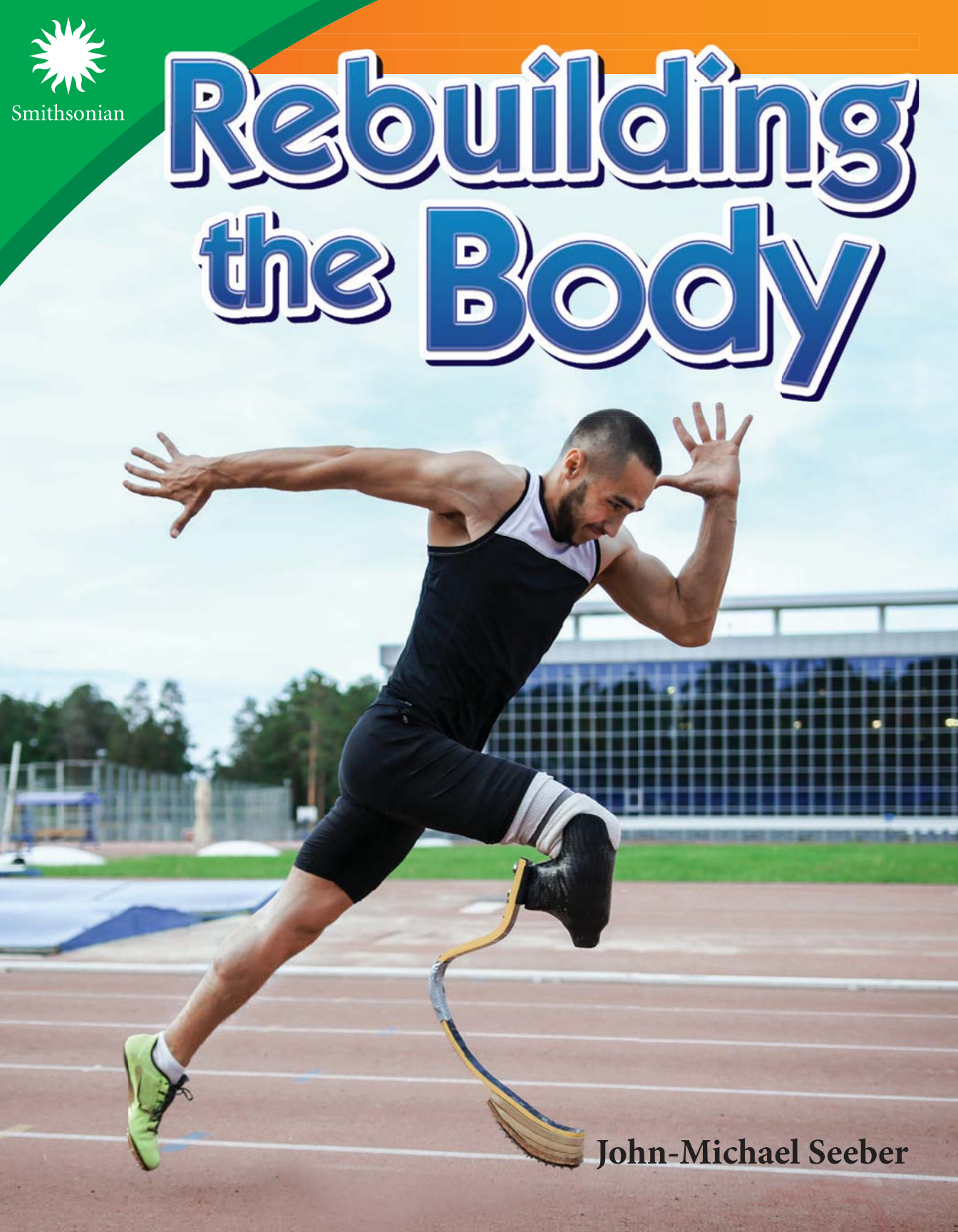
Smithsonian

Rebuilding the Body



John-Michael Seeber

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An Old Idea with New Technology

Five thousand years ago, a woman walked through a crowd. She stood out because she was two meters (six feet) tall, but that was not all. If you saw her face, you might think she had special powers. It seemed as though fire or a small sun was shining out of her left eye. She had the earliest **prosthetic** (prahs-THEH-tik) eye ever found, a round piece of tar covered with gold. **Prostheses** (pras-THEE-seez) are artificial body parts. Since ancient times, people have found ways to replace missing or damaged body parts. Carved wood replaced a missing leg. A hook was used to replace a lost hand. Today, scientists and engineers are building better prostheses. Researchers are finding new ways to send signals back and forth between the brain and a prosthesis. Today, you can peel fruit or write a letter with an artificial hand. Technology can help people get out of wheelchairs and climb mountains. People work hard to create all these things. They keep working to turn problems into solutions.

This illustration shows a woman from around 2850 BC with a prosthetic eye.

prosthetic eye

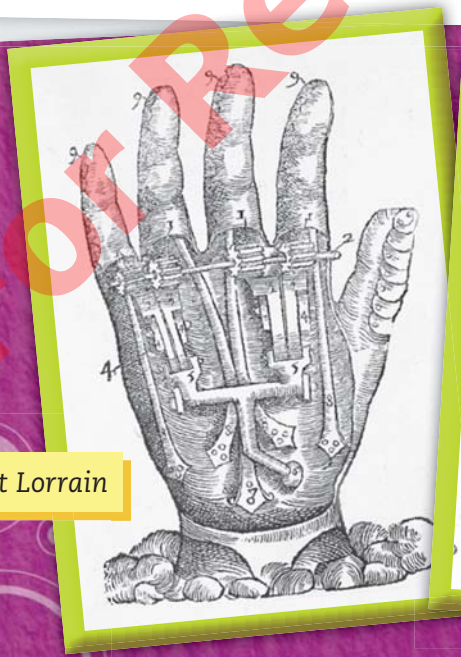
Scientists found a big toe on a mummy that was made of leather and wood.

A Helping Hand

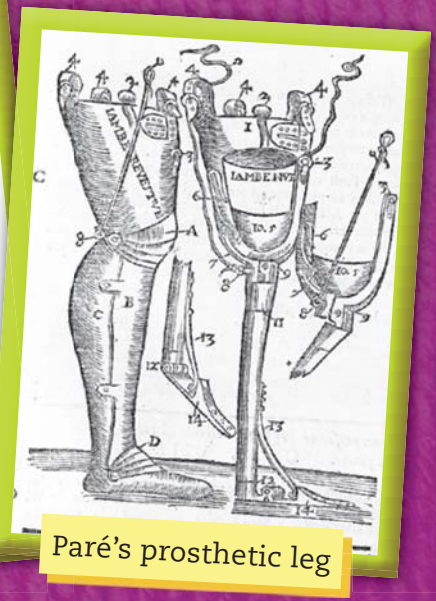
The human hand is complex. Hands are strong enough to hold heavy weights and gentle enough to pick flowers. Hundreds of years ago, a person with a missing hand might have used a hook, if they could afford it. Early engineers ran into many problems when they tried to replace missing limbs.

Many different skills were used to solve these problems. Ambroise Paré (am-BWAHZ pah-RAY) was a barber and a surgeon in the French army in the 1530s. When soldiers injured their hands, arms, or legs, their wounds could become infected. Sometimes, Paré had to **amputate** the wounded limbs.

Paré started making artificial hands so he could help **amputees**. He wanted to make a hand that could hold things. He invented the first mechanical hand. He called it *Le Petit Lorrain*. It worked using metal gears and springs. A French captain wore it into battle. He said it helped him hold the reins of his horse. Paré also designed a prosthetic leg that could bend at the knee. People often call him the Father of Prosthetics.



Paré's *Le Petit Lorrain*



Paré's prosthetic leg

This illustration shows Ambroise Paré performing surgery.

TECHNOLOGY

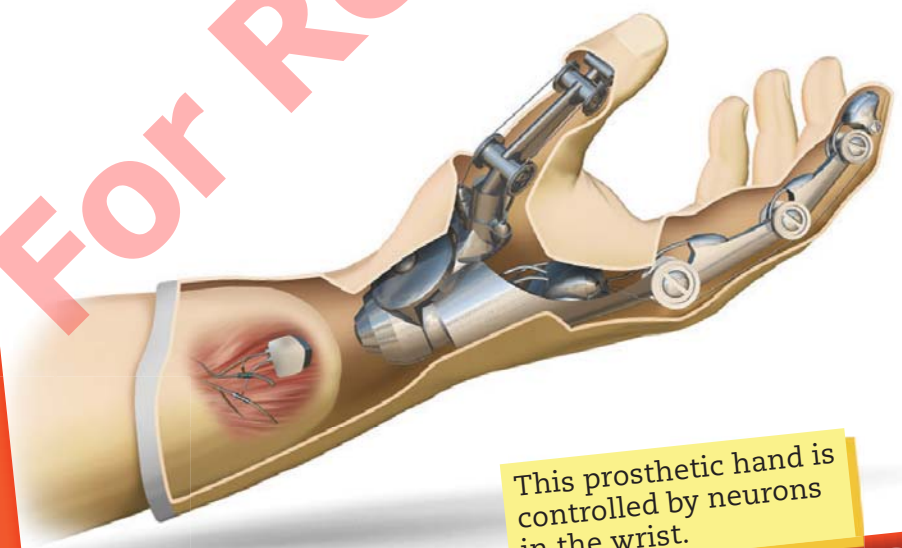
Clamps Save Lives

In Paré's time, many people bled to death after amputation. Doctors did not have a good way to stop wounds from bleeding during surgery. Paré solved this problem by using a tool called a clamp. Clamps are still used in surgery. They pinch veins and arteries until doctors can sew them closed. Clamps keep many patients from dying during amputation.

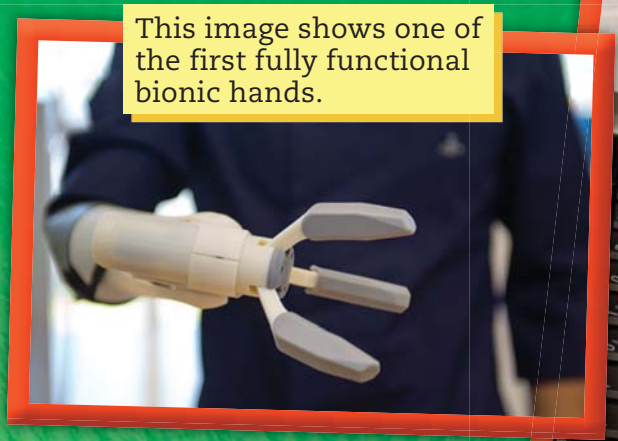
Scientists want to make artificial limbs that do more of the things natural arms and hands can do. One problem is finding out how to make artificial limbs move.

Natural limbs move with just a thought. Cells called motor **neurons** send signals from the brain. These signals tell muscles what to do. Small hand movements use thousands of neurons. Moving a whole arm uses millions. Engineers are trying to control **bionics**, which are electrically powered prostheses, the same way.

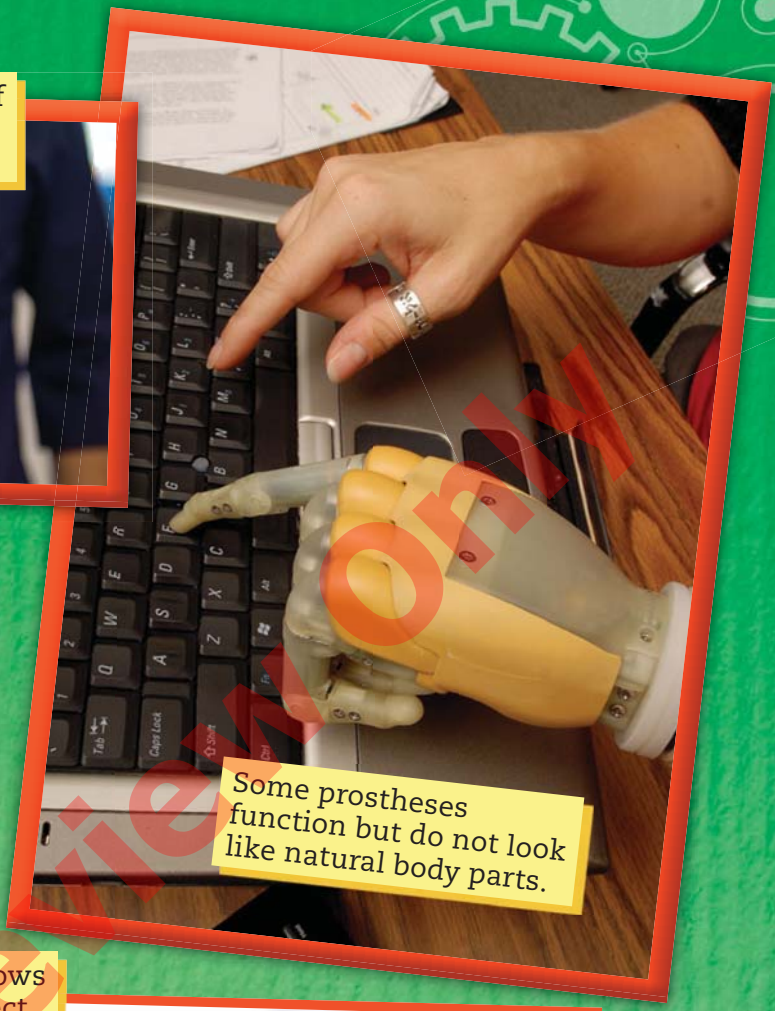
The first step in moving bionics with the mind is to read brain signals. The second step is to find out how the new limb can read the signals. Engineers have developed a way to read some brain signals. They read motor neurons under the skin close to the missing limb. But this method cannot read many neurons at once. Some researchers are trying to get patients' brains to read signals directly from the spinal cord. This lets their brains read more neurons, but it is more dangerous.



This prosthetic hand is controlled by neurons in the wrist.



This image shows one of the first fully functional bionic hands.



Some prostheses function but do not look like natural body parts.

This illustration shows how neurons connect muscles to the brain.

There are about 86 billion neurons in a human brain.

STEAM CHALLENGE

Define the Problem

Prostheses cannot just look like the part they are replacing; they must function like the part as well. Your task is to create a device that can pick up various objects and put them down like a real hand.

Constraints: Your device should be operated using only your thumb and index finger. It should be constructed with objects that are found around the classroom.

Criteria: Your device should be able to pick up the following items from a bucket: a number cube, an eraser, and a coin. Each object should be carried across the room and placed in an empty bucket without being dropped.

Research and Brainstorm

Look at all the ways your hand picks up objects. How can you replicate those movements in your device? What materials will you use to control your mechanical hand?

Design and Build

Sketch a plan for your device. Make sure to include which materials will be used for each part. Build your device.

Test and Improve

Use your device to lift one object out of a bucket and carry it across the room. Place the object in an empty bucket on the other side of the room. Repeat for each object in the bucket. If you drop an item, leave it on the floor where it fell. How did your device perform? Modify your design and try again.

Reflect and Share

How can you make your device more lifelike? Can your device be modified to move on its own? What changes would need to be made?