

The Great Company Adventures • Book 48 of 50

ASML
**THE
MACHINE THAT PRINTS WITH
LIGHT**

seven doors, ten mental models, and the machine of light that draws every chip on Earth.

"Discovering the businesses that built the modern world"

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THE GREAT COMPANY ADVENTURES

Discovering the businesses that built the modern world.

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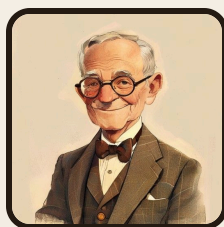
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MEET THE CHARACTERS



SIRI



BEN



WARREN



CHARLIE



FEMKE

A curious girl named Siri, a wise old teacher named Ben, and his student Warren with Warren's partner Charlie — together discovering the businesses that built the modern world, one adventure at a time.

THE GLOBAL 50

One great company per volume · Fifty adventures, one modern world

SPACE & EXPLORATION

1. SpaceX — *“The Fire That Comes Back”*

MANUFACTURING & ENGINEERING

2. Toyota — *“The River That Builds Cars”*
3. Siemens — *“The Factory That Builds Factories”*
4. Caterpillar — *“The Machines That Move Mountains”*
5. Boeing — *“The Bird With Six Million Pieces”*
6. Airbus — *“The Plane Four Countries Built”*

ENERGY & INDUSTRY

7. Shell — *“The Sunlight Buried at Sea”*
8. ExxonMobil — *“The Ancient Sunlight Machine”*
9. GE Vernova — *“The Wheel That Makes Lightning”*

COMMUNICATION

10. AT&T — *“The Voice Inside the Wire”*
11. Qualcomm — *“The Whisper in the Air”*
12. Ericsson — *“The Towers That Talk”*

TRANSPORTATION

13. Tesla — *“The Car With No Engine”*
14. John Deere — *“The Machine That Feeds the World”*
15. UPS — *“The Promise in a Brown Truck”*

INFRASTRUCTURE

16. ABB — *“The Arms That Never Tire”*
17. Schneider Electric — *“The Guardian of the Grid”*

MATERIALS

18. Corning — *“The Thread of Light”*
19. DuPont — *“The Inventors of Almost Everything”*

SCIENCE & TOOLS

20. 3M — *“The Factory of Ten Thousand Ideas”*
21. Bosch — *“The Spark in Every Machine”*
22. Honeywell — *“The Dial That Tames the Weather”*

MEDICINE & BIOTECHNOLOGY

23. Pfizer — *“The Shield in a Tiny Vial”*
24. Roche — *“The Detectives of the Blood”*

25. Novo Nordisk — *“The Key to a Billion Locks”*

26. Johnson & Johnson — *“The Little Bandage That Grew”*

FOOD & AGRICULTURE

27. Nestlé — *“The Cup That Wakes the World”*
28. Cargill — *“The Invisible Harvest”*

FINANCE & COMMERCE

29. Visa — *“The Handshake Inside the Card”*
30. Mastercard — *“The Two-Second Trust Machine”*
31. Walmart — *“The Store That Never Runs Out”*
32. Costco — *“The Treasure Warehouse”*
33. FedEx — *“The Race Against the Sun”*

CONSUMER INNOVATION

34. Disney — *“The Factory of Dreams”*
35. LEGO — *“The Brick That Builds Anything”*
36. Sony — *“The Pocket Full of Music”*
37. Coca-Cola — *“The Secret in the Red Can”*
38. Nike — *“The Shoe That Learned to Fly”*

LUXURY & CRAFTSMANSHIP

39. Rolex — *“The Heartbeat on Your Wrist”*
40. LVMH — *“The Suitcase That Conquered the World”*

COMPUTING & DIGITAL CIVILIZATION

41. Apple — *“The Glass That Thinks”*
42. Microsoft — *“The Invisible Machine”*
43. Google — *“The Library With No Walls”*
44. Amazon — *“The Box That Crossed the World”*
45. NVIDIA — *“The Brain Made of Sand”*
46. Intel — *“The First Thinking Chip”*
47. TSMC — *“The Invisible City”*
48. ASML — *“The Machine That Prints With Light”*
49. OpenAI — *“The Machine That Learned to Talk”*

THE FINAL DISCOVERY

50. The Company Yet to Be Built — *“The Adventure You Will Build”*

THE LAMP IN THE ATTIC

Midnight. Homework: not happening. Because Grandpa Ben's brass compass just started... trembling.

TIK-TIK

It spun. Locked. And pointed straight UP — at the attic hatch.

SPIN

Of course it's the creepy attic.

Up the ladder, torch in her teeth. Dust. Boxes. And one covered shape on a table.

It's never done THIS before.

Please don't be spiders. Please.

Under the sheet: Grandpa's old photo lamp. One round glass eye, pointed down at a blank sheet.

She switched it on and slid a paper cut-out under the beam. A crisp shadow printed itself below.

Wait. Light can DRAW things.

The diary flipped open by itself. Fresh ink.

A LAMP? All that spinning for a LAMP?

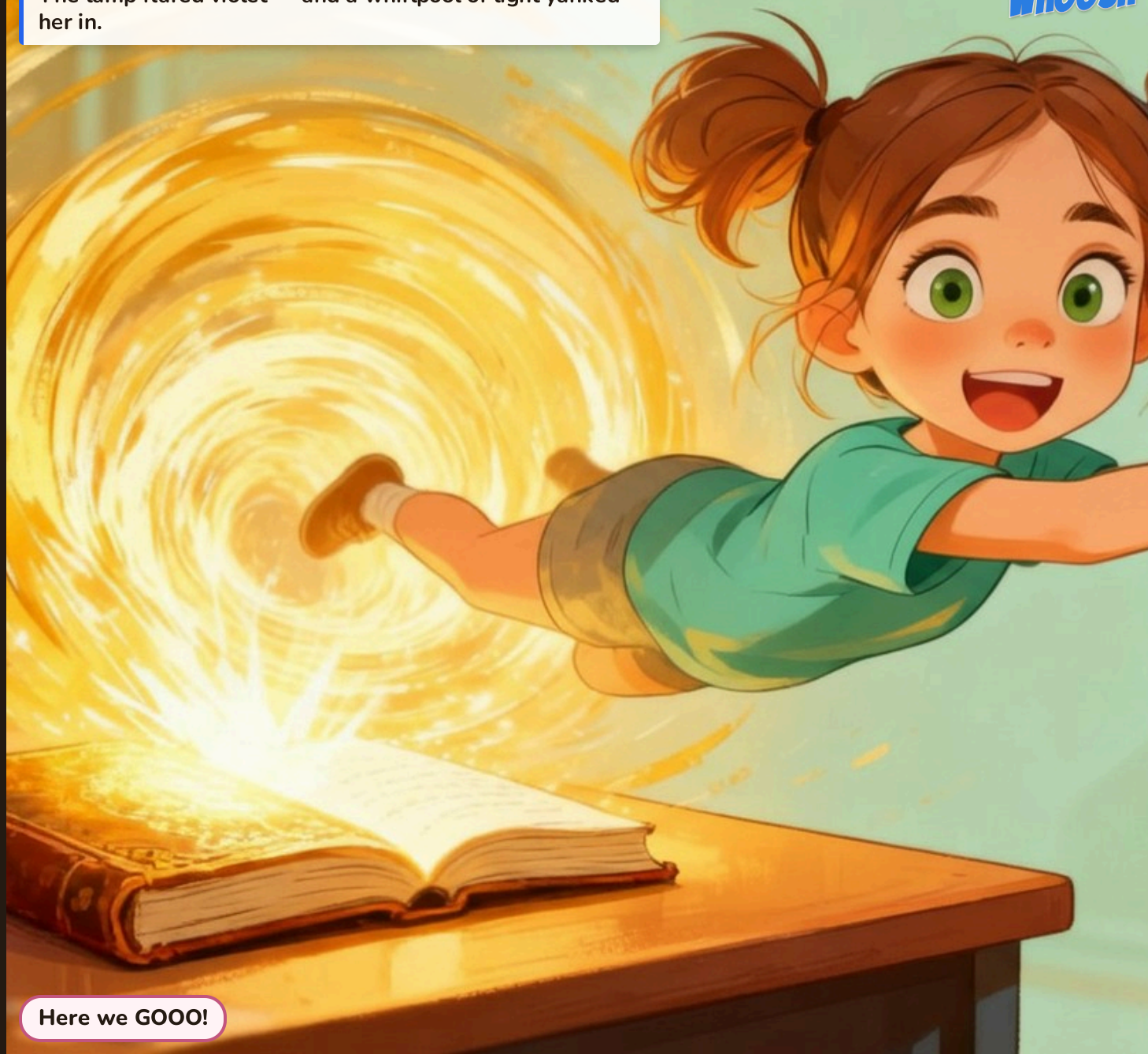
“Every chip on Earth is drawn by light, little one. One company builds the lamp that draws them. Go and find the machine of light.”

★ WORTH REMEMBERING

Chip streets are thinner than a virus — far too small for any blade or drill. So nobody carves them. They are **printed**: patterns of light, shone onto a coated wafer, again and again and again.

The lamp flared violet — and a whirlpool of light yanked her in.

WHOOSH



Here we GOOO!

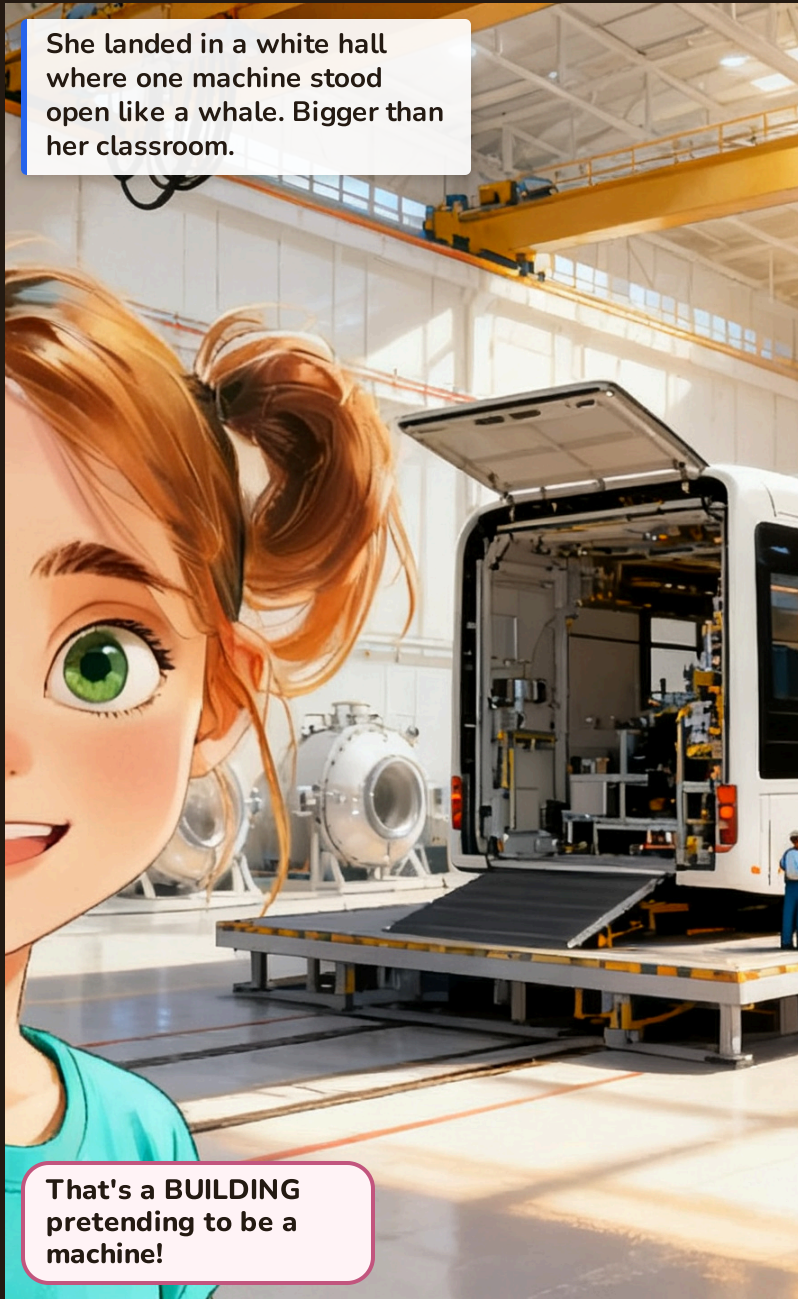


SIRI'S SECRET NOTEBOOK

Biggest mystery yet 💡

- ① How does LIGHT draw streets thinner than a virus?
- ② Grandpa says ONE company builds the lamp for the whole world. Prove it, compass.

THE MACHINE BEHIND THE MACHINES



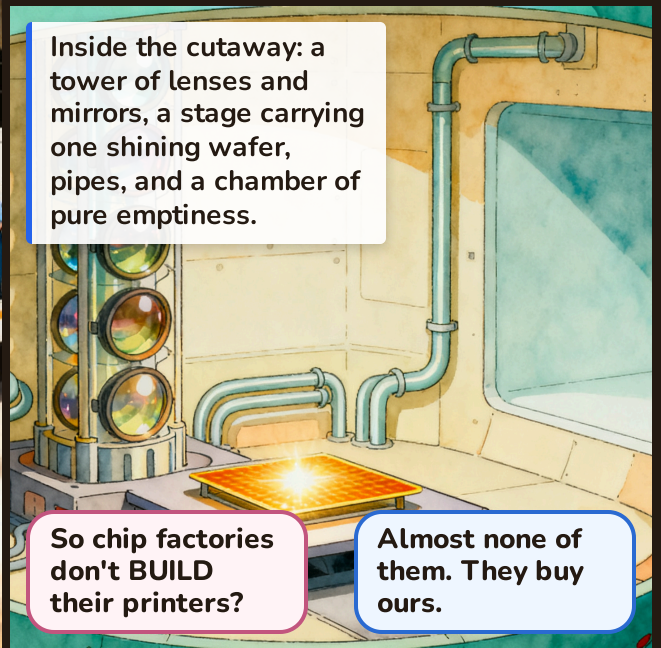
She landed in a white hall where one machine stood open like a whale. Bigger than her classroom.

That's a **BUILDING** pretending to be a machine!



An engineer waved from the platform. *"I'm Femke. We build the printers that print chips."*

Best. Job. EVER.



Inside the cutaway: a tower of lenses and mirrors, a stage carrying one shining wafer, pipes, and a chamber of pure emptiness.

So chip factories don't **BUILD** their printers?

Almost none of them. They buy ours.

★ WORTH REMEMBERING

Every chip factory starts as a shopping list, and the priciest line is the printing machine — a **lithography scanner**, heavy as two buses, delivered in dozens of crates.

Femke unrolled a parchment map. Seven glowing doors.
"Seven secrets. Open them all and you'll understand this machine."





SIRI'S SECRET NOTEBOOK · THE QUEST MAP

- 1 THE INK — light that draws?
- 2 THE SHRINK — draw big, print small
- 3 THE BLUR — why lines smear
- 4 THE WATER — a puddle that sharpens
- 5 THE STAR — making impossible light
- 6 THE MIRRORS — no glass allowed
- 7 THE STILLNESS — standing still to the
atom. Let's GO 🌍

INK MADE OF LIGHT

3a Door One: syrup that remembers

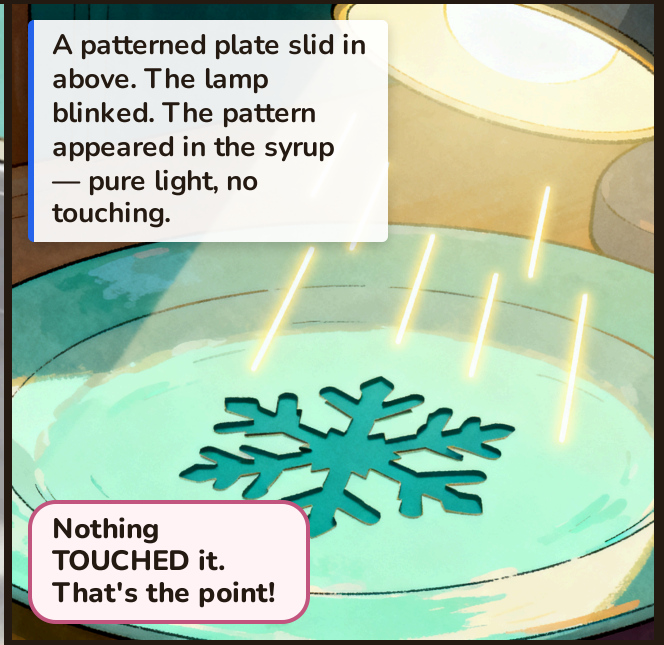
A wafer spun. One drop of glossy syrup spread into a coat thinner than a soap bubble.



“Photoresist. It changes wherever light touches it.”

Paint that REMEMBERS being lit!

A patterned plate slid in above. The lamp blinked. The pattern appeared in the syrup — pure light, no touching.



Nothing TOUCHED it. That's the point!

Then: rinse away the changed part. Bite the bare stripes with chemicals. Wipe clean. One layer done.



One layer. Out of about a hundred.

Now you know why a chip takes months.

★ WORTH REMEMBERING

Print, wash, etch, strip — that loop is the beating heart of chipmaking. Every loop lays one more storey on a city that will never be seen by any eye. 🧪

In the old days the plate was pressed right onto the wafer. One dust speck ruined both.



Squashing your homework onto wet paint!

★ WORTH REMEMBERING

Pressing the mask against the wafer scratched the mask and copied every speck. Lifting the pattern away and **projecting** it instead saved the mask — and made everything after it possible.



SIRI'S SECRET NOTEBOOK · DOOR 1 UNLOCKED

Light-memory syrup → shine a pattern → rinse → etch → repeat ~100x. Old way = press the plate on (dust ruins it). New way = project it from above. Don't touch what you love. 🖋️

DRAW BIG, PRINT SMALL

"Door two," said Femke. "We draw each layer's map BIG — then shrink it four times through the lenses."



Big mistakes shrink into tiny ones!

★ WORTH REMEMBERING

Four-times reduction is a quiet superpower: a flaw on the big plate becomes four times smaller on the wafer. It is far easier to make a big plate nearly perfect than a small one exactly perfect. 🔍

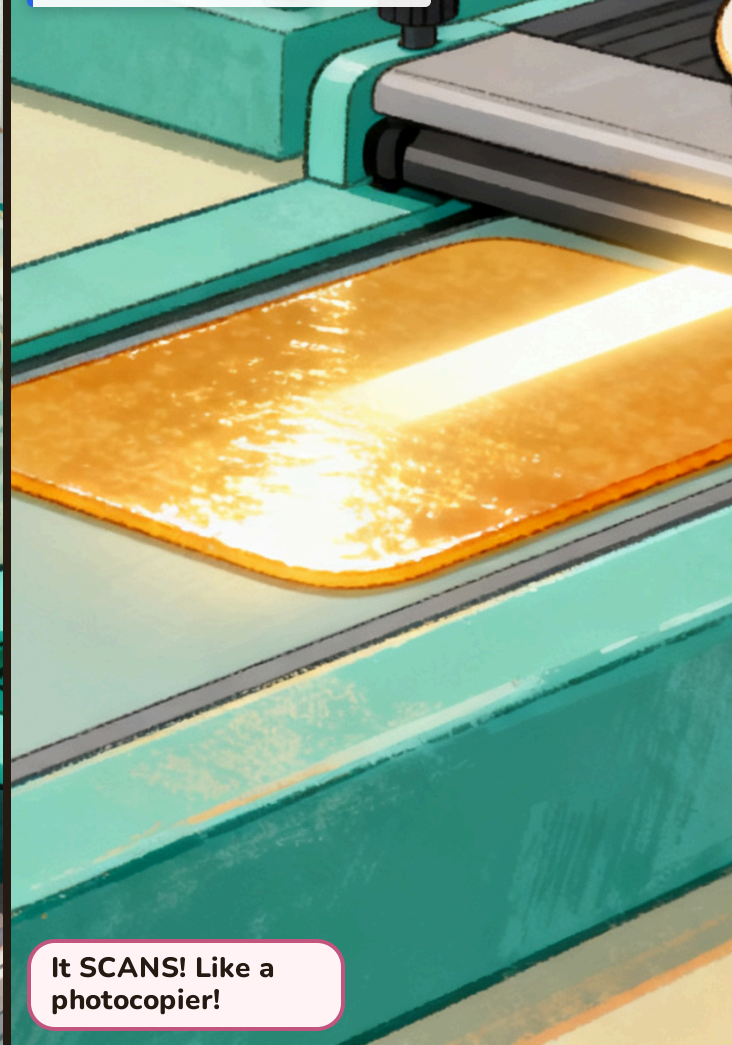
The plate itself travelled in a sealed case, carried like a crown jewel. Weeks of work in a single sheet of glass.



It gets its own BODYGUARD?

One scratch and every chip inherits it.

Then the surprise: the light didn't flash the whole plate at once. A narrow slit stayed still while the stage slid the wafer through.



It SCANS! Like a photocopier!

★ WORTH REMEMBERING

A narrow slit uses only the sweetest, sharpest part of the lens. Sliding plate and wafer in opposite directions, in perfect step, prints a big field with a small perfect window. 📐

📖 SIRI'S SECRET NOTEBOOK · DOOR 2 UNLOCKED

Draw big → shrink 4×. The glass plate is treated like treasure. And the light doesn't flash — it SCANS, using only the best sliver of the lens. Cheating with geometry again!



THE BLUR

5a Door Three: the wall everyone hits

Femke squeezed the plate's lines closer. Closer. Closer. Then two crisp stripes smeared into one grey smudge.

At a pond she dropped pebbles. Long slow ripples bumped the reeds. Tiny quick ripples slipped straight through.

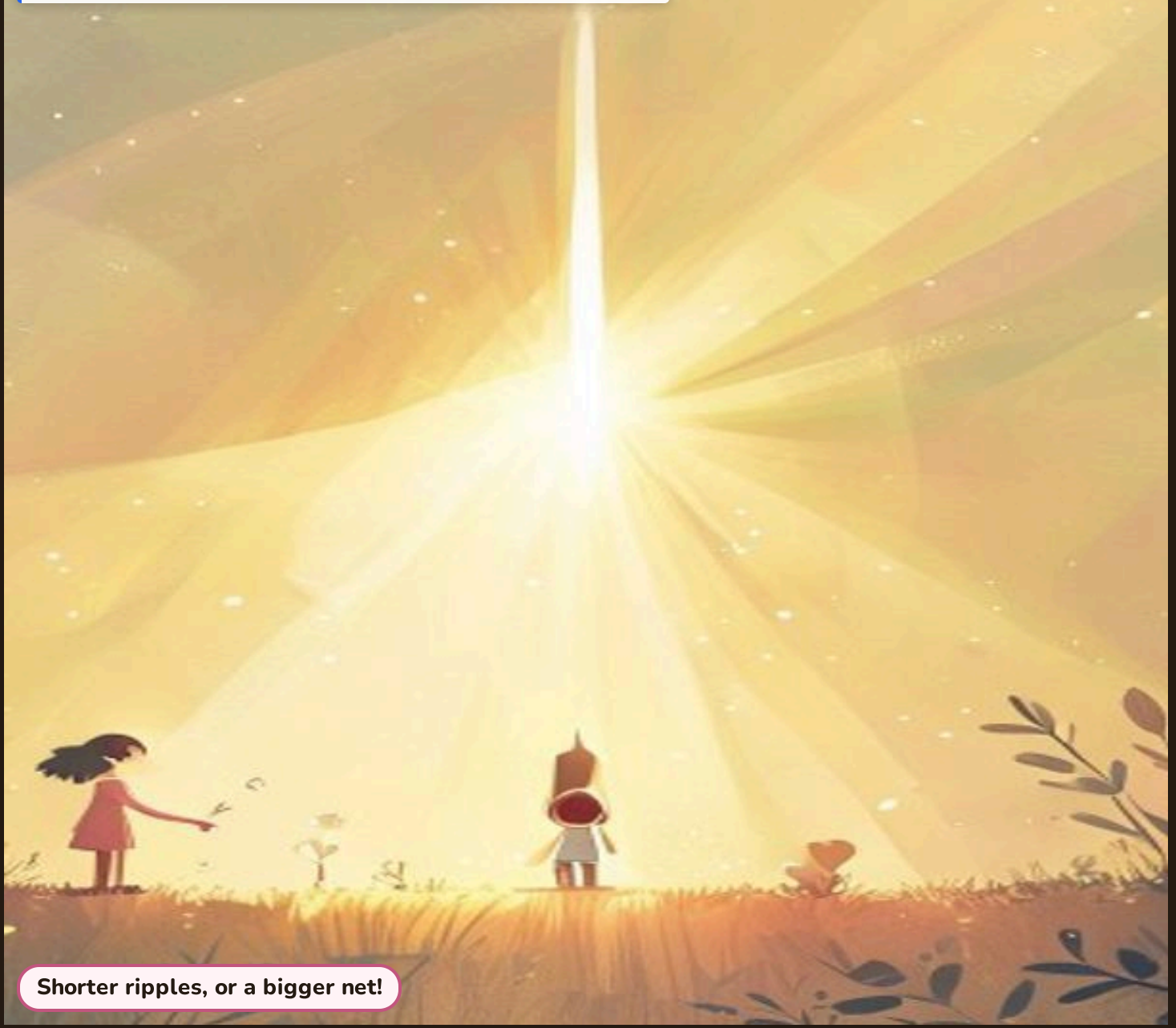
NO! It went
BLURRY. Why?!

Light is a WAVE.
Big waves can't fit!

★ WORTH REMEMBERING

Light spreads and bends as waves, so no lens can draw a line much finer than its wavelength allows. This is not bad engineering. It is a rule of the universe. 🌊

"Two escapes," said Femke. "Shorter waves. Or a lens that gathers light from a WIDER angle."



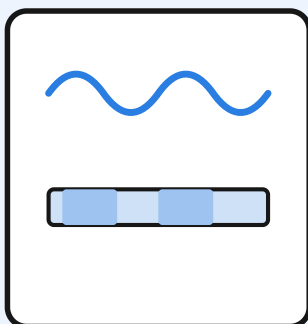
Shorter ripples, or a bigger net!

★ WORTH REMEMBERING

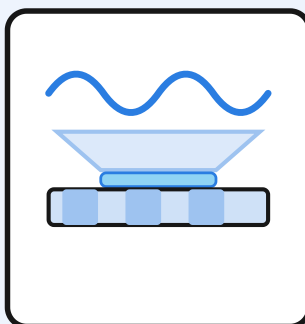
Engineers call that gathering angle the **numerical aperture**. Wider angle, sharper dot. Every leap in chipmaking for forty years has been shorter light, wider angle, or cleverer tricks between them.



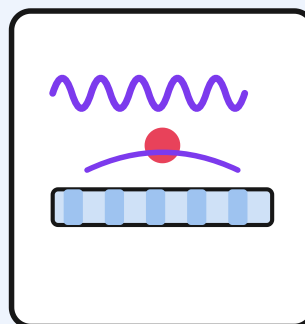
WHY THE LIGHT HAD TO CHANGE



LONG WAVES
lines stay wide



ADD WATER
wider angle, finer lines



EUV LIGHT
short waves, mirrors only



SIRI'S SECRET NOTEBOOK · DOOR 3 UNLOCKED

Blur isn't sloppiness — it's PHYSICS. Waves spread. Only two real escapes: shorter waves, or a wider light-catching angle. Everything else is a clever workaround. 🌊

THE PUDDLE THAT SHARPENS

At a kitchen table, Femke set a straw in a glass of water. It looked snapped in half.



Light **BENDS** in water. I knew that one!

“Door four. Fill the gap under the lens with pure water. Now the lens can use a wider fan of light.”



You print through a **PUDDLE?!**

A moving puddle. It follows the lens.

★ WORTH REMEMBERING

Immersion lithography: a thin film of ultrapure water between the last lens and the wafer widens the usable angle and sharpens every line — with no new colour of light at all. 💧

It nearly failed. Bubbles. Droplets left behind. Tiny stains. Years of fiddling with a puddle that had to move at speed.



One bubble ruins a whole chip?

★ WORTH REMEMBERING

Rivals chased an exotic new light instead. The water idea looked humble and unglamorous — and it won, because it kept every other part of the machine that already worked. Boring ideas that fit can beat brilliant ideas that don't. 🏆

📖 SIRI'S SECRET NOTEBOOK • DOOR 4 UNLOCKED

Water under the lens = sharper lines, same lamp. Nearly killed by BUBBLES. Lesson: the winning idea was the modest one that fitted everything else. 💧

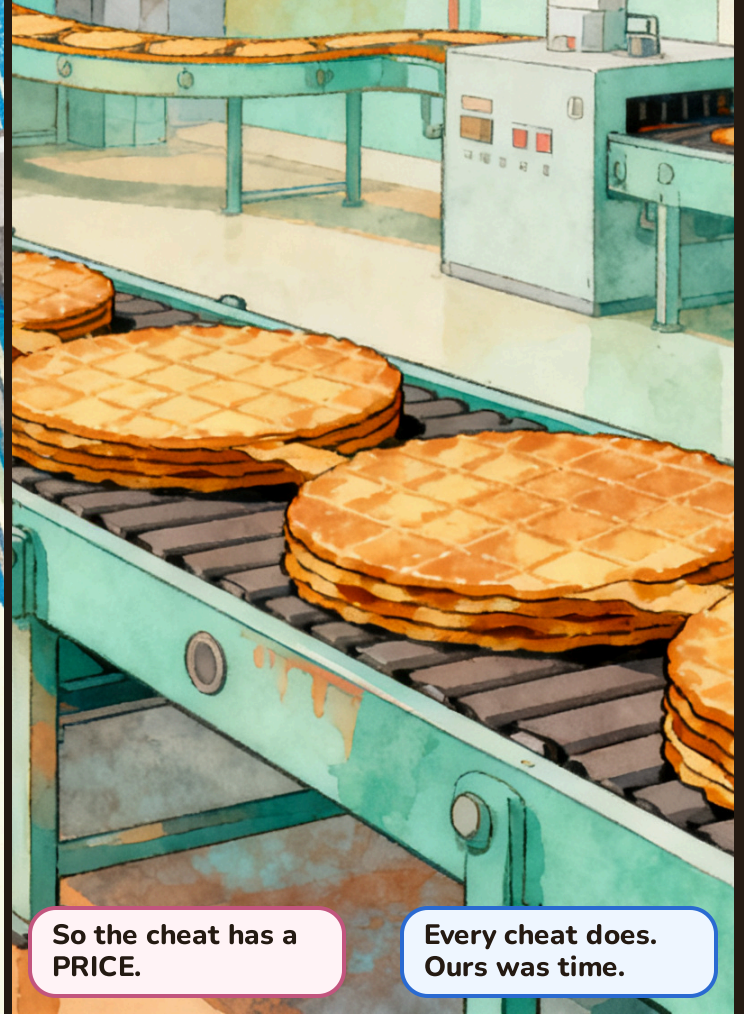
DOING IT TWICE (AND TWICE AGAIN)

"When even water ran out, we cheated: print half the lines, then print the other half in between."



Two prints, one layer! Sneaky!

But the wafer looped through the same machine again and again. Slower. Pricier. More chances to slip.



So the cheat has a PRICE.

Every cheat does. Ours was time.

★ WORTH REMEMBERING

Multiple patterning squeezed years of extra progress out of old light. It also meant more steps, more cost and tighter alignment — which is exactly why everyone wanted the impossible light to finally arrive. ⌚

Femke drew a ladder with rungs crowding together near the top. *"That's where we were. Still climbing. Barely."*



You need a whole new ladder.

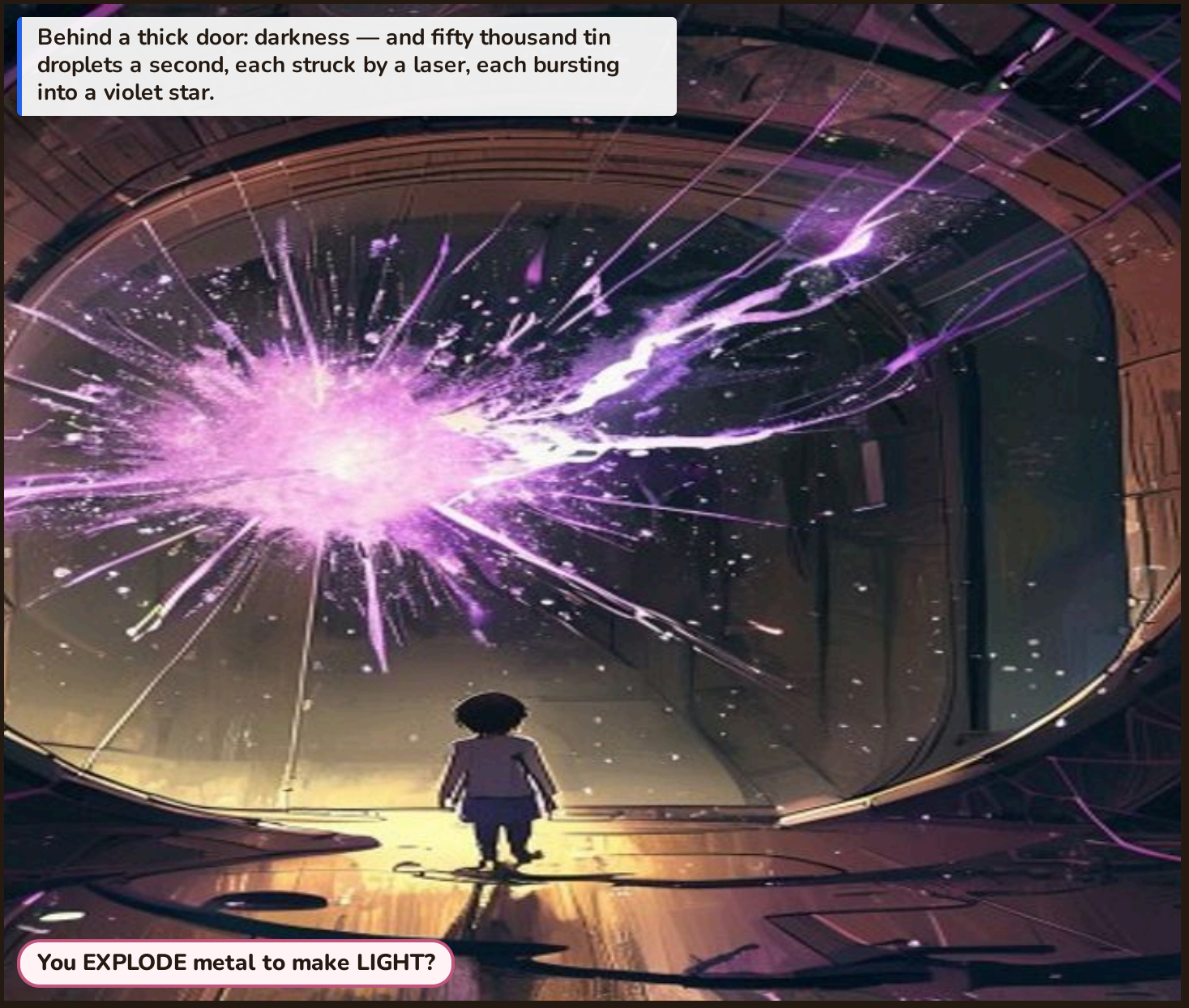
 SIRI'S SECRET NOTEBOOK

Trick: print half the stripes, then the rest in between. Buys progress, costs time and money. The rungs kept getting closer... so somebody had to build a NEW ladder. 🪜

A STAR IN A BOTTLE

8a Door Five: making impossible light

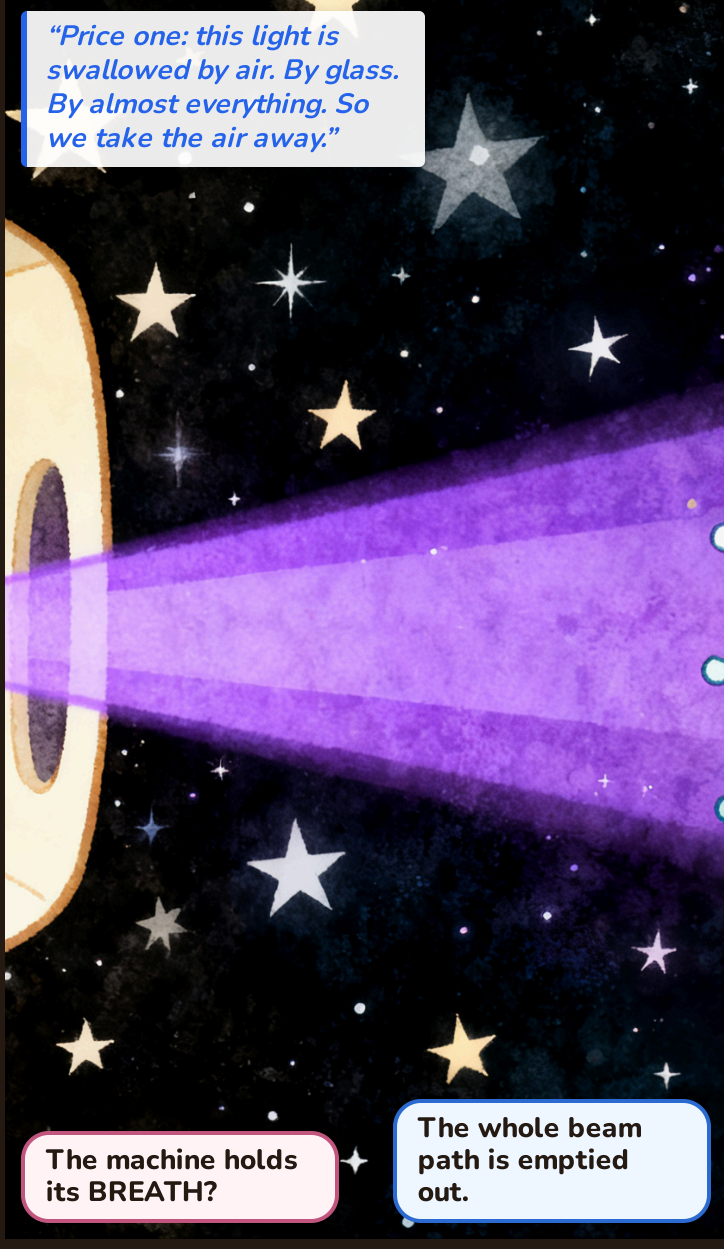
Behind a thick door: darkness — and fifty thousand tin droplets a second, each struck by a laser, each bursting into a violet star.



You EXPLODE metal to make LIGHT?

★ WORTH REMEMBERING

The plasma glows in extreme ultraviolet, a wave about **fourteen times shorter** than the light used before. Shorter waves, finer lines. Nature charged a brutal price for the upgrade.



*"Price one: this light is
swallowed by air. By glass.
By almost everything. So
we take the air away."*

The machine holds
its BREATH?

The whole beam
path is emptied
out.



*"Price two: it was far too
dim for years. Brighter,
brighter, brighter — a
decade of patient work."*

Nobody clapped for
that decade, did
they?

★ WORTH REMEMBERING

A dim lamp means slow printing, and slow printing means chips too costly to sell. Much of the twenty-year effort was not inventing the light at all — it was making it **bright and reliable enough to earn its keep.** ✨

📖 SIRI'S SECRET NOTEBOOK • DOOR 5 UNLOCKED

EUV = light 14× shorter, made by zapping tin droplets 50,000×/sec. Air eats it → vacuum. And the real battle was BRIGHTNESS, fought for a decade with no applause. ✨

MIRRORS INSTEAD OF LENSES

9a Door Six: when glass gives up

Femke opened a padded case. Inside, on black velvet: one curved mirror with a faint rainbow sheen.

Under magnification the mirror was dozens of paper-thin layers stacked like a wafer biscuit, each bouncing back a sliver of violet.

Glass swallows this light. So — no lenses. At all.

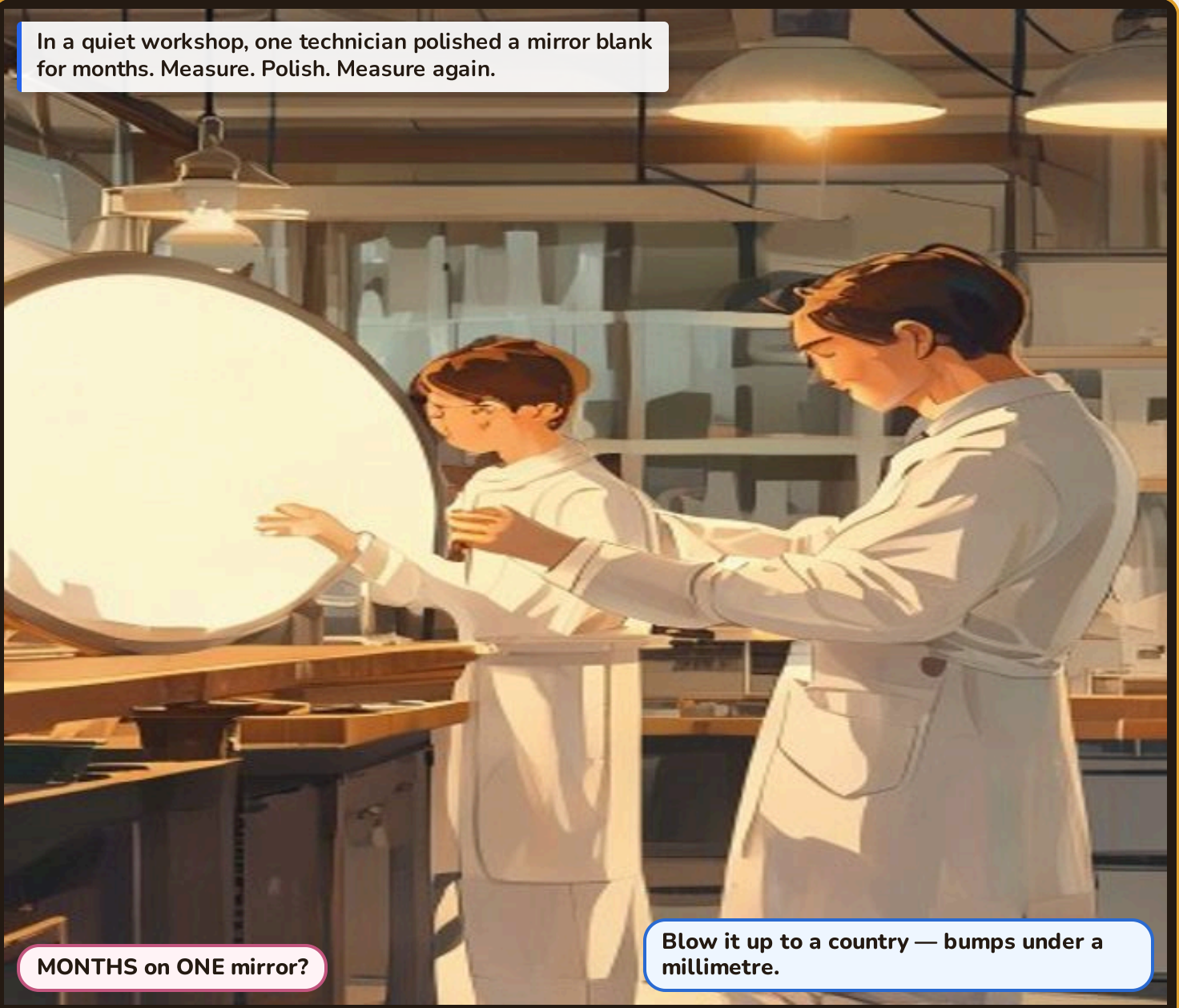
You built the whole machine out of MIRRORS?

One layer barely reflects. FIFTY layers do!

★ WORTH REMEMBERING

No single material reflects extreme ultraviolet well. So the mirror is built from stacked layer-pairs whose tiny reflections add together — a **multilayer mirror**, physics assembled by the sheet. 🍪

In a quiet workshop, one technician polished a mirror blank for months. Measure. Polish. Measure again.



MONTHS on ONE mirror?

Blow it up to a country — bumps under a millimetre.

★ **WORTH REMEMBERING**

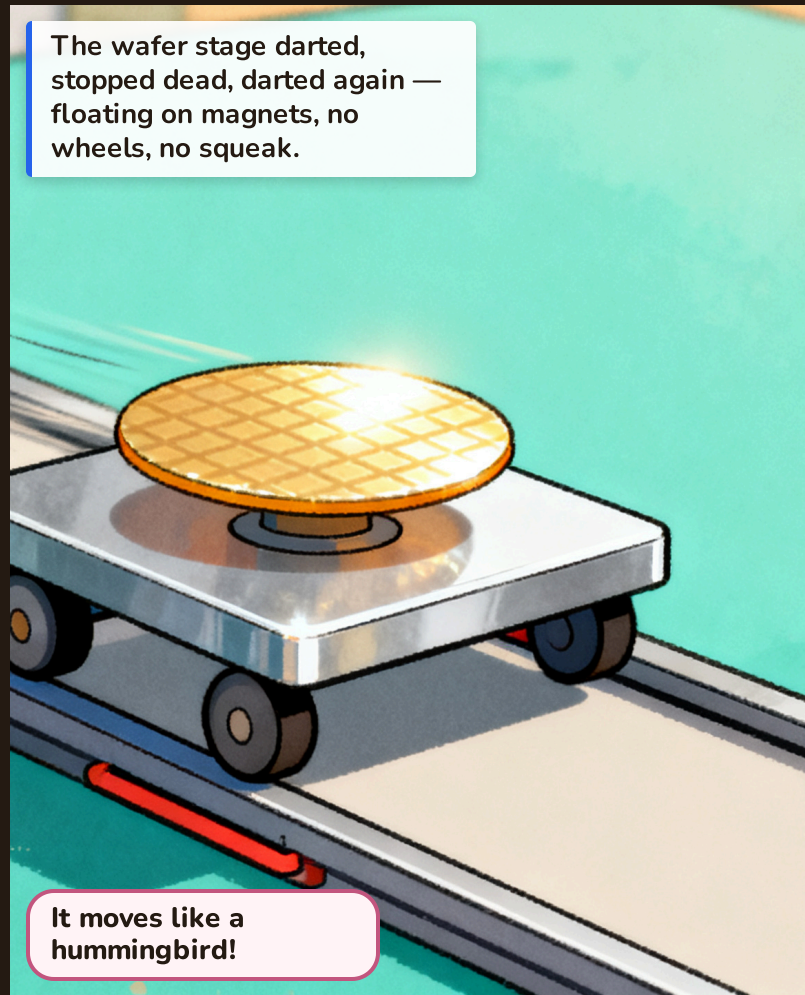
Every mirror loses a little light, so a beam bouncing off many of them arrives faint. That is why smoothness matters so much: the difference between a machine that works and one that merely glows. 🧪

📖 **SIRI'S SECRET NOTEBOOK • DOOR 6 UNLOCKED**

No glass allowed → mirrors. Not plain mirrors: dozens of stacked layers whose little reflections **ADD UP**. Polished for months to a smoothness that sounds made up. 🔍

STANDING PERFECTLY STILL

10a Door Seven: the quietest sprint



The wafer stage darted, stopped dead, darted again — floating on magnets, no wheels, no squeak.

It moves like a hummingbird!

"Every new layer must land on the last one. Miss by a whisker and the streets don't connect."

So this layer has to **FIND** the last one!

A sensor arm swept the wafer, mapping tiny marks left by earlier layers. Then the machine adjusted — and printed.

It reads the map before drawing on it!

★ WORTH REMEMBERING

Lining up layers is called **overlay**, and the allowed error is a few billionths of a metre. The stage must therefore sprint, stop and hold still while the floor, the air and even heat conspire against it. 🎯

★ WORTH REMEMBERING

A degree of warmth swells metal. A footstep shivers a floor. So the machine sits on its own suspension, in its own climate, measuring itself thousands of times a second and correcting as it goes.



SIRI'S SECRET NOTEBOOK · DOOR 7 UNLOCKED

Printing is only half of it. The other half: land each layer on the one before, within billionths of a metre — while sprinting. The machine measures ITSELF, constantly. 🎯

THE VILLAGE THAT BUILDS IT



Femke's map lit up: thousands of small workshops on three continents, each sending one perfect piece to one plain building among canals.

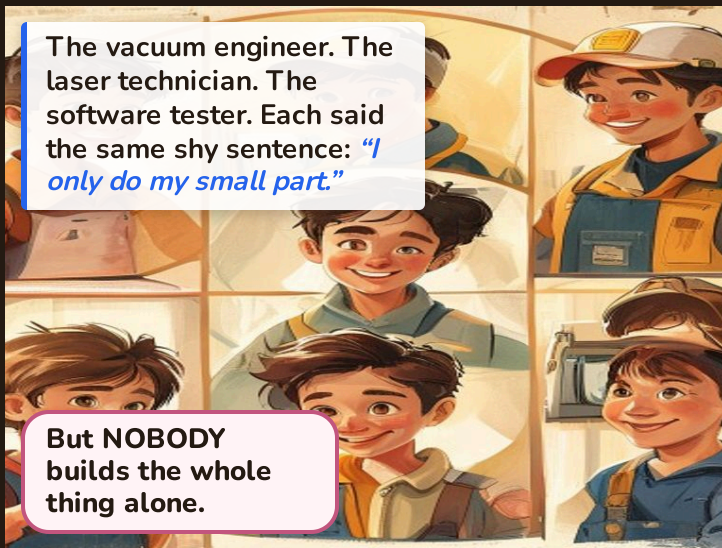
So who actually **BUILDS** the machine?

Everyone does. We put it together.



The mirror maker. Months per mirror, and nobody else in the world makes them this well.

One partner for the most vital part!



The vacuum engineer. The laser technician. The software tester. Each said the same shy sentence: *"I only do my small part."*

But **NOBODY** builds the whole thing alone.



Then dozens of huge crates, a cargo plane at dawn, and months of careful assembly inside a customer's cleanroom.

You ship it in **PIECES** and rebuild it there?

And then we stay. For years.

★ WORTH REMEMBERING

Sit with that: **nobody on Earth builds this machine alone.** One company designs it, integrates it, installs it and keeps it healthy — conducting thousands of specialists into a single instrument. The conducting is the invention. 🎵

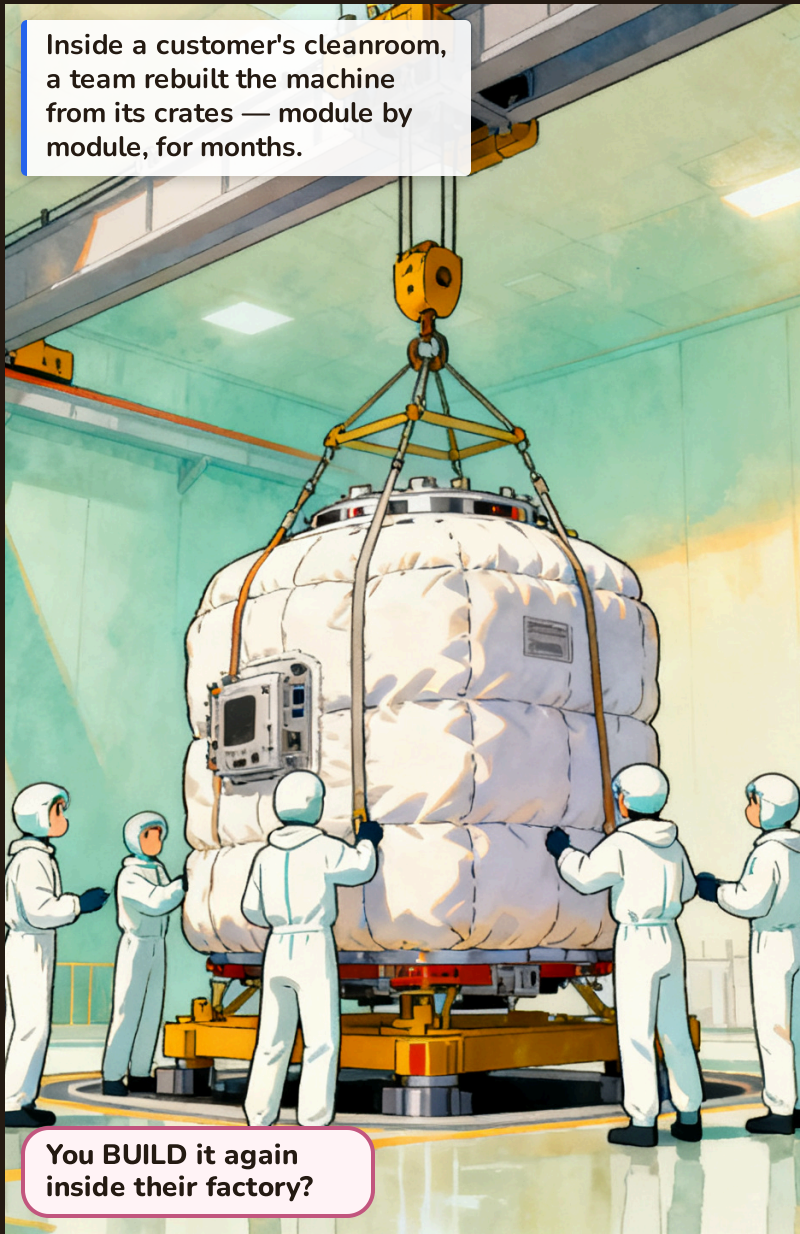
📖 SIRI'S SECRET NOTEBOOK • ALL SEVEN DOORS OPEN

Thousands of suppliers → one machine → dozens of crates → months to install → engineers who never really leave. So who ARE they? Compass is spinning again 🧭

THE DAY THE MACHINE ARRIVES

12a Siri's question Flips

Inside a customer's cleanroom, a team rebuilt the machine from its crates — module by module, for months.



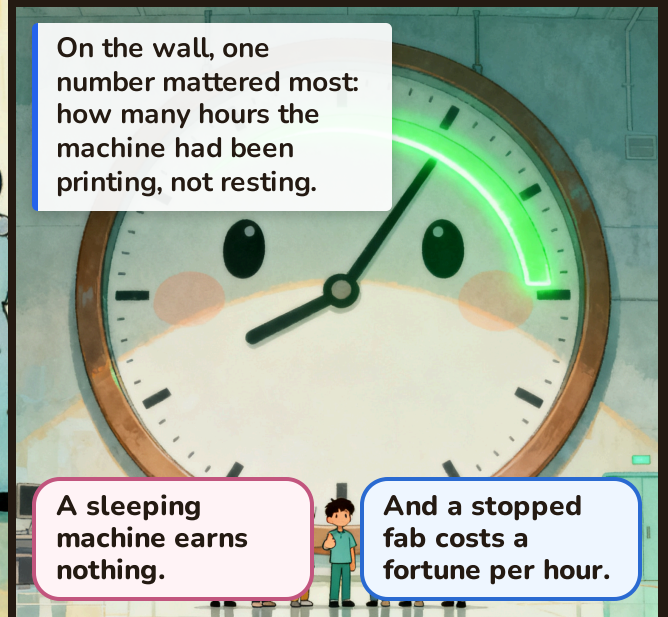
You BUILD it again inside their factory?

Around it, a whole chip factory waited: coaters, ovens, etchers, testers. The printer sat at the centre like a heart.



Everything else is waiting on THIS.

On the wall, one number mattered most: how many hours the machine had been printing, not resting.



A sleeping machine earns nothing.

And a stopped fab costs a fortune per hour.

★ WORTH REMEMBERING

A printing machine that runs is worth vastly more than one that merely exists. So the promise being sold is not metal — it is **uptime**: it will print, tonight, and tomorrow night, and the night after.

Service engineers lived beside it. Tuning, upgrading, swapping worn parts, teaching the next shift.



You never really leave, do you?

 SIRI'S SECRET NOTEBOOK

My question flipped: not 'how does it work' → 'why would anyone pay a fortune for it?' First answer: they're not buying metal. They're buying UPTIME. 🕒

WHY IT COSTS LIKE AN AIRLINER

Femke wrote a price on the board. Siri read it twice. Then a third time.



That's a PLANE.
That's a whole
plane!

"Now divide," said Femke. Billions of switches per chip. Thousands of chips per wafer. Wafer after wafer, all year.



Each little switch
costs almost
NOTHING.

★ WORTH REMEMBERING

Warren's favourite riddle: **price is what you pay, value is what you get.** A frightening price becomes a bargain when it is spread over an ocean of output — and a bargain when it isn't spread is still a waste. 💛

"And every new machine prints finer streets. More switches per wafer. Cheaper thinking, year after year."



That's why my games got better AND cheaper!

★ WORTH REMEMBERING

Making each switch cheaper is the quiet engine under sixty years of computing. Every phone, every scan, every helper light on a desk is downstream of that one falling cost.

📖 SIRI'S SECRET NOTEBOOK

Answer #1: VALUE. A terrifying price ÷ an ocean of tiny switches = a bargain. And the machine's real product isn't chips — it's cheaper THINKING, every year. 💡

THE BET NOBODY ELSE WOULD MAKE

Femke opened an old cabinet of doubts: papers, reviews, warnings. Everyone agreed the impossible light was, well, impossible.

"We kept going anyway. Two decades of spending before it printed a single good chip."

Everybody said NO?

Nearly everybody. For a very long time.

TWENTY YEARS with no reward?!

★ WORTH REMEMBERING

Almost no company can point at one hard thing for twenty years. Owners get impatient, leaders change, budgets get cut in bad years. **The rarest resource in business is not money. It is patience.** ⌚

In 2012, several big customers chipped in to help fund the research — because they needed it to exist.

Then, around 2018, the impossible light finally went to work in real factories, printing real chips, all night long.



Your CUSTOMERS paid for the lab?

They wanted the future built. So did we.



Twenty years... for that one quiet night.

★ WORTH REMEMBERING

Notice what the long bet bought: not just a machine, but a **head start no one can copy quickly**. A rival starting now must survive the same twenty years — while the leader keeps moving. 🏁

📖 SIRI'S SECRET NOTEBOOK

Answer #2: PATIENCE. Two decades, mountains of money, everyone doubting. Customers helped fund it. Then one ordinary night, it just... worked. Impossible is often only slow. ⌚

THE FLEET THAT KEEPS PAYING

On a screen, every machine ever shipped glowed on a world map. Hundreds of them. All still working.



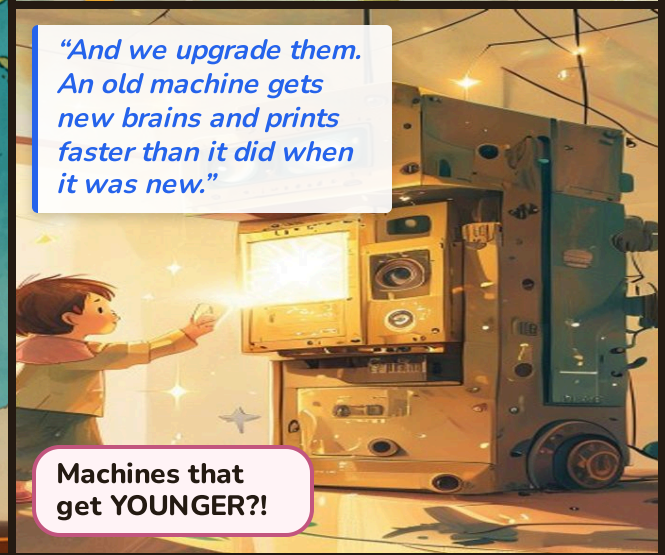
They're all still ALIVE out there?

Spare parts. Fresh mirrors. Skilled hands on call. The fleet needed feeding, every single day.



So selling it is only the start.

"And we upgrade them. An old machine gets new brains and prints faster than it did when it was new."



Machines that get YOUNGER?!

★ WORTH REMEMBERING

An **installed base** is a business that keeps earning after the sale: service, parts and upgrades. It also keeps the maker close to the customer's hardest problems — which is where the next machine is born. 🔧

📖 SIRI'S SECRET NOTEBOOK

Answer #3: THE FLEET. Hundreds of machines out there needing parts, care and upgrades. Value → patience → fleet. Now, seriously: WHO are these people? 🗺️

THE SHED BESIDE THE WINDMILLS

The compass pulled them out into sunrise: flat green fields, canals, cyclists, and one long glass campus.

ASML! The machine of light is **THEIRS!**

"1984. Two Dutch companies started it together. The first team worked out of a prefab hut in a car park."

A HUT? Building the world's finest machine?

"For years it was tiny and struggling. Machines sold in ones and twos. One parent company nearly walked away."

They almost didn't make it at all!

"Then, in 1991, a machine customers actually loved. Reliable. Steady. Boring, in the best way."

Boring is a **COMPLIMENT** here, isn't it?

★ WORTH REMEMBERING

No castle starts as a castle. In its first decade this company was small, late and often losing — and the thing that saved it was not a genius flash but a machine that simply kept working. 🛠️

📖 SIRI'S SECRET NOTEBOOK • THE REVEAL

ASML. 1984, a prefab hut in the Netherlands. Nearly folded. Survived on **RELIABILITY**, not brilliance. And it's now the only place on Earth that builds the impossible light. I actually gasped. 💡

FOUR CHOICES THAT CHANGED EVERYTHING

"2001. Two stages: measure one wafer while printing another. Same hour, far more wafers."

Measure AND print? That's DOUBLE!

"Around 2004, rivals chased an exotic new colour of light. We chased a puddle of water. The puddle won."

The humble idea beat the fancy one!

"2013: they bought their light-source partner outright — because the hardest part shouldn't be someone else's problem."

If it's the scariest part, OWN it.

"And the mirrors stayed with the German optics partner — decades of shared work, one impossible craft."

Own the scary part. Marry the rare part.

★ WORTH REMEMBERING

Four choices, one pattern: **make the machine earn more per hour, fit the customer's world, own what terrifies you, and keep your rare partners close for decades.** None of them was a lucky guess.



THE STORY IN TIME

1984

ASML begins as a Dutch joint venture, in a hut beside a factory.

1991

The PAS 5500 wins customers with plain reliability.

1995

The company lists publicly and starts investing far harder.

1997

Long-term research into extreme ultraviolet light begins.

2001

TWINSKAN: one wafer measured while another is printed.

2007

Immersion printing — water under the lens — sweeps the industry.

2013

It buys its light-source partner to master the hardest part.

2018

Extreme ultraviolet enters real, high-volume production.

2024

The first High-NA machines ship, bigger and sharper still.

Always

One rule: keep pointing at the hard thing. 💡



SIRI'S SECRET NOTEBOOK

Two stages (2001) → the water trick (2007) →
buy the light source (2013) → keep the mirror
partner forever. Pattern: earn more per hour, fit
reality, own the scary bit. 🛠️

THE CASTLE OF LIGHT

A warm glow. A whiff of cherry cola. Warren and Charlie, the partners from Omaha, before a shining castle.

Under a windmill's slow shadow, the two old friends let her lay out the walls, one by one. Nodding. Chuckling. Correcting.

The only question that matters for a hundred years: what keeps invaders OUT?

Walls! I've been collecting them ALL BOOK!

Scarier than any school quiz. A hundred times more fun.



THE CASTLE WALLS • WHY RIVALS CAN'T COPY IT



Wall One: Twenty Years of Trying

Rivals cannot buy the two decades of failure that taught this machine to work. Money can hire people. It cannot hurry time.



Wall Two: A Village of Suppliers

Thousands of specialists, some making one part for nobody else on Earth. Copying the machine means copying the village around it.



Wall Three: Living Inside the Fab

Engineers install, tune and upgrade for years. Service, parts and upgrades earn steadily long after the sale — and teach the next machine.



Wall Four: Learning From Everyone

It serves the whole industry, so it sees the whole industry's hardest problems. Nobody else gets that many lessons per year.

Charlie tapped his thick glasses. *"Turn the telescope around. Don't ask how it wins — ask what would DESTROY it. Invert, always invert."*



Find every way to LOSE... then don't go there!



THE CASTLE WALLS · WHY RIVALS CAN'T COPY IT



Crack One: The Wild Cycle

Chip demand swings hard. In a scared year customers stop ordering, and the temptation is to cut the very research that built the castle.



Crack Two: Few Customers

Only a handful of companies can afford the leading machines. When one pauses, the whole order book feels it.



Crack Three: The Rule-Makers

Governments decide who may buy such machines at all. A business this important is never left alone.



Crack Four: The Rare Partner

The finest mirrors come from essentially one partner. Depth of friendship is also depth of dependence.



★ WORTH REMEMBERING

Charlie's ruin-it checklist: cut research in a frightened year. Let a machine become unreliable. Squeeze customers who have nowhere else to go. Forget that the suppliers are the company too. Now — **just never do those.**

Warren raised his cola. *"Some businesses sell a product. This one sells the next twenty years of everyone else's progress. And it earned that by waiting."*



The treasure was never the machine!



SIRI'S SECRET NOTEBOOK · THE CASTLE

WALLS: patience ⌚ village 🤝 fleet-service 🔧 learning 📖. CRACKS: wild cycles 🌊 few customers 👥 rule-makers 🌍 one mirror partner 🔍. Charlie: INVERT. Warren: patience is a wall nobody can rent. 🏰

THE JUDGE'S QUESTIONS

Warren built a tiny courtroom beside the canal — and put the MACHINE on the witness stand.

“Every business answers a judge someday. The judge is the future. Today, that's you.”

TOK TOK

Siri banged the little gavel and fired Warren's five eternal questions.



Order in the court!

Question one, witness: will people still need you in thirty years?



★ WORTH REMEMBERING

The Owner's Court:  Enduring need? —

'While anyone wants cheaper thinking, someone must print it.'  Trust earned? — 'Hundreds of

my sisters run every night in other people's factories.'  Reinvesting wisely? — 'A vast

share of every good year goes straight back into research.'  Copyable with money? — 'The

metal, slowly. The twenty years and the village, no.'  What breaks you? — 'Impatience. Only

ever impatience.' Court adjourned for lemonade.

Last exhibit: a painting of 2056. Different machines, different shapes — the same stubborn question underneath.



The SHAPE changes. The NEED never does.

 SIRI'S SECRET NOTEBOOK · JUDGE ANY BUSINESS

Warren's five: ① enduring need? ② trust earned? ③ reinvests wisely? ④ copyable with mere money? ⑤ what breaks it? Works on soap, railways, machines of light — anything. (He never once mentioned a share price.) ⚖️

THE NEXT THIRTY YEARS

"Next: a bigger mirror system that catches a wider fan of light. Sharper prints, bigger machines, taller halls."

The lens gets a growth spurt!

"And chips are being stacked and joined like bricks — so progress isn't only about finer lines any more."

Build UP when you can't build SMALLER!

"Meanwhile, helper machines are hungry. Every clever new brain wants more printed switches."

Everything is going to want a BRAIN.

On a rooftop at dusk, Siri thought it through the way Grandpa taught her.

Don't bet on the machine. Bet on the NEEDS.

★ WORTH REMEMBERING

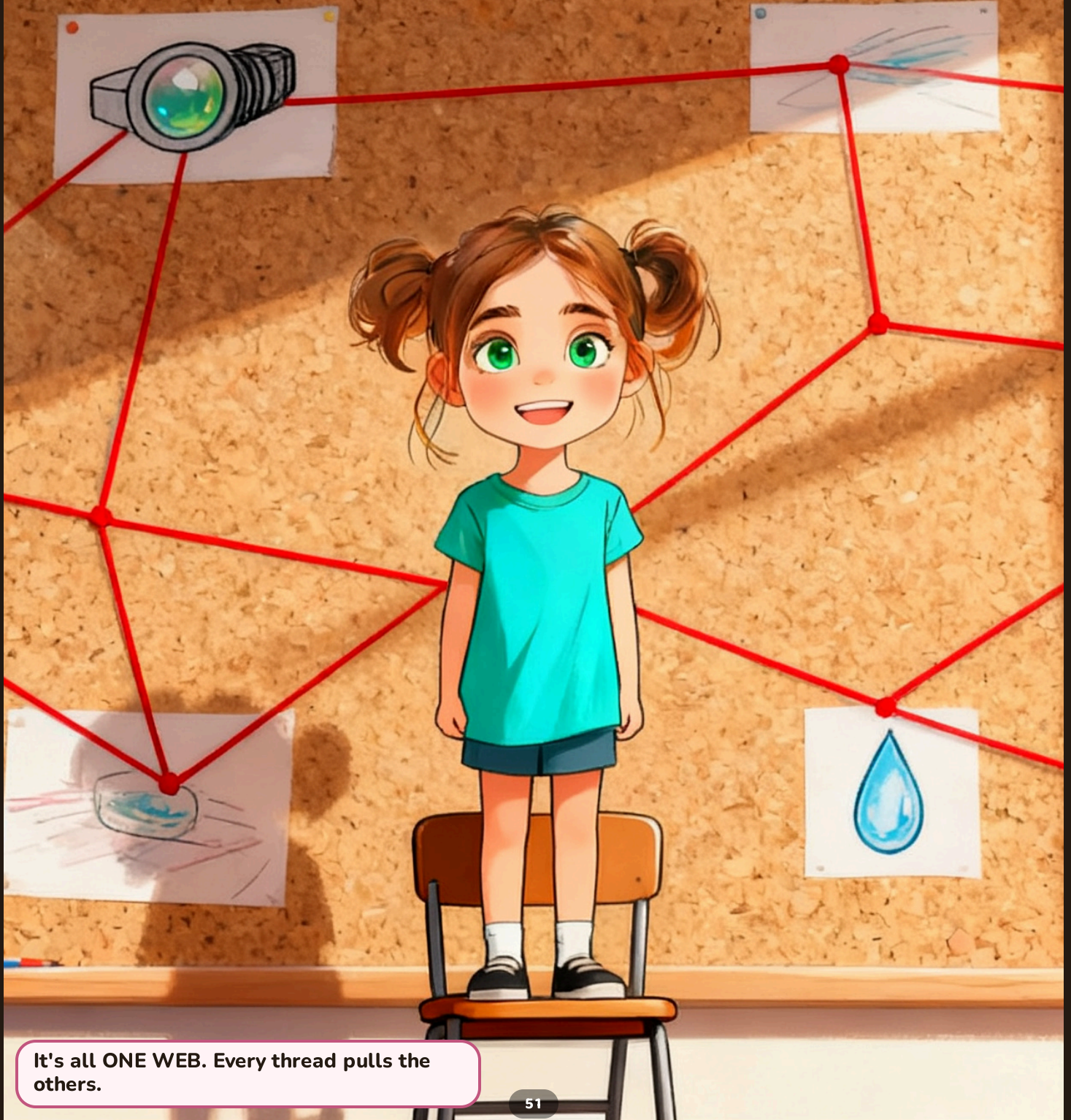
No crystal balls — just visible currents: wider-angle machines, brighter light sources, stacked and packaged chips, fabs rising on several continents, and computing appetite growing faster than anything before it. 🧙‍♂️

📖 SIRI'S SECRET NOTEBOOK

2056 watchlist: High-NA, brighter stars, stacked chips, fabs everywhere, hungry AI.
Rules: bet on needs, not shapes · patience is a wall · own the scariest part. 🧙‍♂️

THE SECRET NOTEBOOK

Home stretch. Siri pinned every discovery to her wall and joined them with red string.



It's all ONE WEB. Every thread pulls the others.



★ WORTH REMEMBERING

The Science Web, one breath: light-memory syrup takes a pattern → draw big, shrink four times → waves blur, so shorten them or widen the angle → water sharpens → tin stars make impossible light → mirrors replace glass → and every layer lands on the last within billionths of a metre. **Ordinary physics, stacked extraordinarily.**



★ WORTH REMEMBERING

The Business Web, one breath: value (cheaper thinking every year) → patience (twenty years before one good chip) → the fleet (service, parts, upgrades) → the castle (patience + village + fleet + learning), patrolled by Charlie's inversion and judged in Warren's court.

Underneath: thousands of strangers, conducted into one instrument.

The true test: she retold the whole thing to her little cousin. With a torch and a paper cut-out. He got it.



If a torch can teach it, you really know it.



SIRI'S SECRET NOTEBOOK • THE LATTICEWORK

Charlie's word for my string-wall: a LATTICEWORK. Ten models from ONE machine: print-don't-carve · shrink-to-forgive-mistakes · waves-set-limits · humble-ideas-that-fit-win · own-the-scary-part · uptime-is-the-product · price-vs-value · installed base · patience-as-a-moat · invert. 🕸

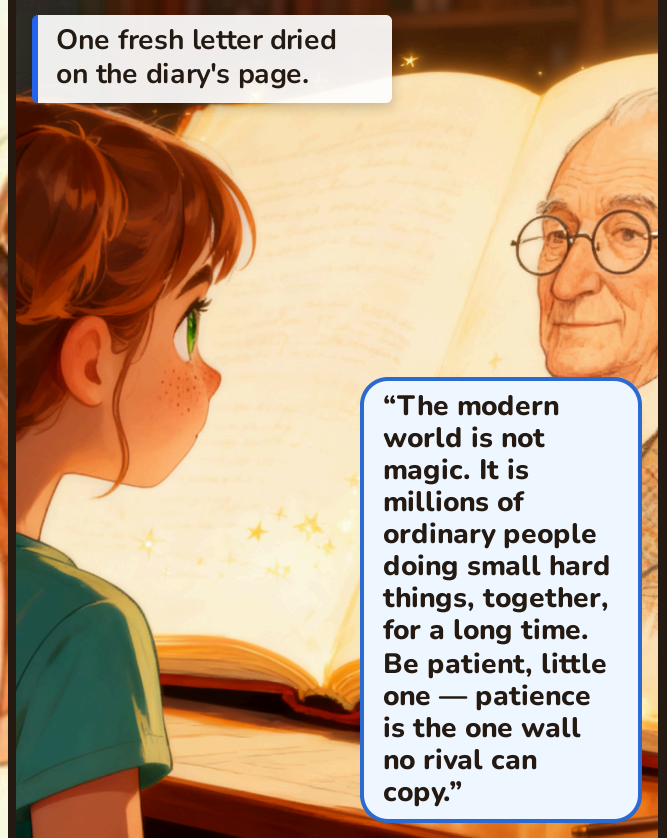
COMING HOME

Her own bed. Morning. The compass: quiet. The house: lit differently, somehow.



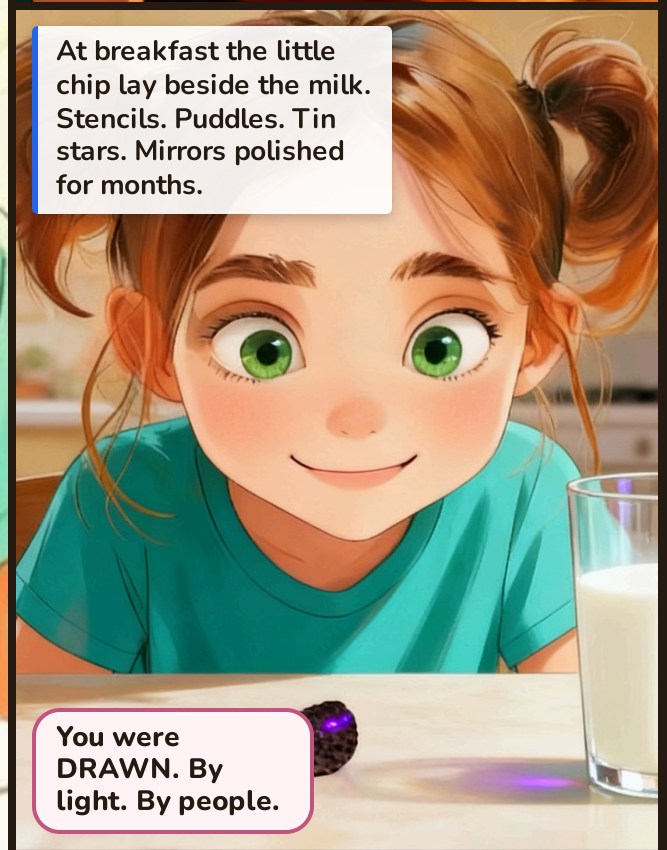
Was it real? It FELT real...

One fresh letter dried on the diary's page.



"The modern world is not magic. It is millions of ordinary people doing small hard things, together, for a long time. Be patient, little one — patience is the one wall no rival can copy."

At breakfast the little chip lay beside the milk. Stencils. Puddles. Tin stars. Mirrors polished for months.



You were **DRAWN**. By light. By people.

Later she climbed back to the attic and switched the old lamp on, just to watch a shadow print itself again.



Same trick.
Fourteen billion
times smaller.

She hugged the diary tight. Far away, past canals and windmills, a long glass campus caught the morning sun.



Show me the next
one, Grandpa. ♥

★ WORTH REMEMBERING

Feel the unlock: a wave of light too short for air to survive, born from exploding tin, folded by mirrors smoother than anything in nature, laying streets no eye will ever see — and twenty patient years standing behind every one of them. **Nothing, from now on, is just anything.**

📖 SIRI'S SECRET NOTEBOOK · VOLUME CLOSED

Seven doors. Ten mental models. One castle built out of patience. But the compass is twitching toward the family computer downstairs... the one that answered me in whole sentences last night. Who taught it to TALK? 🗑️💬



OUR PHILOSOPHY

We believe the greatest gift we can give a child is the ability to think.

Inspired by the multidisciplinary thinking of [Charlie Munger](#) and the rational, long-term philosophy of [Warren Buffett](#), our comics connect science, technology, business, history, and human behavior to show how the real world works.

Every story begins with a scientific idea and follows its journey into innovation, industry, and the businesses that create value for society. Along the way, children learn that great companies are built on curiosity, experimentation, integrity, and long-term thinking.

Our goal is not to teach children how to invest, but to help them build the mental models needed to understand the world, ask better questions, and think independently.

The companies featured in *The Great Company Adventures* are educational case studies—not investment recommendations. They show how knowledge, innovation, and perseverance turn ideas into products, services, and enduring businesses.

LEARN THE SCIENCE. • UNDERSTAND THE BUSINESS. • THINK FOR LIFE.

EVERY ORDINARY THING HIDES A SECRET.

Siri opened all seven doors of the machine of light.
But the compass is twitching again — at the family
computer, which just answered her question in
whole sentences. Nobody taught it her homework.
So who taught it to talk?

NEXT ADVENTURE · The Machine That Learned to Talk →