Image Teardowns

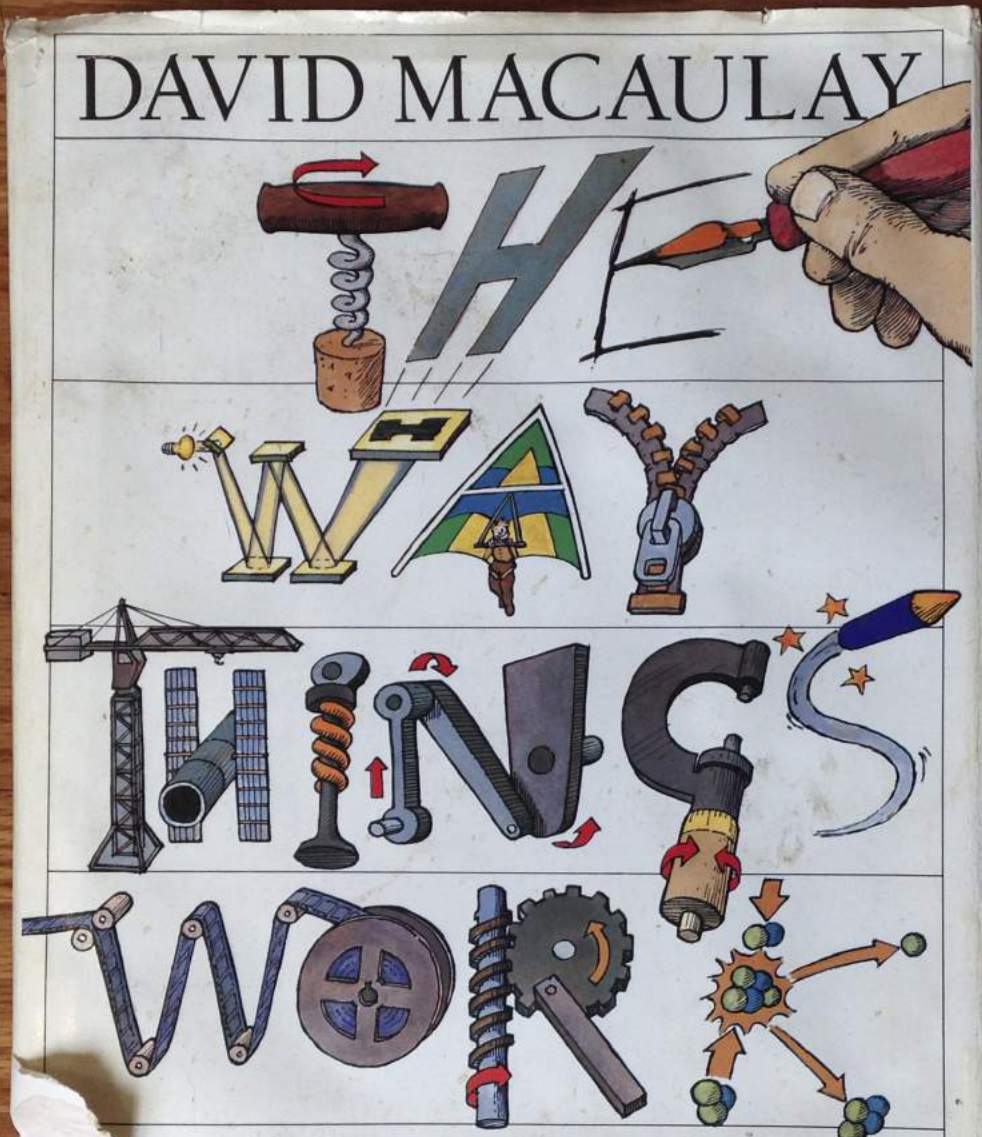
CASE STUDIES IN WEB PERFORMANCE

ERIC PORTIS ✯ 2017-08-30

WHO AM I?

ERIC!

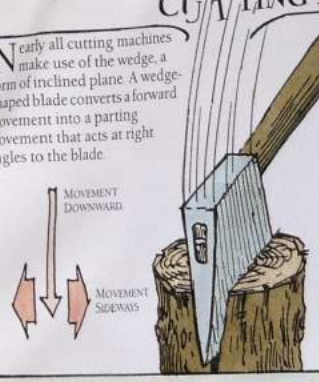
DAVID MACAULAY



FROM LEVERS TO LASERS, CARS TO COMPUTERS—
A VISUAL GUIDE TO THE WORLD OF MACHINES

CUTTING MACHINES

Nearly all cutting machines make use of the wedge, a form of inclined plane. A wedge-shaped blade converts a forward movement into a parting movement that acts at right angles to the blade.



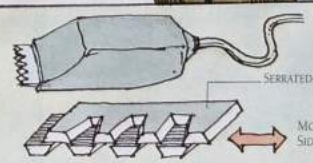
SCISSORS

Each blade acts as a first-class lever (see p.23). The sharpened edges of the blades form two wedges that cut with great force into a material from opposite directions. As they meet, they part the material sideways.

AXE

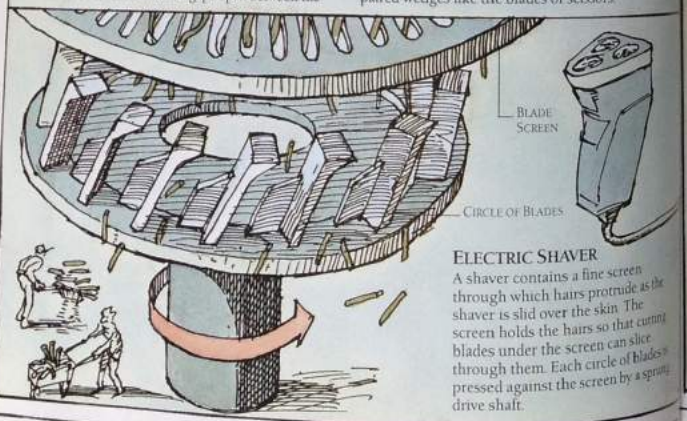
An axe is simply a wedge attached to a shaft. The axe's long movement downward creates a powerful sideways force that splits open the wood.

The axe has another hidden wedge: a sliver of metal driven into the top of the shaft. As this jams the shaft tightly in the socket in the axe's head.



ELECTRIC TRIMMER

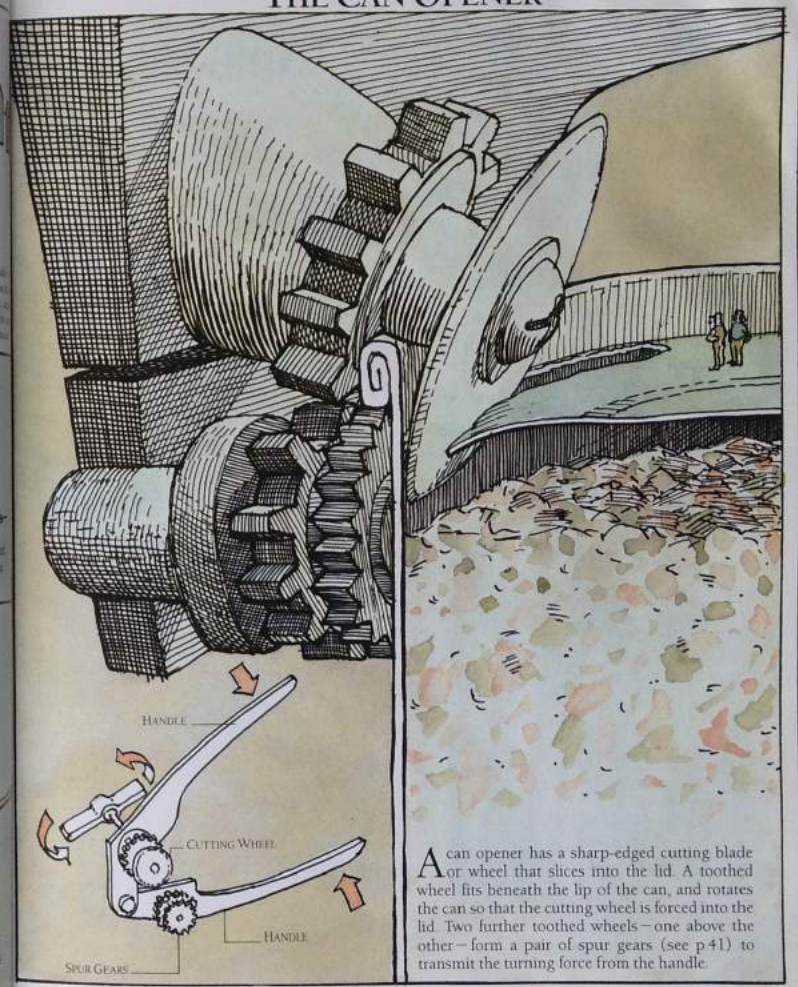
An electric trimmer contains two serrated blades driven by a crank mechanism (see pp.52-3). The blades move to and fro over each other. As gaps open between the serrations, stems or hairs enter to be trapped and then sliced as the blades cross. The trimmer's blades act as paired wedges like the blades of scissors.



ELECTRIC SHAVER

A shaver contains a fine screen through which hairs protrude as the shaver is slid over the skin. The screen holds the hairs so that cutting blades under the screen can slice through them. Each circle of blades is pressed against the screen by a sprung drive shaft.

THE CAN OPENER



A can opener has a sharp-edged cutting blade or wheel that slices into the lid. A toothed wheel fits beneath the lip of the can, and rotates the can so that the cutting wheel is forced into the lid. Two further toothed wheels – one above the other – form a pair of spur gears (see p.41) to transmit the turning force from the handle.

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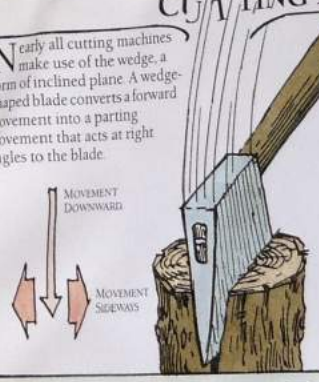

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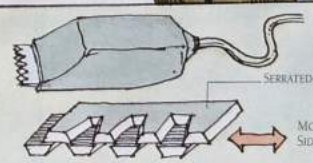

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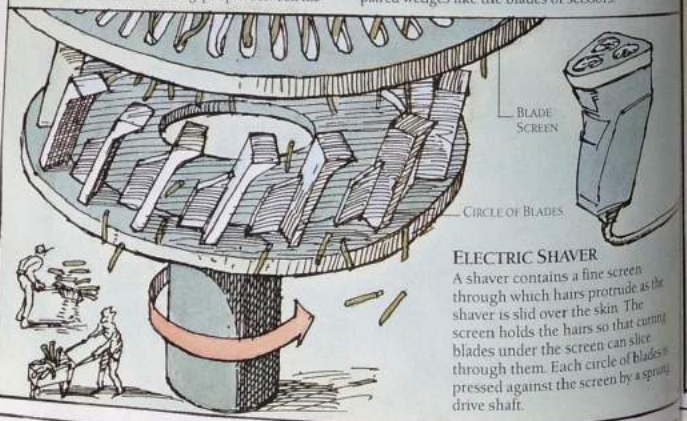

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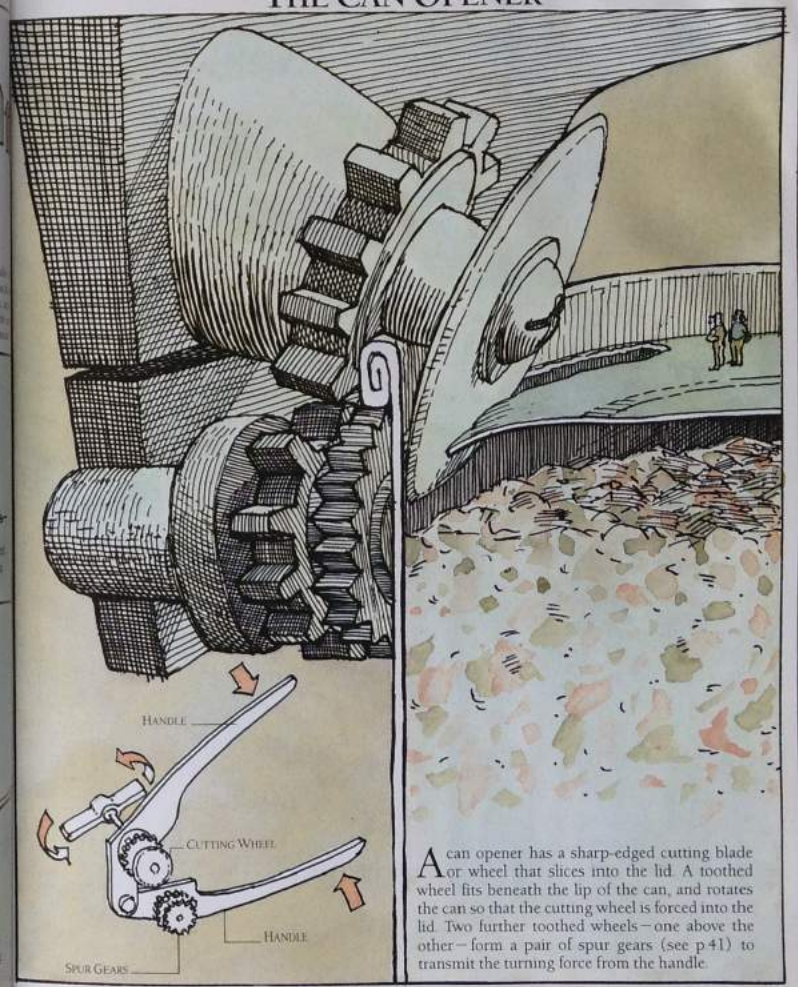

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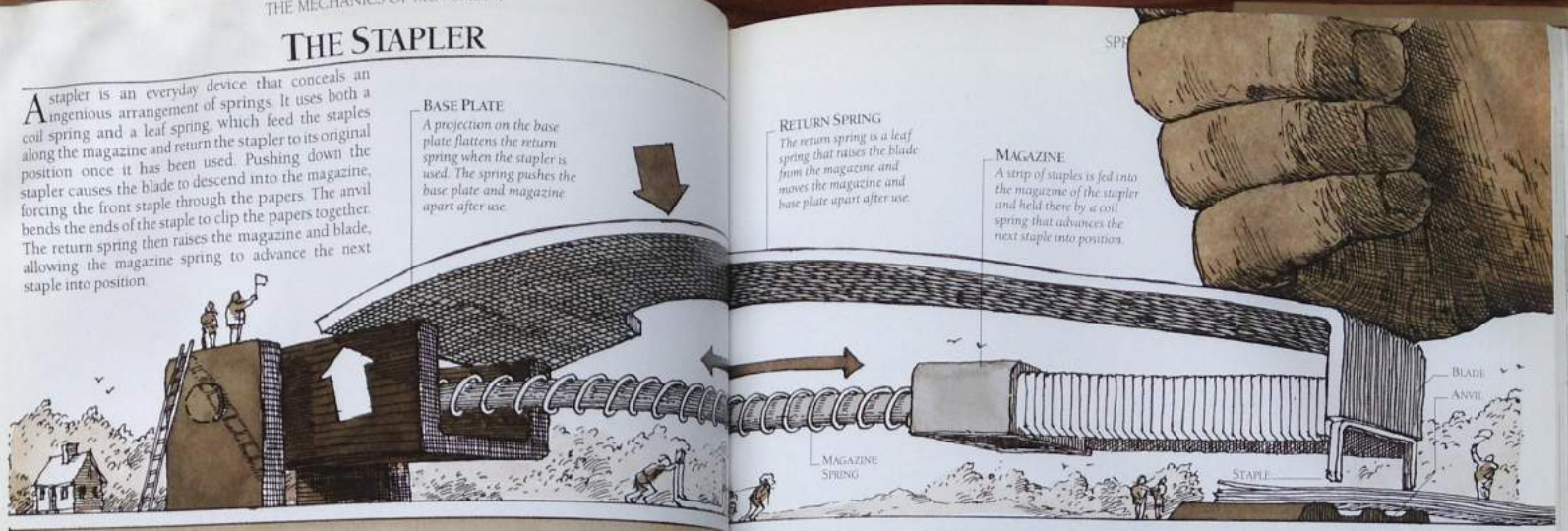
THE STAPLER

A stapler is an everyday device that conceals an ingenious arrangement of springs. It uses both a coil spring and a leaf spring, which feed the staples along the magazine and return the stapler to its original position once it has been used. Pushing down the stapler causes the blade to descend into the magazine, forcing the front staple through the papers. The anvil bends the ends of the staple to clip the papers together. The return spring then raises the magazine and blade, allowing the magazine spring to advance the next staple into position.

BASE PLATE
A projection on the base plate flattens the return spring when the stapler is used. The spring pushes the base plate and magazine apart after use.

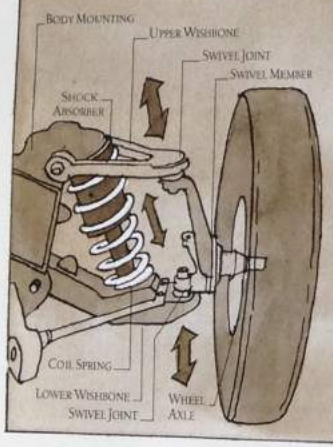
RETURN SPRING
The return spring is a leaf spring that raises the blade from the magazine and moves the magazine and base plate apart after use.

MAGAZINE
A strip of staples is fed into the magazine of the stapler and held there by a coil spring that advances the next staple into position.



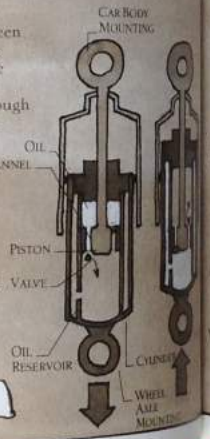
CAR SUSPENSION

The suspension of a car allows it to drive smoothly over a bumpy road. The wheels may jolt up and down, but springs between the wheel axles and the body of the car flex and take up the force of the jolts. This ensures that the force of the bumping is not transferred to the car. Springs alone produce a bouncing motion, so the suspension also contains dampers commonly known as shock absorbers. These slow the movement of the springs to prevent the car and its occupants bouncing up and down.

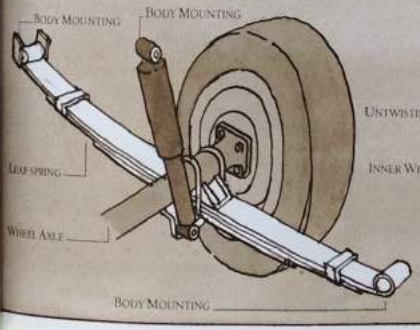


SHOCK ABSORBER
A shock absorber is fixed between the wheel axle and car body. Its piston moves up or down as the suspension spring flexes. As it does so, the oil is squeezed through channels in the piston, slowing the piston's movement.

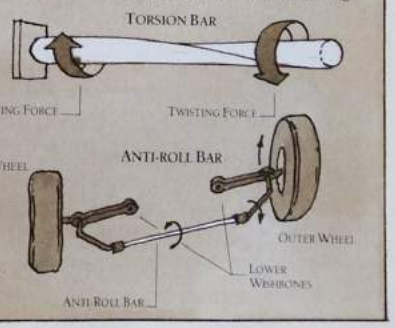
COIL SPRING
Smaller vehicles have a coil spring and shock absorber attached to each wheel. The axle of the wheel is attached to hinged struts so that it can move up and down. The spring and shock absorber are fixed between the car body and the struts, or "wishbones."



LEAF SPRING
Larger vehicles have heavy-duty leaf springs and shock absorbers to cushion the ride. The leaf spring is a stack of steel strips slightly curved so that the spring straightens when the vehicle is loaded. The axle is attached at or near the center of the leaf spring, and the ends of the spring are fixed to the body. The shock absorber is fixed between the axle and body.



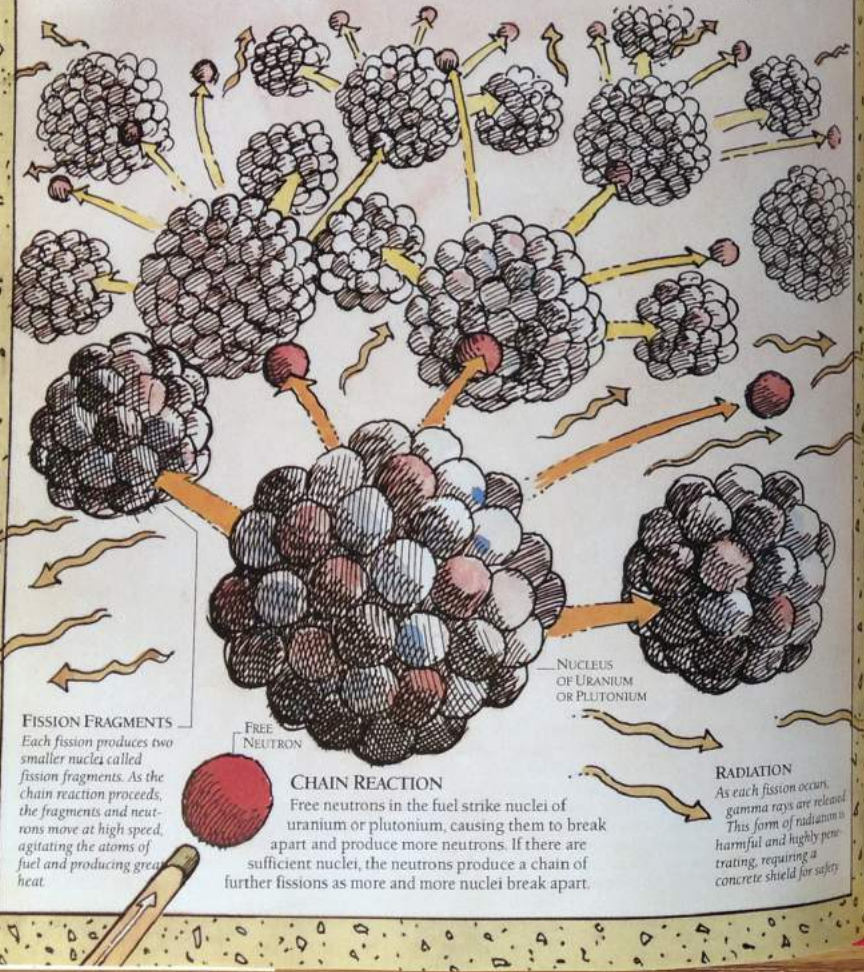
TORSION BAR
A torsion bar is a steel rod that acts like a spring to take up a twisting force. If the bar is forced to twist in one direction, it resists the movement and then twists back when the force is removed. Many cars contain an anti-roll bar fixed between the front axles. This rotates as the wheels go up and down. If the car begins to roll over on a tight corner, the anti-roll bar prevents the roll from increasing.



NUCLEAR FISSION

Nuclear power gets its name because the process of power production takes place inside the nucleus. Each atom of fuel contains a central particle called the nucleus, which is itself made up of even smaller particles called protons and neutrons.

The kind of nuclear reaction that happens inside a nuclear reactor is called nuclear fission. The fuel is uranium or plutonium, two very heavy elements which have many protons and neutrons in their nuclei. Fission starts when a fast-moving neutron strikes a nucleus. The nucleus cannot take in the extra neutron, and the whole nucleus breaks apart into two smaller nuclei. Several neutrons are also released and these go on to break more nuclei, which produce more neutrons and so on. Because the first neutron sets off a chain of fissions, the nuclear reaction is called a chain reaction. Without control, it can multiply rapidly and produce enormous heat in a fraction of a second.



FISSION FRAGMENTS
Each fission produces two smaller nuclei called fission fragments. As the chain reaction proceeds, the fragments and neutrons move at high speed, agitating the atoms of fuel and producing great heat.

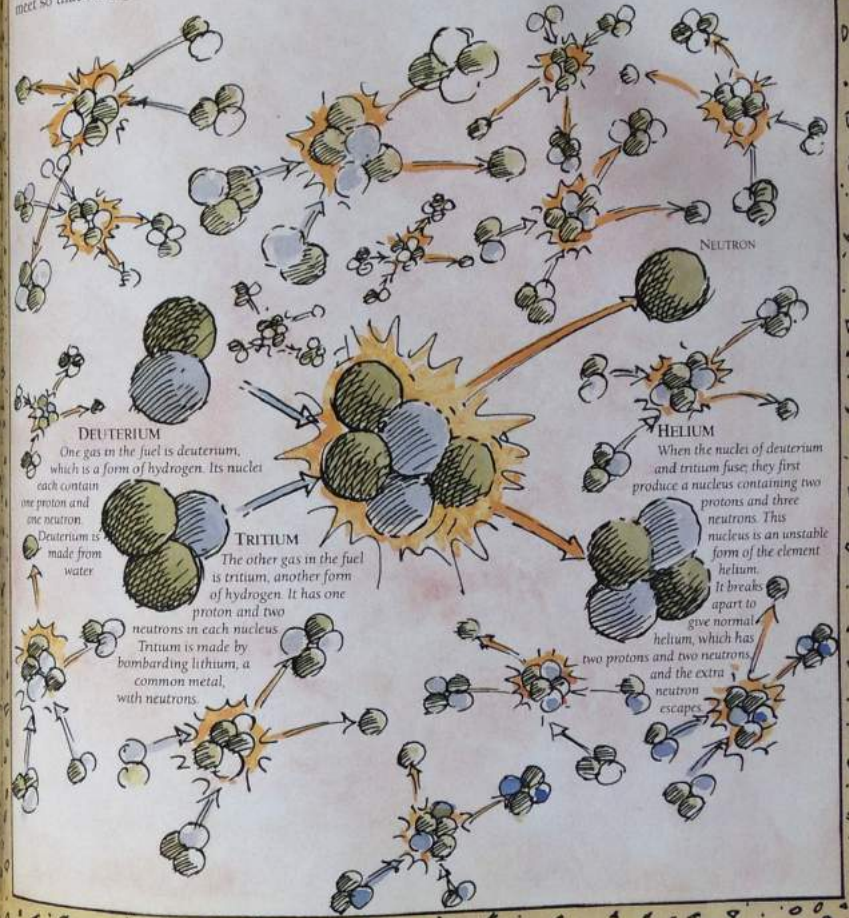
CHAIN REACTION
Free neutrons in the fuel strike nuclei of uranium or plutonium, causing them to break apart and produce more neutrons. If there are sufficient nuclei, the neutrons produce a chain of further fissions as more and more nuclei break apart.

RADIATION
As each fission occurs, gamma rays are released. This form of radiation is harmful and highly penetrating, requiring a concrete shield for safety.

NUCLEAR FUSION

Nuclear power can be produced by a process called fusion as well as by fission. In this kind of reaction, the nuclei of the fuel come together and do not break apart. Unlike fission, nuclear fusion occurs only with small atoms whose nuclei contain very few protons and neutrons. The gaseous fuel consists of two different forms of hydrogen, which is the lightest of the elements. To produce nuclear fusion, pairs of nuclei meet so that their protons and neutrons fuse together and become a single nucleus. A spare neutron is left over. The fused nuclei and neutrons move off at high speed, producing great heat. Radiation is not emitted, but the neutrons are harmful.

To get the nuclei to meet and fuse, the atoms must be banged together with tremendous force. This can only be done by heating the fuel to temperatures of millions of degrees. Nuclear fusion powers the Sun, and it also occurs in thermonuclear weapons.



DEUTERIUM
One gas in the fuel is deuterium, which is a form of hydrogen. Its nuclei each contain one proton and one neutron. Deuterium is made from water.

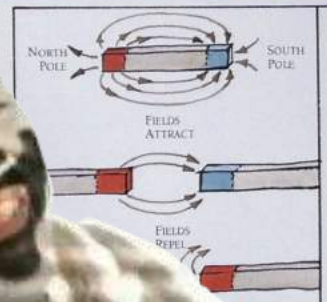
TRITIUM
The other gas in the fuel is tritium, another form of hydrogen. It has one proton and two neutrons in each nucleus. Tritium is made by bombarding lithium, a common metal, with neutrons.

HELIUM
When the nuclei of deuterium and tritium fuse, they first produce a nucleus containing two protons and three neutrons. This nucleus is an unstable form of the element helium. It breaks apart to give normal helium, which has two protons and two neutrons, and the extra neutron escapes.

MAGNETISM

ON SHOEING A MAMMOTH

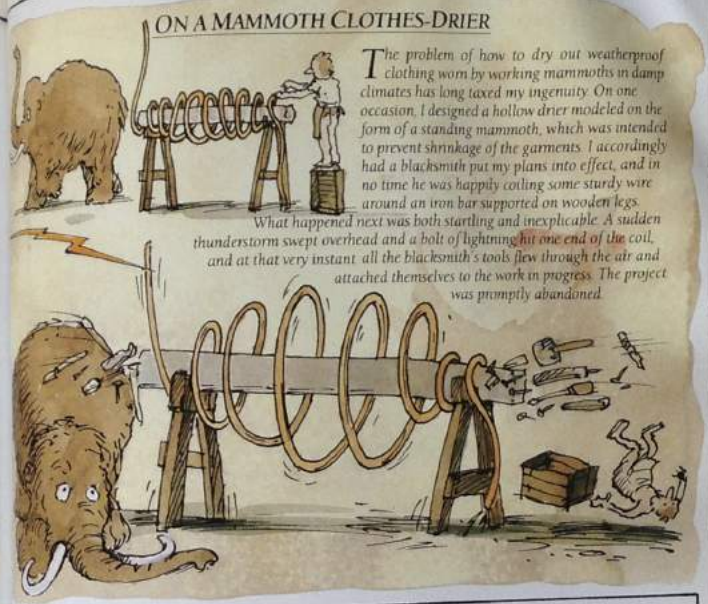
Working mammoths wear out their shoes with great rapidity, so it was with extreme interest that I watched a blacksmith fitting new improved shoes to a volunteer beast. The test had mixed results. Shoe wear was reduced to zero, but only because a strange and powerful attraction between opposite shoes prevented all movement on the part of the wearer



ON A MAMMOTH CLOTHES-DRIER

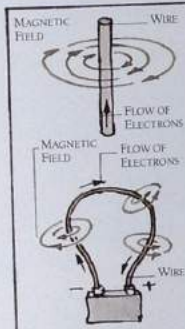
The problem of how to dry out weatherproof clothing worn by working mammoths in damp climates has long taxed my ingenuity. On one occasion, I designed a hollow drier modeled on the form of a standing mammoth, which was intended to prevent shrinkage of the garments. I accordingly had a blacksmith put my plans into effect, and in no time he was happily coiling some sturdy wire around an iron bar supported on wooden legs.

What happened next was both startling and inexplicable. A sudden thunderstorm swept overhead and a bolt of lightning hit one end of the coil, and at that very instant all the blacksmith's tools flew through the air and attached themselves to the work in progress. The project was promptly abandoned.



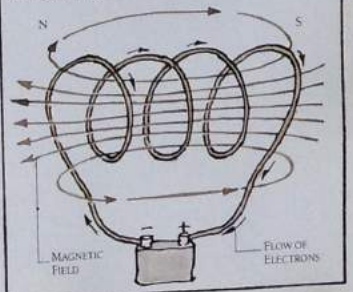
ELECTRICAL MAGNETS

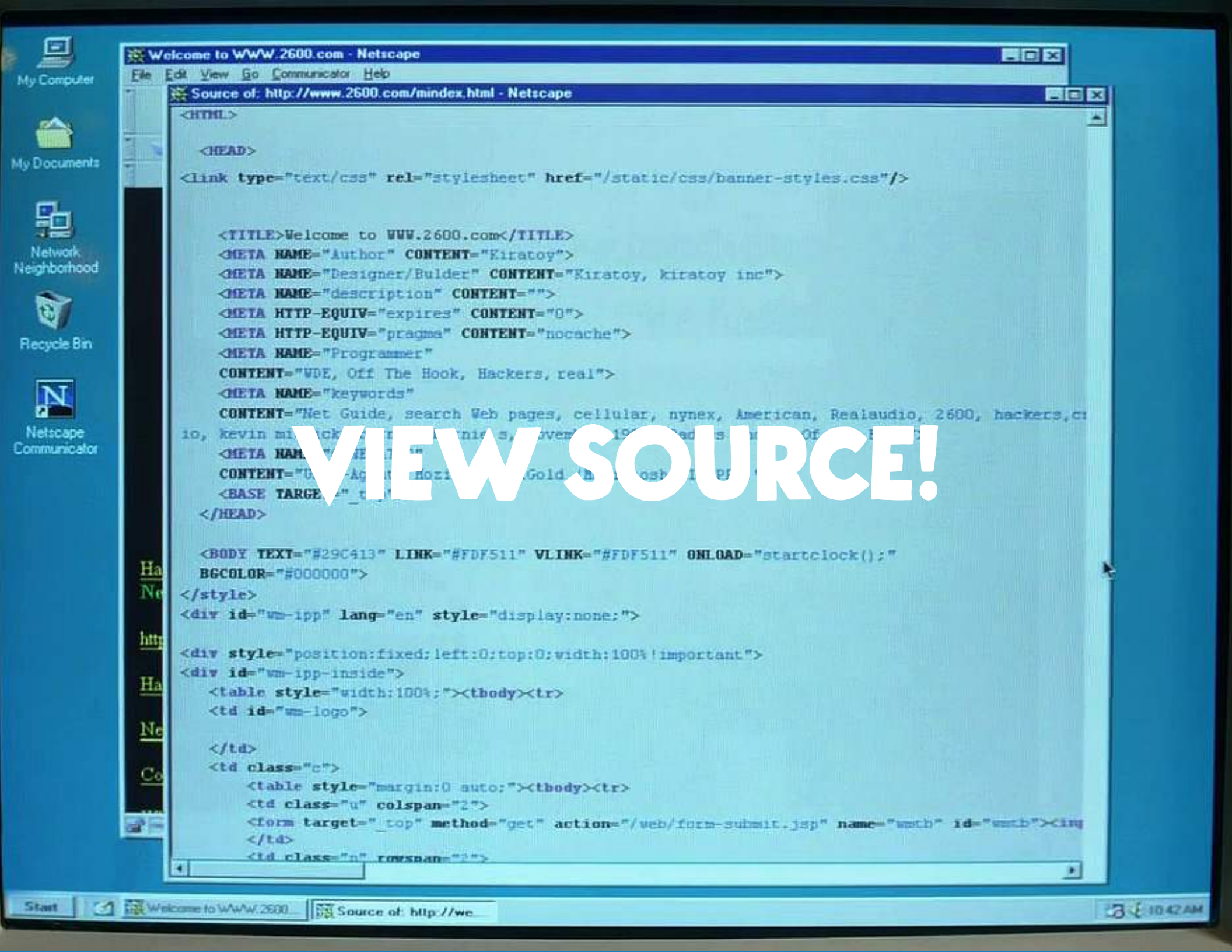
When an electric current flows through a wire, a magnetic field is produced around it. The field produced by a single wire is not very strong, so to increase it, the wire is wound into a coil. This concentrates the magnetic field, especially if an iron bar is placed in the center of the field. Electromagnets can be very powerful – as the blacksmith finds out. A sudden burst of current momentarily transforms his clothes-drier into a powerful electromagnet which attracts all nearby iron objects to its poles.



SINGLE WIRE
The lines of force form circles around the wire.

COIL OF WIRE
The lines of force of all the loops in a coil combine to produce a field that is similar to the field around a bar magnet. The poles of the electromagnet are at either end of the coil.

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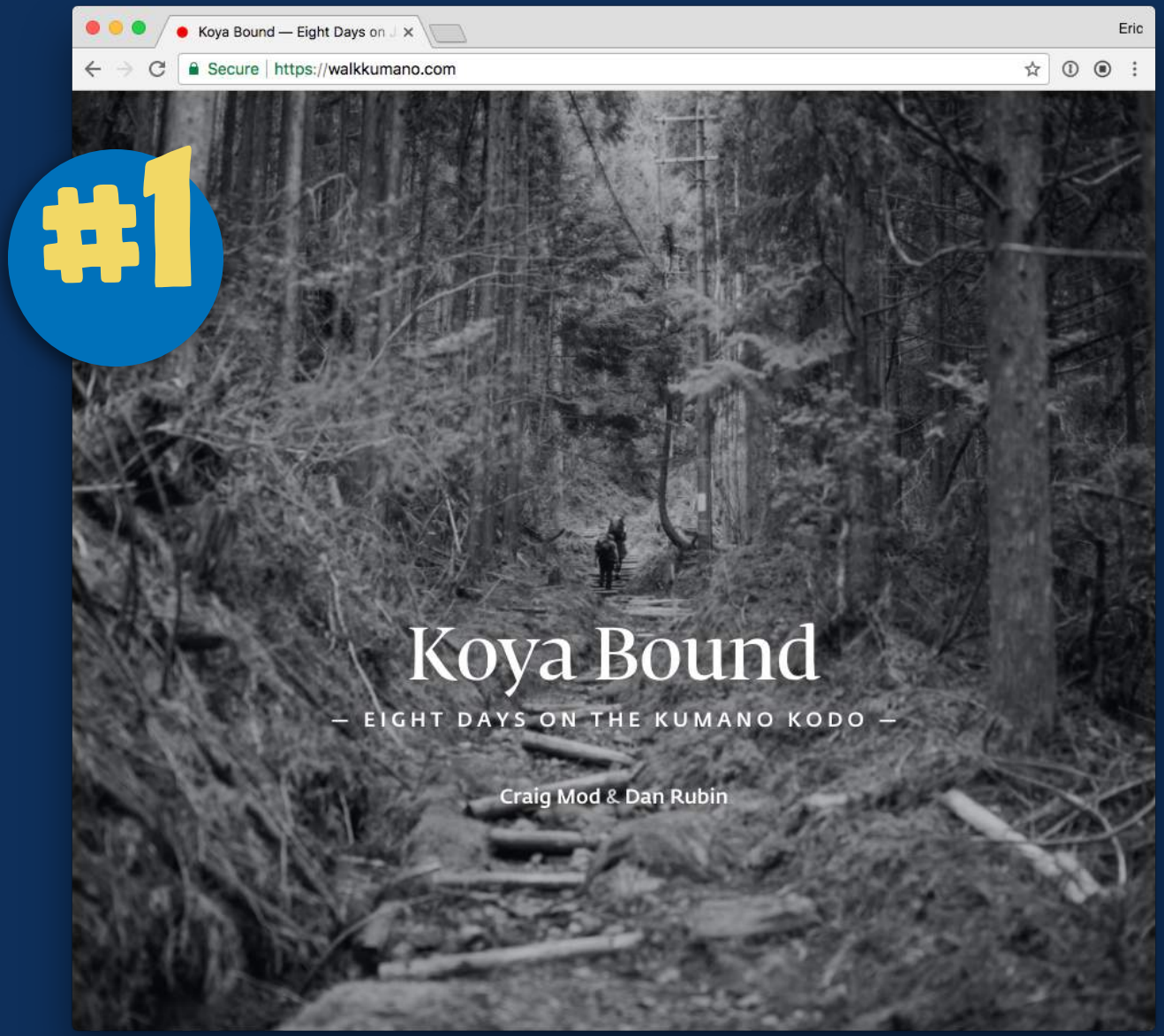

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Framing questions

1. what is this?
2. what's the primary content?
3. who made it?
4. who is it for?
5. what job is it doing?

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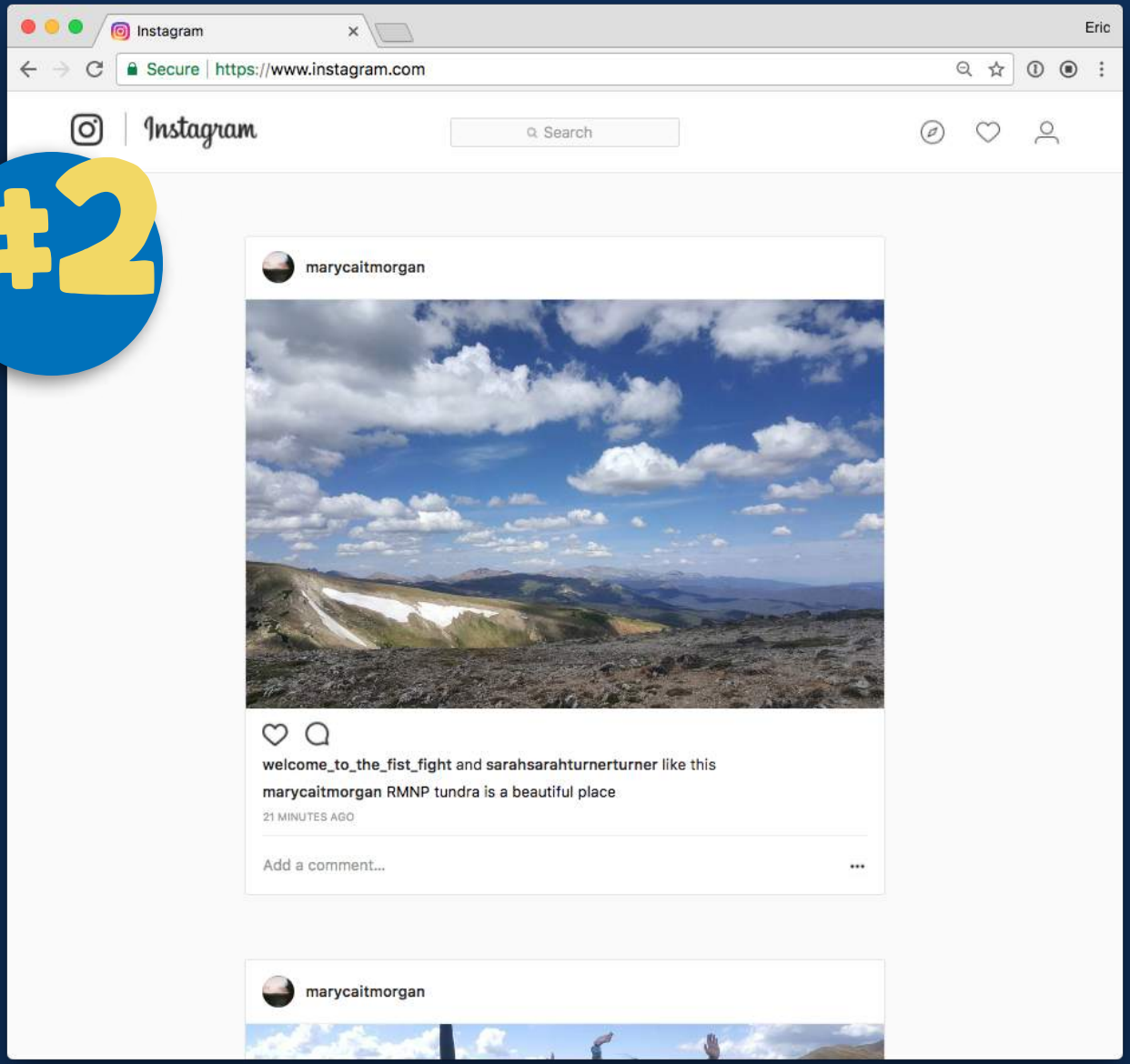

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DYNAMIC, USER-GENERATED content.
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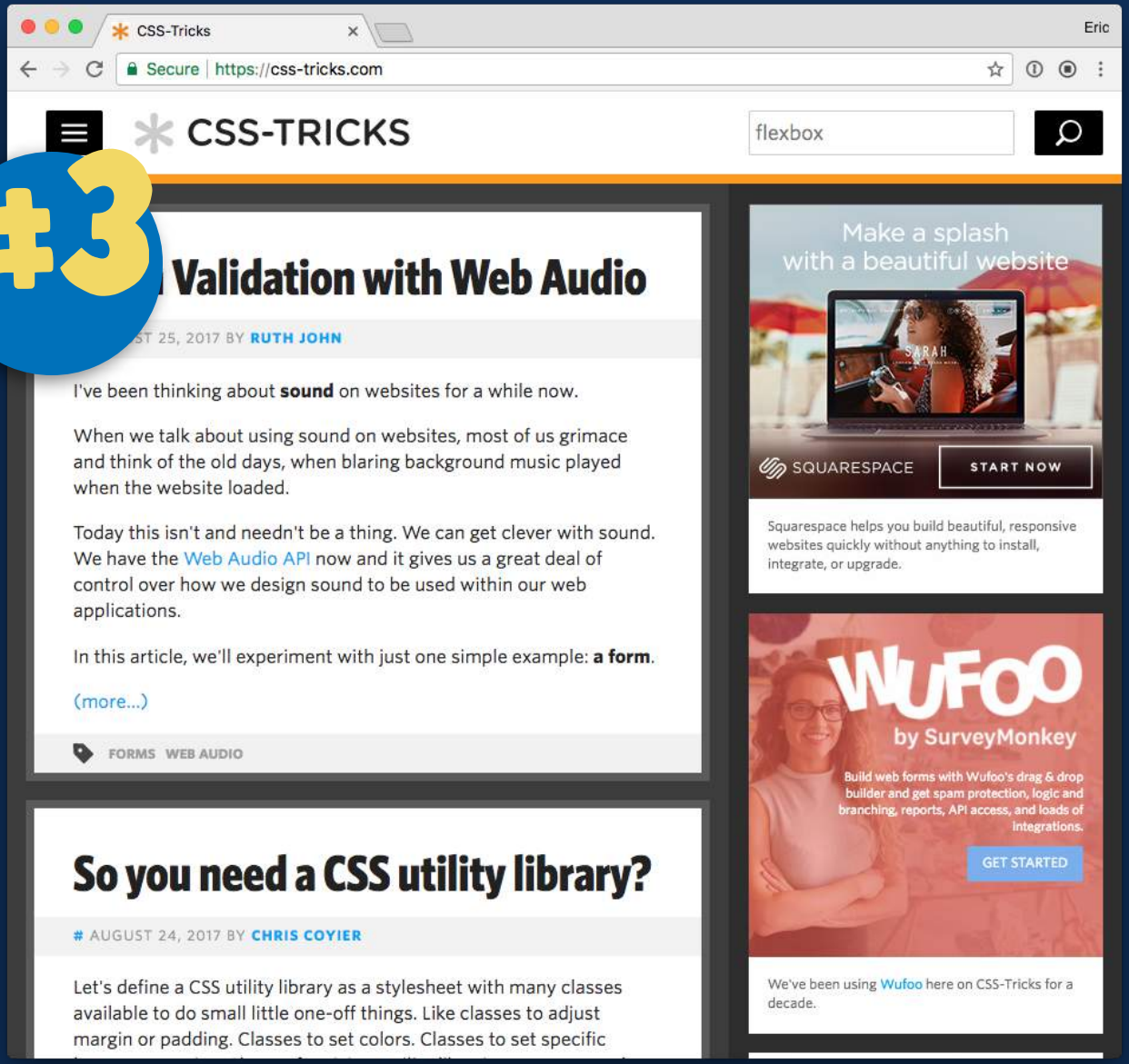

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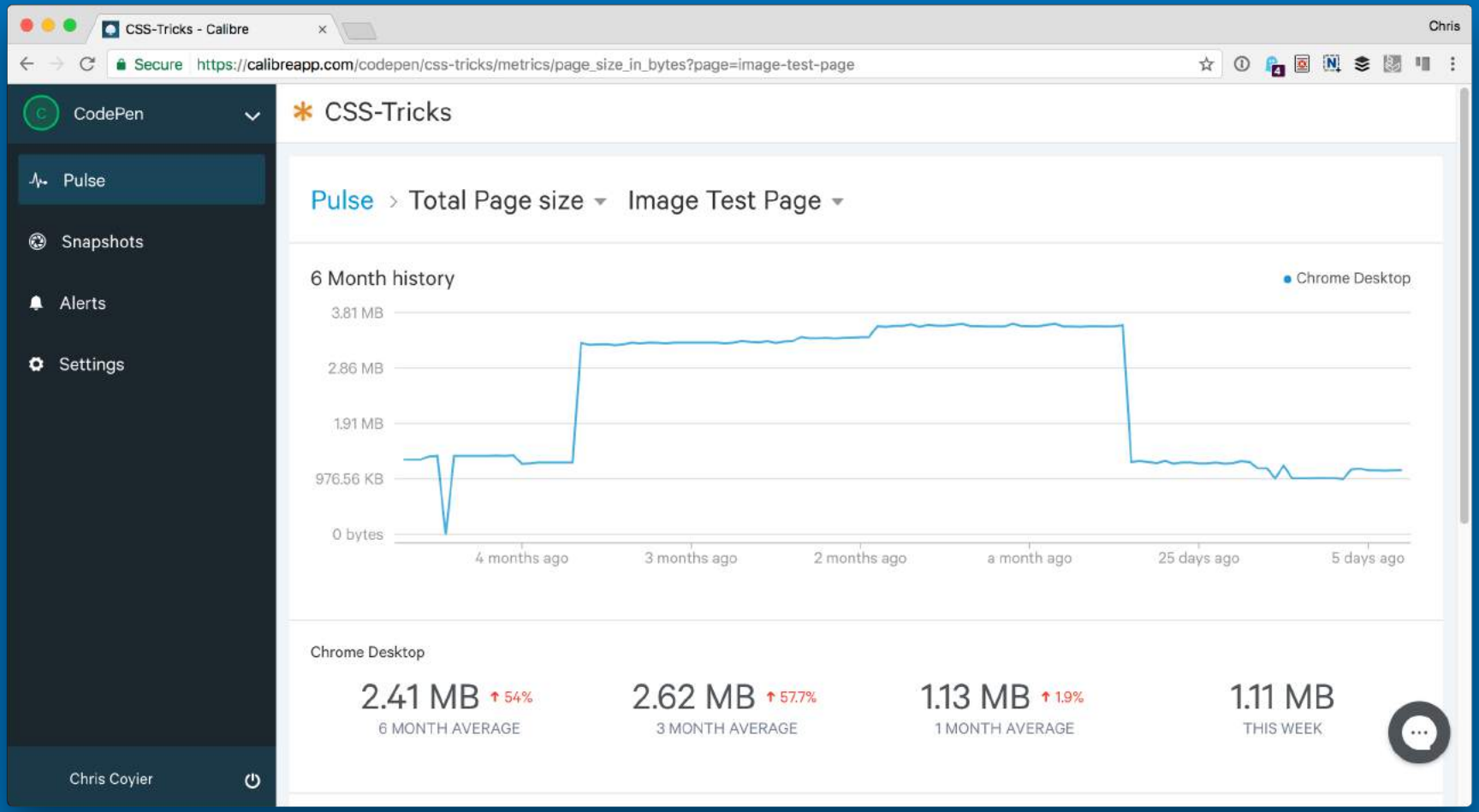
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Chris Coyier

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