



UP, UP, AND AWAY

THE HISTORY OF AVIATION

WRITTEN & ILLUSTRATED BY
TOMÁŠ SMOT SVOBODA

 albatros

HELLO FRIENDS!

You've opened this book just in time. My grandchildren Molly and Simon are waiting here in my study. I'm going to the kitchen to get the goodies Grandma Elizabeth has prepared for us. While I'm gone, why not explore the room so you know what we're going to talk about today?

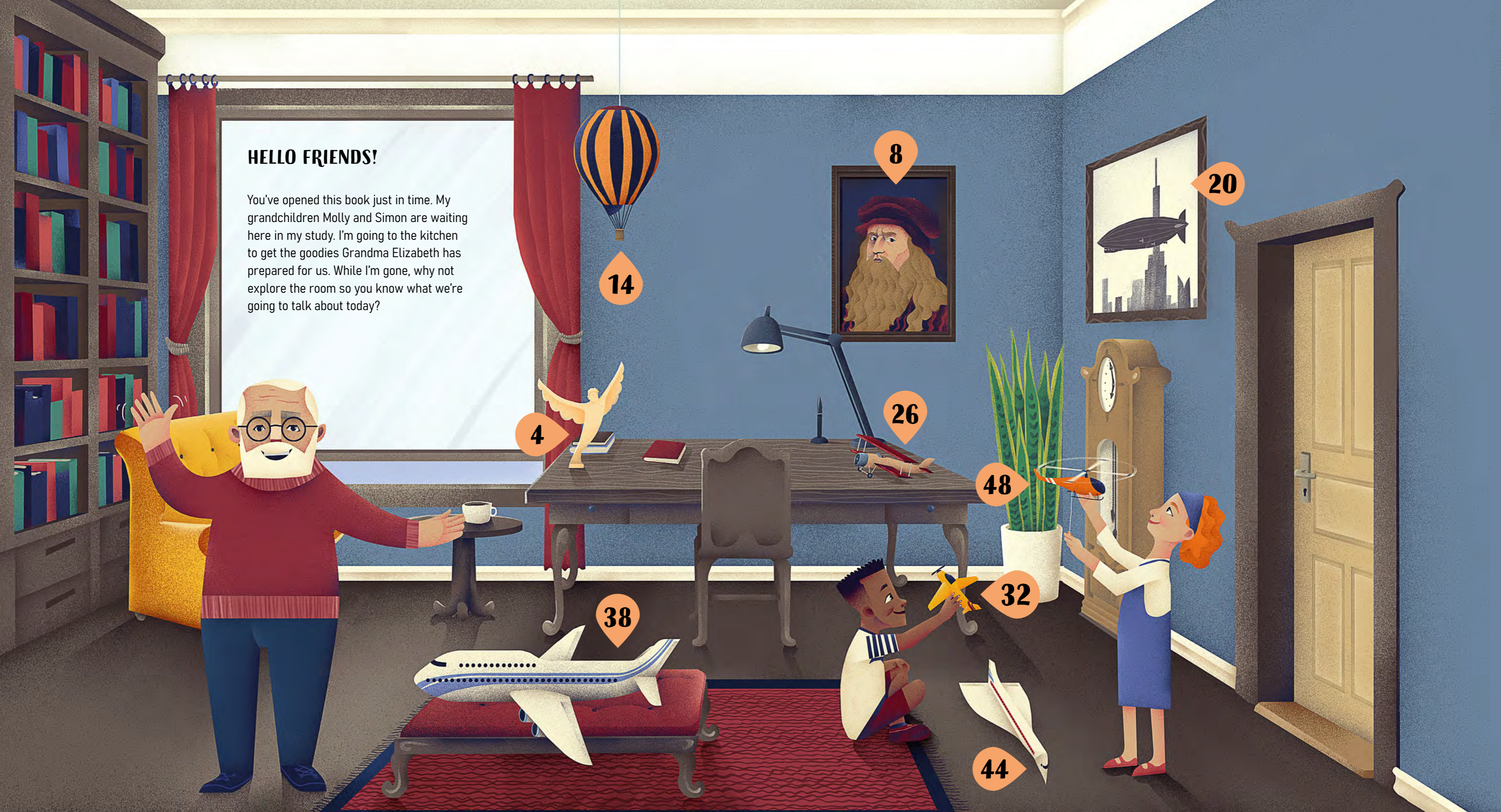


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FEATHERED MUSE

The bird is to aviation what the muse is to the artist – an inspiration! A perfect example of this is the genius artist Leonardo da Vinci. His ideas for flying machines, based on bird flight, were far ahead of his time.

RENAISSANCE MAN

Leonardo da Vinci painted the *Mona Lisa*, the most famous painting of all time. Besides being a brilliant artist, Leonardo was also an inventor, architect, sculptor, naturalist, musician, designer, and engineer. He lived in Italy during the 15th and 16th centuries, a period known as the Renaissance.



PRINCIPLE OF HELICOPTER FLIGHT

In addition to designing winged flying machines, Leonardo also imagined the idea of helicopter flight. He envisioned a machine with an “aerial screw,” which would be powered by four people running in circles.

OVERHEAVY MACHINE

Staying on a merry-go-round for too long can make you dizzy. That might be why Leonardo never built his aerial screw. It would have been difficult to control and far too heavy to lift four people into the air. Still, Leonardo’s idea was very important for the future of flying machines.

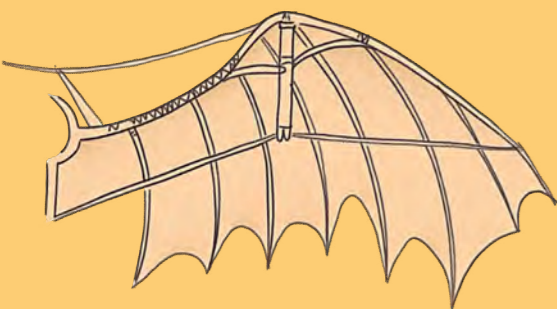


I SHOULDN'T HAVE HAD SECONDS AT LUNCH.



ON THE FLIGHT OF BIRDS

From a young age, da Vinci was fascinated by flying. He made detailed studies of how birds and bats fly, examining their wings closely. His notebook, called the *Codex on the Flight of Birds*, includes an impressive 1,700 drawings spread across 1,600 pages.



IDEAS ON FLYING

He also designed an ornithopter, a type of flying machine that's heavier than air and powered by people. His notes included ideas for the wings, how they would flap, and how the ornithopter would land. Since no complete drawing of the machine has been found, we don't know exactly what it looked like. However, there is some evidence that da Vinci built and tested the ornithopter in 1504. It was said that his assistant flew it for several miles from the hills of Fiesole, but this is almost certainly untrue.

EVERYONE WILL BE FLYING IN A YEAR.

I WOULDN'T WISH TO UPSET YOU, SIGNOR LEONARDO, BUT I'D SAY IT'LL BE MORE LIKE SEVERAL CENTURIES.



RENAISSANCE PARACHUTE

Among the celebrated inventor's notes and sketches, there is a design for a parachute shaped like a pyramid. It had four equilateral triangles with sides over 20 feet long. In 2008, Swiss amateur parachutist Olivier Vietti-Teppa became the first person to build and successfully use one, jumping from a height of over 2,000 feet.

CONQUEST OF THE ENGLISH CHANNEL

On January 7, 1785, French balloonist Jean-Pierre Blanchard and American physician John Jeffries became the first people to successfully cross the English Channel by balloon. They took off from England and reached France, but not without a challenge. As the balloon started losing altitude toward the end of the flight, they had to shed as much weight as possible, eventually even discarding most of their clothing. For his daring achievement, Blanchard was awarded a lifetime pension by the king and became famous across Europe for his public flights. He even toured the USA, showcasing his skills to many people, including President George Washington.

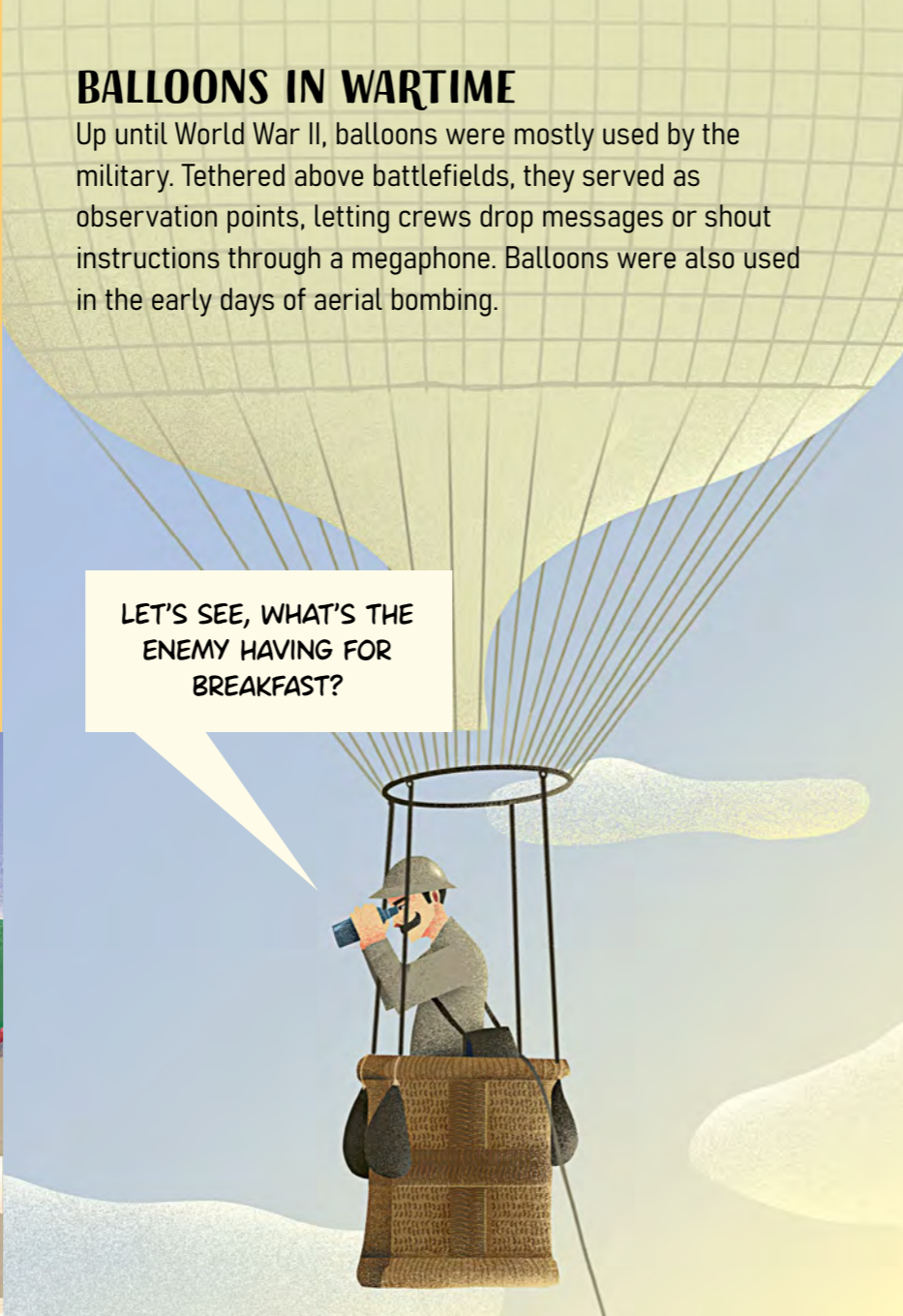


SWIFT AS THE WIND

Balloon races are not always about speed. One of the most famous and oldest competitions is the Gordon Bennett Cup, where balloons compete to see which can fly the farthest. The current record, set in 2005, is held by Bob Berben and Benoît Siméons from Belgium, who flew an incredible 3,400 miles in 65 hours! There are many other balloon competitions too, like ones for accuracy of landing, chasing another balloon, or flying the least distance while trying to stay in the air for a set amount of time.

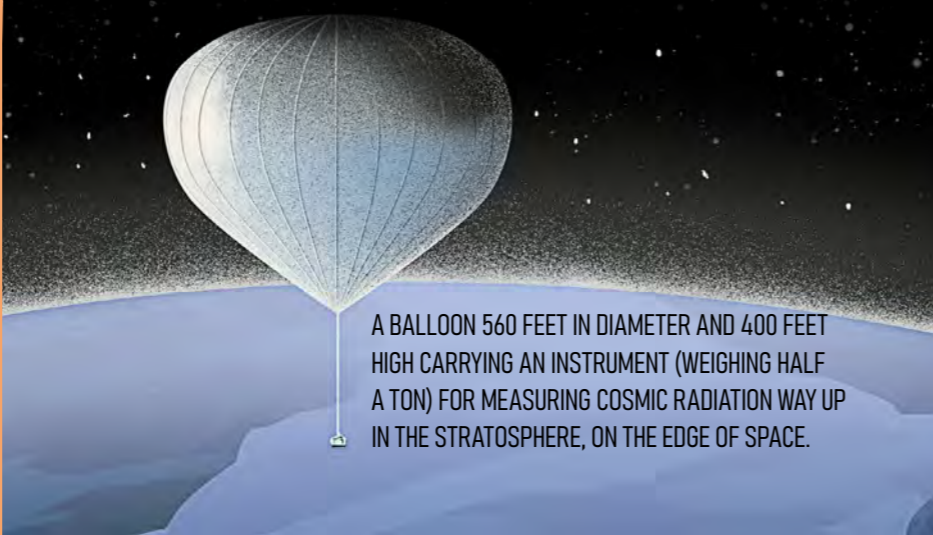
BALLOONS IN WARTIME

Up until World War II, balloons were mostly used by the military. Tethered above battlefields, they served as observation points, letting crews drop messages or shout instructions through a megaphone. Balloons were also used in the early days of aerial bombing.



USES OF BALLOONS

Balloons weren't just for the army. The post office used them to deliver letters and packages. Nowadays, meteorologists use small balloons with special instruments called "radiosondes" to gather information on things like temperature and air pressure up to 18 miles high. Modern helium-filled balloons even help astronauts explore the edges of outer space. Balloons are also popular for sightseeing flights and fun races that people enjoy watching.



WHERE'S ITS RUDDER?

A balloon can't be steered like a car or plane. It goes wherever the wind takes it. However, the pilot can control the balloon's altitude by making it rise or fall. Since wind direction and speed can change at different heights, the pilot might use these changes to guide the balloon to a certain area.

FIRE, THE GOOD SERVANT

Burners in the basket of a hot-air balloon are used to heat the air inside, which makes the balloon rise. When the burner is turned off, the air cools down, and the balloon begins to fall. There's also a vent at the top of the balloon to let out there hot air, helping to control its altitude.

THE ADVANTAGE OF GAS

A gas balloon doesn't have a burner. Instead, it uses sandbags as ballast to control its altitude. By dropping sand from the sandbags, the balloon becomes lighter and rises. To make the balloon fall, the pilot releases some of the gas through a vent, similar to the one in a hot-air balloon. A gas balloon can stay in the air for several days if it doesn't release too much gas.



HOT AIR OR GAS?

Hot-air balloons are usually bigger than gas balloons because hot air needs a larger space to create enough lift. In contrast, gases like hydrogen and helium are lighter than air and can lift a much smaller balloon while still providing the same buoyancy.

EARLY BIRDS

Balloons are often seen in the early morning because the sun heats the air and creates warm updrafts, known as thermals. These updrafts help lift the balloon into the sky. By midday, when the sun is strongest, the heat can cause the balloon to overinflate and potentially burst. Therefore, balloons are usually flown in the morning, evening, or during cooler seasons. They don't fly in the rain or snow due to the risk of damage and reduced visibility.



A LOOK INSIDE THE ENVELOPE

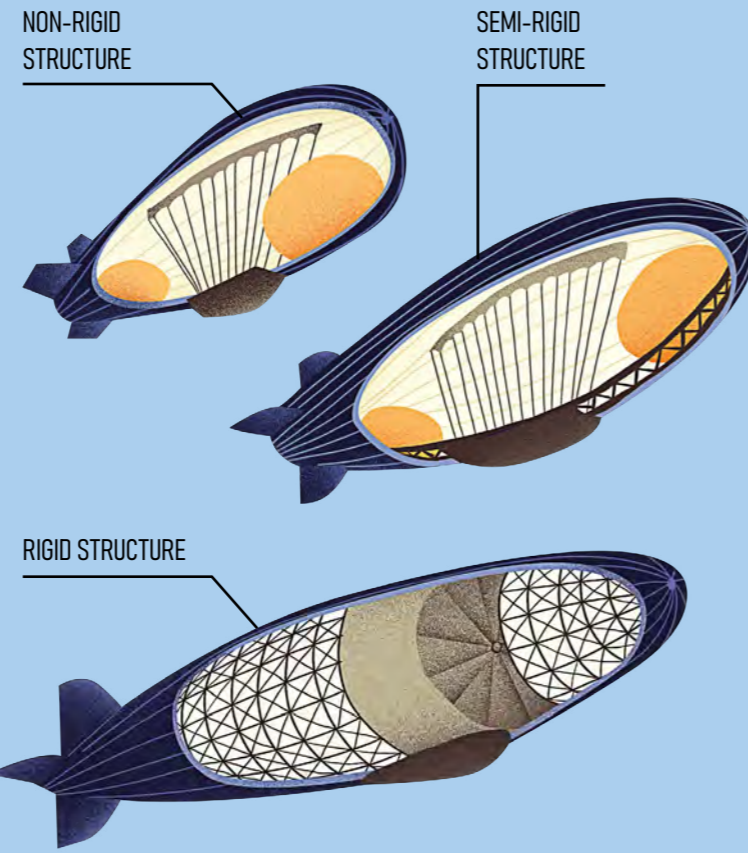
An airship's envelope can have different designs. In one type, known as a **non-rigid airship**, the envelope is filled mostly with gas, and it keeps its shape because of the pressure of the gas inside pushing against the air outside. As the gas can expand or shrink with changes in altitude, there are special compartments inside the envelope called ballonets that hold air. The pilot can inflate or deflate them during flight to balance the pressure and help keep the airship steady. Many early airships were designed this way.

The next type of airship is called a **semi-rigid airship**. Inside the envelope, there's a long beam called a keel that runs from the front to the back. This keel helps keep the shape of the airship and holds up the cabin, engines, and other parts. Along with the gas and a ballonet, the keel makes sure the airship stays steady in the air. This kind of airship made its first successful flight on November 13, 1902, and some airships today are built like this.

The third type is called a **rigid airship**. It has a strong frame made of materials like aluminum that supports the whole airship. The gas inside is kept in separate sections, or cells, that are built into the frame. This type was designed by David Schwarz, a Croatian inventor. Unfortunately, he passed away before seeing it fly. Rigid airships are famous for being used in Zeppelin aircraft.

KING OF THE AIRSHIPS

Count Ferdinand von Zeppelin was not a real king but is often called the "king of airships" because of his significant contributions to airship design. Born in Germany in 1838, he served in the army for many years. After retiring at 53, he began building rigid airships. In 1900, his first airship, named LZ1, made its first flight over Lake Constance and stayed in the air for 18 minutes.



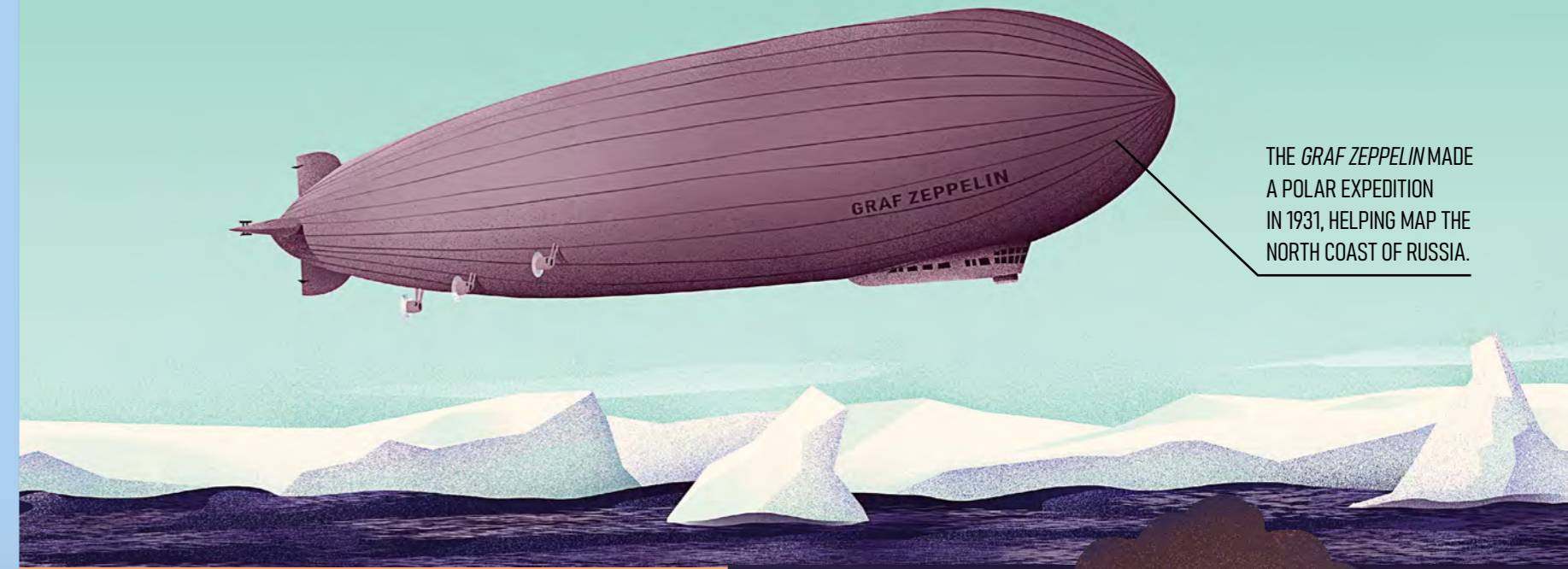
FROM MINUTES TO HOURS

The first flight was just the start. The third model, the LZ3, could stay in the air for up to 8 hours. This impressed the German army so much that they bought it from Count von Zeppelin. His later airships were designed to carry passengers and were made by the DELAG company, which von Zeppelin set up for this purpose. He also founded a shipyard, a factory for making gears used in machines, a gasworks (where gas is produced), and a factory for balloon envelopes.

ZEPPELIN ONE, ZEPPELIN TWO ...

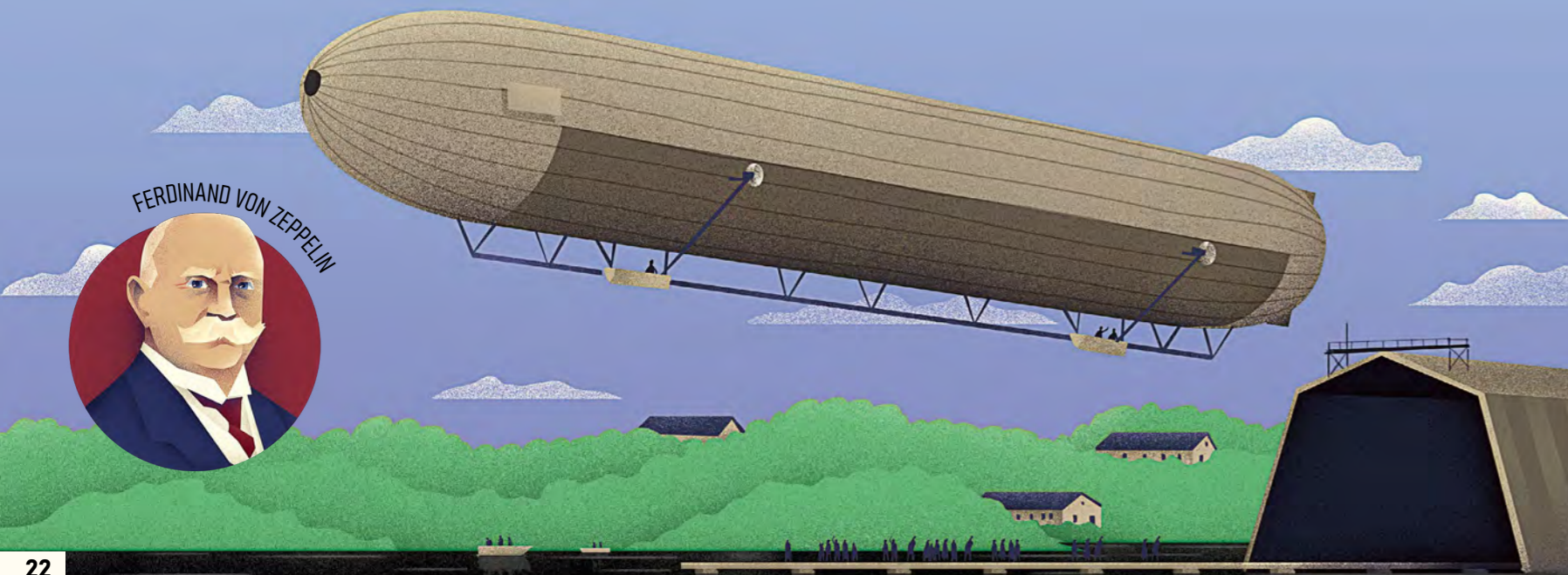
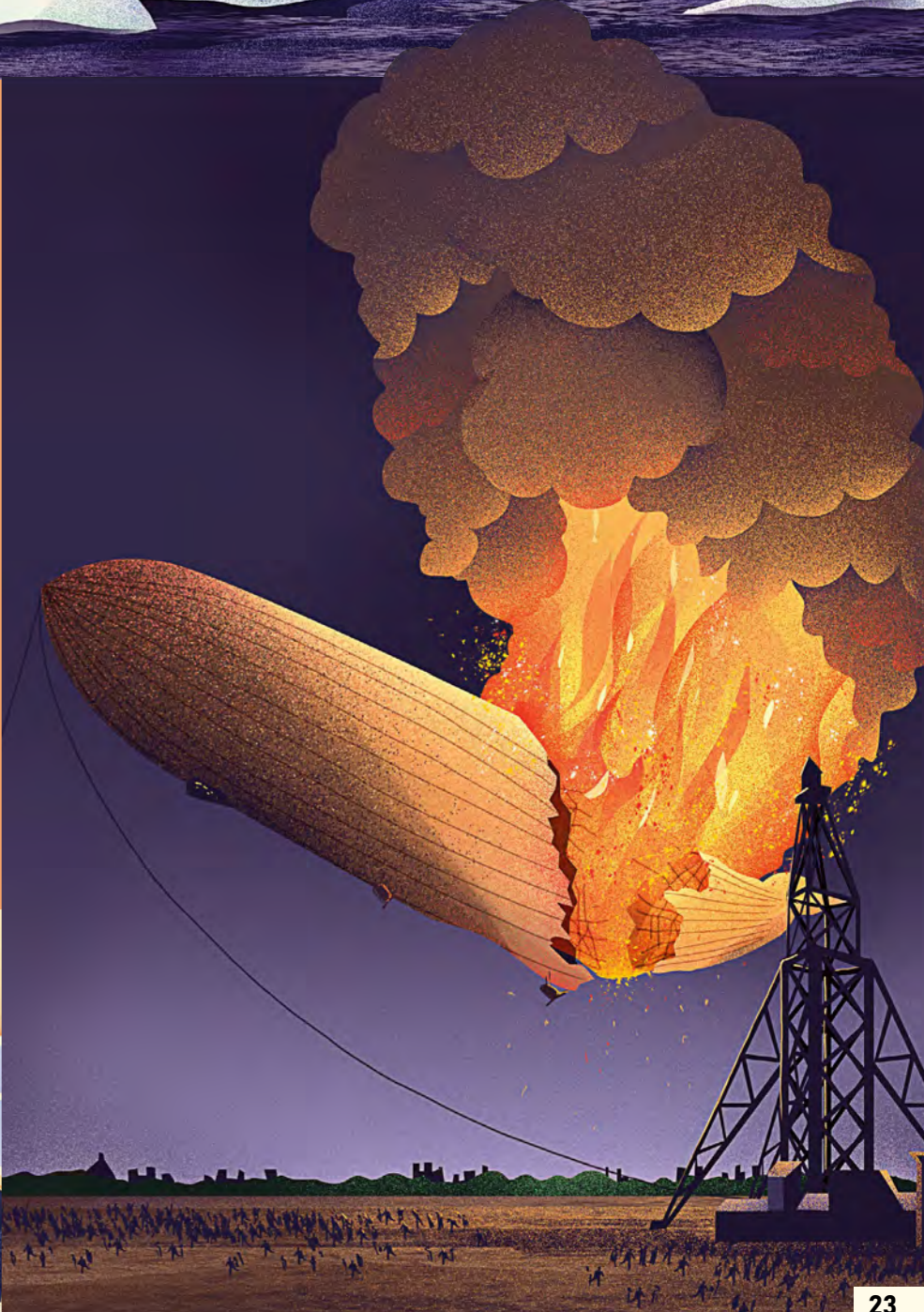
The letters "LZ" stand for "Luftschiff Zeppelin," which in German means "Zeppelin airship." The number shows the order in which the airships were made – first, second, third, etc. The most famous passenger-carrying airship was the LZ 127 *Graf Zeppelin*. Named after Count von Zeppelin, it was

the first airship to fly around the world, completing the trip in two weeks in 1929 with paying passengers on board. The *Graf Zeppelin* also made regular flights between Germany and Brazil. During its ten years of service, it traveled over 1 million miles.



KING-SIZED HINDENBURG

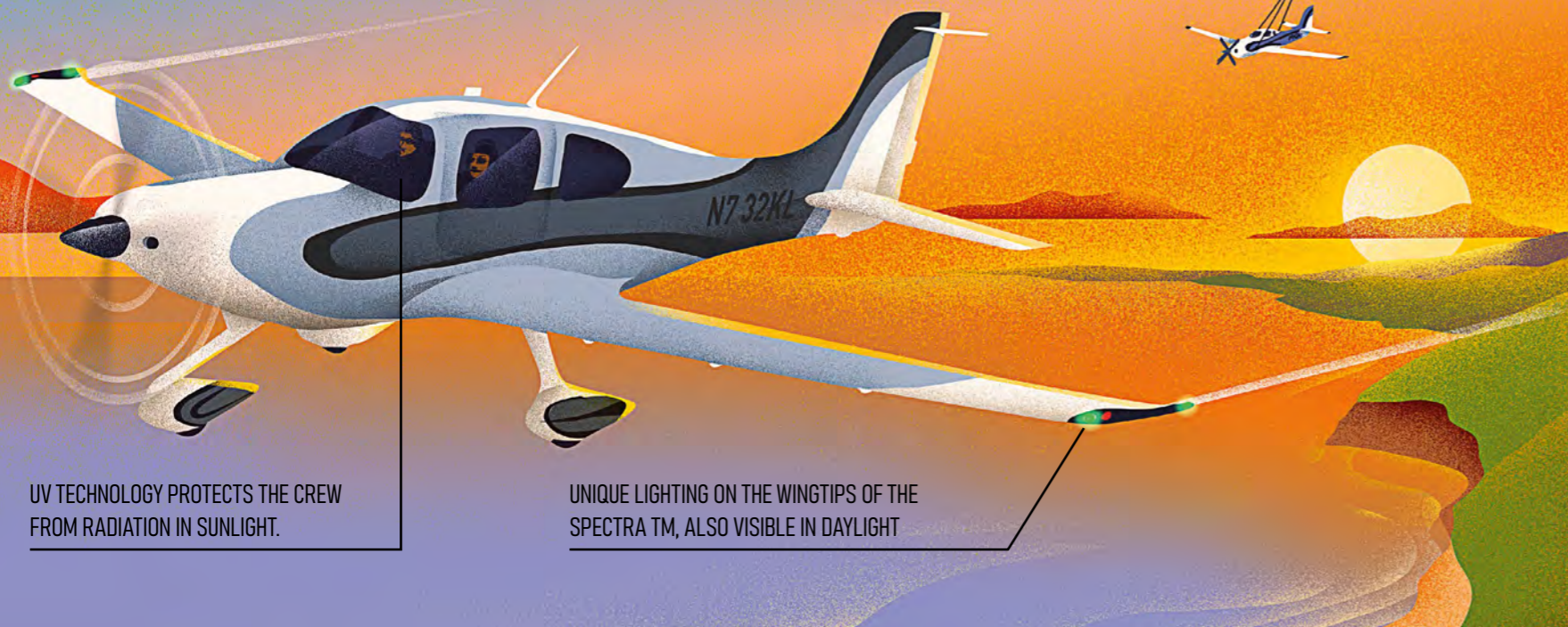
The *Graf Zeppelin* was an impressive 774 feet long, but the biggest airship ever was the *Hindenburg*. At 804 feet, it was almost three times the length of today's large airplanes. The *Hindenburg* had a new kind of metal framework called duralumin. Its cabins for 72 passengers were built inside the envelope to make the airship more streamlined. It had amazing features, including showers, an observation deck with a pianist, and hot meals. However, on May 6, 1937, as the *Hindenburg* was landing in New Jersey, tragedy struck. A fire on the deck quickly spread, and the airship was destroyed in seconds. After this disaster, all other large airships were taken out of service, ending the golden age of airships.



SAFETY IN THE AIR

Flying in a plane is actually quite safe. One of the safest planes today is the Cirrus SR22. It has a special parachute built into it, inspired by car safety features. The inside of the Cirrus SR22 is designed for comfort, with space for 4-5 passengers. It even has cool features like charging ports for your cell phone and, a display to check fuel levels, flight records, and the plane's performance. Since it started flying in 2001, the Cirrus SR22 has become one of the most popular passenger planes.

WINGSPAN: 38 FEET
LENGTH OF CRAFT: 26 FEET
HEIGHT OF CRAFT: 9 FEET
SPEED: 231 MPH
ENGINE: 310 HORSEPOWER
CONTINENTAL IO-550-N

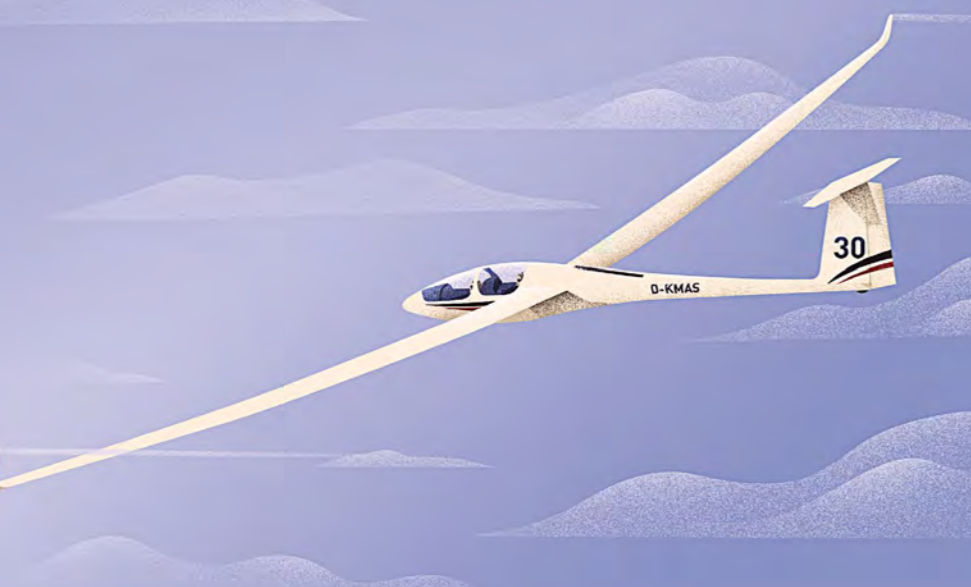


UV TECHNOLOGY PROTECTS THE CREW FROM RADIATION IN SUNLIGHT.

UNIQUE LIGHTING ON THE WINGTIPS OF THE SPECTRA TM, ALSO VISIBLE IN DAYLIGHT

SILENT AIRPLANES

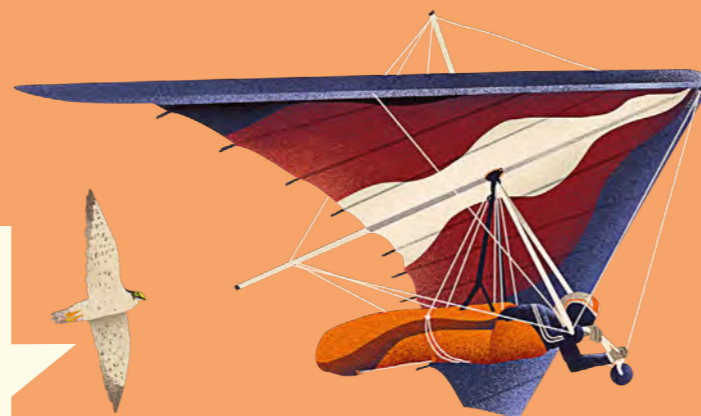
Planes with silent engines don't exist yet, but gliders don't need engines at all. They are lifted into the air by being pulled with a tow plane or a long rope and winch, similar to how a kite flies. Once in the sky, gliders use rising air currents, like a bird, to stay up. They can fly for hundreds of miles and reach speeds of over 125 mph. There are even glider competitions for the longest flight and for performing tricks.



HANG-GLIDERS

A typical hang-glider has a triangular wing made of sailcloth. The pilot holds onto a crossbar that hangs from the wing. To launch, the pilot usually runs downhill to get airborne. Hang-gliders can fly for dozens or even hundreds of miles. In 2004, Angelo d'Arrigo flew a hang-glider over Mount Everest, the world's highest mountain.

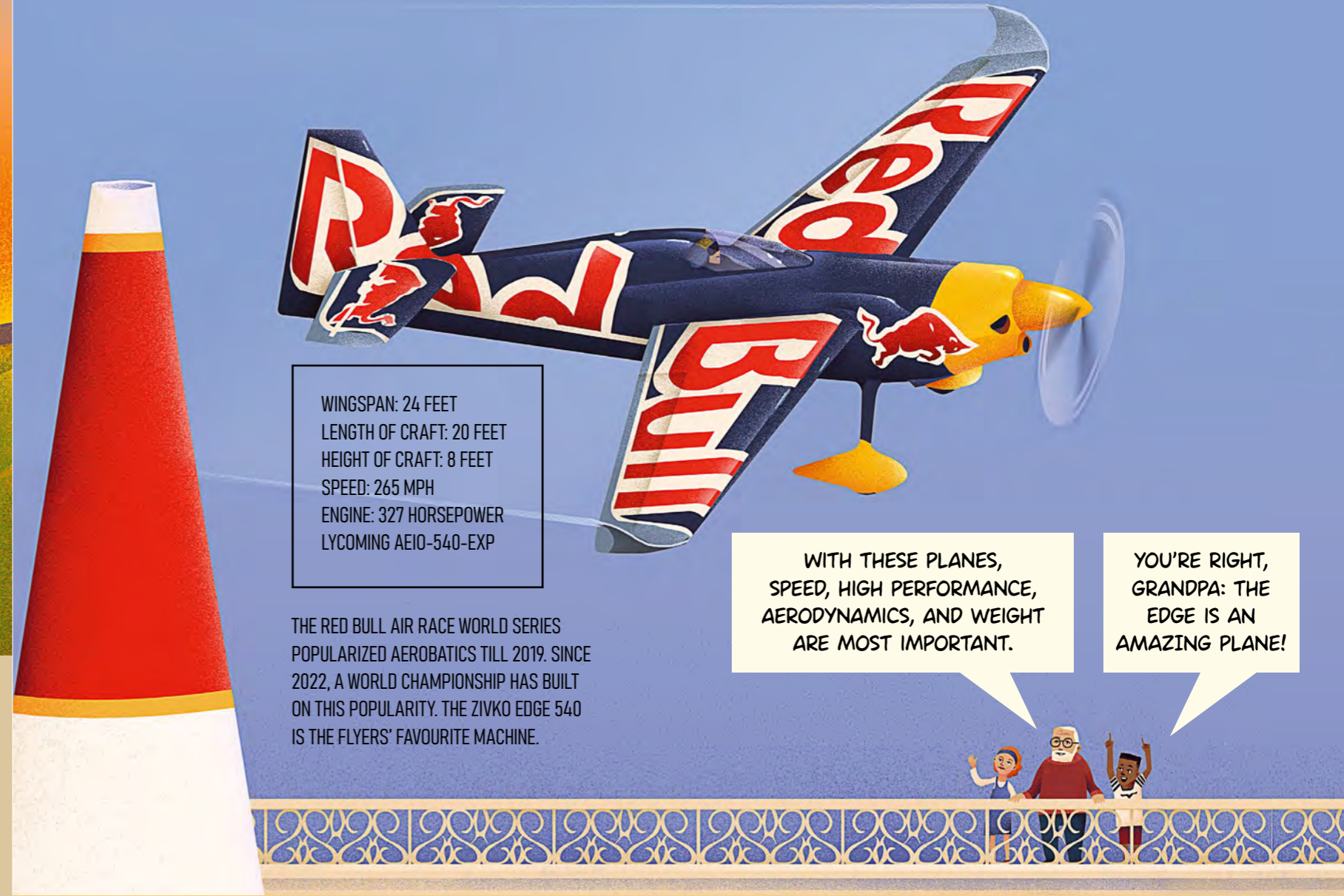
DOES "RIGHT OF WAY" MEAN NOTHING TO YOU?



AEROBATICS

Planes can indeed perform acrobatics, which, for airplanes high up in the sky, is known as *aerobatics*. During aerobatic routines, pilots make planes do amazing tricks like loop-the-loops, sharp turns, spirals, and quick dives. One popular

plane for aerobatics is the Zivko Edge 540 V3. It's made from advanced materials like carbon fiber, making it both light and strong. This plane is known for its great flying abilities, even at slower speeds.

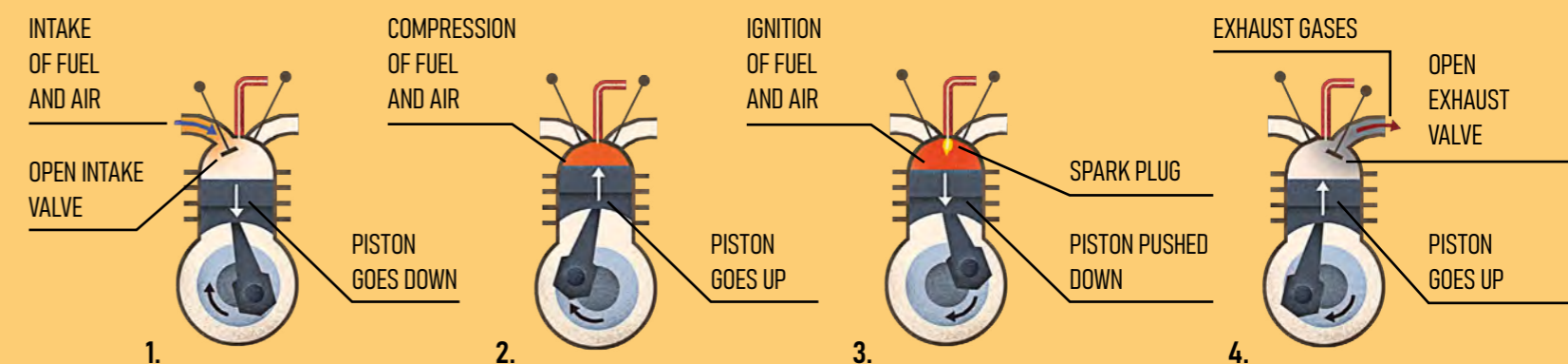


WINGSPAN: 24 FEET
LENGTH OF CRAFT: 20 FEET
HEIGHT OF CRAFT: 8 FEET
SPEED: 265 MPH
ENGINE: 327 HORSEPOWER
LYCOMING AEIO-540-EXP

THE RED BULL AIR RACE WORLD SERIES POPULARIZED AEROBATICS TILL 2019. SINCE 2022, A WORLD CHAMPIONSHIP HAS BUILT ON THIS POPULARITY. THE ZIVKO EDGE 540 IS THE FLYERS' FAVOURITE MACHINE.

WITH THESE PLANES, SPEED, HIGH PERFORMANCE, AERODYNAMICS, AND WEIGHT ARE MOST IMPORTANT.

YOU'RE RIGHT, GRANDPA: THE EDGE IS AN AMAZING PLANE!



ENGINES

There are two main types of engines in small planes: piston engines and jet engines. Let's focus on piston engines first. They are usually four-stroke engines, which means they go through four steps over and over. Here's how it works:

Intake Stroke: The piston moves down, pulling in a mix of fuel and air.

Compression Stroke: The piston moves up, squishing the fuel and air mixture and heating it up.

Power Stroke: A spark plug creates a spark that ignites the fuel, causing a small explosion. This explosion pushes the piston back down.

Exhaust Stroke: The piston moves up again to push out the spent gases from the engine.

This cycle keeps repeating, giving the engine power to drive the plane.

GREAT DESIGN

Airliners don't fly quite that fast. The famous British-French Concorde was the closest, reaching speeds of about 1,354 miles per hour. It looked very futuristic and even won a design award. Sixteen Concorde's were built, and they mostly flew with Air France and British Airways starting in 1976.

THERE BEFORE YOU KNOW IT!

The Concorde was so fast that passengers barely had time for a meal! The plane's high speed put a lot of stress on its all-metal structure. Because of the intense heat from flying so fast, Concorde's metal body expanded by 8 inches at full speed.

The Concorde's operating costs were very high, and it never made a profit. After a tragic accident in 2000, the plane needed expensive repairs. Costs continued to rise, and with a drop in travel interest following the September 2001 terrorist attacks, the Concorde was retired in 2003.

WINGSPAN: 84 FEET
LENGTH OF CRAFT: 200 FEET
HEIGHT OF CRAFT: 40 FEET
SPEED: 1,354 MPH
ENGINES: 4x ROLLS-ROYCE/SNECMA
OLYMPUS 593 JET WITH AFTERBURNER

ENGINES WITH
AFTERBURNERS
FITTED IN PAIRS

STREAMLINED SURFACES
TO IMPROVE FLOW
AROUND THE WINGS



TOO NOISY

The Concorde was so loud at take-off that it could be heard from 5 miles away. Because of this noise, it wasn't allowed to fly out of many airports. The plane mainly flew across the ocean between Paris or London and New York. With space for up to 128 passengers, it could make the trip in half the time of other planes. The fastest flight ever recorded was from New York to London, taking just 2 hours, 52 minutes, and 59 seconds.

THE COCKPIT
TILTED ON LANDING
AND TAKE-OFF TO
ALLOW PILOTS TO
SEE THE RUNWAY.

ON TAKE-OFF, THE TAIL WAS PROTECTED
BY A RETRACTABLE BUMPER WHEEL.

MIGHT THE CONCORDE RETURN?

The Concorde might not fly again, but there are new projects working on similar planes. These projects aim to solve the problem of the loud sonic boom, making it quieter, like the sound of a car door closing. They also plan to make these planes cheaper and more eco-friendly. The goal is to create a plane that flies four times faster than the speed of sound.



KINDS OF ROTORS

Large helicopters often have two main rotors. These can be different types: **coaxial**, where the rotors are stacked on top of each other; **intermeshing**, where the rotors overlap; and **quadcopters**, with four rotors. Two of the most interesting types are **tandem** and **transverse** rotors.

ALL ABOARD, TROOPS!

The legendary Boeing CH-47 Chinook is a tandem-rotor helicopter. Since its first flight on September 21, 1961, it has been used in many tough combat situations, mainly to move troops and deliver supplies on the battlefield. It can carry up to 55 troops or a load of 28,000 pounds. It features a loading ramp at the rear and three external cargo hooks. For its size, it has an impressive top speed of 195 mph.



TANDEM ROTORS

LENGTH OF CRAFT: 98 FEET
HEIGHT OF CRAFT: 19 FEET
ROTOR DIAMETER: 60 FEET
TAKE-OFF WEIGHT: 50,000 POUNDS
ENGINE: 2x LYCOMING T55-GA-712
TURBOSHAFT, EACH WITH 3,750
HORSEPOWER

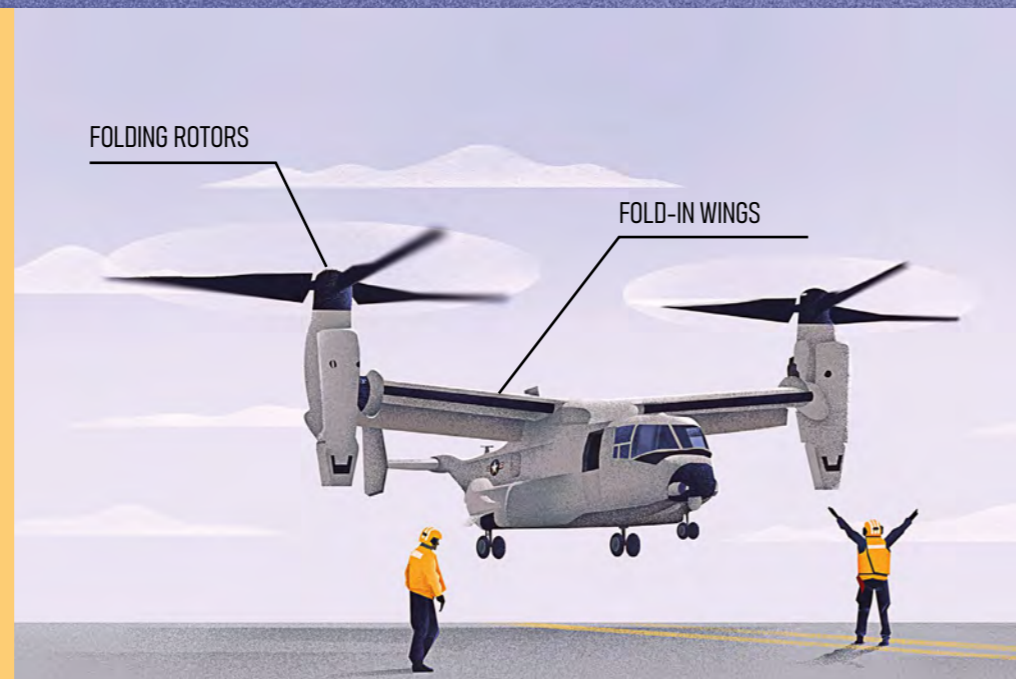
THE LARGE LOADING RAMP AT THE REAR SERVES FOR THE DROPPING OF PARATROOPERS.

SIMON, MOLLY,
PLEASE STOP
JUMPING ABOUT!

CONVERTIPLANE

The Bell Boeing V-22 Osprey is a unique **convertiplane**, which means it combines the features of a helicopter and an airplane. It can take off and land vertically like a helicopter, thanks to its rotors, but it also has the speed and range of a fixed-wing aircraft. This mix of features makes it very adaptable.

The Bell and Boeing companies worked together to create the V-22 Osprey. It first flew in 1989 but wasn't used until 2007. The time spent developing it paid off. The Osprey can fold its rotors and wings in 90 seconds, making it more compact. It can fly at speeds of up to 350 mph and has a range of about 1,000 miles – or 2,175 miles with extra fuel tanks. It can carry 32 troops or up to 20,000 pounds of cargo inside and 15,000 pounds of cargo outside.



FOLDING ROTORS

FOLD-IN WINGS

LENGTH OF CRAFT: 57 FEET / HEIGHT OF CRAFT: 22 FEET
ROTOR DIAMETER: 39 FEET / WINGSPAN: 46 FEET
TAKE-OFF WEIGHT: MAX. 47,400 POUNDS
ENGINE: 2x T406/AE 1107C-LIBERTY TURBOSHAFT, EACH WITH OVER 6,000 HORSEPOWER

REALITY OR SCI-FI?

The Osprey looks like something from a sci-fi movie. Designers have big imaginations, and the helicopters of the future will look even more futuristic. They'll use the latest materials and technology to keep costs low and make them work better. Just like with airplanes, more and more future helicopters will be unmanned and operated by computers.

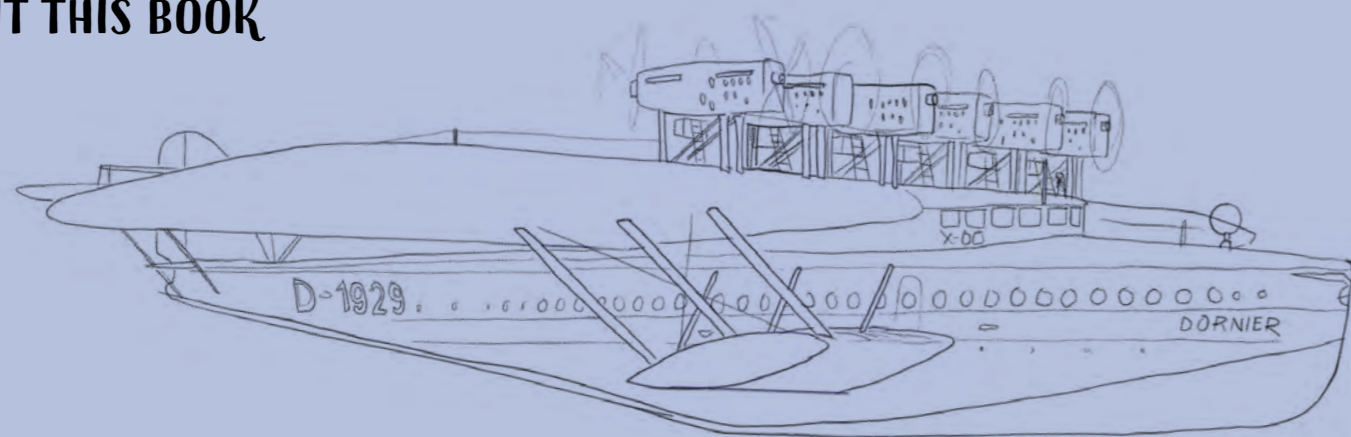


THE NORTHROP-GRUMMAN MQ-8 IS AN UNMANNED HELICOPTER USED FOR RECONNAISSANCE, SURVEILLANCE, RESEARCH, AND LASER TARGETING OF OBJECTS ON THE GROUND.

PROTOTYPE OF THE SIKORSKY S-97 RAIDER, WHICH WILL REACH SPEEDS OF 273 MPH AND BE ABLE TO OPERATE WITHOUT A PILOT.



ABOUT THIS BOOK



Summer 1981, end of the school year. A proud first-grader, I show my grandmother the big “A” on my report card. She rewards me with an ice cream and a book. I fall in love with the book – not because of the subject, though, but because of my name in the title: *Tommy’s Discoveries*. Everything that Tommy in the book goes through, I go through alongside him. The memory has remained so sharp that when I got a chance to write a children’s book of my own, I wanted to give my readers the same feeling. On opening my book, he, she, or they are welcomed by Grandpa Edward, so becoming part of the adventure.

In 1993, I was waiting at Frankfurt Airport for a flight to New York with my mates from the Czech national baseball team, about to fly for the first time. I’d never been more nervous. But when I laid eyes on the double-decker Boeing, my nervousness gave way to awe. I’ll never forget the size of the thing, the take-off forcing me back in my seat, and the landing at the second attempt (the pilot got it wrong the first time around). As you see, I didn’t have to search very hard to find a subject for my book.

At first, however, I was unsure where to begin and how to go about it. Czech writer Zdeněk Svěrák once remarked that

when he writes for children, he gets down on his knees to see the world from a child’s perspective. I opted for this approach. I used social media to ask parents to find out what interests their children most about flying. In this way, I gathered lots of questions and suggestions that have helped me see my subject through a child’s eyes.

To find answers to all that interests the children, I had to do my research. I read books with titles like *The Aircraft Book: The Definitive Visual History*, *An Encyclopaedia of Modern Aircraft*, *How Airliners Fly*, *Ask the Pilot*, and even *Myths and Legends of Ancient Greece*. I searched the internet for interesting stories about aircraft and people who developed them. I discovered many more interesting things than I was able to include in this book. But all the most interesting stuff is here.

I’m confident that young readers will enjoy this book. What’s more, I trust that some will be inspired to explore the subject and take the adventure further. Who knows? Maybe they are the pilots and aircraft designers of the future!

Tomáš SMOT Svoboda, a.k.a. Air Ace

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BOOKS I REALLY ENJOYED, AND YOU WILL TOO.

The Aircraft Book: The Definitive Visual History, by DK, 2021

Means of Transport That Changed the World, by Štěpánka Sekaninová, Tom Velčovský; Albatros, 2022

Means of Transport That Almost Changed the World,
by Štěpánka Sekaninová, Tom Velčovský; Albatros, 2023

*The Encyclopedia of Modern Aircraft: From Civilian Airliners
to Military Superfighters*, by Jim Winchester; Thunder Bay
Press, 2006



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Look up at the sky, kids. What do you see? Do you see fluffy clouds and birds soaring high? Is that an airplane, leaving a long white trail behind it? Where could it be headed? Oh, and look – there's a hot-air balloon gently drifting over that hill. Imagine how amazing it must be to see the world from way up there! And check out that rescue helicopter zipping through the sky. It's flying so fast!






If you're super curious about the sky, come join Grandpa Edward and his grandkids on an exciting journey through the history of flying. Discover the many famous aviators, incredible aircrafts, and amazing events that have transformed how we travel.

So, what are we waiting for? Up, up, and away!



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