasons of the year. These areas of interest are often not directly related to the study of tracks, but if the children are encouraged to follow them up, the results can be very rewarding to the whole class.

In some classes, the activities of TRACKS have led to work in social studies, math, language arts, geography, and art. Here, for example, is an excerpt from one teacher's report:

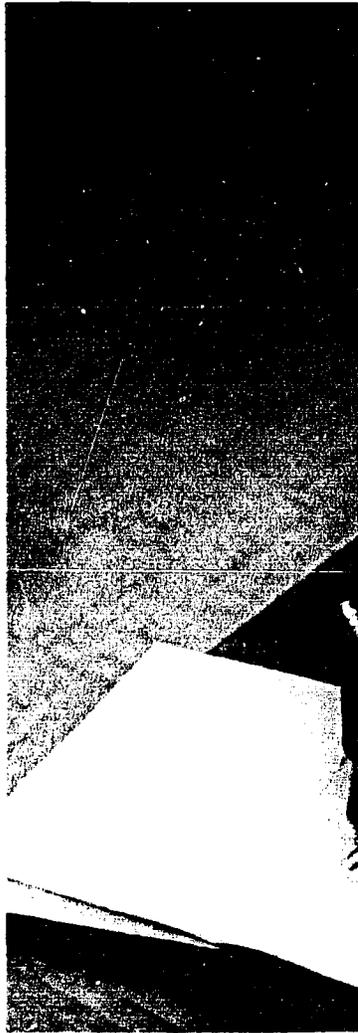
The study of tracks led some children to classifying the various types of animals they knew about (reptile, mammal, etc.). This led naturally into where each type of animal lived, and its adaptation to the area. This developed into an ecological study of the interrelationships of plant and animal life, an investigation of what constitutes a properly balanced "life cycle" (using an aquarium-terrarium the children built), and a study of land change (from pond to marsh to meadow to woods to forest, together with the types of animals and plants that live in each). We took many field trips and even developed a nature trail.

During our discussion of animal classification, we began to work on the BONES\* unit. We worked on animal skeletons for a few days as a group. Several fifth grade boys became fascinated with a human skeleton that was available and spent three weeks putting it together and taking it apart again. A lot of advice (but no help) from the sidelines kept interest in it alive.

From ecology, we went on to discuss man's role in nature and what he has done both to improve it and to harm it. The litter and trash on our own playground and along the roadside started this discussion. Several children participated in the town's annual cleanup day, taking litter to the town dump. A field trip to our nearest river was enough to begin our study of water pollution.

\*Available from Webster Division, McGraw-Hill Book Company, Manchester Road, Manchester, Missouri 63011.





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### **Track Cards**

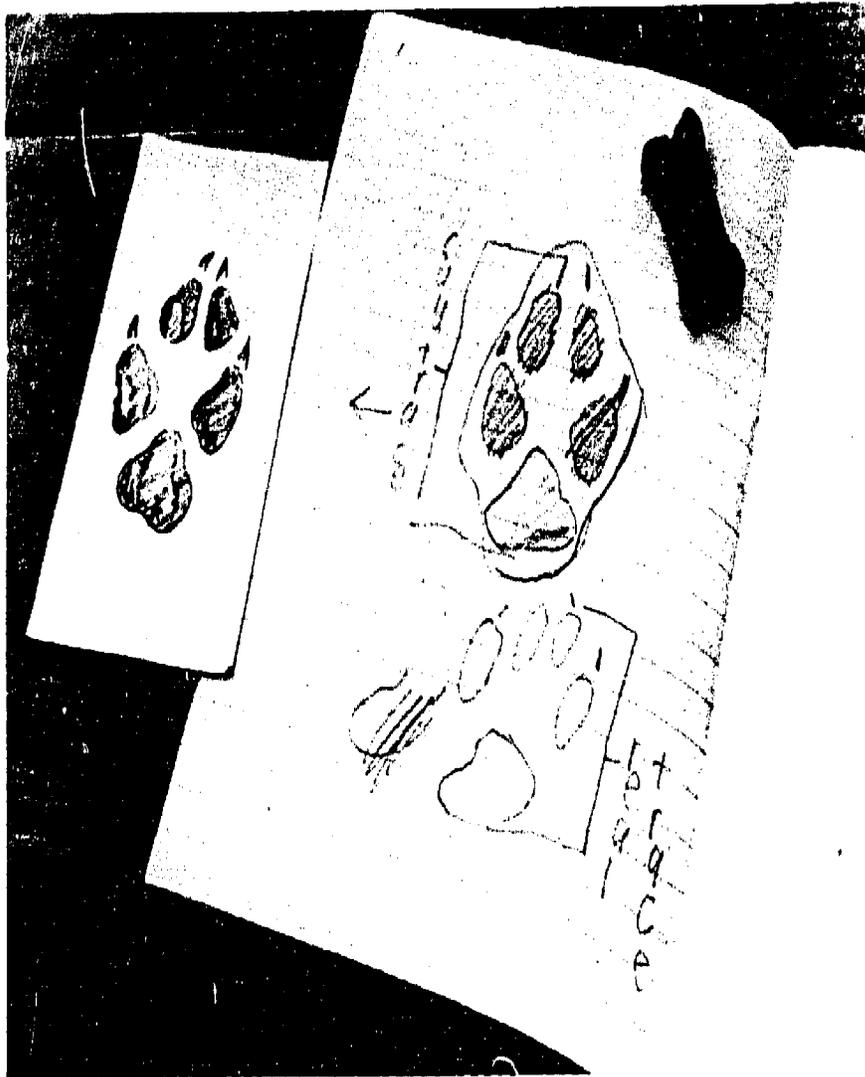
In *TRACKS*, children work with sets of *Track Cards* that show 52 life-size drawings of the prints made by 14 animals. In each set of *Track Cards* are photographs of the 14 animals that made the prints. Children try to identify the animals that made the prints, classify the prints according to their characteristics, make track patterns with the cards, and relate the prints to the photographs of the animals.

### **Mystery Track Cards**

The *Mystery Track Cards*, a set of 10 large cards with life-size drawings of the prints of large mammals, can add excitement to the unit as children puzzle over what animals could leave such large tracks.

### **Track Picture Book**

The *Track Picture Book* shows many kinds of tracks—tracks made by wind or wave, wheels, tires, runners of sleighs, and snowballs rolling down a hill. Snow, sand, dust, water, and even air carry imprints of the many things which move on their surfaces and through them. The pictures are fun to interpret, and they encourage children to look for tracks and to make them.



### Track Patterns and Film Loops

Understanding animal track patterns calls for some knowledge of animal locomotion. Animals walk and hop, trot and gallop; these are complex movements. Children need to watch animals, imitate them, draw them, and watch them again. The TRACKS film loop *The Horse: Walk, Trot, and Gallop*\* shows the different gaits of a horse in slow motion. The film loop *Escape in Mammals* has also proved interesting to children (see page 14). Since children can study these film loops by themselves over and over again without disturbing their classmates, they have time to puzzle out the way in which an animal moves and makes its tracks.

\*Available from Webster Division, McGraw-Hill Book Company, Manchester Road, Manchester, Missouri 63011.

### Additional Materials

The following materials are useful to have on hand:

- clay
- plaster of paris
- talcum powder
- flour
- a paintbrush
- cellophane tape
- magnifying glasses
- a stamp pad
- tempera paint
- panes of glass
- sheets of paper
- crayons
- erasers
- carrots
- potatoes
- toy cars
- animal food
- a knife
- wax
- ball-point pens
- petroleum jelly
- Big Boy Tinkertoy set

David Webster



### Finding Tracks

Tracks show up best in mud, sand, dusty roads, and snow. You don't need to venture into the deep wilderness to find the tracks of animals. Within the limits of most large cities, you can discover the tracks of many animals that have adapted to, or have become dependent on, the urban or suburban environment—squirrels, rabbits, mice, rats, woodchucks, birds, skunks, raccoons, and opossums. Children may have noticed dog or cat prints made accidentally in the fresh, wet cement of a city sidewalk. Certainly, they have seen them in fresh snow. Snow is the best source of tracks, and tracks left in it can be followed and studied for long periods.

Tracks left in mud or dust can rarely be followed for more than a couple of yards in any direction before they are lost. In general, the fields and bare forest floors are simply too dry to reveal any tracks. However, an overgrown field may have a patch of bent or nibbled grass and shrubs marking the passage of an animal. This may lead to other clues that tell about the animal: bits of foods it eats, its droppings, or its sheltering places—such as a rabbit hole or the flattened place under a hemlock tree where a white-tailed deer bedded down for the night.

PLASTER CASTS IN SOIL



POUR PLASTER INTO PAIL, THEN ADD JUST ENOUGH WATER TO MAKE IT PASTY.



PLACE A CARDBOARD COLLAR AROUND THE TRACK. POUR IN THE PLASTER.



WHEN THE PLASTER HAS DRIED, PEEL OFF THE COLLAR.



PLASTER CASTS IN SNOW

THE TEMPERATURE SHOULD BE BELOW FREEZING.



SPRAY WATER ON THE TRACK



ALLOW THE WATER TO FORM AN ICE COATING



MIX PLASTER WITH ENOUGH WATER AND SNOW TO MAKE A PASTY MIXTURE. THE SNOW LOWERS THE TEMPERATURE OF THE MIXTURE, AND KEEPS THE TRACK IMPRINT FROM LOSING DEFINITION

**Making Casts of Animal Tracks**

Plaster casts of animal tracks can be made in soil if the soil is firm or frozen. Loose sand or light, dusty soil will not generally yield good casts.

Plaster casts can be made in snow, but the process is tricky and not always successful. In trial classes the most successful tracks were made in snow when the temperature was 0°F to 20°F and the snow was firm or frozen. Some children also carefully lifted the tracks on shovels, quickly brought them indoors, and froze them solid in the freezer. Later they poured liquid plaster of paris into the frozen tracks.

You can make direct impressions of animals' feet if you smear petroleum jelly on each foot before pressing the foot into a container filled with plaster that has not quite hardened. If you first smear petroleum jelly on this negative cast, you can make a positive cast with more plaster.

**What Can You Learn about an Animal from Its Tracks?**

Tracks can offer many clues to the animal's identity, the direction in which it was going, and its size. They may show how the animal gets its food, what it eats, where it lives, how far it travels, what its enemies are, and what kind of environment it requires for protection.

Each animal, as it moves, leaves a characteristic set or pattern of prints. The size, depth, and arrangement of these prints are directly related to the rate at which the animal was moving, its particular skeletal structure, and the type of terrain in which the prints were made.

#### *How Large Is the Animal?*

Children many times assume that big animals leave big tracks. (They may mean different things by the word "big"—tall, heavy, or long.) A cat is big compared with a mouse, and its prints are longer, wider, and deeper than a mouse's. The prints of the porcupine are deceptive. The porcupine, which is short and weighs no more than a small dog, leaves large prints because it walks flat-footed. A white-tailed deer leaves a small print, although it is tall and weighs over 100 pounds, because it walks on what might be compared to a human being's third and fourth fingernails or toenails.

The size of an animal's print may, then, be related to something beside the overall size of the animal, as the following section shows.

#### *How Does the Animal Use Its Feet?*

Among the four-footed animals, there are three ways of walking. Some animals, such as the porcupine and the raccoon, normally walk with their feet flat on the ground, as people do. Some,







like the dog and the cat, walk on their toes. Still others, such as the horse and the deer, walk on well-developed toenails. The *Bone Picture Book*\* shows the placement of bones in the feet of some animals which engage in various styles of walking and running.

The *Track Cards* that come with the unit show that in some animals the front and the hind feet are similar. The deer, the dog, and the cat stand, walk, and run rather evenly on all four feet, and all four feet are similar. In contrast to these animals are the squirrel and the rabbit, whose hind feet are larger than their front feet. These are animals that sit and hop. The larger hind feet and legs not only support most of the body weight but also furnish the powerful thrust the animal requires for jumping.

#### *What and How Does the Animal Eat?*

When the body weight is supported on the back legs, the front feet can be used for other things, such as holding food. The squirrel is an example. Children may know of other creatures that stand flat on their hind feet and do many things with their front feet.

The opossum seems to have feet at the front and hands at the rear.

\*This student booklet accompanies the Elementary Science Study unit BONES. It is available from Webster Division, McGraw-Hill Book Company, Manchester Road, Manchester, Missouri 63011.

An animal's claws can be thought of as tools that the animal can use for many things. Animals that root about for food, like the skunk, or burrow, like the mole, have claws. Claws are used for many things. Flesh-eating animals—cats, wolves, and bears—use their claws in attacking prey. Most animals that have claws use them for defense.

Children are often very excited when they find evidence that tells them something about an animal's diet.

"Here are some just-opened acorn shells."  
"I found scratches in the ground. Maybe he eats bugs or worms."

#### *Where Does the Animal Live?*

*Can you tell from its footprints where an animal lives?*

Webs between the toes, as in the gull and the beaver, make it almost certain that the animal spends part of its life swimming. Many tree-climbing animals have claws which help them to hold on to vertical surfaces. The giant grizzly bear can dig its own den in the side of a hill with powerful thrusts of its 4-inch claws.

Most animals that spend a great deal of time in snow or soft sand have spread-out, snowshoe-type feet that enable them to walk and run on soft surfaces without sinking.



#### *Keeping Records of Animal Tracks*

Children may want to draw or photograph a track that gives clues about where the animal lives. If you have plaster of paris handy, they can make an impression of the track.\* Later they can try to identify the animal that made the track and answer such questions as:

*Can you tell, just by looking at a track, whether the animal climbs trees, lives in the ground, or lives in or near water? What things might you look for that would help you answer this question?*

*How big is the track?*

*How many toes does the animal have? How are they placed on its feet?*

*Are there any claw marks? How many?*

*What animals might leave claw marks?*

*What would animals with claws be able to do?*

*What could animals with webs between their toes do?*

\*See "Making Casts of Animal Tracks," page 6.



### Changes in Track Patterns

Part of learning about an animal from the tracks it leaves is figuring out what the animal was doing at the time. The trails you find are records of a creature pursuing its everyday life. They will vary with every impulse, every important change of purpose, direction, action, and emotion.

Children like to account for these changes:

"Here's where he stopped, here's where he jumped, and here's where it looks like he ran as fast as he could."

The changes in the pattern and the distance between prints can reflect danger and fear of enemies.

*What will you look for to indicate a change in pattern?*

*Why do you think the animal's pace changed?*

*Could it have sensed the presence of an enemy?*

*Can you find the tracks of the enemy if there was one? What was it? What do its tracks tell you? Was it a catlike or doglike animal, or was it something like a hawk or an owl? What clues might such birds leave that would reveal their presence?*

*If you follow the trail a bit further, can you find any more clues?*

Several children who had spent quite a bit of time with TRACKS followed the fresh trail of a white-tailed deer in the snow. They noticed that the hoofprints were close together and that the hind hoofprints were placed almost in the same spot as the front hoofprints. Later the track pattern changed. The split hoof of the deer was spread out more, the print was deeper in the snow, and each hoof left its own mark with no overlap of prints. These signs, combined with the fact that there were large spaces between pairs of prints, led the children to say that the deer was now running. What made the deer run? Probably the children themselves in this case, for no evidence was found of anything else that might have made it run.



In the snow, children may follow a trail to its end, and there are many conclusions.



## II

# Tracks: In and Around the Classroom

### Making Track Traps

Children can make track traps at home or at school by raking up a patch of dirt with a rake to make it soft or by adding water to the dirt in a large area to make it muddy. Some children have spread flour on a cement walk or porch to see how many or what kinds of animals passed near the house or school at night. A tray of foods, such as seeds, bread, or meat, can be placed on the track trap or in snow to lure animals. This may lead to further investigations:

*If you change the type of food you put out for bait, will you attract different animals?*

*What animals come most often to seeds? . . . meat? . . . fruit?*

*Do all seed-eating animals have similar tracks?*

### Animals in the Classroom

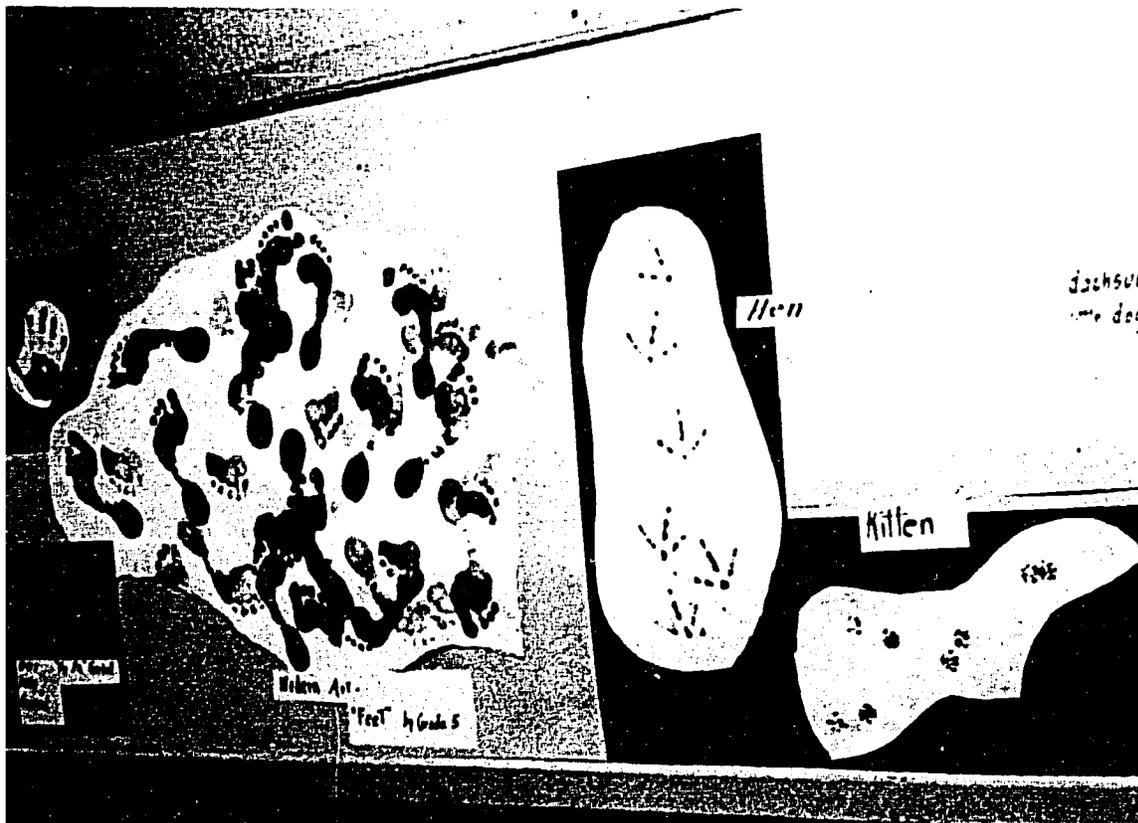
Children are more than willing to bring their pets to school. One trial teacher sent this note home with her children, directly inviting their pets to class:

*Enjoy a change of scene with a chance to meet delightful new friends. You may be sure of gentle handling and a warm room. Please provide your own housing, bedding, seeds, biscuits, or whatever else you eat. Free water will be provided.*

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George E. Hein

room animals, such as gerbils, white mice, rabbits, also furnish interesting tracks. Smear a little paint or washable ink on an easily cleaned surface—perhaps a large piece of glass or plastic—surrounded by large pieces of white paper. Place the animal on the fresh paint or ink and let it walk off the wet surface onto the paper, leaving a paint or ink trail behind.

To get a clear set of prints, hold a little of the animal's favorite food just in front of its nose and

to avoid injury to an animal, you or a student might like to demonstrate how to pick it up. For example, to pick up a gerbil, hold it with two hands around it.

keep pulling it back as the animal approaches. This will keep the animal moving in a straight line. Once you have a nice set of tracks, pick up the animal, or it will wander around leaving a jumble of footprints.

To avoid having the animal fall off a desk in its excitement, this activity is best done on the floor. (One teacher built a high-walled cardboard pen to contain the animal during this activity.) One child might be put in charge of the animal, another assigned to smear the paint onto the glass, and another given the responsibility of washing the painted parts of the animal afterward.

Frogs, toads, lizards, beetles, caterpillars, and turtles are animals that are frequently brought into the classroom. These animals are relatively easy to catch and maintain for a short while, and they usually move slowly enough for children to study.

Children are naturally curious about animals and want to spend time watching and learning about them. If possible, allow time for the animals to be in the classroom for several days before and after track activities.

### Investigating Track Patterns

In some classes, children have studied track patterns and the gaits of animals by watching live animals in the classroom. One class of fourth graders borrowed a rabbit. They gathered around the rabbit and quietly watched it, paying particular attention to the way it moved.

"He just hops."

"He doesn't walk like a dog does."

"Both hind feet move at the same time."

The tracks left on sand showed that the rabbit's hind feet reached ahead of the point where its front feet had landed and that the prints of the hind feet were wider apart than those of the front feet. This happened most often when the rabbit was running.

The same class then referred to the *Track Picture Book* to find examples of prints made by rabbits in the wild.

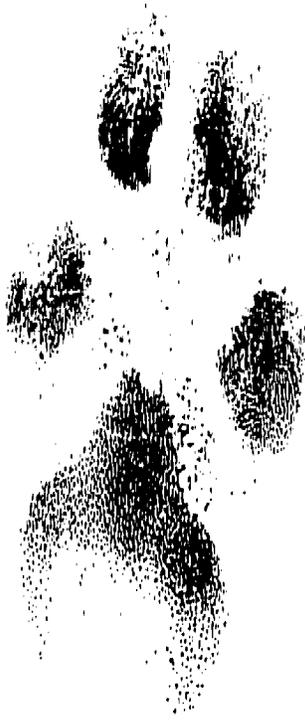
Still later, the children tried to imitate the rabbit's hop by getting down on all fours. They found that it was hard to make their feet land consistently in front of their hands when they moved slowly, but it was easier when they moved quickly.

As they observed further, they found that when the rabbit moved slowly, it, too, did not place its rear feet way ahead of its front feet; only at a fast pace was it able to do this. In fact, the faster it ran, the farther ahead its rear feet landed.

In one trial class, the teacher brought his dog to school for the children to use in their study of tracks. The children carried out water and made a



Dog



large puddle on a concrete walkway outside the classroom, and the dog was encouraged to move through the puddle at various speeds. Many children drew pictures of the wet tracks left behind on the dry concrete. One child outlined the tracks with a pencil and had a record of the track size and pattern which could be studied long after the print had evaporated.

"When the dog runs, his track is broader."  
"Here's where he was walking, and here's where he was running."  
"He jumped here. Look how big the track is."

The children spent much time looking at and drawing the track patterns left by the dog's wet feet on dry concrete. This led to questions:

*How does the dog's walking track pattern compare with its running track pattern? What are the differences?*



Dog walking



If children observe carefully, they may notice that when a dog runs it leaves a broader track print than it does when it walks and that the distance between the front and rear tracks is longer.

In one class, a discussion led into a comparison of cat and dog tracks in relation to the way these animals use their feet.

*What do cats use their claws for?  
What do dogs use their claws for?  
Does a cat walk differently than a dog? How?  
How is a dog's walking track pattern different from a cat's?  
Do all dogs walk the same way?*

In a class where the children had carefully inked the paws of a gerbil and a mouse and then released both on a piece of white paper, they noticed that the two animals left a similar track pattern. Both placed their hind feet ahead of

their front feet when bounding. This brought up the problem of body structure.

*How are the two animals similar in structure?*

Reference to the Elementary Science Study unit BONES\* may be of some help, though children can explore this question by holding the animals and gently feeling for their bones.

\*See page 2.



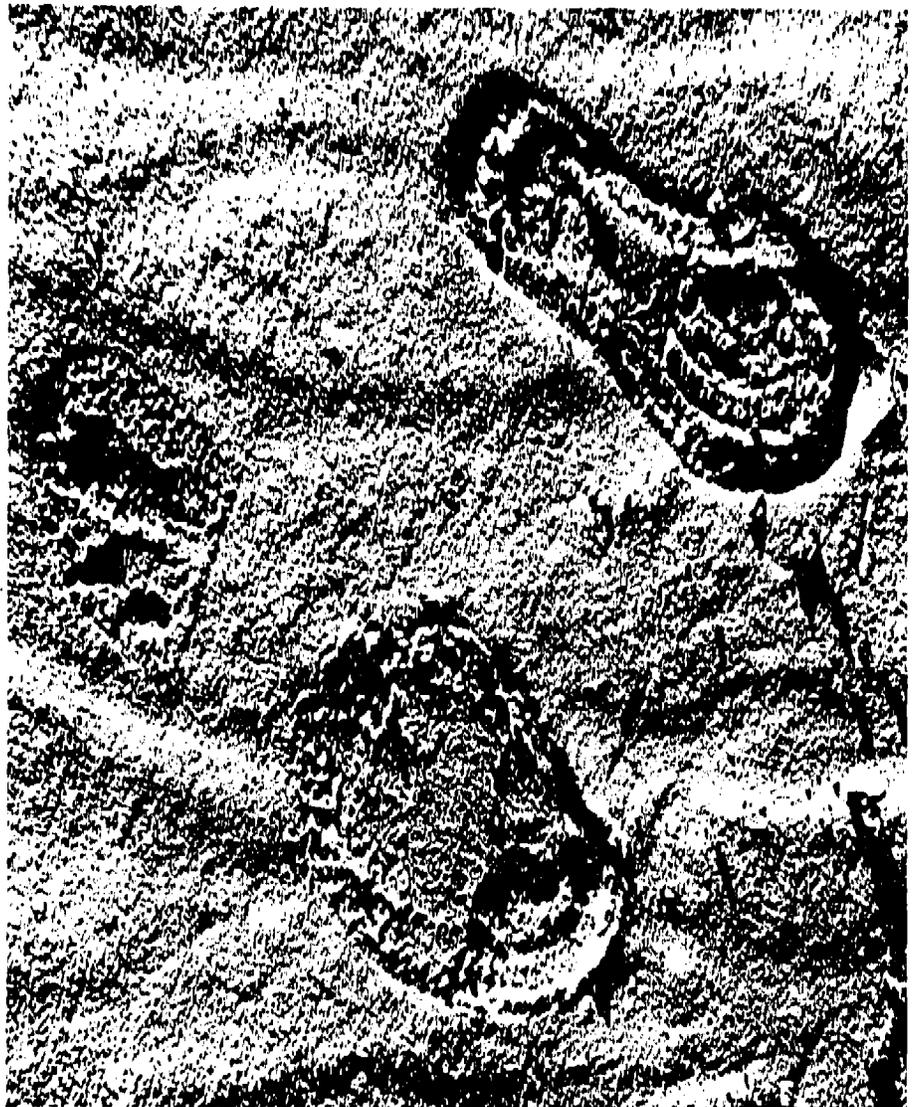
**Seeing How People Move**

*Is a tall person's walk different from a short person's?*

*If two of you run over soft earth (or snow), will there be any difference between your tracks?*

In both cases, look for differences in foot size, in print spacing and depth, and in distance covered by the same number of steps. In some

David Webster



Gervil

1. Alvin and Teddy did it.  
 A tall person walks different than a short person. A tall person walks further apart than a short person.

2.  
 A boy's track is further apart than a girl's track. Carol + Gordon did it.

3.  
 Running is further apart than walking.  
 Also there is less scuffing in running.  
 Timmy did it.

4.  
 There is more scuffing when walking so there isn't so much scuffing. And it is further apart than walking.

5. Skipping - It is mostly scuffing.

Hopping - It looks like a great big rabbit track.

### Using Film Loops

The TRACKS film loop *The Horse: Walk, Trot, and Gallop* shows a horse moving at various gaits. The notes that come with the film loop suggest questions and activities that can accompany the loop.

The film loop *Escape in Mammals\** offers another way to study track patterns. The loop shows, in turn, a North American otter, two jackrabbits, and a pronghorn antelope, each employing its own method of escape. The box notes give very accurate descriptions of each animal's escape gait.

*How do the gaits of these animals differ from one another?*

*Do other animals that are similar in appearance escape or run quickly with the same movements?*

One effective method of using the film loops has been to let a loop run continuously during the entire class period. In trial classes, the children referred repeatedly to a loop shown in this way, as they drew track patterns on the board or in their notebooks. Some tried to imitate the movement on all fours. Others used the first two fingers of each hand to describe to their friends what they thought was happening.

\*Available from Ealing Corporation, 2225 Massachusetts Avenue, Cambridge, Massachusetts 02140.

### Visiting the Zoo

On a trip to the zoo, a group of children watched a variety of animals in a more or less free state using various methods of locomotion. Several children noticed that when the lion moved, it put its hind foot in exactly the same place the front foot had occupied. They drew the correct assumption that there would be one track impression where there had actually been two tracks.

### Related Track Investigations

Fingerprints, handprints, and footprints can be thought of as clues to identification. With a stamp pad, the children can make a class file of fingerprints. Using hand lenses, they can make comparative studies of their own fingerprints as well as the prints of others.

Questions like these have been heard in trial teaching classrooms:

*How many types of fingerprints can you find?*

*Are both your thumb prints identical?*

*Do your toes have prints like your fingers?*

Children can have a bit of detective fun by lifting fingerprints from glasses, lunch boxes, or desk tops. Any powder will do. Simply powder the

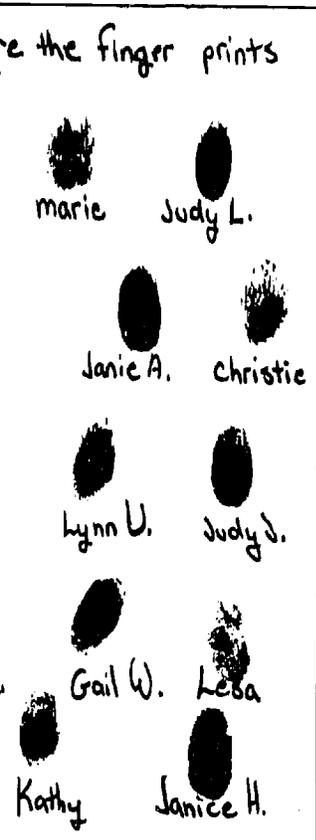
cases, you may notice a track that will show that the person landed on his heel or took off from his toes. How would you recognize these signs?

*What is the difference between walking and running?*

*What happens when you change from walking to running? Do a person's tracks point out the differences?*

*What sort of tracks and track patterns would be left by someone skipping? ... galloping? ... hopping?*

*Does this tell you something about an animal's tracks and patterns?*



the tires of cars in the teachers' parking lot and rubbing crayons across the paper, one class accumulated a file of mystery tire-tread cards. Others in the class were given opportunities to try to locate the cars that had the particular tire-tread pattern depicted on the mystery card. This activity might be used with sneaker-sole patterns.

In one class, children used a Big Boy Tinkertoy set to construct animals with flexible joints. Rubber bands were used as muscles. These Tinkertoy animals were later used to help children study the complex process of how animals move.



using a paintbrush to distribute powder. Then blow away the excess powder. Place a piece of cellophane tape across the print, lift the tape and print from the surface. Comparing this print with a class file of prints, children might be able to identify the car or lunch box.

made rubbings of tire-tread patterns by holding pieces of paper up against



ster

Track picture stories offer children a good opportunity to apply what they have learned. A track picture story is a drawing of tracks which tell a story. Teachers, many times, have drawn their own picture stories, basing them on stories from a child's reader.

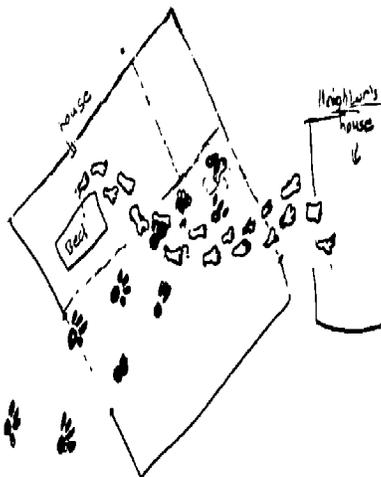
Such stories can be introduced at any time, but they seem to be more appealing and generate more interest if they are offered after children have had the experience of making direct observations. If children have learned to identify tracks and the characteristics of the animals that make them, they are better prepared to unravel and reconstruct the story of "What Happened Here?"





# What Happened HERE?

Dog  
Man



## Key

A man dog saw the bone in the mans house and went to get it but the man saw the dog and got scared and ran to his neighbor's house for cover

A picture story

There are several possible approaches. Children can interpret track picture stories, draw pictures to illustrate track stories, or make up their own picture stories and track stories for classmates

## Interpreting Track Picture Stories

You might start by showing a track picture story such as the one at the left.

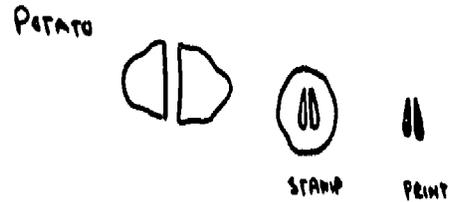
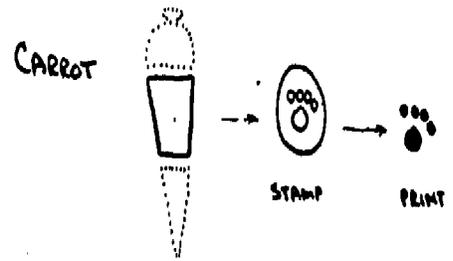
In one class, the illustration on page 19 was copied onto a transparency and shown on an overhead projector. In other classes, a picture story was drawn by the teacher and mimeographed, so that each child could have a copy.

The picture stories can involve one animal—perhaps showing the prints that it made as it searched for food—or they can include different animals, such as a bobcat and a rabbit. The picture story might be built around the way the rabbit avoided the bobcat, which was on the prowl for food.

Questions such as the following will help to get a class started:

- What story do the tracks tell?*
- What kinds of animals do you think were involved? How many?*
- Which way were they going?*
- Which one saw the other one first? How can you tell?*
- Did they change their speed? How can you tell?*

Later, students have shown great interest in creating their own picture stories for others to use. A few children will use symbols to represent



animal tracks and may provide a key for explanation. Most children will represent the animal track as it appears in nature.

## Track Stamps

To help their picture stories come alive, children may want to carve out tracks in materials that can then be used for stamping animal prints on paper.

Carrots, potatoes, and pencil-top erasers have proved to be very successful media for track carving. Carrots and potatoes are best carved when they are fresh and firm. When allowed to dry, they become flabby and hard to handle. A sharp-pointed instrument is best for cutting, and the work calls for care and patience. The material is trimmed out, and the track features are left raised, ready to be inked on an ink pad and stamped on paper or other surfaces.

Some students have simply drawn a print on a pencil eraser, using a ball-point pen, and pressed the eraser on paper, redrawing the track when the ink wore off the eraser.

### Track Stories

To relate TRACKS to language arts activities, many teachers have let children write their own stories about animals in the wild. Often, the children's stories are about animals they know well and have studied, but some stories concern people, and these can be fun.

Several boys in one class wrote a story at home. The next day at school, the boys left footprints and prints of objects in the soft soil of the school playground to show what was happening in the story. These prints were the only clues the rest of the students had. In this case, a boy had been carrying a pail and a large block of wood. At one point as he crossed the yard, the boy put down the pail to rest his arm. Then he picked up the pail again and proceeded along. Later he stopped to rest and sat on the block of wood. Still later he left both the block and the pail and went to help a man with a cane into the school building.

Following is an example of a track picture story that appeared in print long ago. It was written by a famous naturalist, Ernest Thompson Seton.

### Record of a Woodland Tragedy\*

On February 15, 1885, near Toronto, I made the record shown on page [19]. It is really a condensation of the facts, as the trail is shortened where uninteresting.

At A, I found a round place about five inches long by nine, where a Cottontail had crouched during the light snowfall. At B, he had leaped out and sat looking around. The small prints in front were made by his fore feet, the two long ones by his hind feet; and farther back is a little dimple made by the tail, showing that he was sitting on it.

Something apparently alarmed him, causing him to dart out at full speed toward C and D. Now a remarkable change is to be seen. The marks made by the front feet are behind the large marks made by the hind feet, because the Rabbit overreaches each time, the hind feet track ahead of the front feet. The faster he goes, the farther ahead those hind feet get; and what would happen if he multiplied his speed by ten, I really cannot imagine. This overreach of the hind feet takes place in most bounding animals.

Now the Cottontail began a series of the most extraordinary leaps and dodgings (D, E, F) as though trying to escape from some enemy. But what enemy? There were no other tracks. I began to think the Rabbit was crazy, was flying from an imaginary foe, that possibly I was on the trail of a March Hare.



\*From *Animal Tracks and Hunter Signs*, by Ernest Thompson Seton. Copyright © 1958 by Julia M. Seton. Copyright © 1925, 1926, 1927, 1928 by Ernest Thompson Seton. Reprinted by permission of Doubleday & Company, Inc.

But at G, I found, for the first time, some spots of blood. This told me that the Rabbit was in real danger, but it gave no clue as to the source of that danger: A few yards farther, at H, I found more blood, Twenty yards more, at I, on each side of the Rabbit trail were the obvious marks of a pair of broad, strong wings.

Oho! Now I knew the mystery of the Cottontail running from a foe that left no track. He was pursued by an eagle, a hawk, or an owl.

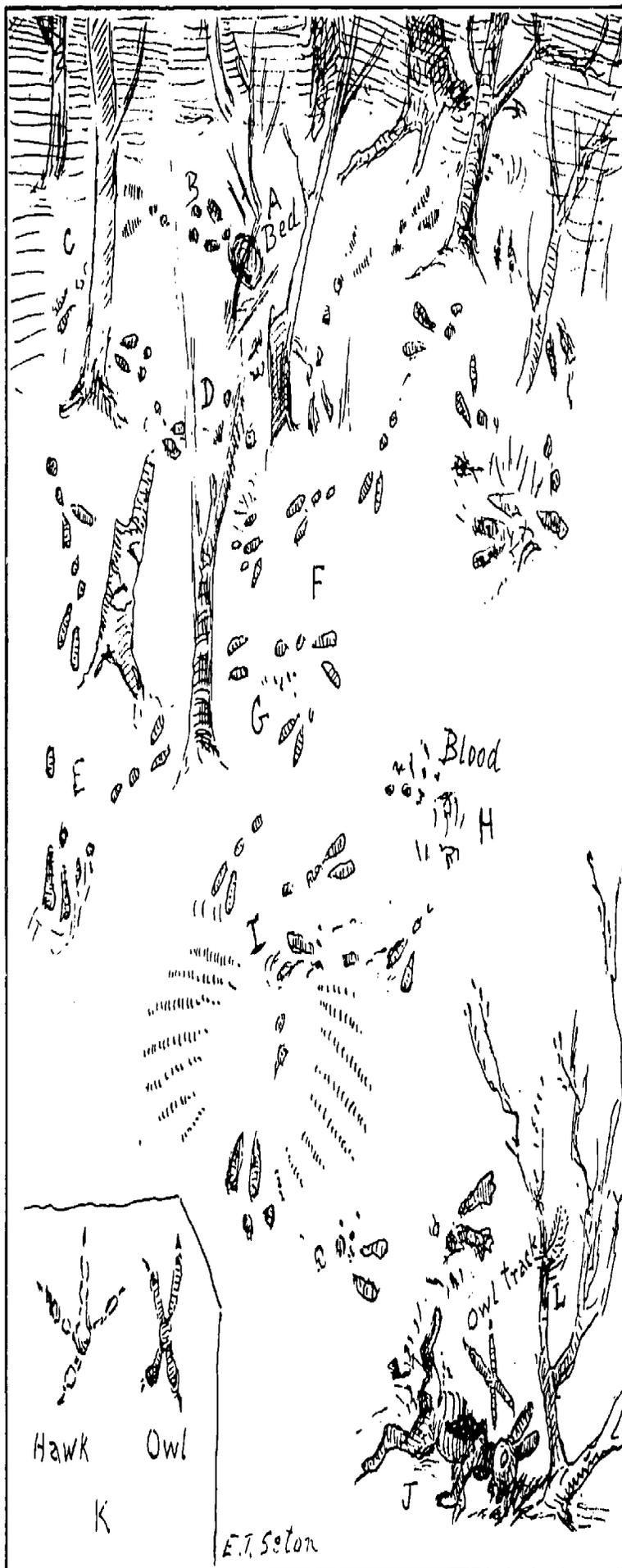
A few yards more and I found the remains (J) of the Cottontail partly devoured. This put the eagle out of the question; an eagle would have carried the Rabbit off bodily. A hawk or an owl, then, was the assassin.

I looked for something to decide which, and, close by the remains, found the peculiar two-paired track of an owl. A hawk's track would have been at K, three toes forward and one toe back; while the owl nearly always sets its feet on the ground with two toes back.

But which owl? There were in the valley at least three species that might be blamed. I looked for more proof, and got it on a nearby sapling—one small feather (L), downy, as are all owl feathers, and bearing three broad bars; telling me plainly that a barred owl had been there lately, and that, therefore, he was almost certainly the slayer of the Cottontail.

As I busied myself making notes, what should come flying up the valley but the owl himself, back to the very place of the crime, no doubt intent on completing his meal. He alighted on a branch ten feet above my head, just over the Rabbit remains, and sat there muttering in his throat. I had neither gun nor camera, but he remained very still for a long time. A sketchbook was at hand, so I made a portrait, which is now among my trophies of the chase.

The proof in this case was purely circumstantial; but I think that we can come to only one conclusion—that the evidence of the track in the snow was complete and convincing.



# IV

Using  
the  $M_j$   
and th



**ack Cards,  
Track Cards,  
k Picture Book**



Combined with finding tracks in the field and observing animals both in and around the classroom, the printed materials for students will help to expand some of the ideas they may have about tracks.

### Track Cards

The *Track Cards* contain a complete set of footprints of 14 different animals—11 mammals, 1 amphibian, and 2 birds. Each print has been drawn life size and often in more detail than would be seen in a track on the ground. Large photographs of the 14 animals—numbered consecutively with the *Track Cards* for convenience (53–66)—are packaged with the set. The animals and their prints were selected partly because they are likely to be familiar and partly because of the differences the tracks exhibit. One set of *Track Cards* and photographs is recommended for every two children.

Trial teachers found that if they gave each set of cards a code number, fewer cards were lost and fewer sets got mixed up.

#### *Introducing Track Cards*

Teachers have begun in a variety of ways. Some have given a set of *Track Cards* without the photographs to each pair of children and let them try to find out, by sorting and classifying, just how many animals are represented on the cards. Others have used a few cards to lead off discussions of the differences between tracks, for example—

*How do you decide which front and hind pairs go together?*

One teacher began with the animal photographs, and let the children talk about each animal.

*How big do you think it is?  
Have you ever seen one? Where?  
Where do you think it might live?  
What would its track look like?*

In another class, the photographs were passed out to pairs of students. They were asked to try to figure out what sort of feet each animal would need for the life it leads and to draw what they thought the footprints would look like. (This is difficult to do for some of the animals, notably the muskrat.) Following this activity, the *Track Cards* were passed out to pairs of students. The children sorted the cards for some time before anyone realized that the footprints were related to the animal photographs that they had been working with.

Another approach, which might serve as an introduction to *Tracks*, is to let the children try to match the *Track Cards* with the animal photographs. They will do this easily for a few of the more obvious combinations, but they may have considerable difficulty with others. The children can pursue this activity in their free time.

Some children may ask how big the animals in the photographs really are. The tracks are life size, but the photographs cannot be. Problems of scale have not arisen in most trial classrooms, probably because many children have considerable knowledge of animals by the



time they are nine or ten. However, a discussion about size may be useful.

#### *Games with Track Cards*

Games are always fun, and the following games can help children to improve their ability to observe and compare and can increase their familiarity with tracks.

1. "What Animal Is It?" Until the cards become familiar, one child, holding up a card, can challenge his partner with "What animal is this?" Or, without showing the card, the challenger (perhaps the teacher) can begin to offer clues about the track or the animal, to help someone guess what it is.
2. "Concentration" or "Memory" Two or more can play. All cards are dealt facedown in a square between the players. The first player turns over two cards. If they match, he gets another turn to try for another matched pair. If they do not match, both cards are put facedown again. Let the children decide what a match will be—for example, any two feet of the same animal, two front feet, or two hind feet.
3. "Dig" This game is a variant of fish and is best played only after the children can identify the tracks in the set. Two can play, but three or more are better. Four cards are dealt to each person, and the remainder of the set is left facedown.



Each player, in turn, attempts to complete a "book" made up of all four cards (prints) of one animal. (The two birds can be omitted.) In some classes, children have preferred to dig for pairs rather than for books of four cards, so as not to have to play with such a large handful of cards. A player has one turn to ask "Do you have a porcupine?" If successful, the asker can have another turn. If unsuccessful, he must "dig" – that is, draw one card from the pile. (If he draws what he asked for, he gets another turn.) The one with the most books wins.

### Mystery Track Cards

The *Mystery Track Cards* can be introduced at anytime during the unit. The prints are life-size and give some idea of what the tracks of large animals look like. The *Mystery Track Cards* can supplement the *Track Cards* at the time they are introduced, or they may be used as "mystery" pictures to let the children puzzle out from their knowledge of hooves, toes, and claws just what kinds of animals could make the tracks.

In one class, these cards were put on display without comment at the end of the first day's discussion. Many of the children did quite a bit of research before the next class in an attempt to identify the prints. During the second class, the children discussed each large footprint and raised

a number of basic questions in the process of trying to identify the prints.

*Is the track life-size?*

*How big might the animal be?*

*How might a foot like this be useful to an animal?*

In Appendix C, you will find notes on the *Mystery Track Cards*.

### Track Picture Book

The *Track Picture Book* can be introduced in a variety of ways. You may give a copy to each child or to every two children and let the class ask questions after everyone has looked at the book. Some teachers have started the study of TRACKS by discussing several of the pictures in the book. In many cases, the *Track Picture Book* can serve as a reference when problems in track placement or identification arise.

At first, children may skim through the *Track Picture Book*, only later considering each picture in detail.

While studying each picture, children have solved many of the problems by reconstructing in sand or snow (often with a toy car) the details shown

in a photograph. Suggestions for activities that can accompany the *Track Picture Book* are given in Appendix A.

Children can paste into the *Track Picture Book* (or into their own scrapbooks) photographs or drawings of tracks they have seen. They can make up questions to accompany their pictures.

Many of the problems shown in the photographs are easily solved with a bit of reasoning and discussion. Appendix A offers help only with the more difficult of the situations.

The key to using the *Track Picture Book* problems effectively is to allow the child to speculate, guess, and *be wrong about* what he thinks is the answer and, possibly, put aside the unsolved problem until he has made more firsthand observations.

In some cases, there are very definite answers, but in others there are many possible answers to the questions asked, and a child must choose for himself the answer that fits his experience. In no case are all the possible answers given.

In several trial teaching classes, children took pictures of tire, machine, and animal tracks. Then they made up questions and stories for other classmates to read and puzzle over. These were pasted into the *Track Picture Book* or were posted on the bulletin board.



# Appendix A

## Activities and Answers For Track Picture Book Problems

**Page 2** Children delight in trying to make a tire tread out of clay which will produce the tracks shown on this page. Stamp pads, snow, or powder can be used, though powder seems to work best.

**Page 3** Children can draw on paper (or model in clay) the tire-tread pattern they think these tires would leave in snow or sand.

**Page 4** One child solved this question by making a wheel out of clay. With a pencil, he pressed into the clay a tread pattern similar to that of the tractor tires. Then, by rolling the clay wheel through talcum powder, he was able to see the result.

**Pages 5-6** A teacher's car or toy cars whose front wheels can change direction have been used to help children think about these problems. Many children have inked the wheels on a stamp pad, then "driven" the toy car on a piece of paper.

**Page 7** The tracks were made by a car that drove over fresh snow in a parking lot and packed it down. The wind blew away the loose snow, leaving the packed snow behind. Why do the two tracks change into four?

**Page 9 (left)** The tracks are "scratch marks" left by a hot-rodder who "popped" his clutch into low as his car rolled backwards.

**Page 13** Mont-Saint-Michel in France.

**Page 16 (left)** Someone walked over loose snow and packed it down. The wind then blew away the loose snow around the packed tracks.

**Page 16 (right)** Snow became packed under the weight of the person. Then the prints froze hard. Later, as the temperature rose, the looser snow melted first. This happens most often in dry, fluffy snow. Children might like to make prints like these for themselves.

**Page 18** There are many possible ways of making the three kinds of tracks in snow. How many can the children find?

**Page 20** Can children tell in which direction the vehicles were moving?

**Page 23** Many children are sure that the tracks are those of an animal with which they are very familiar.

**Page 24 (left)** A sea gull's tracks.

**Page 24 (upper right)** The photograph shows several things: the direction in which a white-tailed deer was going, its speed, and the type of material in which the track was made.

**Page 24 (lower right)** One front and one rear print of a raccoon.

**Pages 25-26** As with the print of the deer on page 24, many details of the animal's passing can be seen if you look carefully and have

experience with tracks both inside and outside of the classroom.

**Page 28** The tracks were made by a muskrat. The muskrat's dragging tail made the line.

**Page 32 (upper)** These are mice tunnels.

**Page 32 (lower)** Squirrels often make holes in the snow in search of food.

**Page 34 (left)** These are sea gull tracks left in the sand where a live clam was eaten. Sea gulls carry a clam into the air in their beaks and then let it drop to the hard wet sand, where it cracks open.

**Page 38** The volcano is Paricutin. It began erupting on the cornfields of a Mexican farmer in 1943.

**Page 42 (left)** The tracks were made by lumps of snow thrown over the edge of its path by a snowplow.

**Page 42 (right)** This is a close-up view of one of the dotted trails left by a lump of snow.

**Page 43 (left)** The piece of seaweed blown by wind made the path in the sand.

**Page 43 (right)** The photograph shows cracks in dried mud. The tiny round marks were made by raindrops.



**Deer Mouse**

Found in most parts of North America, this wild mouse lives in burrows on sandy beaches and builds nests in trees. It eats seeds, nuts, and insects. (Cards 1, 15, 29, 41, 53)



### **Porcupine**

This animal is a walker and a climber. On the ground it is slow, relying on its armor of quills for defense. Long claws and heavily calloused soles assist the porcupine in climbing trees, where it spends much time eating twigs and the inner layers of bark. (Cards 2, 16, 30, 42, 54)

**26**

**50**

Photographed by Harold



Inc.



### **Striped Skunk**

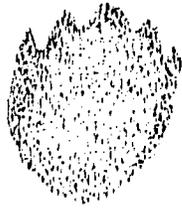
The skunk seems to walk flat-footed on its hind feet but only partially so on its forefeet. The long front claws help it in digging for its diet of insects, grubs, eggs, and even the flesh of decaying animals. Often the claws on the hind feet do not show in the print, which gives it something of the appearance of a human footprint. (Cards 3, 17, 31, 43, 55)



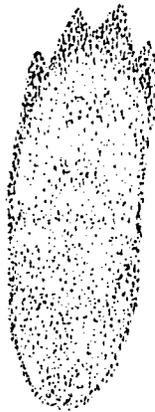
**Bullfrog**

The bullfrog is the largest of the common frogs (4" x 7") and is found along the edges of most ponds and swamps. The webs do not usually show up in the track print. (Cards 4, 18, 32, 44, 56)





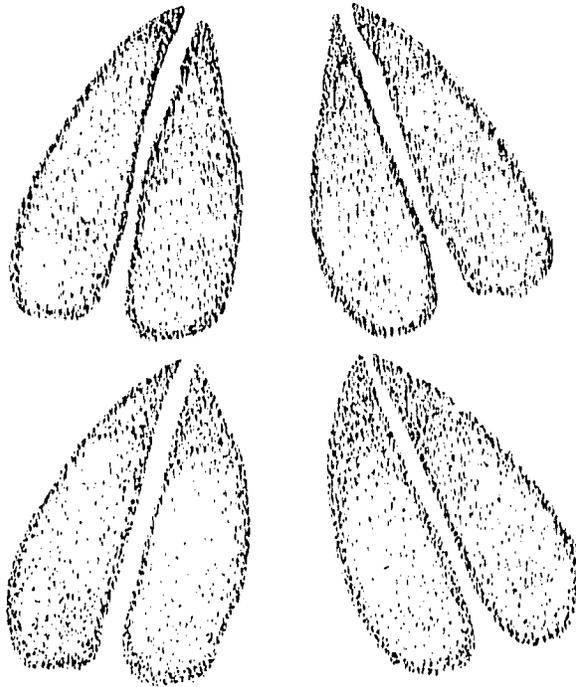
Box



### **Cottontail Rabbit**

A rabbit's hind feet are markedly longer than its front feet. Hopping and bounding are normal methods of locomotion in rabbits and hares. The large back legs and feet give the push required to lift them off the ground. When bounding, the rabbit characteristically brings its hind feet down in front of its forefeet.

The fur on the underside of the paws obscures the prints of the toes and claws. Cottontail tracks might be found in gardens after a fresh night snow. (Cards 5, 19, 33, 45, 57)

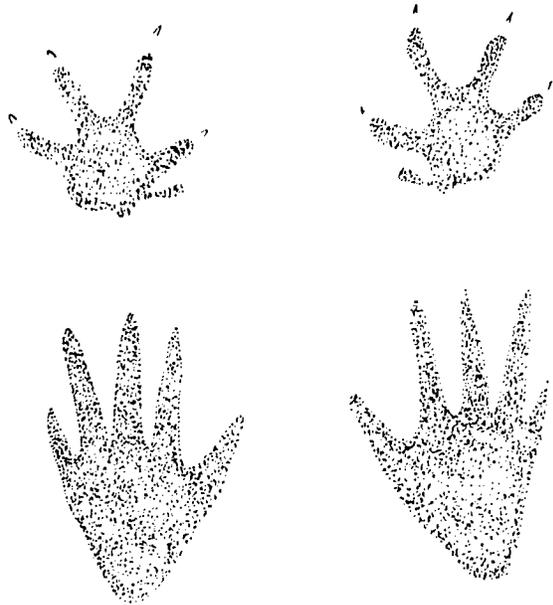


### White-tailed Deer

Deer prints are made by the nails of the third and fourth toes of each foot. The feet of males and females are much alike in size, though those of a buck tend to turn out while those of a doe point straight ahead. The white-tailed deer is found in brushy areas and farmland throughout the country, except in parts of the West. Its western relative, the mule deer, leaves almost identical tracks (though a different track pattern). When a deer runs on soft ground or in snow several inches deep, the side toes (or dewclaws) may also show. See *Track Picture Book*, page 24. (Cards 6, 20, 34, 46, 58)

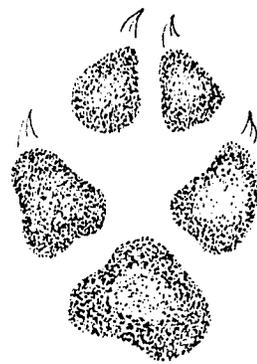
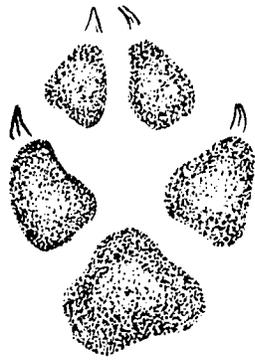
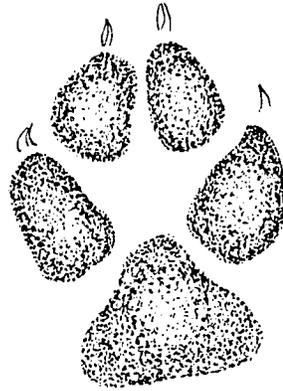
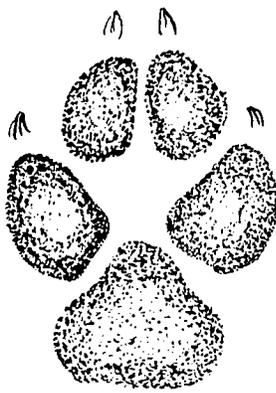


Karl H. Maslowski, from Photo Researchers, Inc.



### Muskrat

The hind foot of the muskrat is partially webbed and is placed flat-footed. The front foot appears to have four toes, but there is a fifth inner toe, reduced to a stub, which shows occasionally. Muskrats live in or near swamps and marshy streams, where you can often see characteristic muskrat lodges built of cattails and other marsh plants. They eat aquatic plants and sometimes clams and frogs. A muskrat track is characterized by the narrow tail mark which may be clearly seen between the footprints in soft mud. Look for the track along the muddy edges of ponds and swamps. See *Track Picture Book*, page 28. (Cards 7, 21, 35, 47, 48)



### Dog

All members of the dog family walk on four toes of each foot, with the claws usually showing in the print. The front tracks are slightly larger than the hind tracks. Coyote and fox tracks are similar and can be found in sand or snow. (Cards 8, 22, 36, 48, 60)





### House Cat

Like dogs, cats walk on four toes, but they do not show their claws in the tracks. The claws are retracted into sheaths when the cat is walking and are thus kept sharp through lack of wear. A cat uses its claws in seizing prey, climbing trees, and defending itself. Tracks of domestic cats and dogs may be found frequently in snow and on soft ground around the school building. (Cards 9, 23, 37, 49, 61)

74



**Raccoon**

The raccoon, like many tree climbers, has long claws. This is another flat-footed walker. A very common mammal, it now comes into towns and cities, attracted by garbage cans. In nature, it eats many things, including fruits, eggs, frogs, and crayfish. Raccoon tracks are common in the sand and mud of stream banks, except in cold winter weather, when the animals retire into their dens. (Cards 10, 24, 38, 50, 62)

Rapho Guillumette Pictures



76

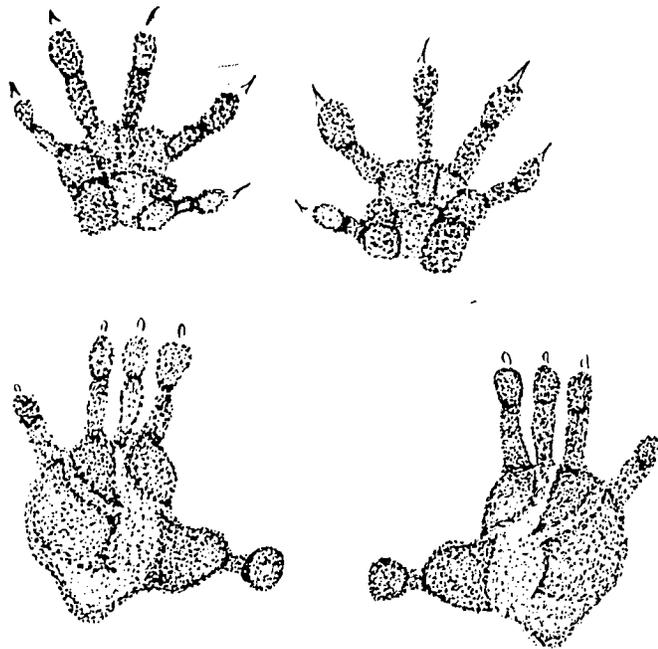


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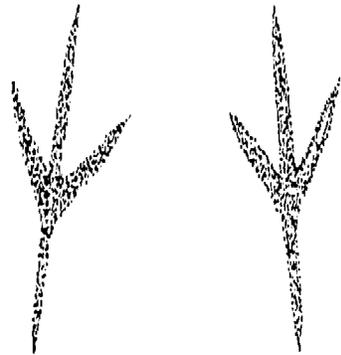
### Gray Squirrel

Since this animal spends much of its time in trees, its tracks are not common on the ground. The gray squirrel resembles other flat-footed walkers in having longer hind feet than forefeet. Its claws assist it in climbing and digging. There is a small knoblike thumb on the front foot, which does not show in the print but which is useful in holding nuts and fruits. Like most tree dwellers, the gray squirrel pairs its forefeet when it runs. (Cards 11, 25, 39, 51, 63)



### Opossum

The opossum track is quite distinctive. The hind foot has an unclawed big toe which points well away from the others; it is used for grasping when the opossum is climbing. This animal is abundant in the southeastern states and prefers a woodland or farm environment. During its nocturnal rambling, an opossum will eat many different things, including fruits, eggs, insects, and vegetables. (Cards 12, 26, 40, 52, 64)



Pigeon

The expression "pigeon-toed" may have come from the way in which this bird places its feet. The pigeon is a common bird in city and countryside, and its tracks may be found around puddles on the pavement and in the mud of farmyards. (Cards 13, 27, 65)





### Great Black-backed Gull

Like the more numerous herring gull, this sea gull is found along ocean and lake shores and even in the interior of the country, where it can be seen on plowed fields and city dumps. Gull tracks may be seen in mud and sand, the webs between the three front toes clearly visible, with a small indentation indicating the presence of a hind toe. The sea gull is typical of most ground-dwelling birds, in that it alternates its feet when it walks. In contrast, perching birds usually pair their feet and hop. (Cards 14, 28, 66)

22

83

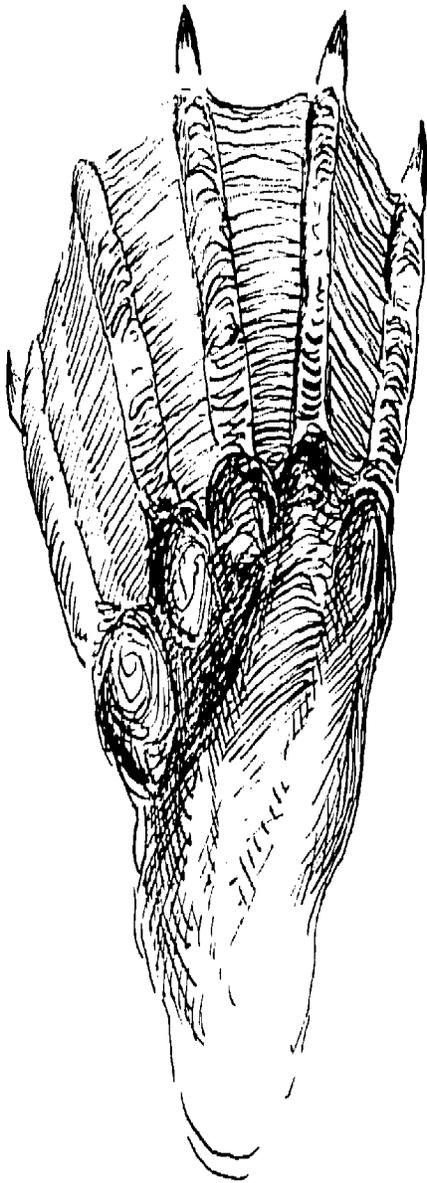
# Appendix C

## The Mystery Track Cards



### Grizzly Bear

This is the track of a hind foot; the front track is about half as long but has 4-inch claws. Grizzly bears are found today in the high mountains of the West and on the Arctic tundra. A bear can stand 6 to 7 feet high on its broad hind feet and weigh as much as 800 pounds. Bears use the same trails year after year, even stepping into the same footprints each time.



Beaver

The beaver is found widely over North America and leaves many signs of its presence: its lodge, dams across swamps, fallen trees, and wood chips. The hind feet of a beaver are surprisingly large. The second claw does not always appear in the track. It is split in two and can be used as a kind of comb. Children may be surprised at the great difference between the front and hind feet of this animal. The large tail drags behind in wavy fashion and often obscures the tracks.



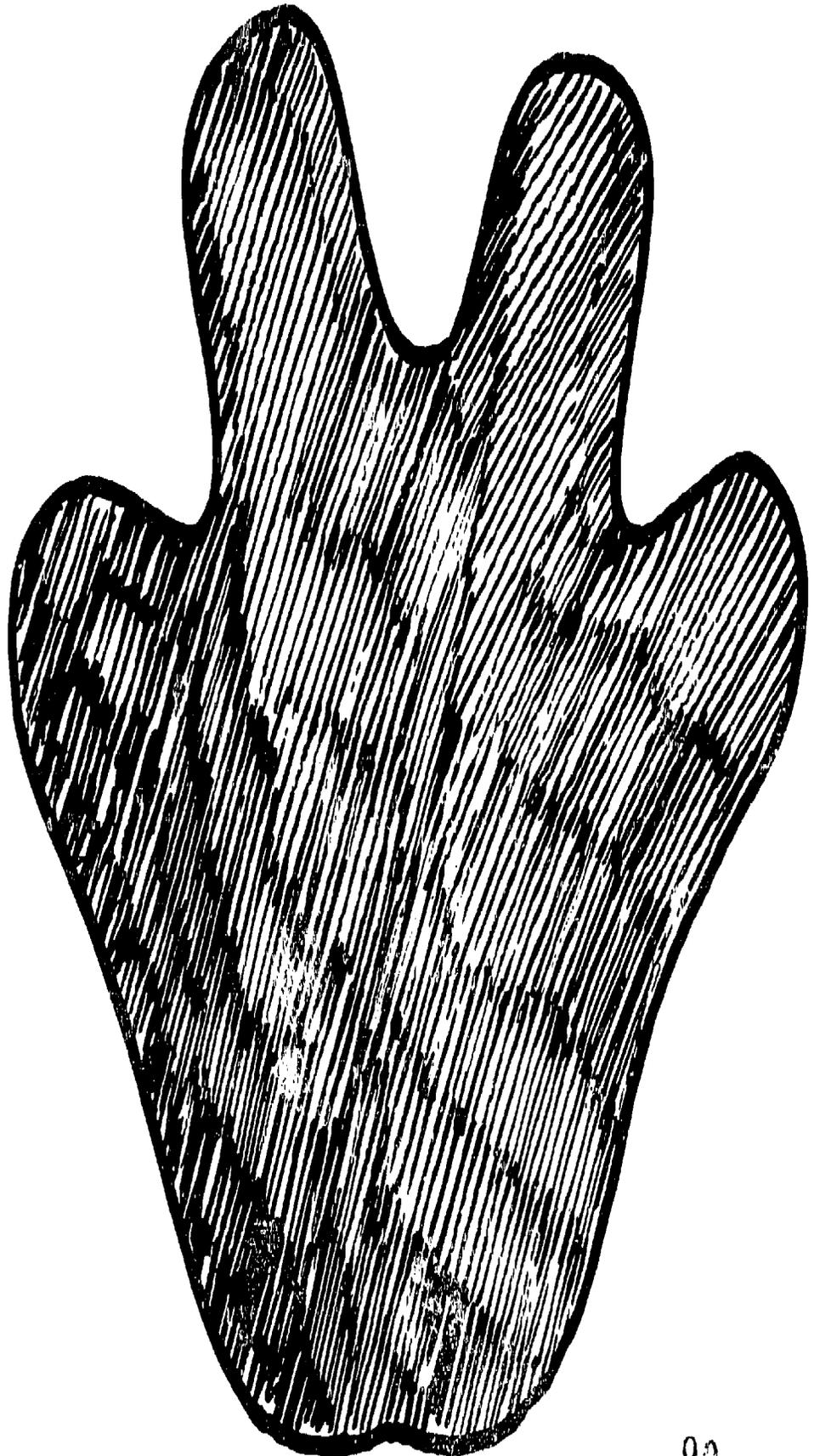
Tiger

The tiger is a powerful mammal. It can weigh 500 pounds and be as long as 9 feet from the nose to the end of the tail. A tiger can kill a deer with a single stroke of its forepaw. The tiger track is typical of the tracks of most members of the cat family. Like other cats, with the exception of the cheetah, tigers pull their claws back into sheaths when they walk or run, so no claw marks show in the tracks.



Gray Wolf

The gray wolf, or timber wolf, is found now in isolated mountain areas of the West and through northern Canada and Alaska. This is the largest wolf; it may weigh as much as a man. Like other members of the dog family, the wolf has somewhat larger forefeet than hind feet. When the wolf runs, the toes of its forefeet spread more than those of its hind feet. In contrast with the dog, the wolf has larger center toes in the hind foot and larger outer toes in the front foot.



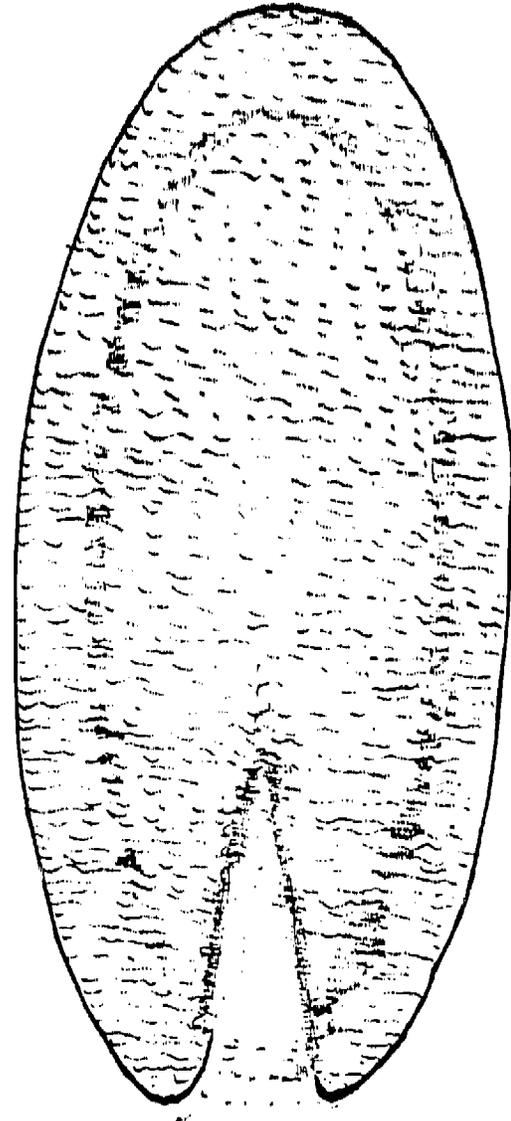
## Hippopotamus

Hippo tracks are found along the muddy banks of lakes and rivers in central Africa. The name means river horse. By day, the animal is usually in the water, even walking along the bottom of a river in its search for underwater plants. All four feet are similar. They support an animal which can be 12 feet long and weigh 3 tons.



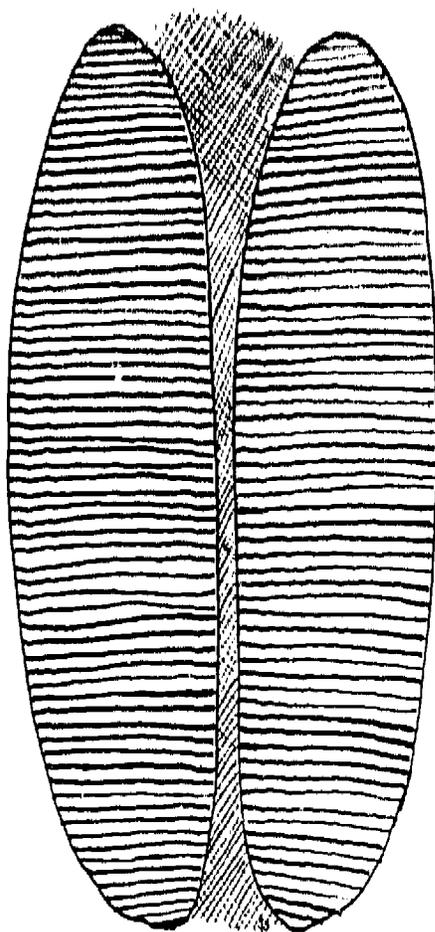
Giraffe

Towering 18 feet into the air, the giraffe feeds on the leaves of trees. It is a member of the even-toed hoofed animals and is a distant relative of the deer. How do the feet of the two animals differ?



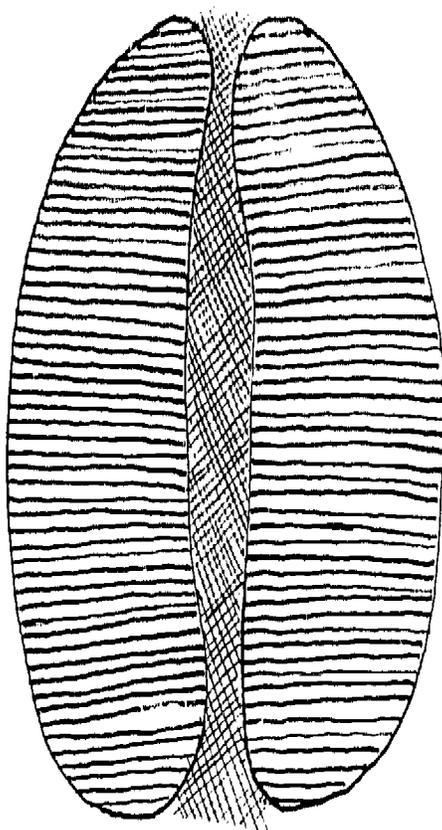
Horse

This track print of the horse shows a track that would be left by an unshod horse. A shod horse would leave a track that clearly showed the hoof outlined by an iron rim. This track is of a saddle horse, a type familiar to suburban and rural riders. A workhorse, being larger, would of course leave a much larger track.



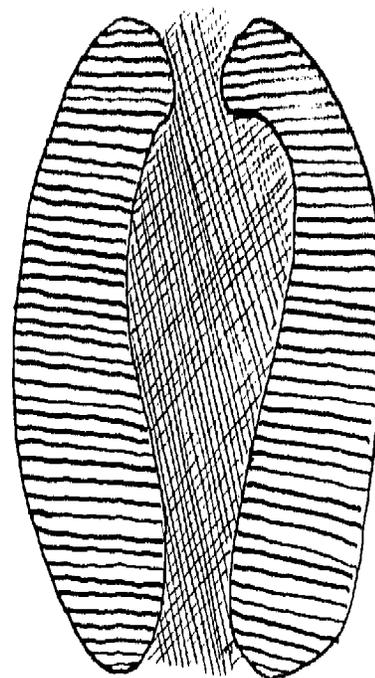
Cow

Similar to deer tracks, but much larger, domestic cattle tracks can be found in any muddy area around a barn or in the fields of any dairy or beef farm.



Pig

The tracks of the domestic pig are similar to those of the deer but more rounded. Pigs root up dirt with their noses and wallow in the upturned dirt, leaving signs of their activity.



Caribou

Found in Canada, Alaska, and other northern areas, caribou have the most distinctive tracks of all the deer. Their hooves are rounded and tend to spread snowshoe-fashion, helping to support the animal in snow. The hind foot is compact, as compared with the spread-out front foot.

# Appendix D

## Books You May Find Useful for Reference

Colby, C. B., *The First Book of Animal Signs*, Franklin Watts, Inc., New York, 1966. Tracks are one kind of animal sign included in this book. Tracks of about two dozen common animals are illustrated and described.

Jaeger, Ellsworth, *Tracks and Trailcraft*, The Macmillan Company, New York, 1967. This excellent book is the most comprehensive and easily available guide for children and teachers. There are hundreds of tracks, illustrated with clear pen-and-ink sketches: tracks made by pets and domestic animals, the tracks of field and forest, tracks of zoo and jungle, bird tracks, amphibian and reptile tracks, and insect and mollusk tracks. In addition, the author has devoted separate chapters to various activities, including tracking games and methods of reproducing tracks.

Mason, George F., *Animal Tracks*, William Morrow & Company, Inc., New York, 1966. Here are pictures of 44 common North American animals with their tracks and footprints. The well-executed line drawings and the simple text make this a good book for children.

Mulle, Olaus J., *A Field Guide to Animal Tracks*, Houghton Mifflin Company, Boston, 1954. This book is the most authoritative and complete work of American animal tracks. It includes all the mammals of North America, as well as many birds and insects. There are more than 1,000 illustrations, and there is a simple key to the tracks themselves which enables the reader to place quickly any animal track that he comes across. It is a book that the beginner can easily use, but it is so informative and detailed that even the most skilled tracker will learn something from it.

Seton, Ernest Thompson, *Animal Tracks and Hunter Signs*, Doubleday & Company, Inc., Garden City, N.Y., 1958. From the frozen plains of Manitoba to the Florida swamps, Ernest Thompson Seton followed, photographed, and sketched the trails of animals and birds wherever they were to be found. The author, one of America's best-loved naturalists, has reconstructed here—in writing and in illustration—many poignant woodland dramas. Here is firsthand excitement for wildlife enthusiasts, young and old.

Tinbergen, N., and E. A. R. Ennion, *Tracks*, Oxford University Press, London, 1967. The tracks and traces of the animal world are of immense variety, and the stories they tell are interpreted in this book with the help of Professor Tinbergen's remarkable photographs and Dr. Ennion's lively drawings. The book shows how to identify some animals from their tracks, how to tell which animal was first on the scene, and how to determine whether the animals were stalking or playing, moving quickly or slowly.

*Pocket Field Guide to Animal Tracks*, Stackpole Books, Harrisburg, Pa., 1968. (No author given) The tracks of 45 different mammals are illustrated in this little book. In addition, information is given about the animals' range, characteristics, breeding, and food.

