

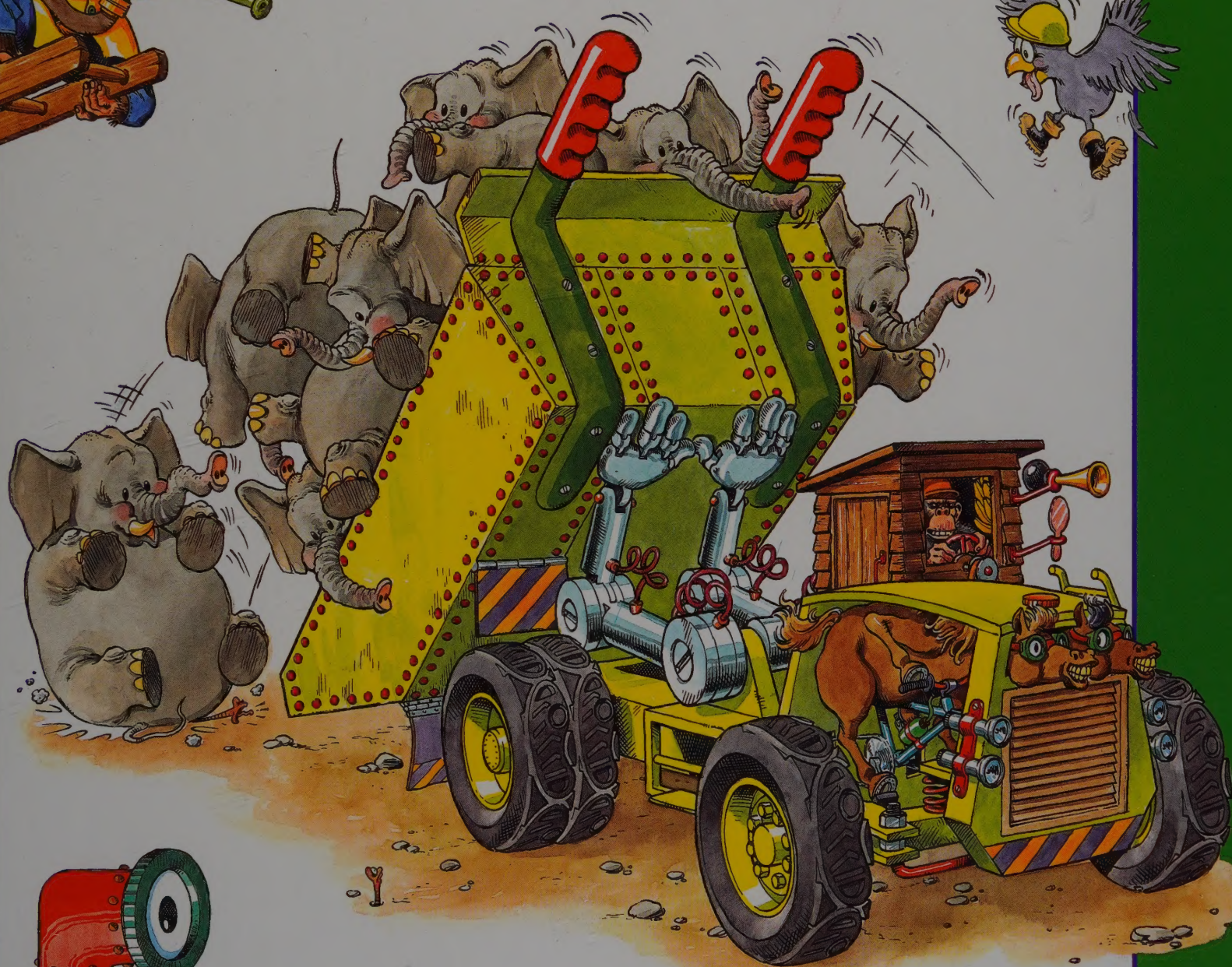


HOW IT WORKS

# Big Rigs



John Malam • Illustrated by Mike Foster



INCLUDES AN AMAZING COLOR POSTER

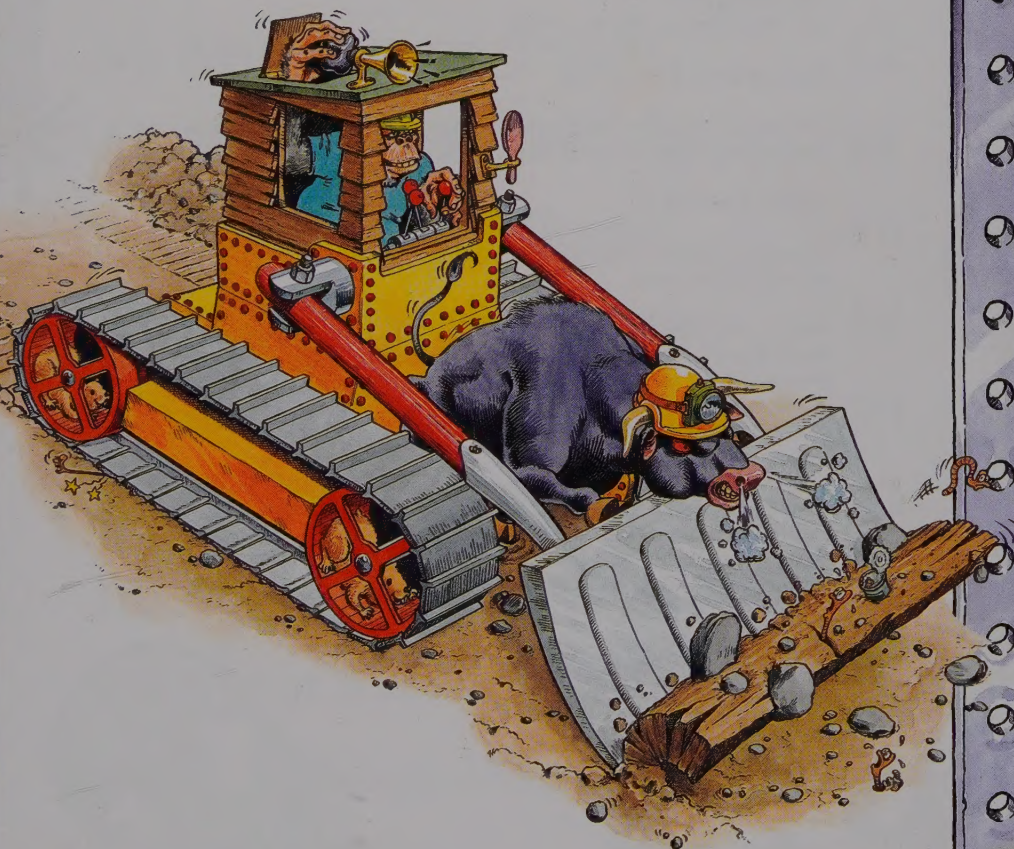






# Big Rigs

John Malam • Illustrated by Mike Foster



Simon & Schuster Books for Young Readers





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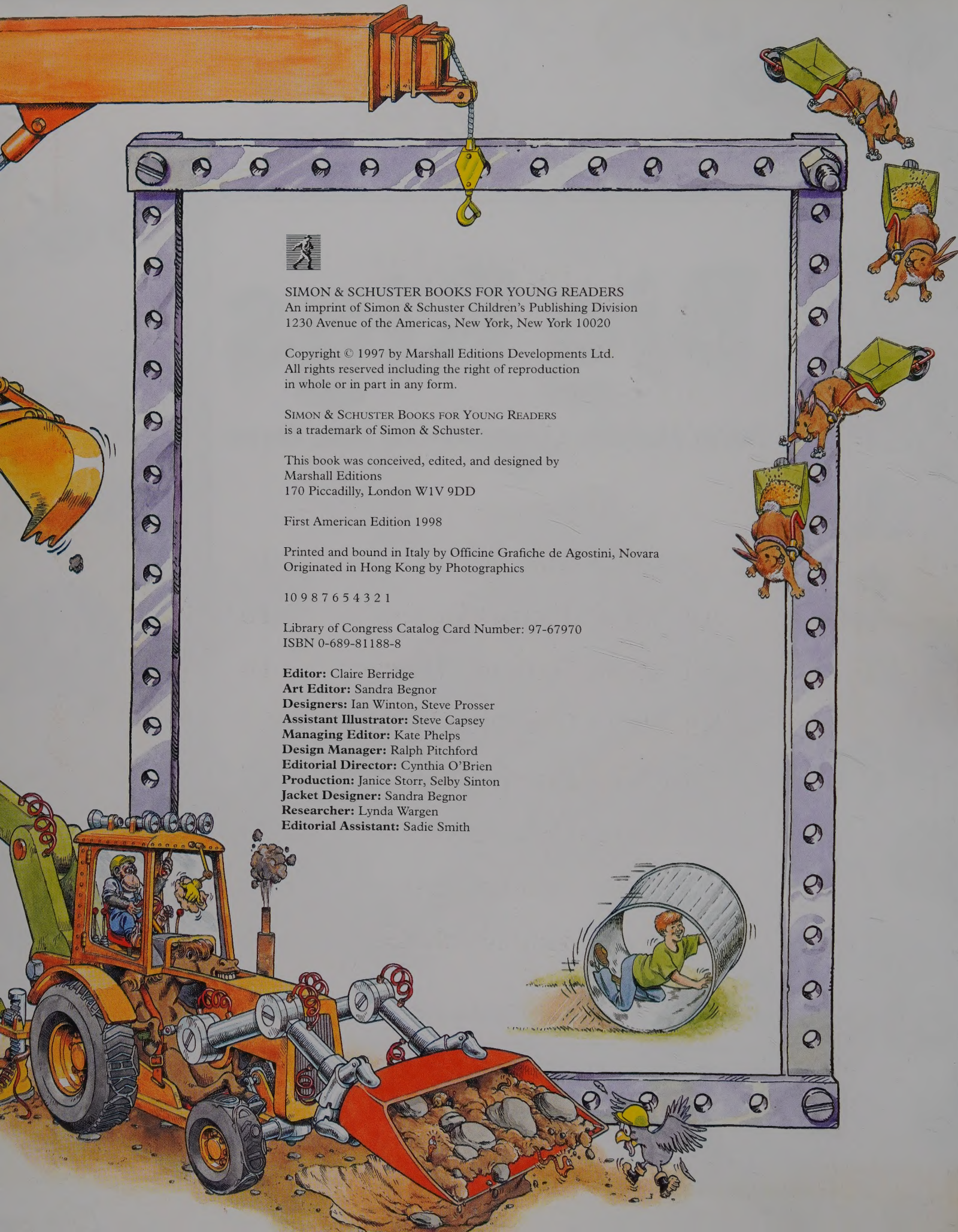
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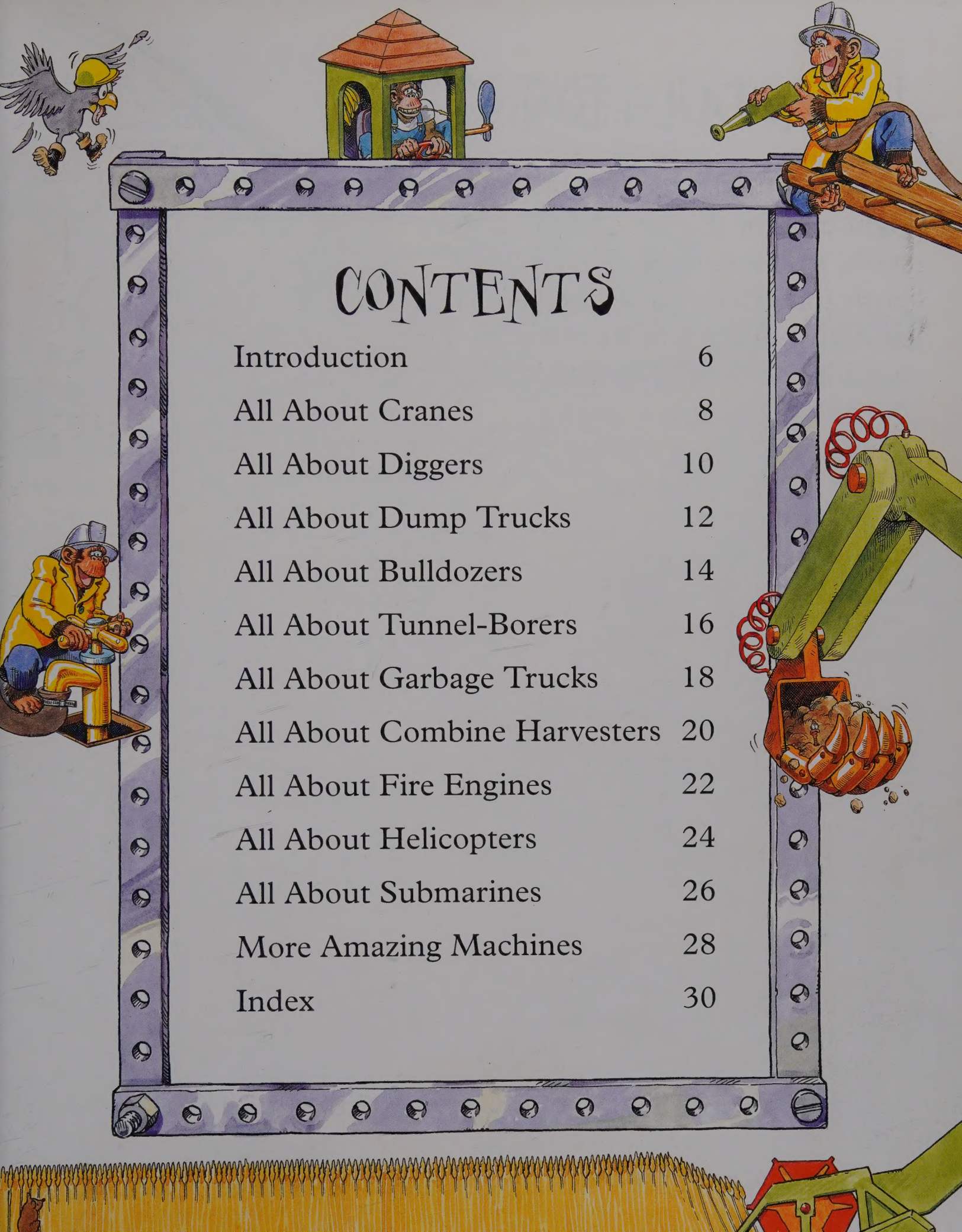
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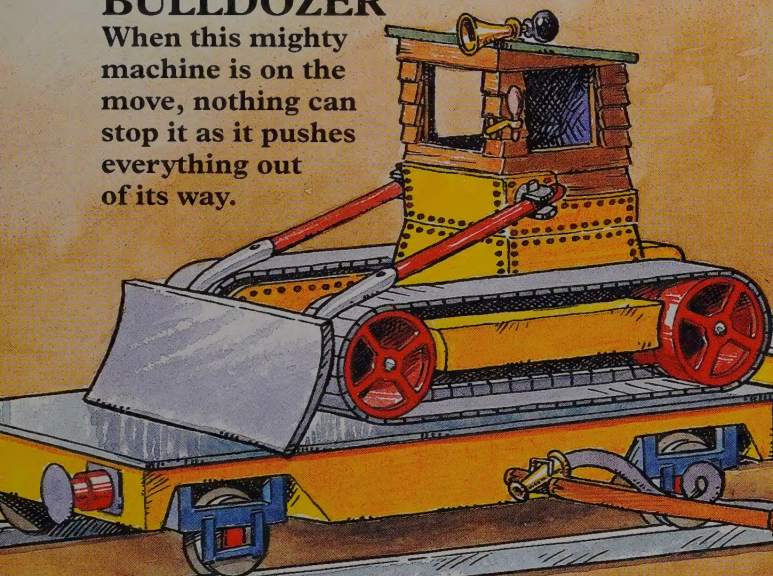


# INTRODUCTION

There's an old saying: "Choose the right tool for the job." Machines are tools, so if you want to lift a load, push something out of the way, or dig a tunnel, you'll need a machine to do it. You'll also need to know how it works—so read on to find out all about mighty machines.

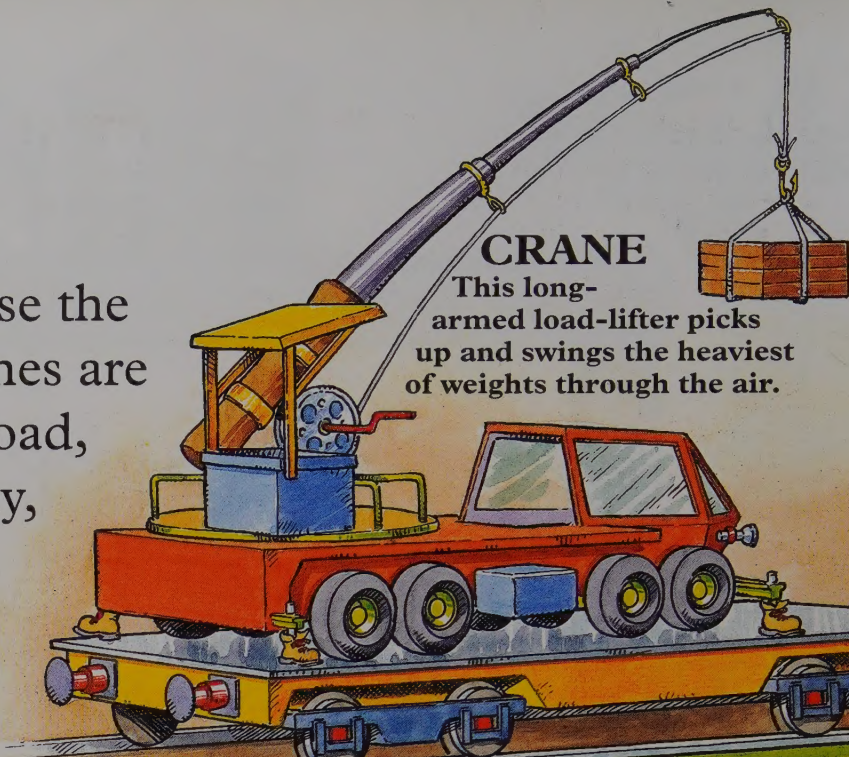
## BULLDOZER

When this mighty machine is on the move, nothing can stop it as it pushes everything out of its way.



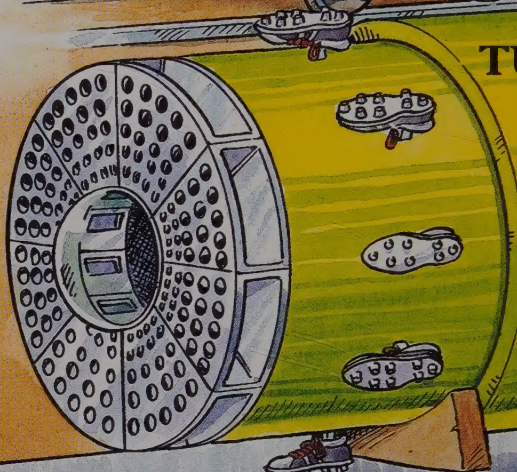
## CRANE

This long-armed load-lifter picks up and swings the heaviest of weights through the air.



## TUNNEL-BORER

Here's a machine you won't see too often—but you'll know where it's been from the train-sized holes it bites through rock.



## FIRE ENGINE

Even if you don't see this machine you'll probably hear it as it rushes to a fire with its sirens blaring, warning people to keep out of its way.





## DIGGER

The digger is two tools in one—a digging tool in back and a loading tool in front.

## DUMP TRUCK

The world's biggest wheelbarrow carries tons of soil and rock on its back.

## COMBINE HARVESTER

From cutting the crop to drying the grain this machine makes short work of a wheat field.

## GARBAGE TRUCK

A machine with a mission: to boldly go in search of garbage and eat it.

## SUBMARINE

The oceans' depths are this machine's home, where it can stay for months at a time.

## HELICOPTER

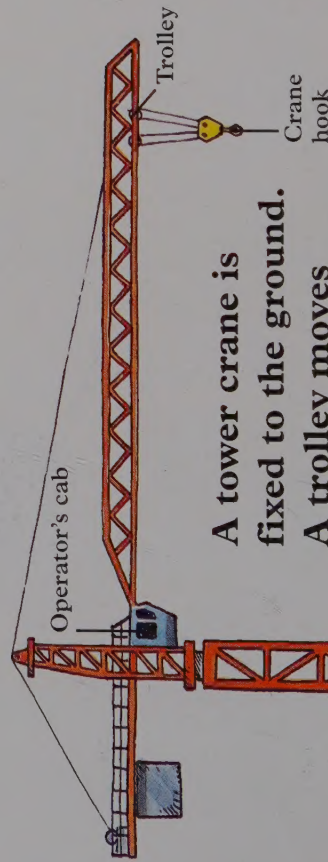
Imagine the power this machine needs to lift off straight into the air, and then fly as easily as if it were a bird or an insect.



# ALL ABOUT CRANES

If you've got a heavy load to move, then let a crane take the strain. Cranes are the weightlifters of the machine world. Their long arms reach out over everything around them, picking up loads with their mighty muscles. And what's more, they can swing right around to lower things to the ground, putting them down carefully, just where they are needed. They make it look so easy!

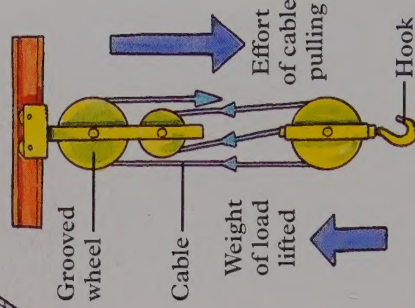
A tower crane is fixed to the ground. A trolley moves along its arm until it is above a load. Then the crane hook is let down on strong steel cables.



Metal arm which extends in sliding sections

A crane's steel cable can be up to 656 feet long, and can hold a load of over 34 tons

Crane hook and pulley block

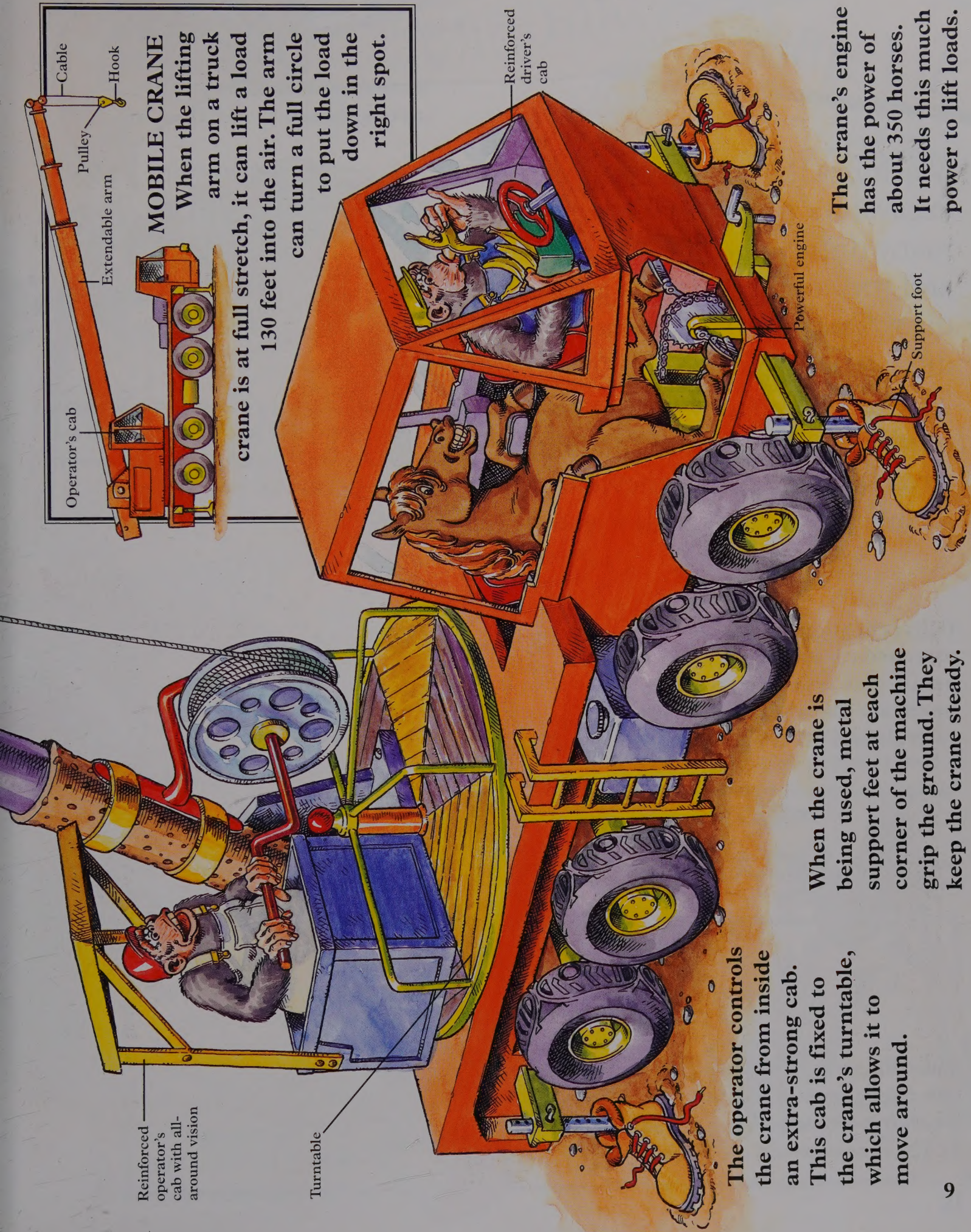


## PULLEY SYSTEM

Pulleys are simple machines. They are grooved wheels, around which a crane's lifting cable is wound. A crane uses pulleys to lift and lower loads. The more pulleys it uses, the heavier the loads it can lift.







Reinforced operator's cab with all-around vision

Turntable

Reinforced driver's cab

Powerful engine

Support foot

## MOBILE CRANE

When the lifting arm on a truck crane is at full stretch, it can lift a load 130 feet into the air. The arm can turn a full circle to put the load down in the right spot.

The operator controls the crane from inside an extra-strong cab. This cab is fixed to the crane's turntable, which allows it to move around.

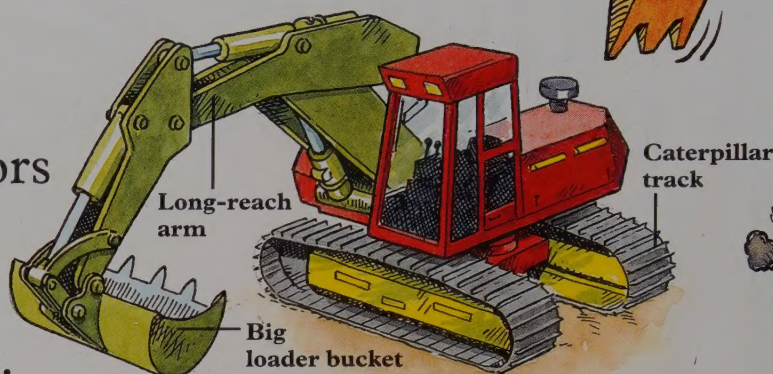
When the crane is being used, metal support feet at each corner of the machine grip the ground. They keep the crane steady.

The crane's engine has the power of about 350 horses. It needs this much power to lift loads.



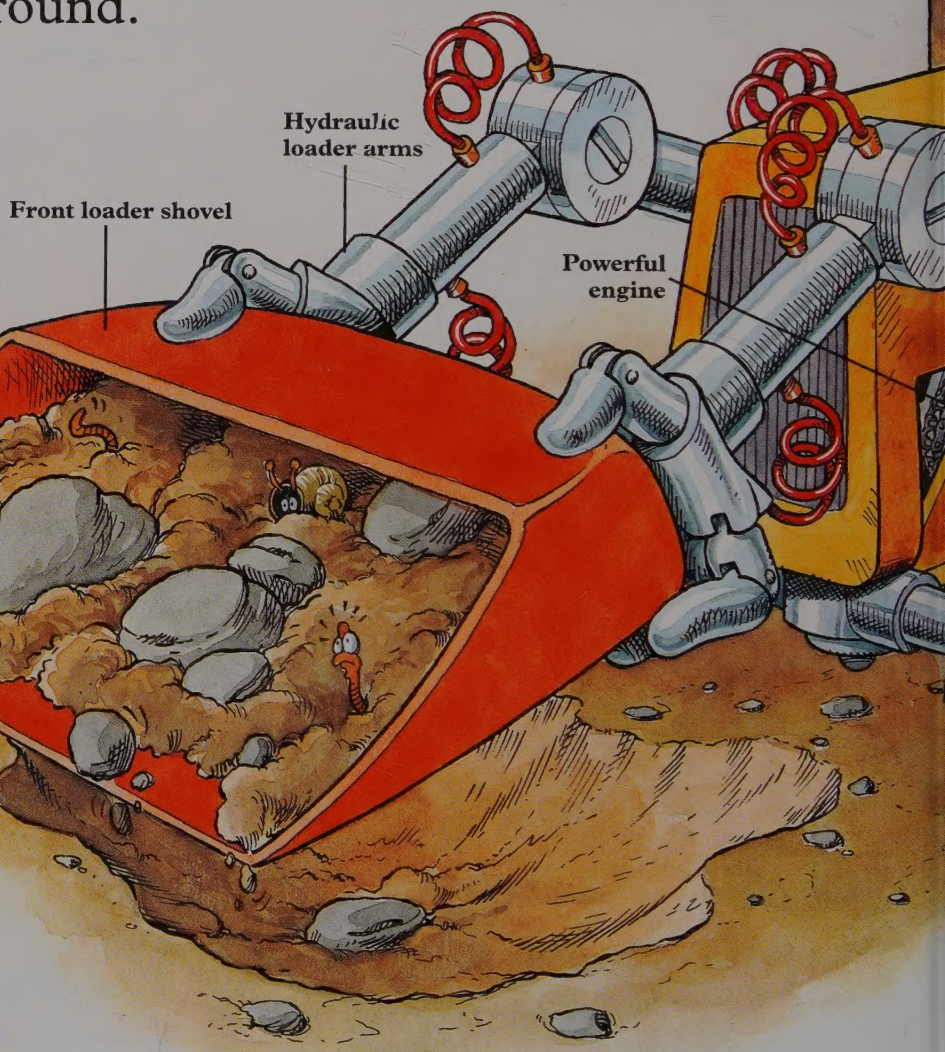
# ALL ABOUT DIGGERS

Machines that dig are called excavators or diggers. There are many different kinds of excavators and they can do various jobs—dig trenches or pits, clear out ditches, and move earth or trees. The digger's buckets, shovels, and other attachments are made of strong metal so that they can dig through even the hardest ground.



Some diggers crawl slowly along on metal tracks. They do extra-heavy work, and have the power of as many as 400 horses.

Different shovels can be attached to the digger's arms. One type of shovel opens up like a giant mouth to grab and lift tree trunks.



This digger is so strong that it can carry up to 8,543 pounds in its shovel—that's about the same as 120 ten-year-old children!



The backhoe arm can dig a hole up to 20 feet deep. When it's not being used as a digger, a rock-breaker hammer drill can be fitted to the long arm.



The driver's seat spins around to face whichever way the digger is working.

Strong bucket with tough teeth for biting into the ground

If the digger is working on a road, rubber pads can be fixed to its two support feet to stop them from damaging the road surface.

Deep-tread rubber tires for extra gripping power

## BACKHOE LOADER

This digger works in both directions. The bucket at the back digs up the ground, then the shovel at the front takes over and scoops up the soil, and carries it away.



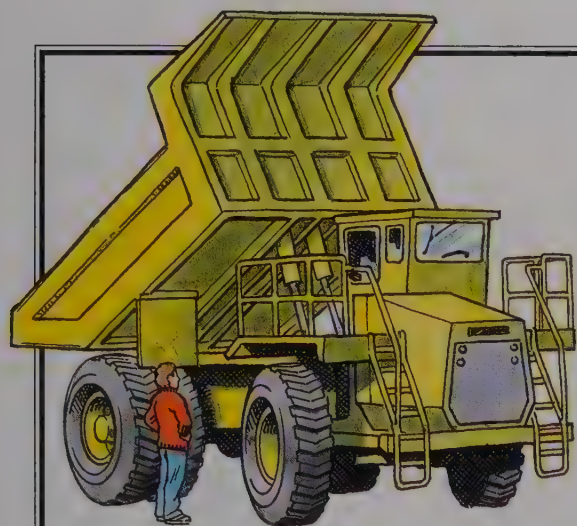


# ALL ABOUT DUMP TRUCKS



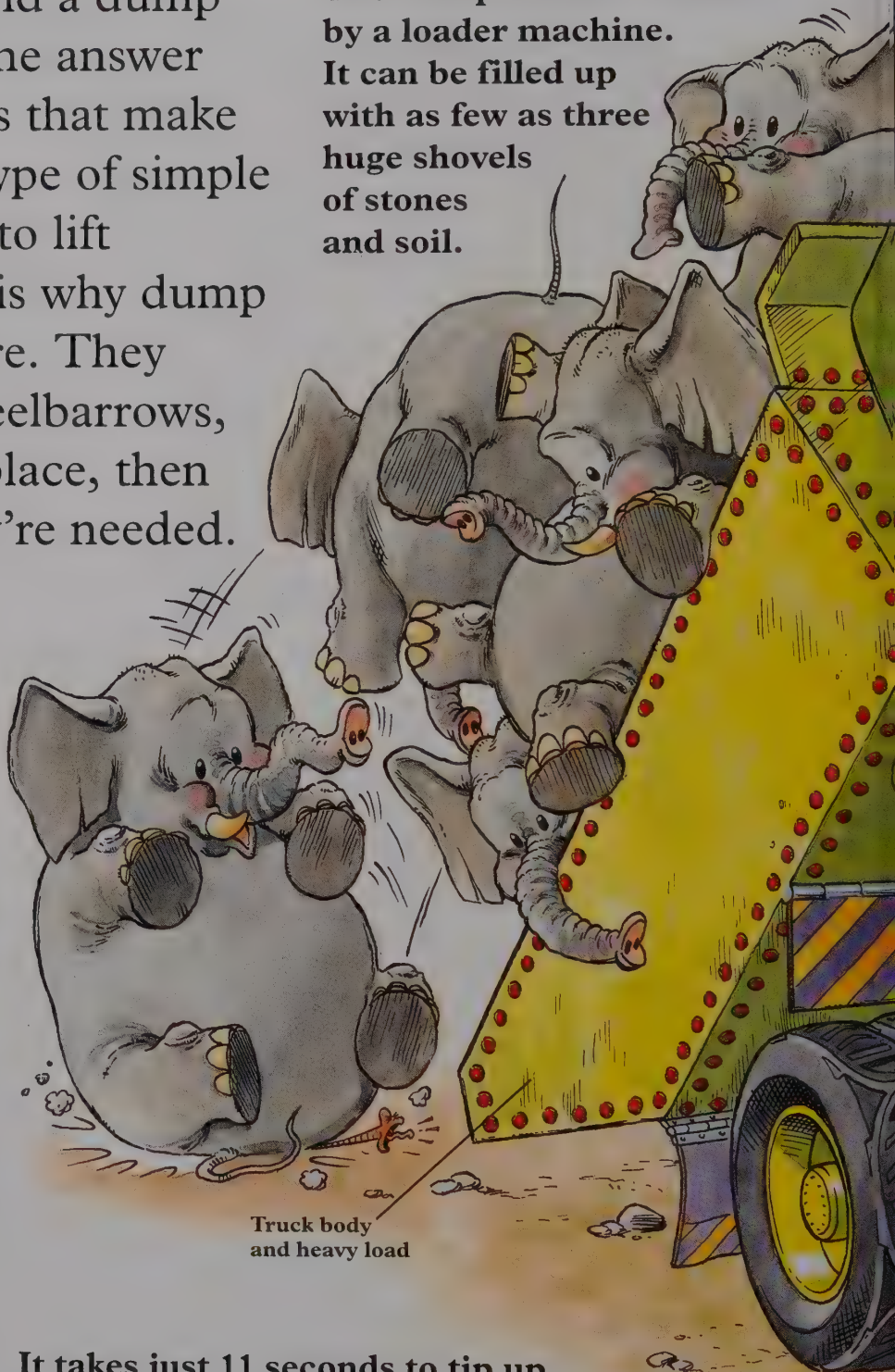
What do a wheelbarrow and a dump truck have in common? The answer is they are both load-lifters that make use of a lever, which is a type of simple machine. Levers are used to lift incredible weights, which is why dump trucks are as big as they are. They work just like gigantic wheelbarrows, carting loads all over the place, then dumping them where they're needed.

The dump truck is loaded by a loader machine. It can be filled up with as few as three huge shovels of stones and soil.



## OFF-HIGHWAY TRUCK

This huge truck is built for rough work on building sites and quarries where it moves loads weighing up to 52 tons. While the truck strains under the effort, the driver sits in cool comfort in the air-conditioned cab.

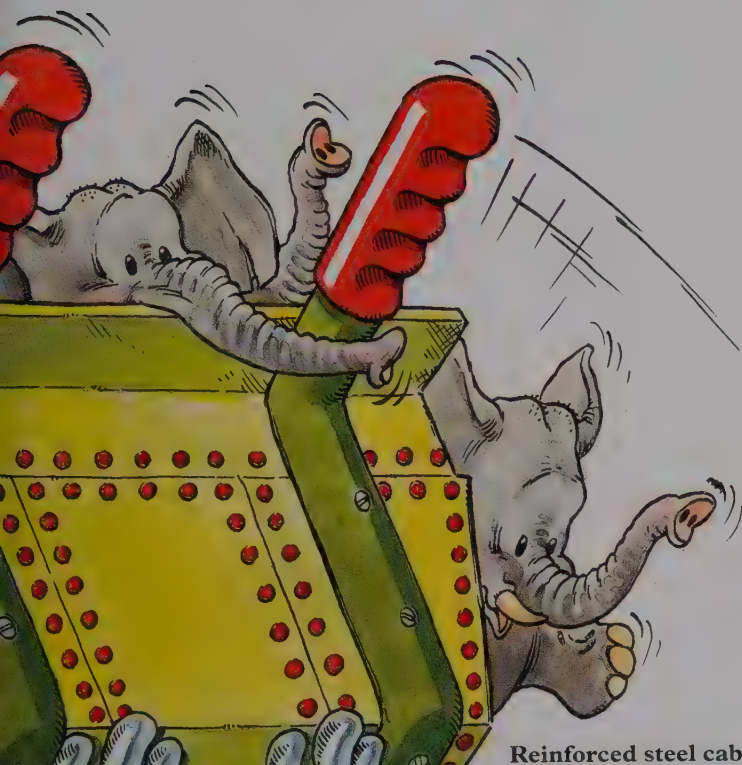


Truck body and heavy load

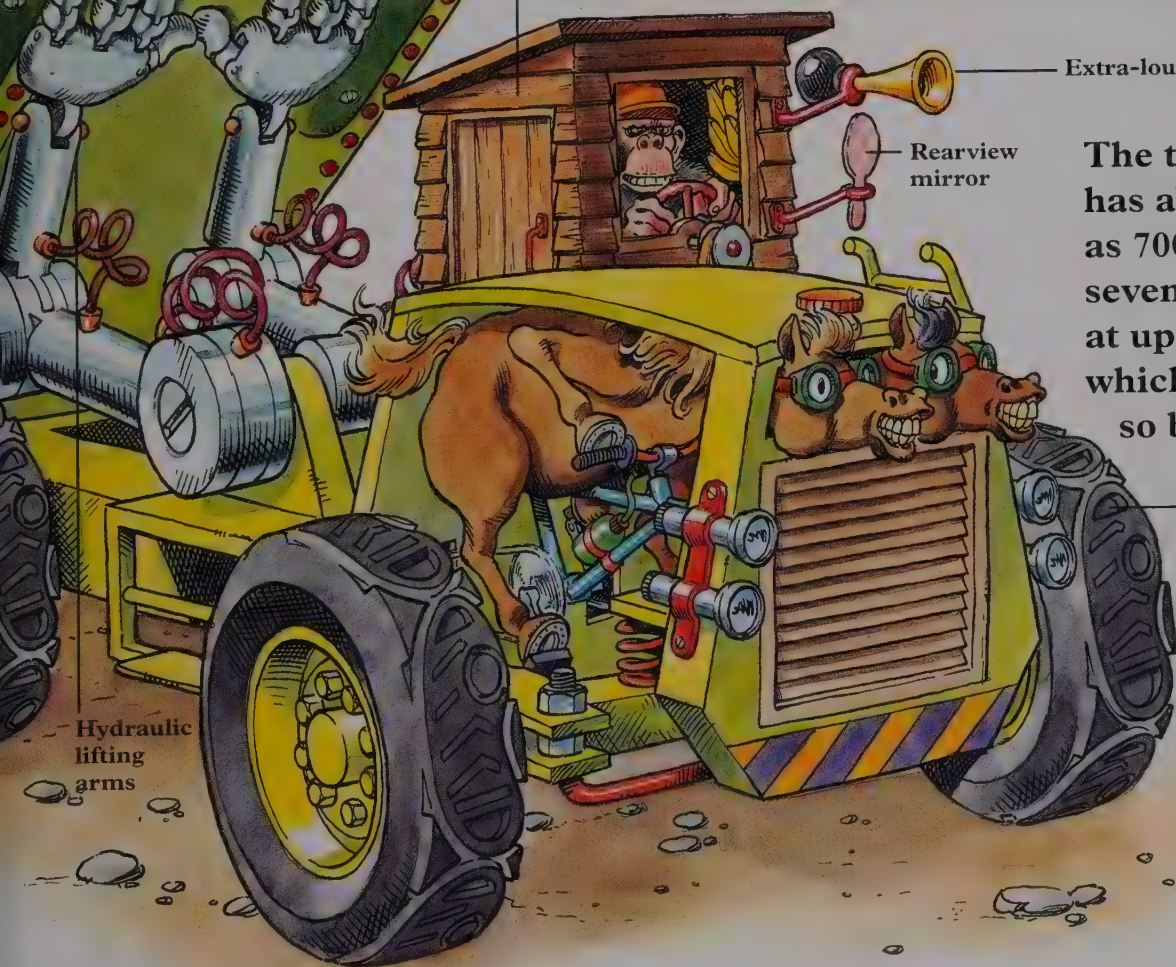
It takes just 11 seconds to tip up the fully-loaded truck body. The empty body is carefully let back down in 14 seconds.



The shape of the truck body makes it easier for loads to be dumped quickly onto the ground.



Reinforced steel cab



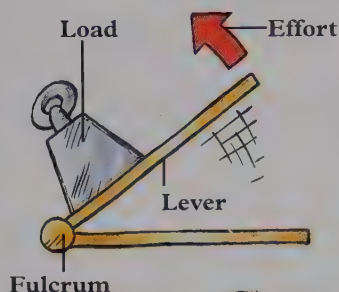
Hydraulic lifting arms

Extra-loud air horn

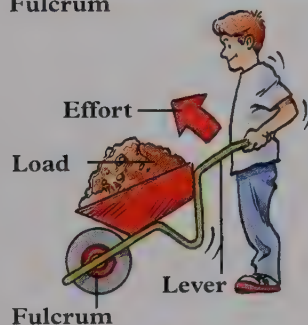
Rearview mirror

Deep-tread rubber tires for extra gripping power

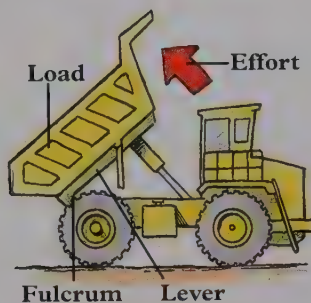
## A LEVER AT WORK



A lever is used to lift a load. It turns on a fixed point called the fulcrum.



A wheelbarrow is a lever. Since the load is near the fulcrum, it can be lifted with a little effort.



A dump truck is a lever too. It's like a big wheelbarrow, and lifts a much heavier load.

The truck's monster engine has about the same power as 700 horses. And with seven gears, it can go along at up to 40 miles an hour, which is fast for something so big and heavy.

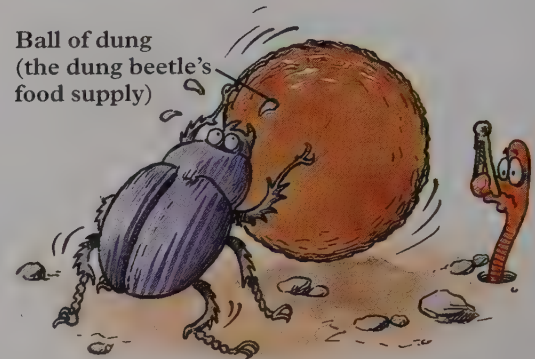
Everything about this truck is big, from its six huge tires to its bright headlights, all controlled by just one skilled driver.



# ALL ABOUT BULLDOZERS

If there's a mountain of earth to move, then a bulldozer has the muscles to push it away. This heavyweight machine works on the roughest ground, clearing it ready for building work to start. Its two tracks creep slowly along like caterpillars, climbing easily over stones and even moving across boggy ground. If it had wheels, it would get flat tires or get stuck in the mud. But this is one machine that doesn't get stopped in its tracks!

Ball of dung  
(the dung beetle's  
food supply)



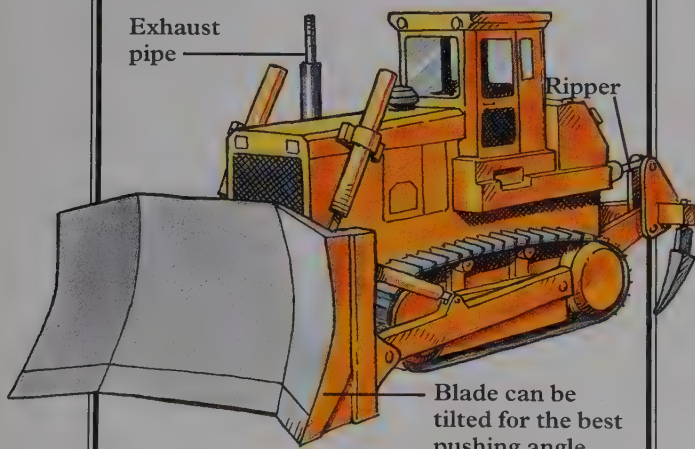
The dung beetle is nature's bulldozer, able to push many times its own body weight.

## MIGHTY BULLDOZER

This strong machine can push with the power of 600 horses, moving at about four miles per hour—an average walking speed. A bulldozer can also break up hard ground by using a ripper.

Exhaust  
pipe

Ripper



Blade can be  
tilted for the best  
pushing angle

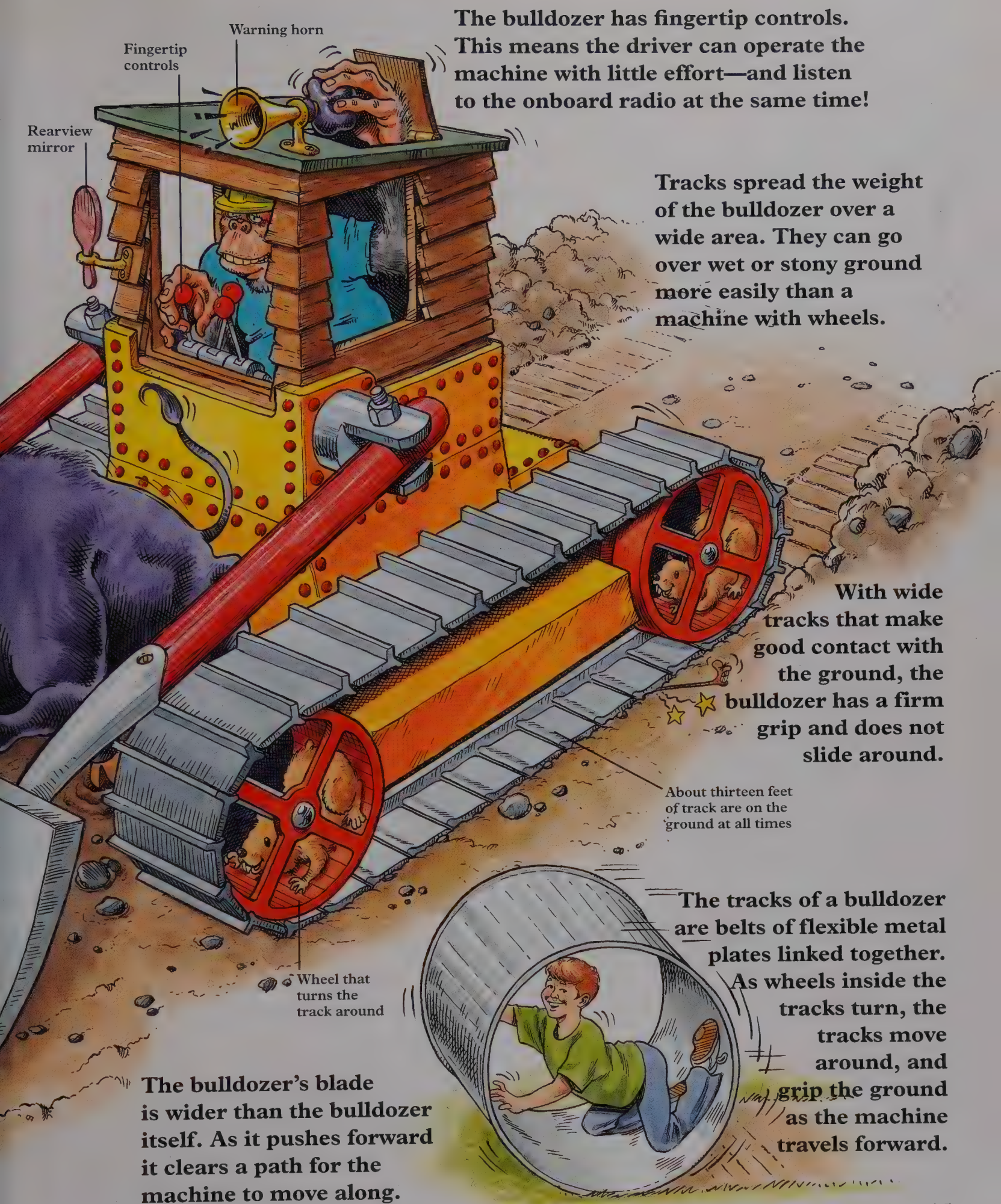
The cutting edge of  
the blade is made  
from extra-tough  
steel for a long  
working life

Blade

The blade digs  
and pushes at  
the same time







The bulldozer has fingertip controls. This means the driver can operate the machine with little effort—and listen to the onboard radio at the same time!

Tracks spread the weight of the bulldozer over a wide area. They can go over wet or stony ground more easily than a machine with wheels.

With wide tracks that make good contact with the ground, the bulldozer has a firm grip and does not slide around.

About thirteen feet of track are on the ground at all times

The tracks of a bulldozer are belts of flexible metal plates linked together. As wheels inside the tracks turn, the tracks move around, and grip the ground as the machine travels forward.

The bulldozer's blade is wider than the bulldozer itself. As it pushes forward it clears a path for the machine to move along.



# ALL ABOUT TUNNEL-BORERS

Think of how a power drill works, drilling a hole through something hard. Now imagine a drilling machine so big and strong that it can eat its way through rock, clay, and earth, burrowing like a mole under rivers and seas. The tunnel it makes becomes the route for a road or railway.

Pieces of cut rock are carried quickly away on a conveyor belt. This is a moving strip of reinforced rubber. The conveyor can be several miles in length.

Cutting head spinning three times a minute

Surrounding rock

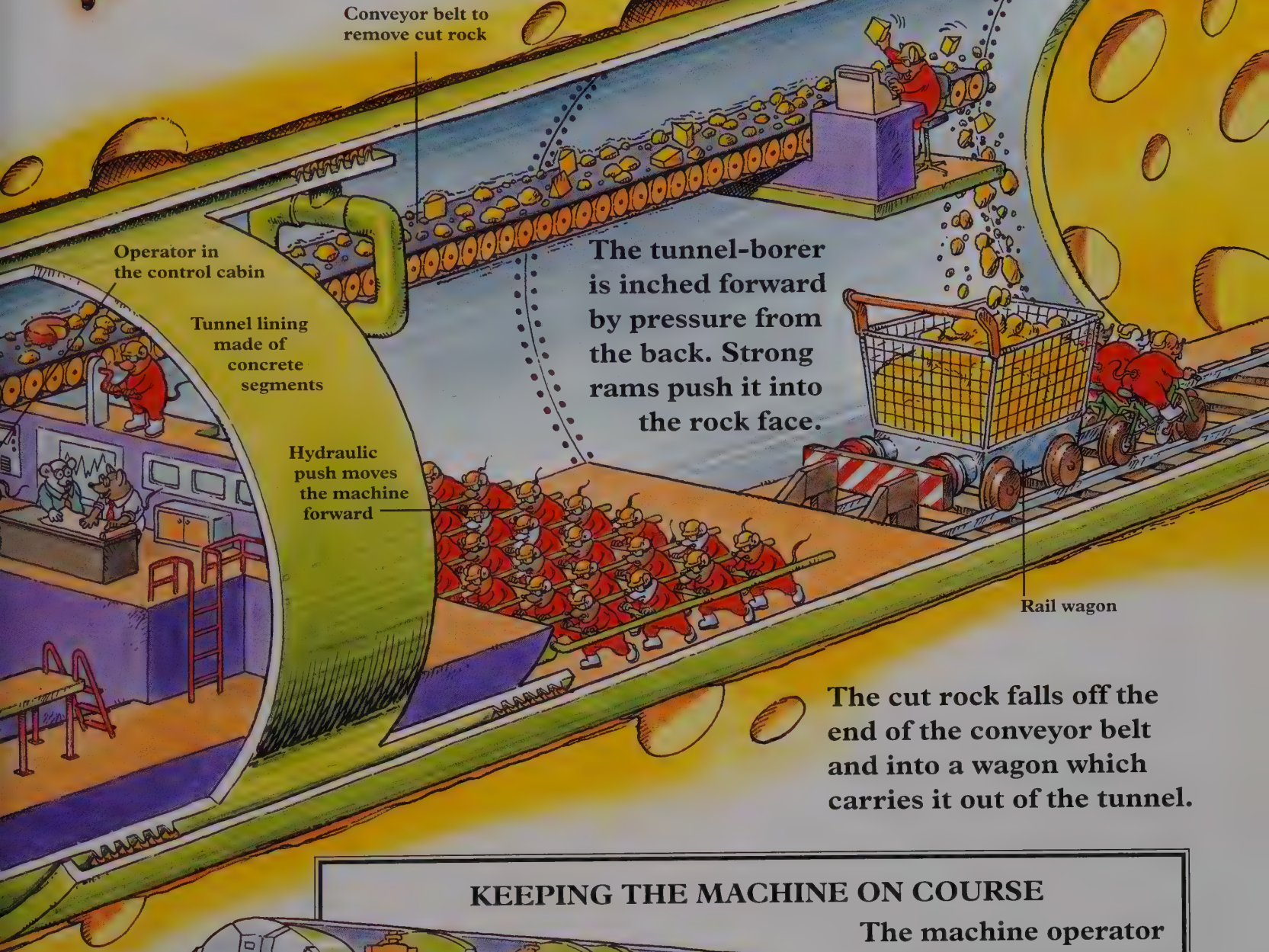
It takes fifty operators to work the machine

The machine can bite through six and a half feet of rock an hour.





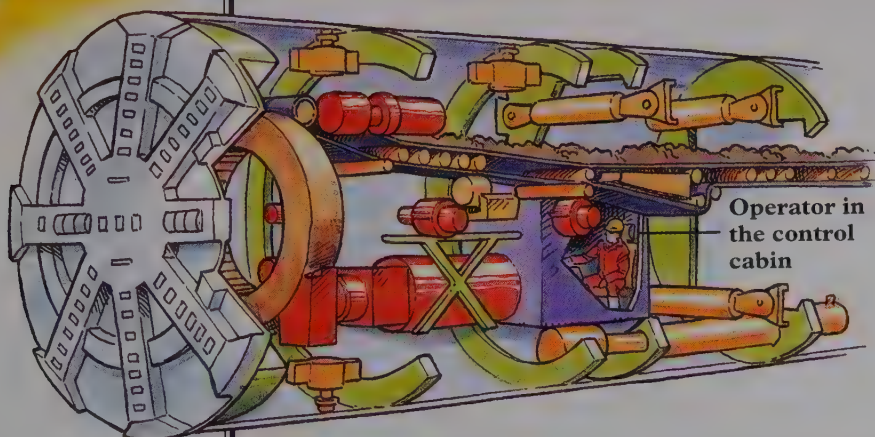
The earthworm and the mole are nature's tunnel diggers. A worm eats the soil in front of it. A mole digs it away with its strong paws.



The tunnel-borer is inched forward by pressure from the back. Strong rams push it into the rock face.

The cut rock falls off the end of the conveyor belt and into a wagon which carries it out of the tunnel.

### KEEPING THE MACHINE ON COURSE

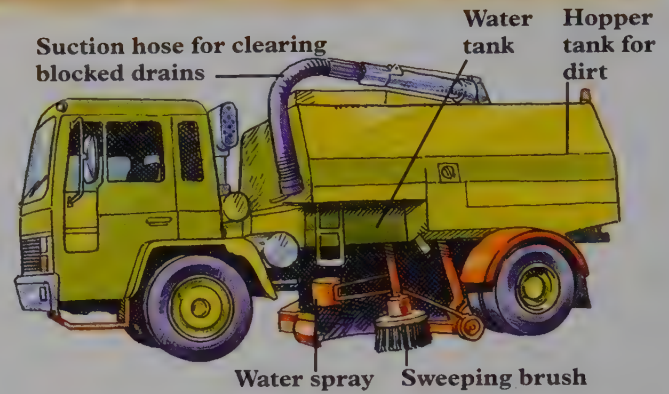


The machine operator sits behind the cutting head. He is in charge of the laser beam that keeps the machine on the right course. He watches the machine's progress on closed-circuit television.



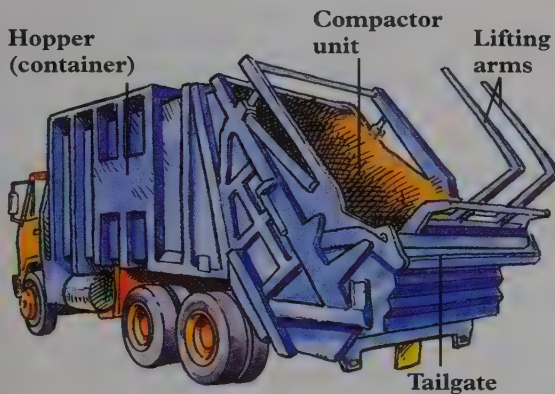
# ALL ABOUT GARBAGE TRUCKS

Whatever the garbage is, there's a machine that will love to swallow it or suck it up. Garbage trucks are the big biters and super sweepers of the machine world. No job is too messy for them—nor too small. Streetsweepers patrol the pavements sucking up litter, while on the streets garbage trucks swallow up garbage from whole neighborhoods—and still have room for more!



A streetsweeper works by spraying water onto the street in front of a brush. The brush spins and sweeps the street, then a pipe inside it sucks up the dirt.

## TRASH MASHER



A garbage truck works by picking up a garbage bin with its lifting arms. The tailgate rises up and the bin is emptied into the compactor unit. This compacts (presses) the garbage into the hopper.





## LOOPING THE LOOP

Aluminum and steel cans are collected with and kept separate from the trash. At the dump they are sent off to be melted down and made into new cans. It takes about ninety days for a can to travel around the “recycling loop,” as it is called.

Person drinking from a can

Garbage bin

Garbage truck

Drink manufacturer

Recycling factory

Garbage dump

Hopper to hold the garbage

A siren at the back of the vehicle makes a beeping noise. This warns people to keep clear while the machine is working.

The compactor works like a gigantic squeezer, packing the garbage as tightly as it can into the hopper. This takes about 30 seconds, then the lifting arms start emptying more trash inside.

Compactor unit

Deep-tread rubber tires for extra gripping power

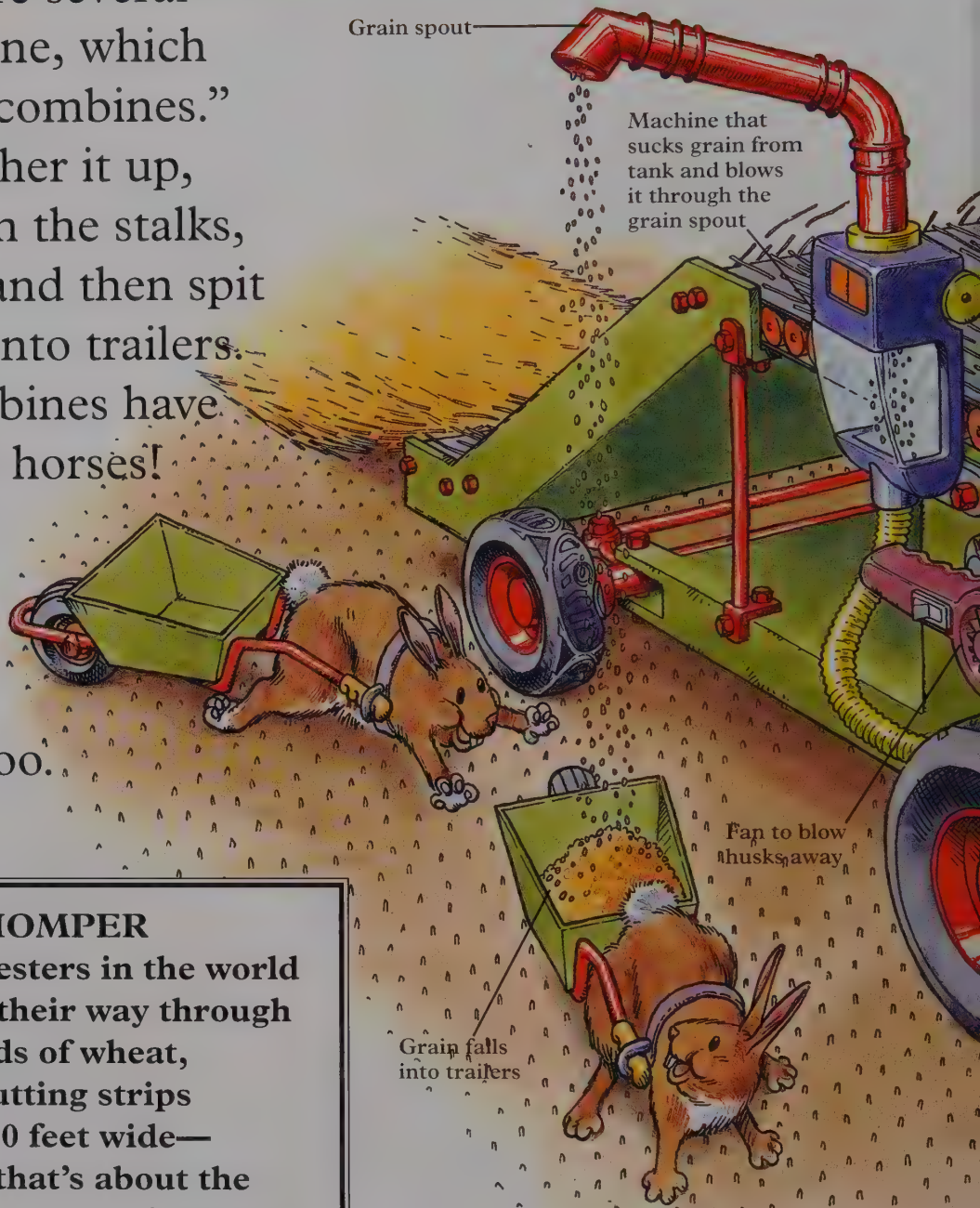
Hazard warning markings





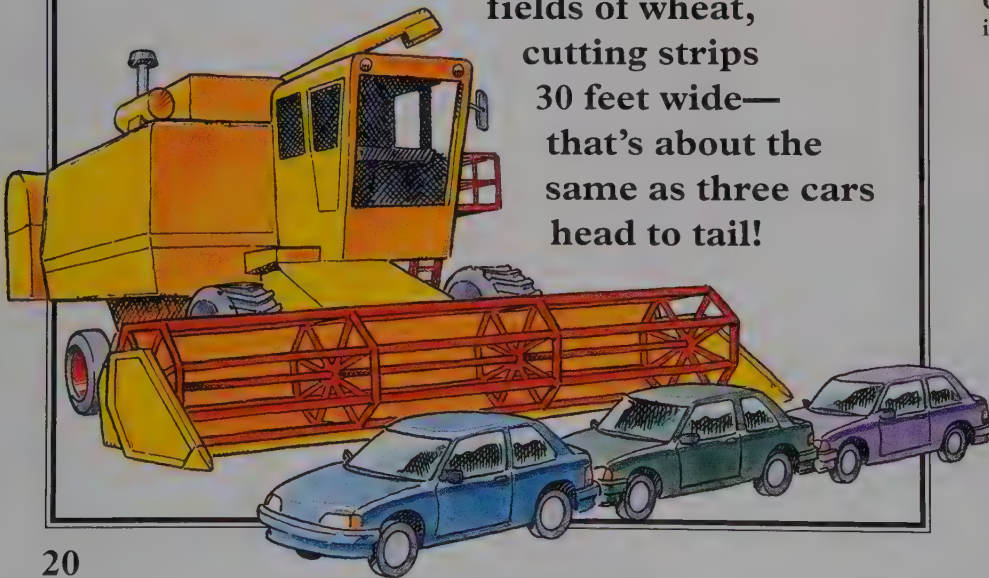
# ALL ABOUT COMBINE HARVESTERS

Combine harvesters are several machines rolled into one, which is why they're called "combines." They cut the crop, gather it up, separate the grain from the stalks, blow the husks away, and then spit the millions of grains into trailers. No wonder some combines have as much power as 300 horses! Most of the time they cut wheat, but with the right cutters, they can harvest fields of corn and sunflowers too.



## CHAMPION CHOMPER

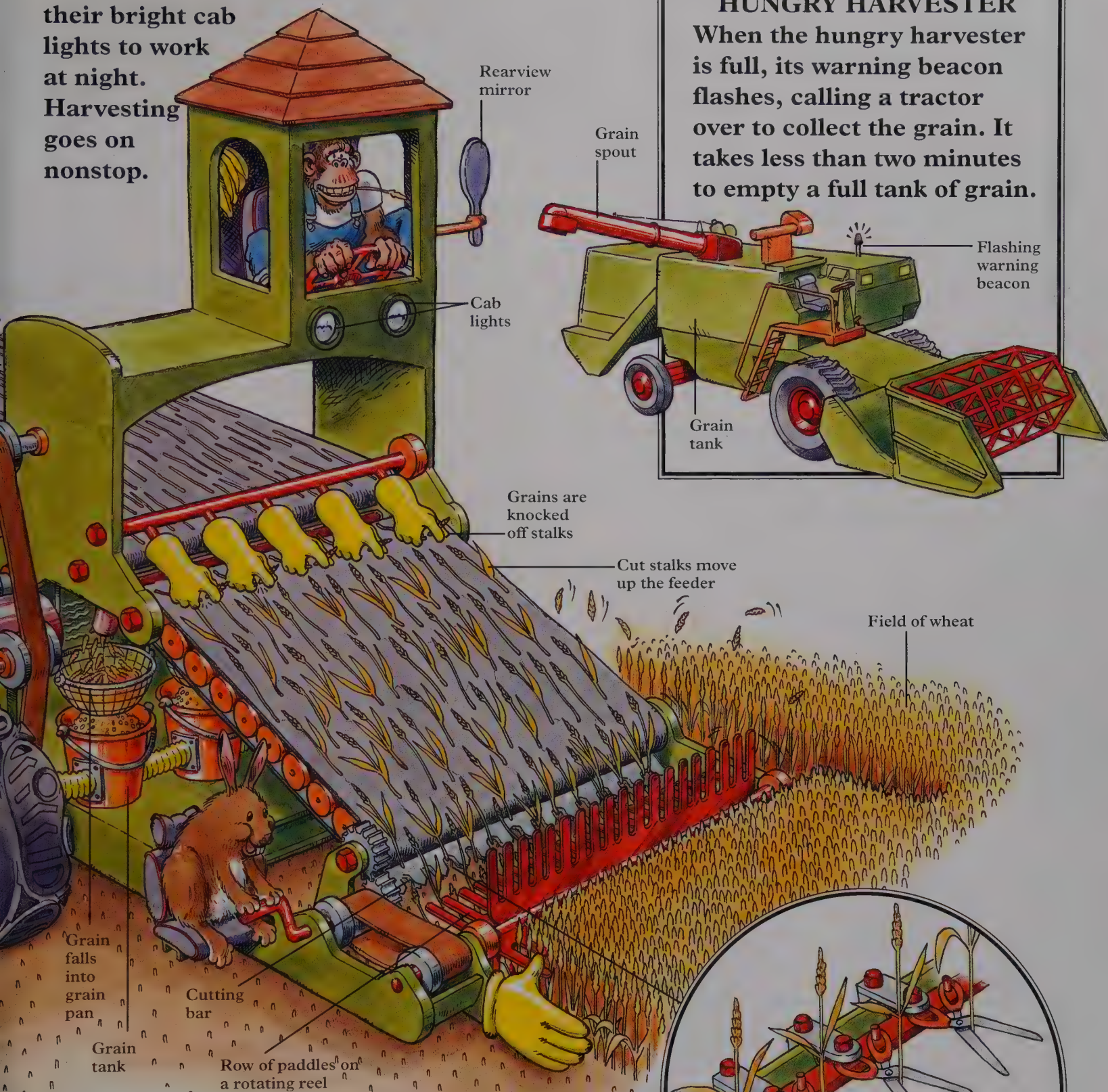
The biggest combine harvesters in the world are in the U.S. They mow their way through fields of wheat, cutting strips 30 feet wide—that's about the same as three cars head to tail!



When the grain tank is full, the harvester empties it into trailers that pull up beside it. They take the grain away to mills where it is made into flour.

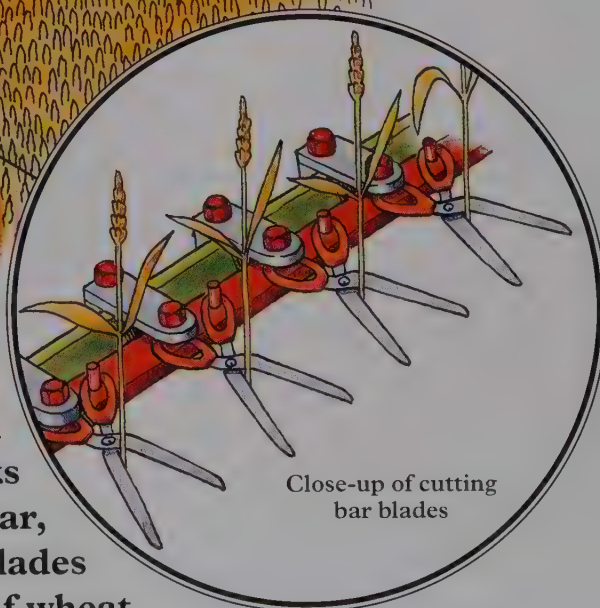


Harvesters use their bright cab lights to work at night. Harvesting goes on nonstop.



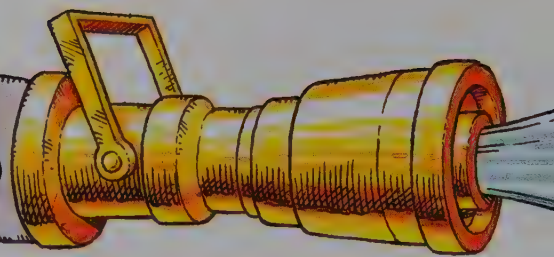
After the grain has been separated from the stalks it falls into the harvester's grain tank.

As the paddles turn they press the stalks against the cutting bar, where scissor-like blades cut off the stalks of wheat.



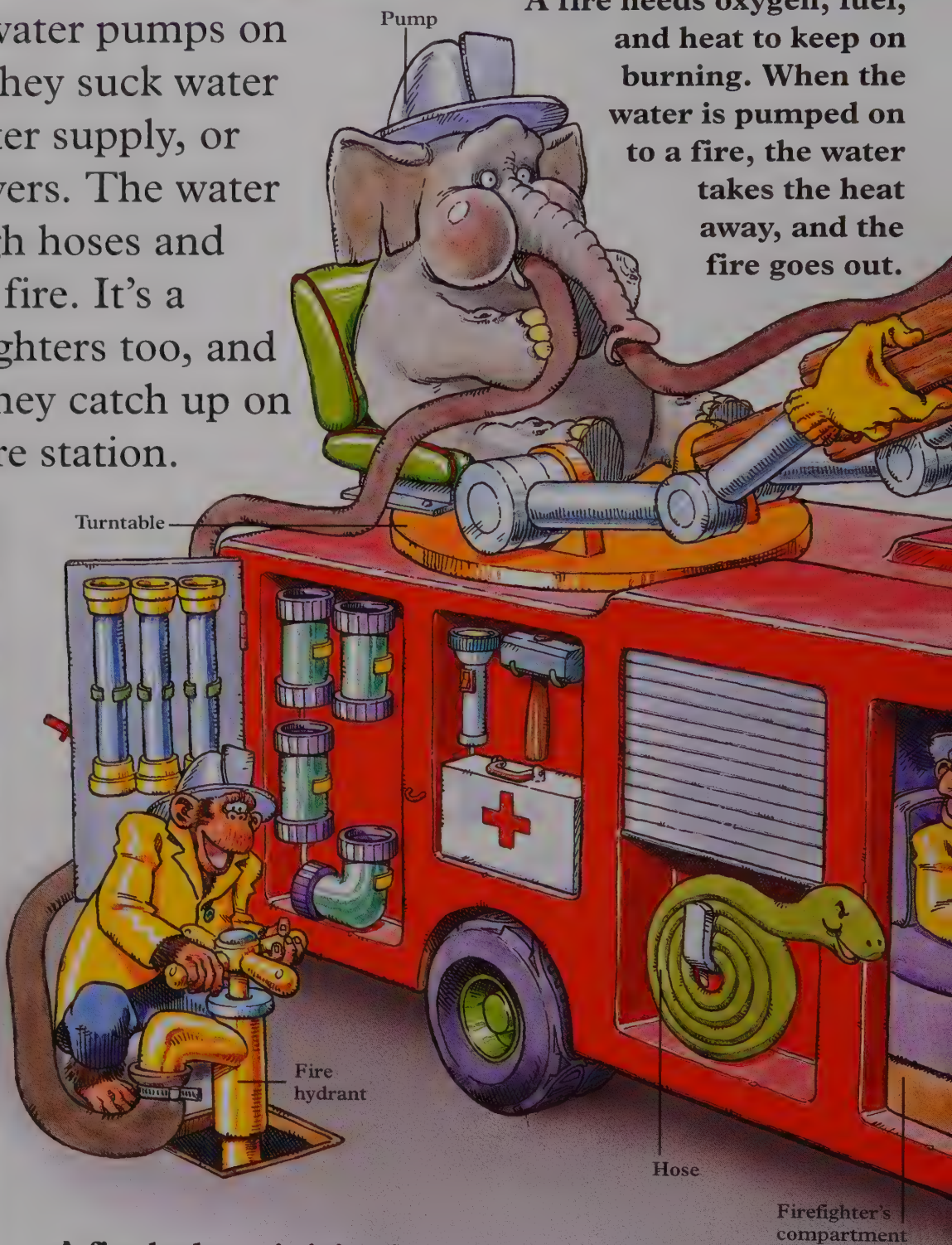
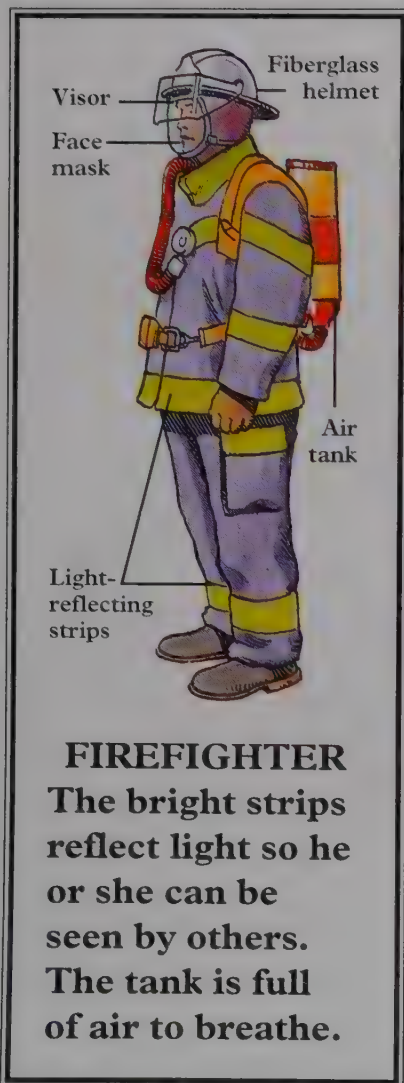


# ALL ABOUT FIRE ENGINES



Fire engines are water pumps on wheels. At a fire they suck water from a town's water supply, or from lakes and rivers. The water is pumped through hoses and squirted onto the fire. It's a busy life for firefighters too, and in between fires they catch up on their rest at the fire station.

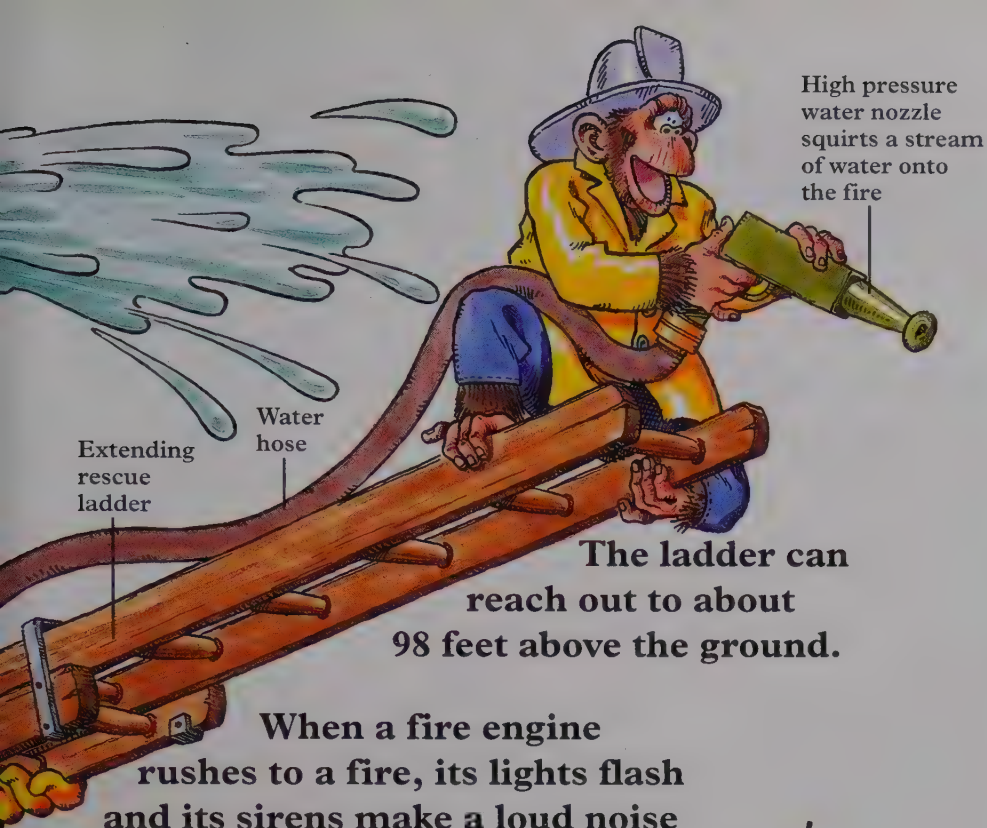
A fire needs oxygen, fuel, and heat to keep on burning. When the water is pumped on to a fire, the water takes the heat away, and the fire goes out.



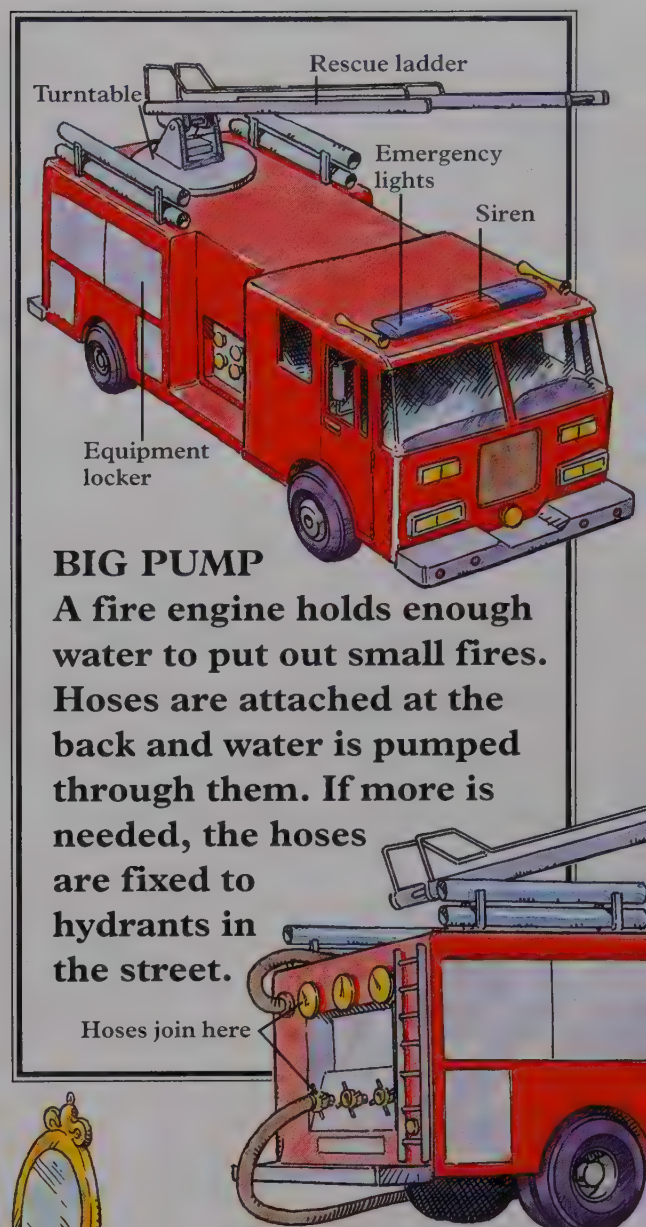
A fire hydrant is joined to a town's water supply. It works like a faucet. When it's turned on a fire engine sucks water from it.

Hoses are kept coiled up like snakes in the equipment locker. Each one is 82 feet long.





When a fire engine rushes to a fire, its lights flash and its sirens make a loud noise to warn other drivers to move out of the way.



## BIG PUMP

A fire engine holds enough water to put out small fires. Hoses are attached at the back and water is pumped through them. If more is needed, the hoses are fixed to hydrants in the street.

Firefighters keep their uniforms in the fire engine. That way everything will be ready for them when they rush to put out a fire.

Most fire engines are bright red or yellow. These colors can easily be seen from a distance.

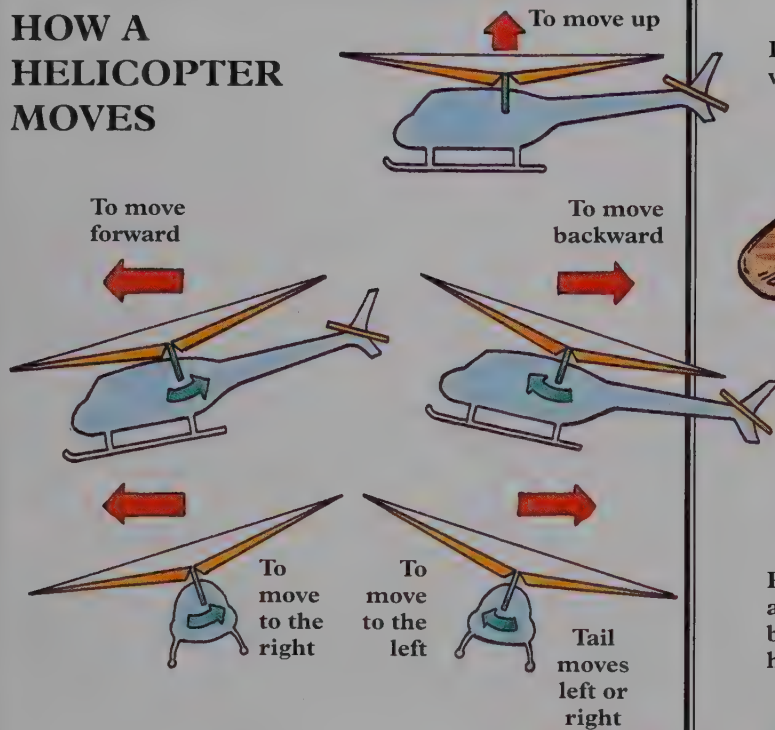


# ALL ABOUT HELICOPTERS

Helicopters and dragonflies have a lot in common. They can take off straight into the air, and settle down on the smallest of landing sites. What's more, they can hover in midair. A helicopter can do this because of its rotor blades. Think of them as being like sycamore seeds—their shape helps them spin.

The tips of the rotor blades travel at more than 62,000 miles per hour, spinning around thousands of times a minute.

## HOW A HELICOPTER MOVES



When the pilot moves the flight controls (green arrows) the helicopter flies in a certain direction (red arrows). The rotors are made to move up or down slightly, which alters the “pitch” or tilt of the blades.



Pilot and co-pilot with flight controls

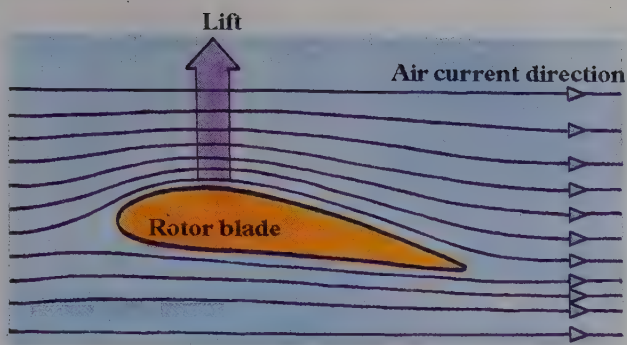
Plastic window

Riveted aluminum body of helicopter

Long range antenna

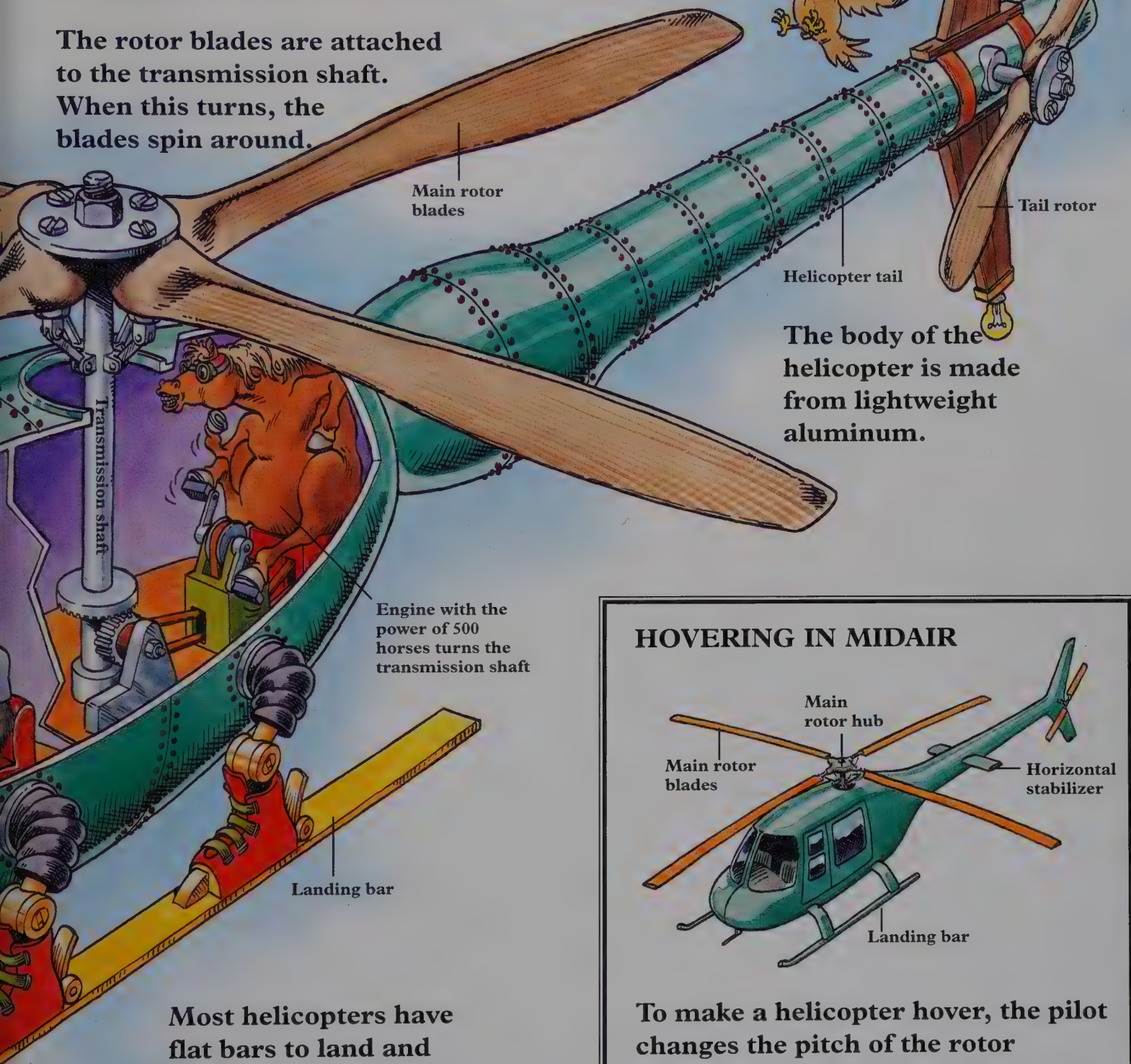
The pilot keeps in touch with people on the ground all the time. An antenna receives and sends messages.





When a rotor blade spins, air flowing over the curved top has further to go and moves faster than air flowing underneath. This makes an upward force or "lift."

The rotor blades are attached to the transmission shaft. When this turns, the blades spin around.



Main rotor blades

Helicopter tail

Tail rotor

Anti-collision beacon

Tail fin

The body of the helicopter is made from lightweight aluminum.

Engine with the power of 500 horses turns the transmission shaft

Landing bar

Most helicopters have flat bars to land and take off on. They are fixed and do not move.

## HOVERING IN MIDAIR



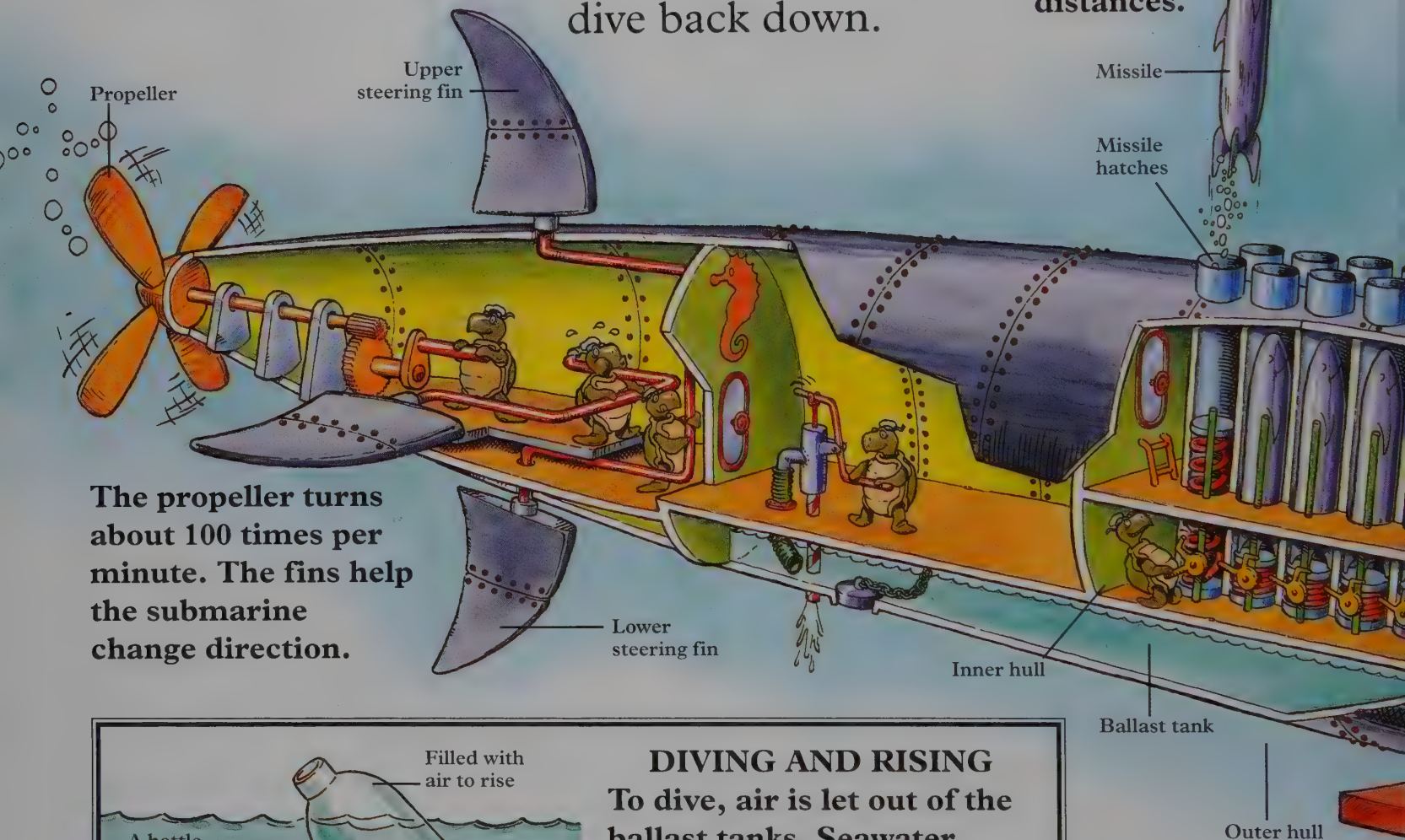
To make a helicopter hover, the pilot changes the pitch of the rotor blades. He tilts them until they are almost flat. This gives less lift to the blades, and the helicopter hovers.



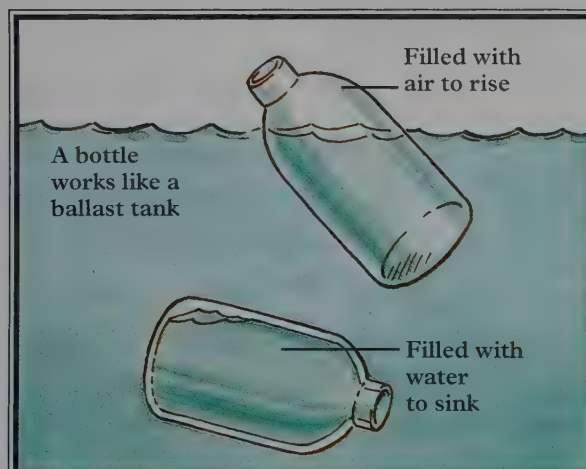
# ALL ABOUT SUBMARINES

Like sharks searching for prey, submarines are hunters of the sea. Inside their metal skin is everything they need to survive underwater for months at a time. Some can sail right around the world without coming up to the surface even once—all they do is take a quick peep through their periscopes, then dive back down.

A submarine can fire missiles into the air. They are like mini-rockets that fly great distances.



The propeller turns about 100 times per minute. The fins help the submarine change direction.



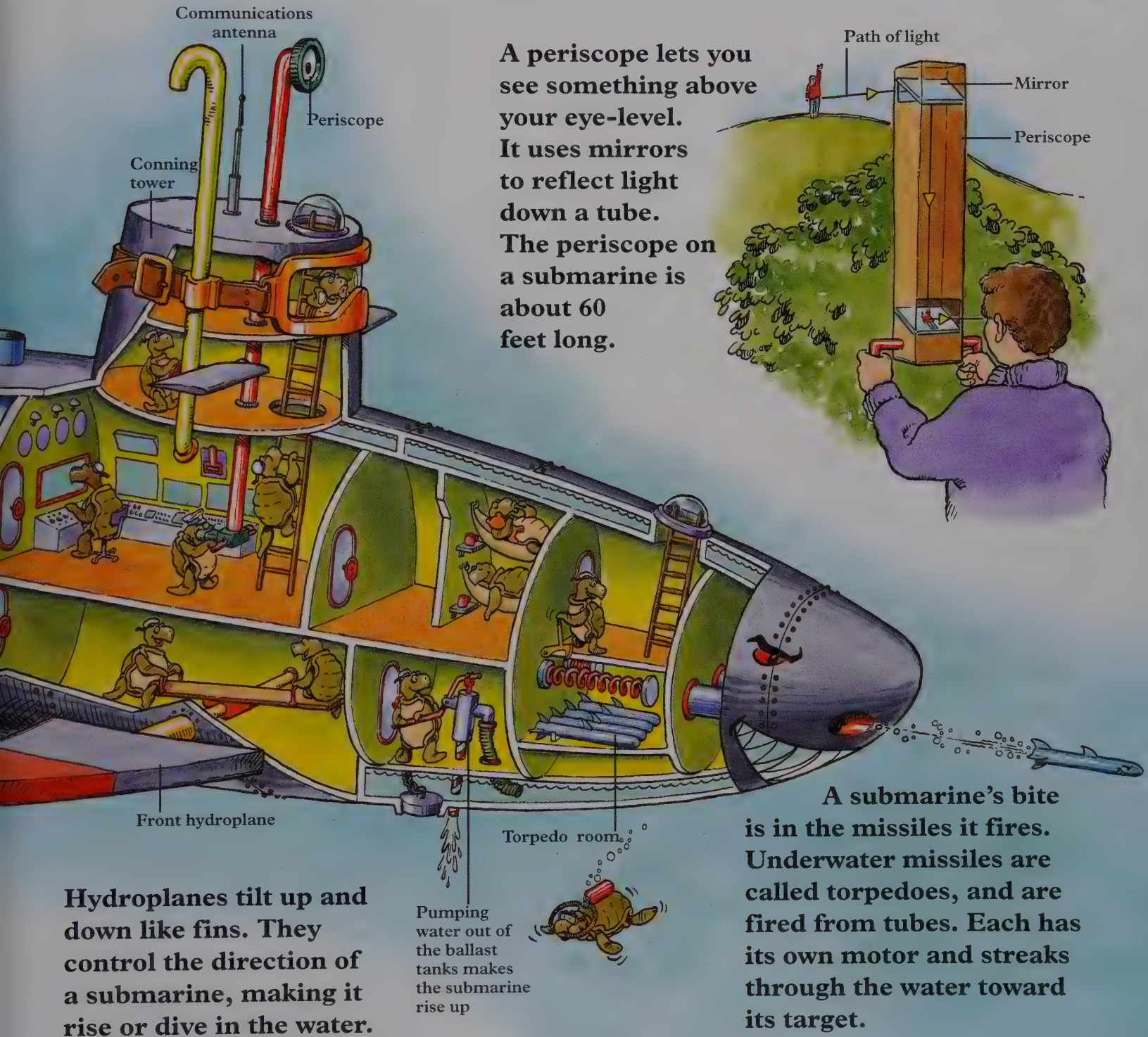
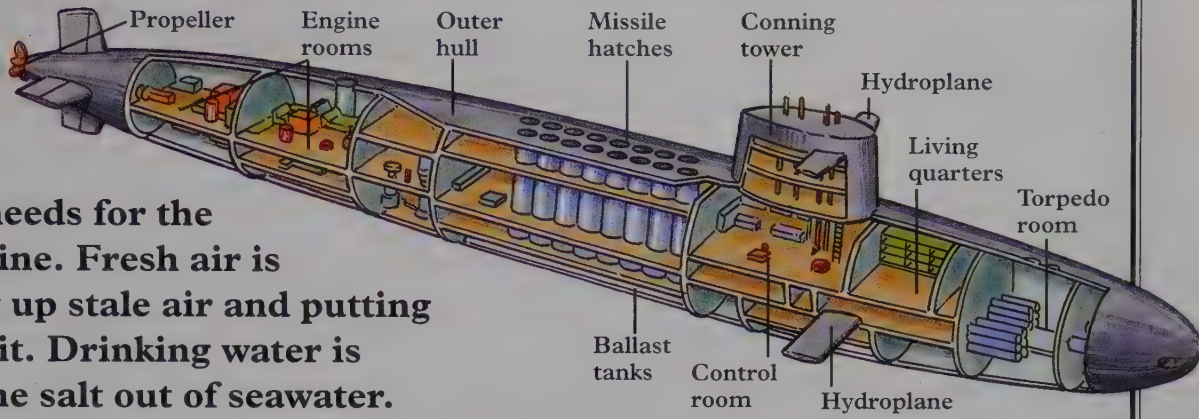
**DIVING AND RISING**  
To dive, air is let out of the ballast tanks. Seawater rushes in. The submarine gets heavy and it sinks. To rise, air is blown into the tanks to force the water out. The submarine becomes lighter, and up it goes.

A submarine has an inner and an outer hull. Its ballast tanks are between the two hulls.

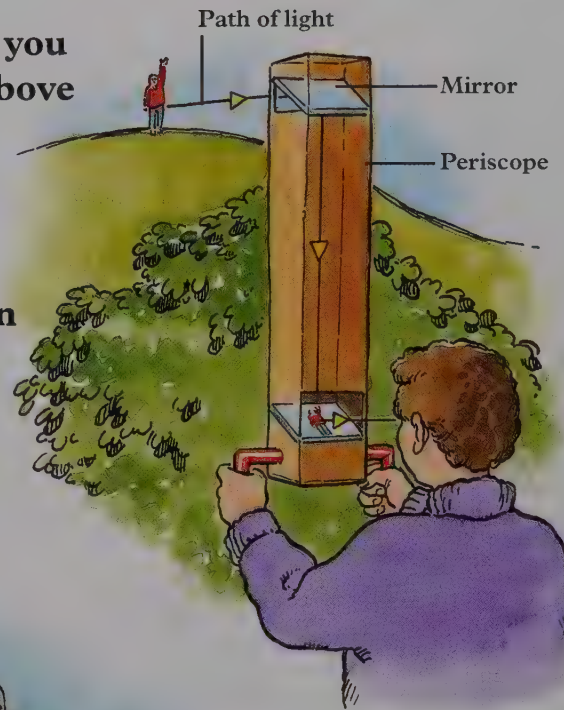


## LIFE ON A SUB

Air to breathe and water to drink are the two most important needs for the crew of a submarine. Fresh air is made by cleaning up stale air and putting oxygen back into it. Drinking water is made by taking the salt out of seawater.



A periscope lets you see something above your eye-level. It uses mirrors to reflect light down a tube. The periscope on a submarine is about 60 feet long.



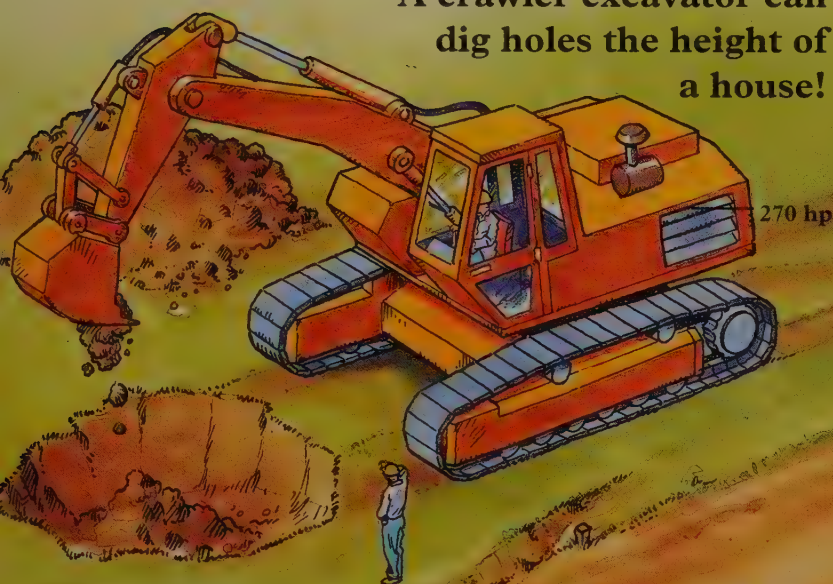
A submarine's bite is in the missiles it fires. Underwater missiles are called torpedoes, and are fired from tubes. Each has its own motor and streaks through the water toward its target.



# MORE AMAZING MACHINES

Can you imagine what it was like before we had machines to do our heavy, backbreaking work? In the past, horses did a lot of the work on farms and building sites, pulling and lifting loads. When machines started to take over from horses, their strength was measured in “horsepower” (hp), which is what we still do today.

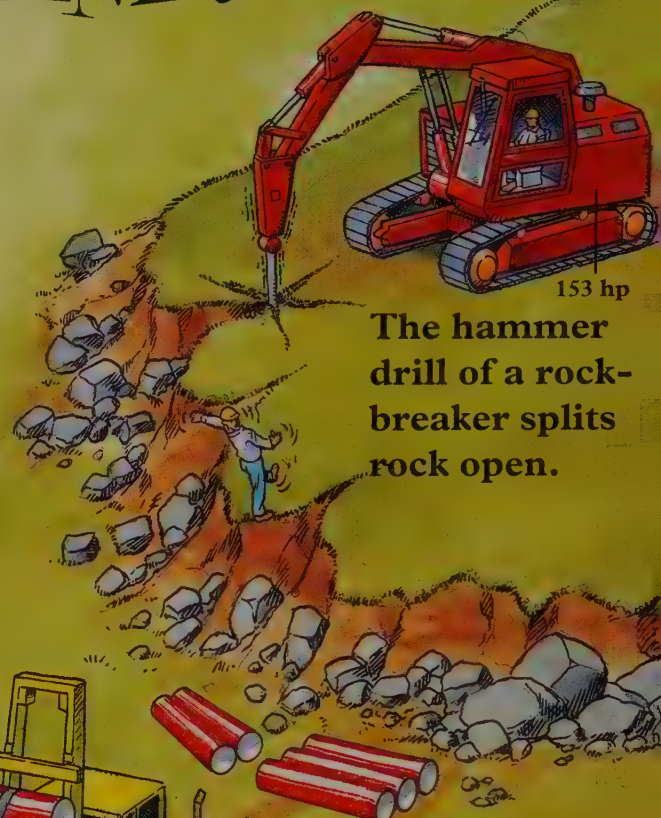
**A crawler excavator can dig holes the height of a house!**



**A scraper works like a razor, shaving off a layer of soil.**



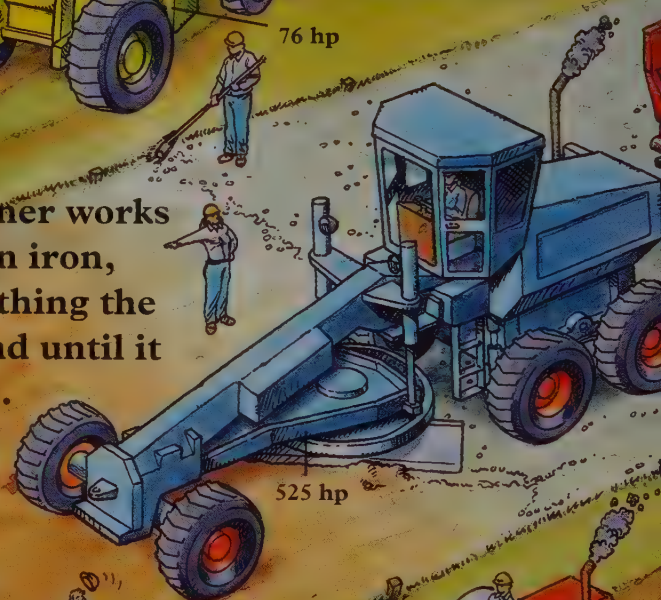
**The hammer drill of a rock-breaker splits rock open.**



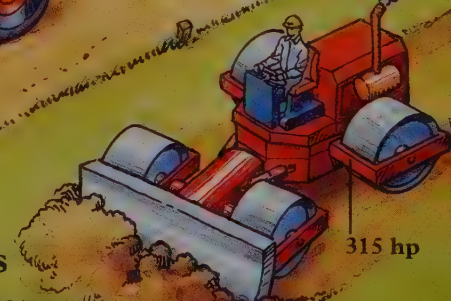
**A forklift truck lifts and transports awkward loads.**



**A planer works like an iron, smoothing the ground until it is flat.**



**A compactor is a mini-bulldozer and steamroller.**

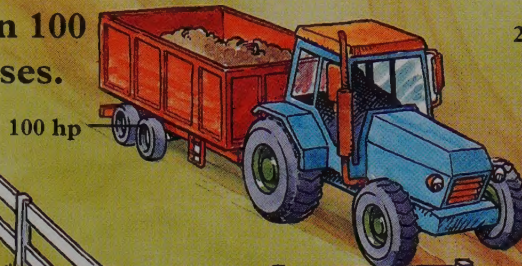






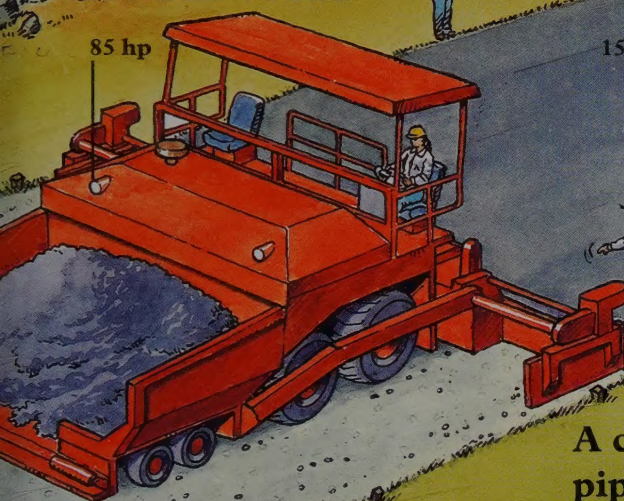
Heavy boulders are no problem for a rock lifter.

One farm tractor can do the work of more than 100 horses.

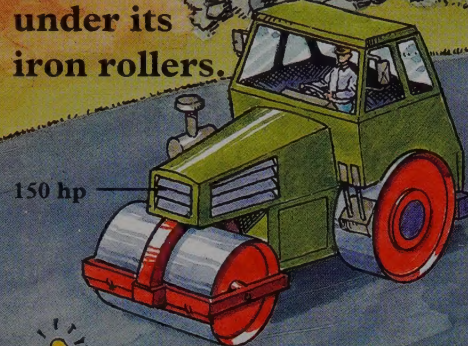


A wheeled loader can be fitted with twelve different types of bucket.

A paver puts down a layer of tarmac for a new road.



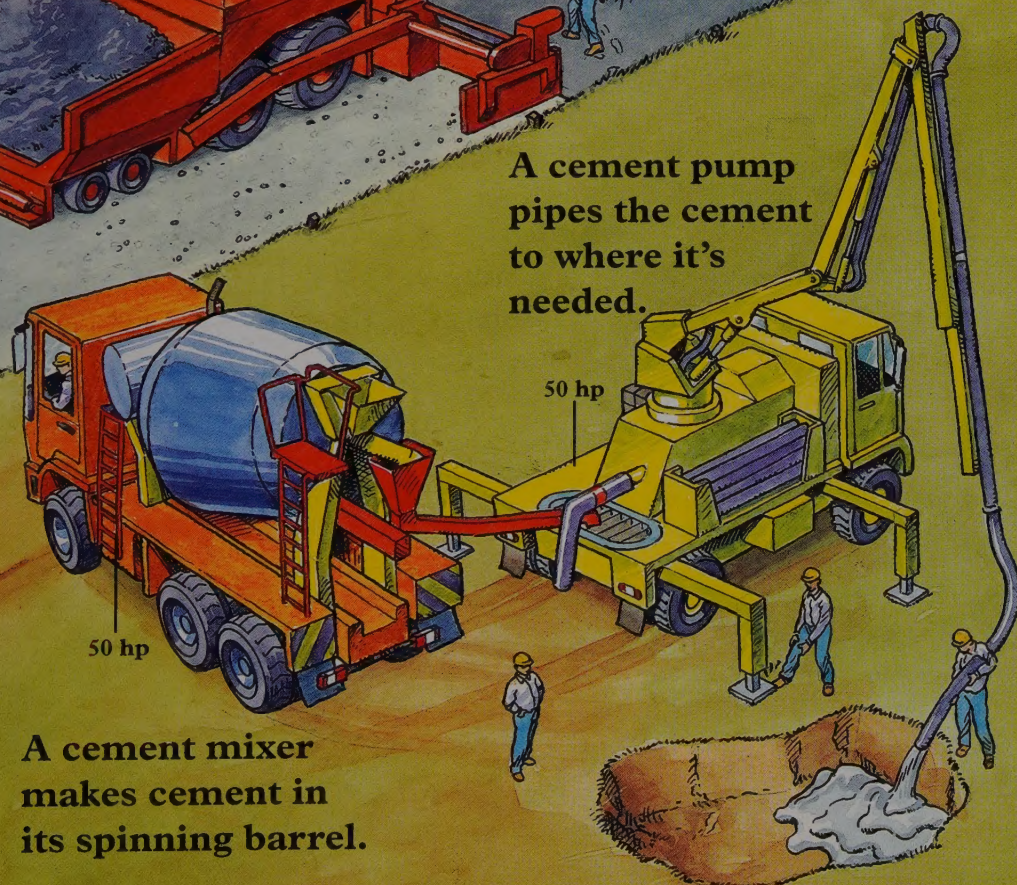
A steamroller flattens the ground under its iron rollers.



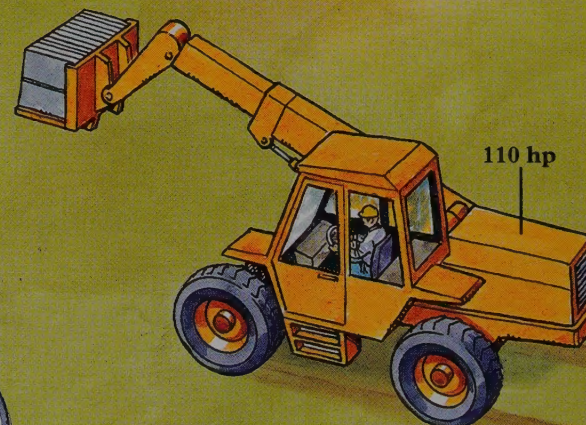
An articulated truck brings building materials to the site.



A cement pump pipes the cement to where it's needed.



A cement mixer makes cement in its spinning barrel.



The arm on a telescopic handler slides in and out, making it a cross between a crane and a forklift truck.





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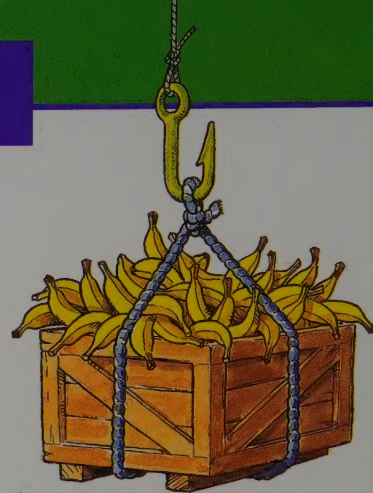
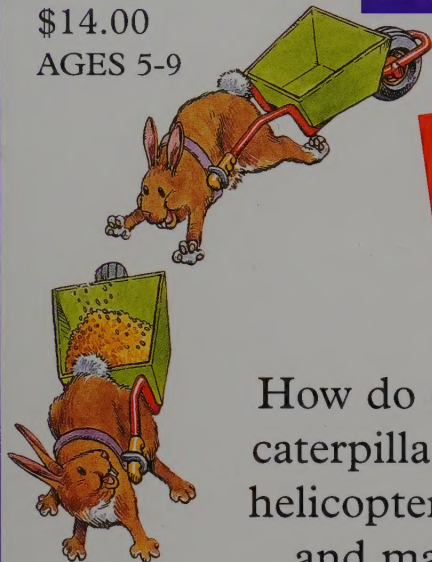


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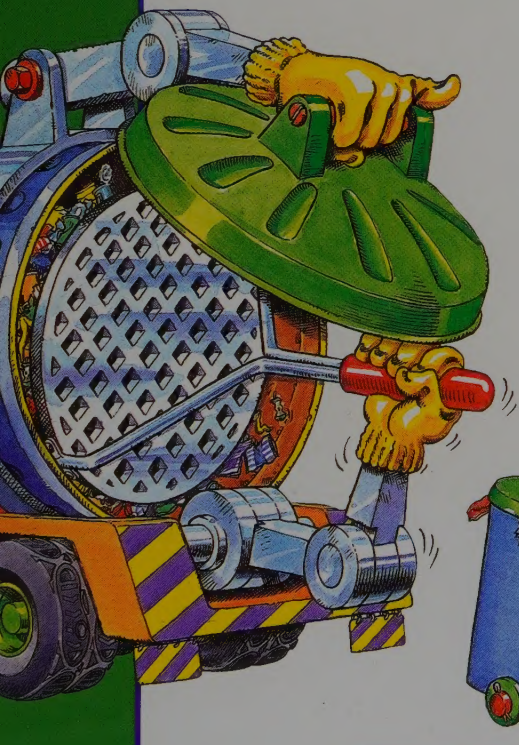


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