ROCKETS and JETS



A PARRISH COLOUR BOOK FOR CHILDREN

ROCKETS AND JETS

by Marie Neurath

Every child has thrilled to stories of jet planes which cross wide oceans in a few hours, of giant rockets which soar up a hundred miles above the earth. But he wants to know more. How do rockets and jets work ? Why can a rocket go higher than a jet plane ? Why do some planes use a propeller as well as a jet ? Will there ever be jet ships and jet cars ? How might the space ship of the future be driven ?

These and a score of other absorbing questions are here answered by means of pictures that *explain at a glance.* All unnecessary details which might obscure the meaning are rigidly excluded. The same object is always shown by the same simple, unmistakable outline ; colour is used to clarify, not to decorate.

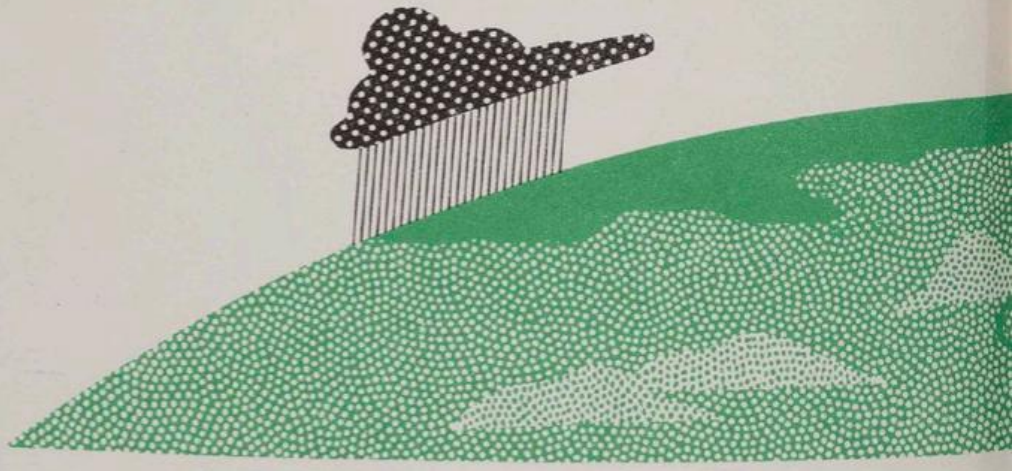
With its bright colours, exciting subject and clear, lively text, this book will hold the attention not only of every child but also of every father.

The technical accuracy of the illustrations in this book has been approved by C. B. Bailey-Watson, technical editor of *FLIGHT.*

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Rockets and Jets





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Rockets and Jets

MARIE NEURATH

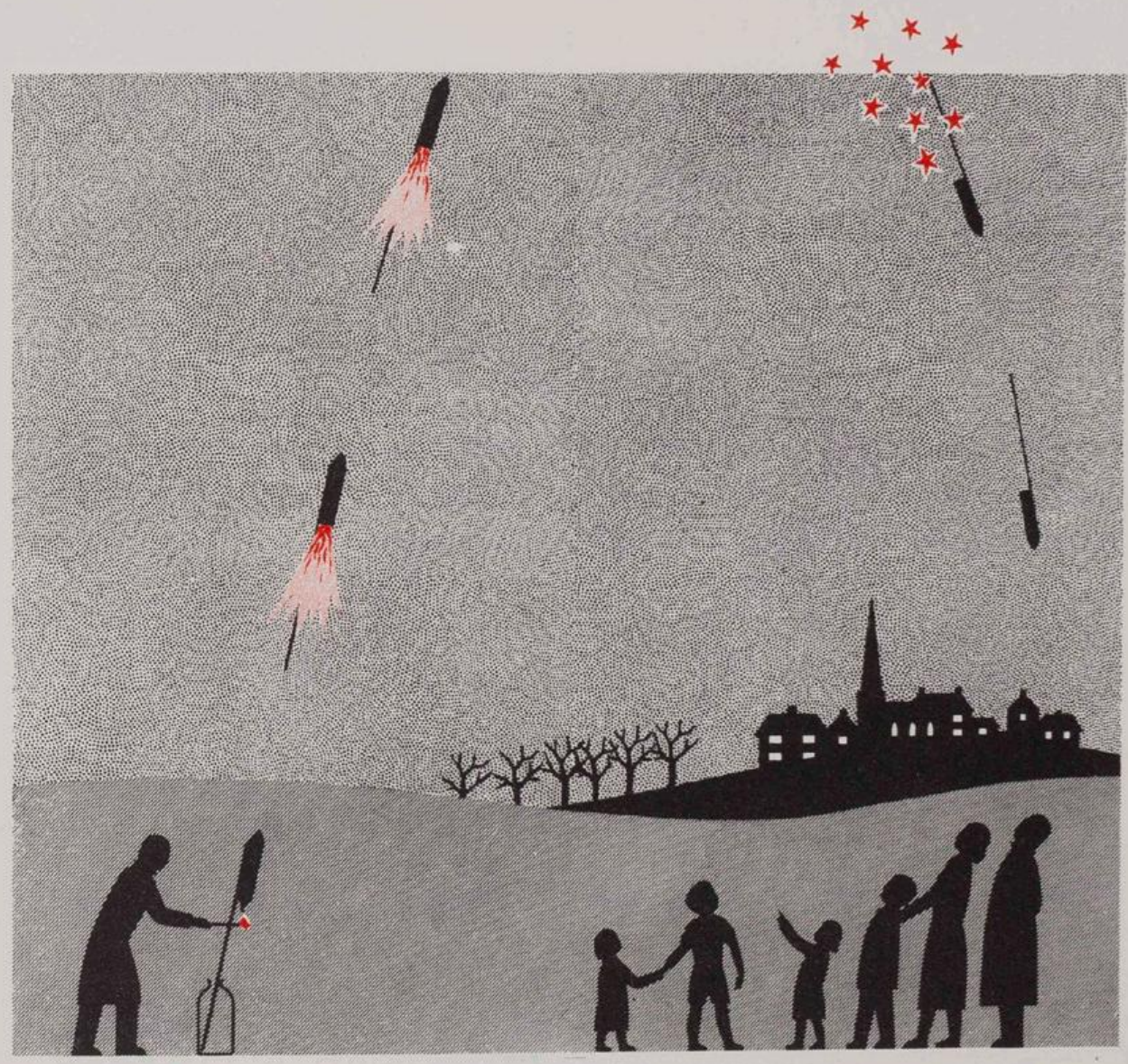


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Burning Powder Sends a Rocket Soaring

The man lights the touch-paper and steps back. For a few seconds it burns steadily, then—swish !—the rocket rises high above the roofs and tree-tops. Inside its head a grey-black powder burns, thrusting the rocket upwards. A cloud of coloured stars—glowing particles of metal—suddenly bursts out.

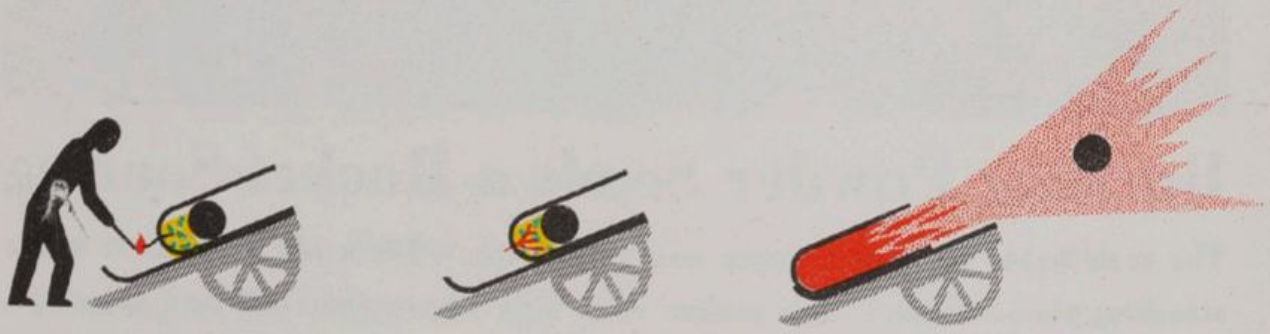
The Thrust which Comes from Burning



Saltpetre (shown yellow) and powdered fuel (shown green) burn furiously together, without the help of air. The mixture is called gunpowder. As it burns, great quantities of gas rush outwards.

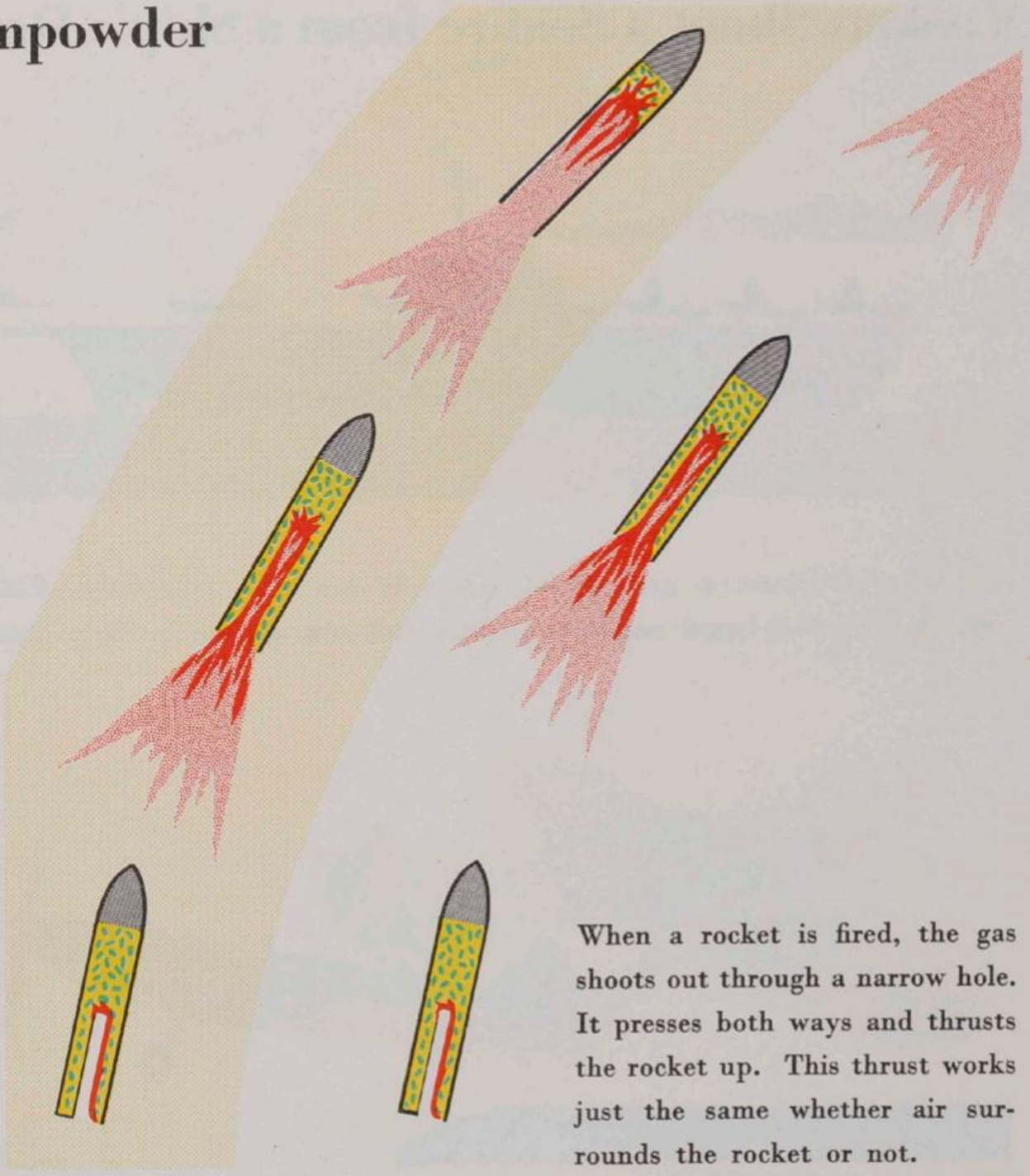


When the gases cannot escape they blow the container into fragments.



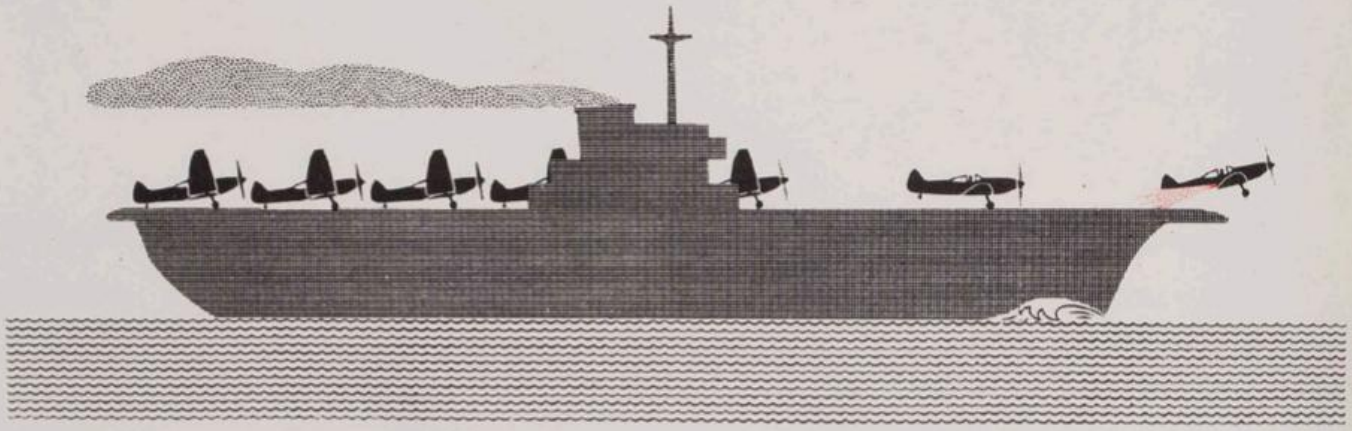
In an old-fashioned cannon, the gas forces its way out by hurling the ball from the mouth of the gun. The gun kicks back as the ball shoots out.

Gunpowder

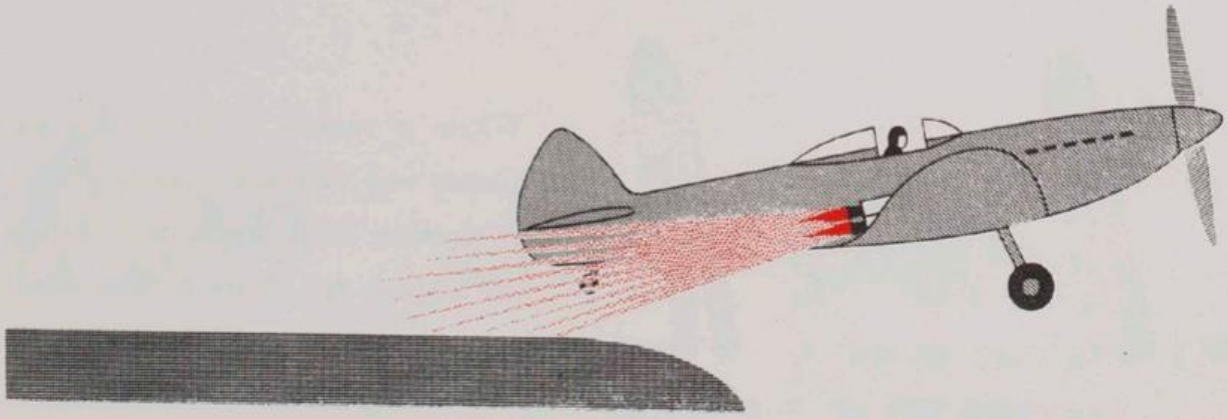


When a rocket is fired, the gas shoots out through a narrow hole. It presses both ways and thrusts the rocket up. This thrust works just the same whether air surrounds the rocket or not.

Rockets Shoot a Seafire from a Ship's Deck

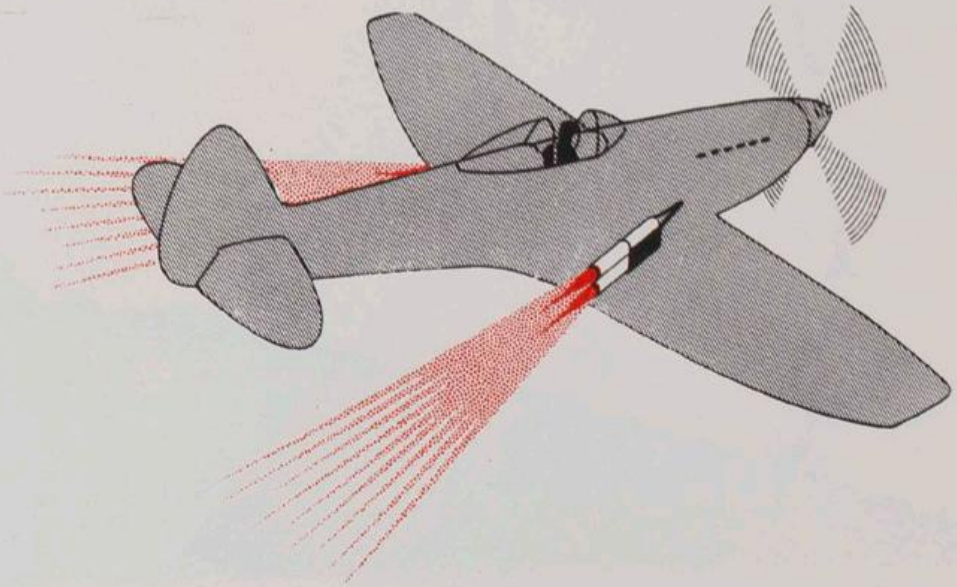


A plane must have a good speed before it can take off safely. This sometimes needs a longer run than a ship's deck can allow. So the airman

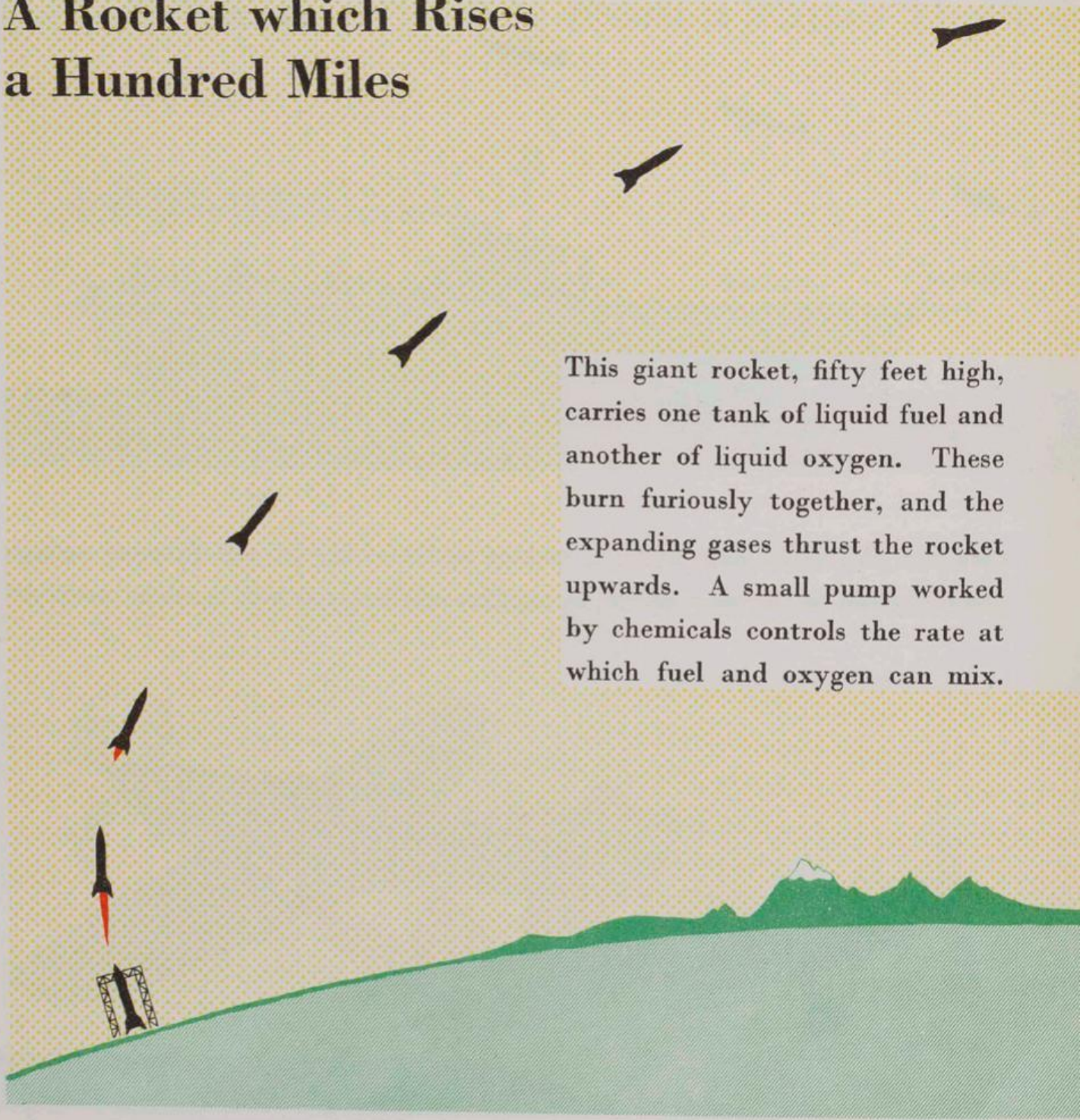




then uses the short, swift burst of rockets to thrust his aircraft forward at high speed. Once in the air, the empty rockets are dropped into the sea.

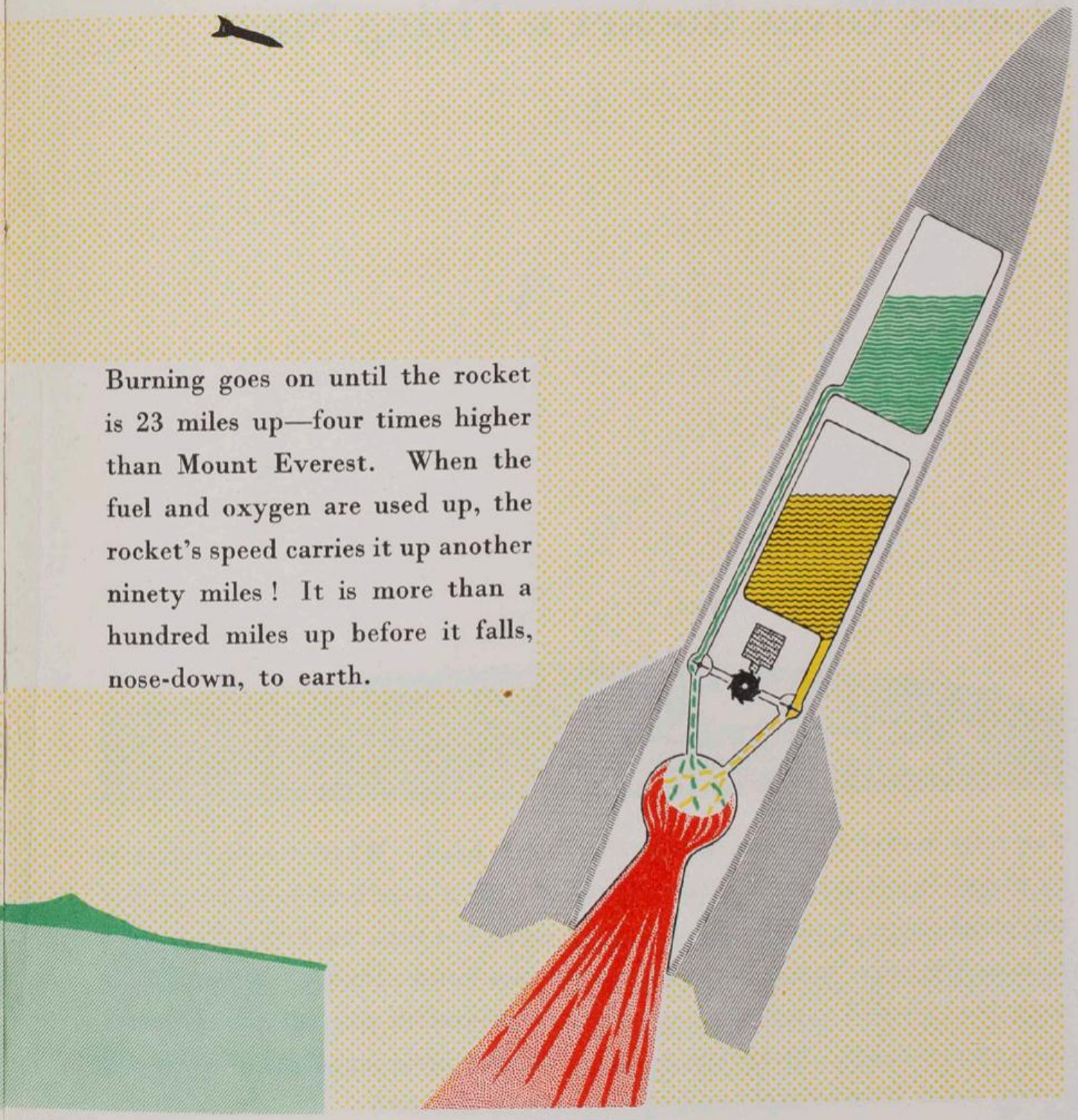


A Rocket which Rises a Hundred Miles

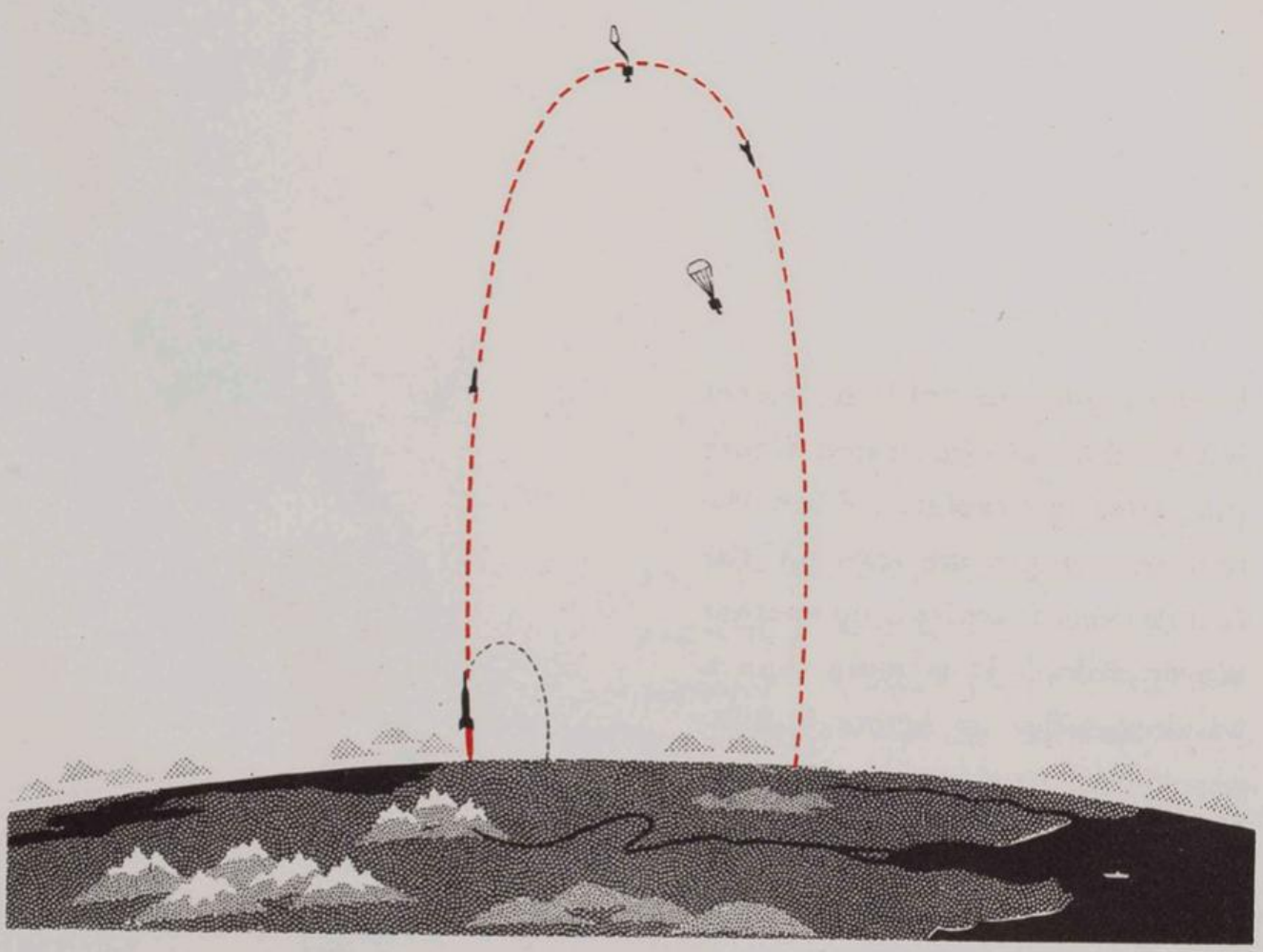


This giant rocket, fifty feet high, carries one tank of liquid fuel and another of liquid oxygen. These burn furiously together, and the expanding gases thrust the rocket upwards. A small pump worked by chemicals controls the rate at which fuel and oxygen can mix.

Burning goes on until the rocket is 23 miles up—four times higher than Mount Everest. When the fuel and oxygen are used up, the rocket's speed carries it up another ninety miles! It is more than a hundred miles up before it falls, nose-down, to earth.

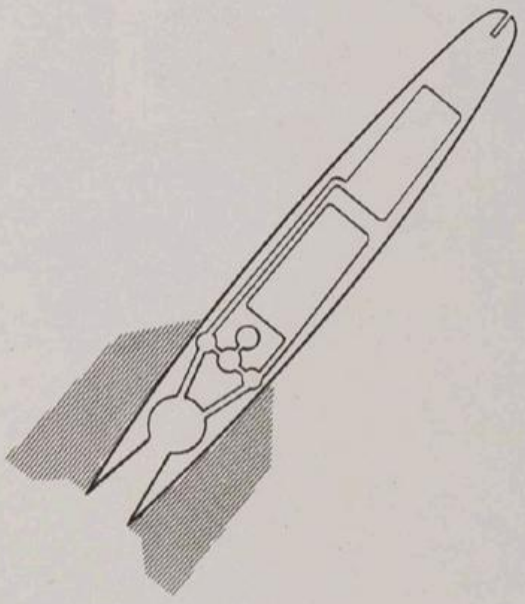


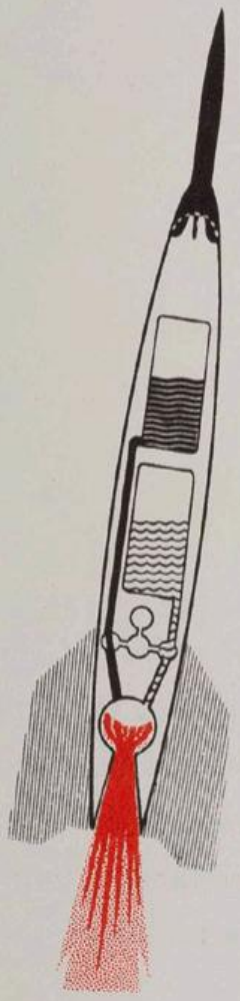
Rocket Gives Rocket a Flying Start



This large rocket has a smaller one fixed to its head. When it is travelling at its highest speed the small rocket is fired off. If it were fired from the ground this small rocket would go up only forty miles, but with the flying start given to it by the larger rocket it climbs another two hundred miles. Rockets have sometimes carried cameras attached to parachutes to photograph the earth from great heights. Some day, perhaps, we shall have snapshots of lands and oceans taken from several hundred miles above the earth.

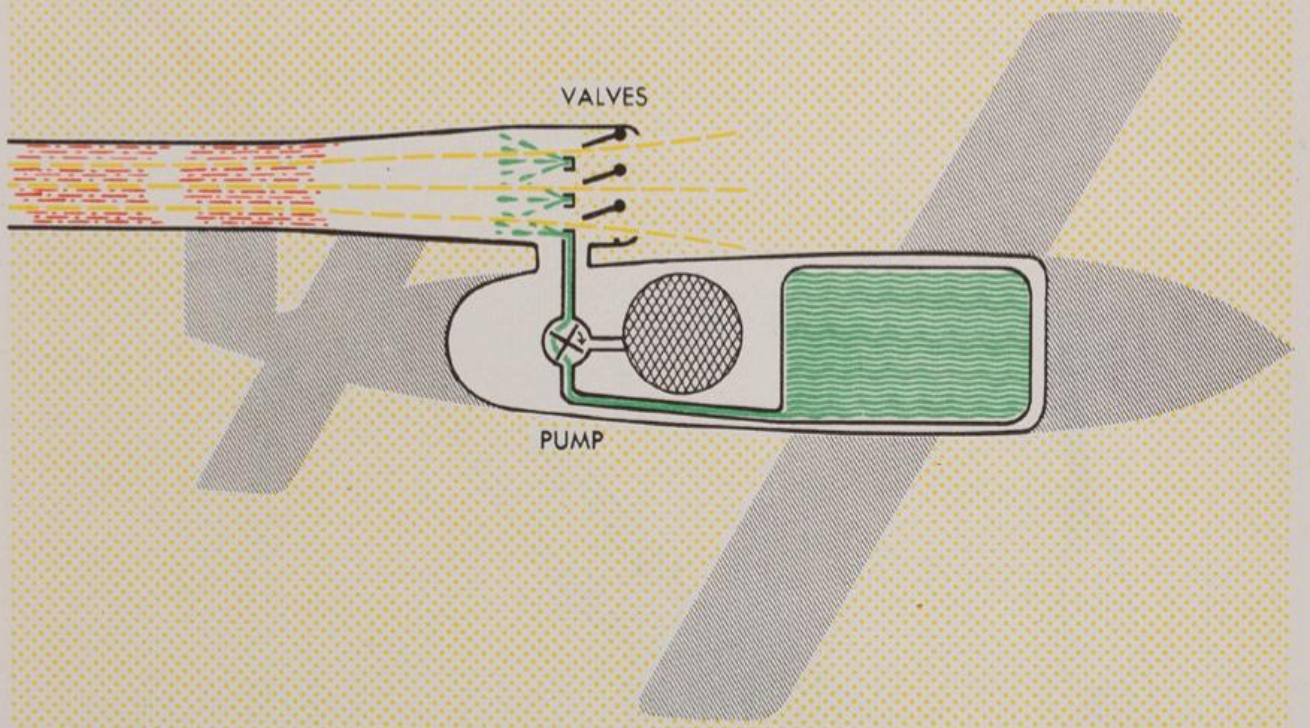




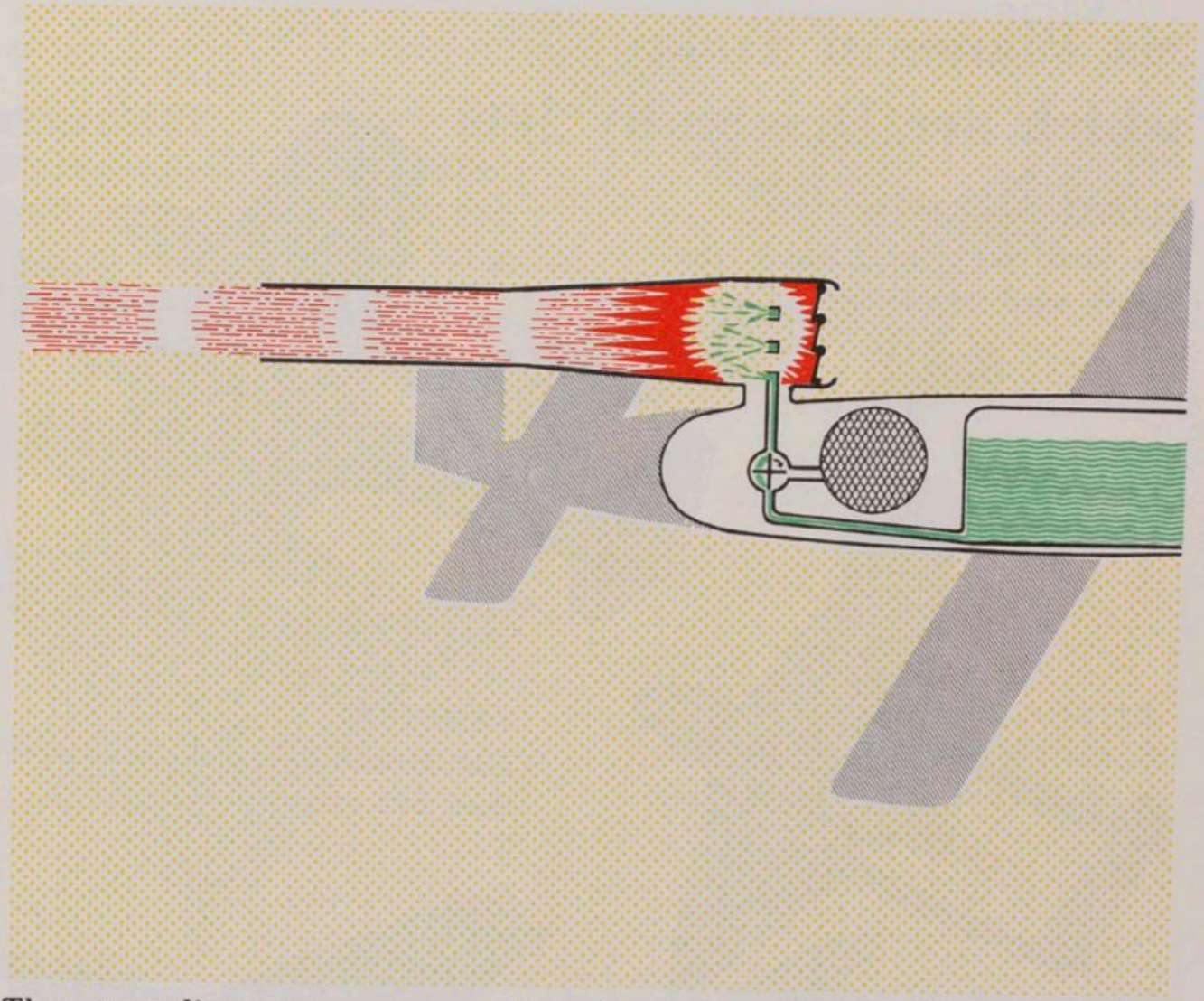


When it is twenty miles up, the large rocket is travelling at nearly four thousand miles an hour (six times faster than the fastest aeroplane). At that moment the small rocket is fired off and shoots upward faster still.

How Thrusting Gas Drives a Plane Without Pilot



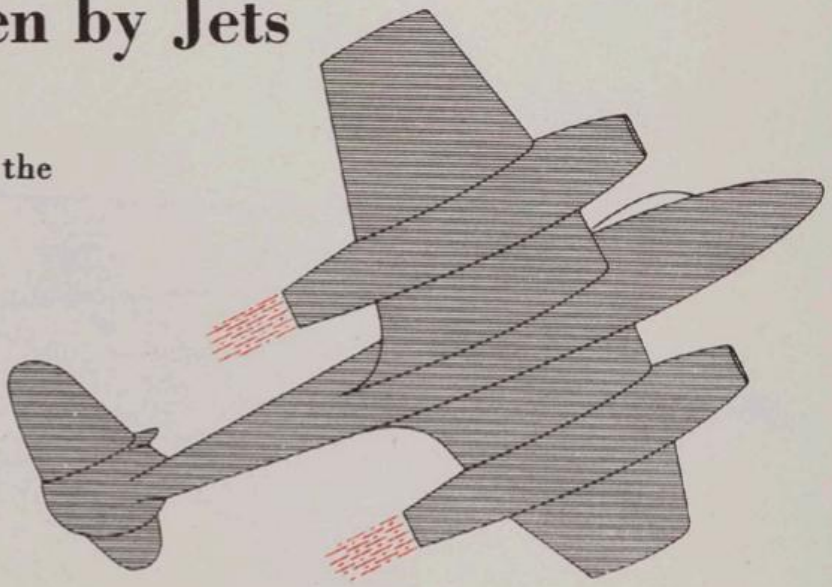
This aircraft is also thrust forward by expanding gas. Above the body of the plane is a bullet-shaped chamber. As the plane flies along, air rushes through valves at the front of the chamber and supplies the oxygen to burn the fuel. In the body of the plane is a tank of liquid fuel which is pumped into the explosion chamber, where it burns rapidly with the air and produces a large amount of gas. The engine is started by electricity, but after that the explosion chamber is hot enough to ignite the fuel.

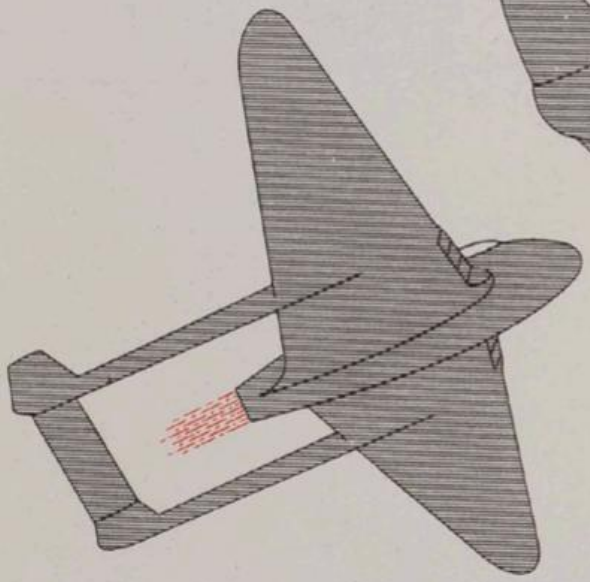


The expanding gas presses against the valves at the front and closes them; all the hot air and gas shoots out from the back. This weakens the pressure in the chamber and the outside air again forces the valves open and rushes in. The valves open and close about forty-five times every second. The many separate puffs of gas, thrusting both ways, push the plane forward. This plane flies without a pilot. It cannot fly in empty space because the fuel needs air before it can burn.

Six Planes of Today which are Driven by Jets

GLOSTER METEOR
The first jet plane which the R.A.F. used in warfare.





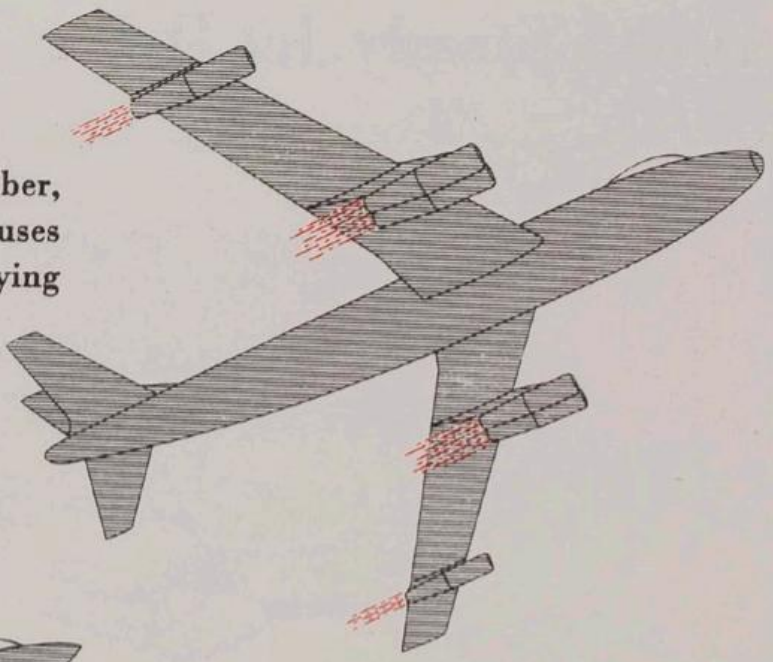
VAMPIRE
First British fighter to fly at more than 500 miles an hour.

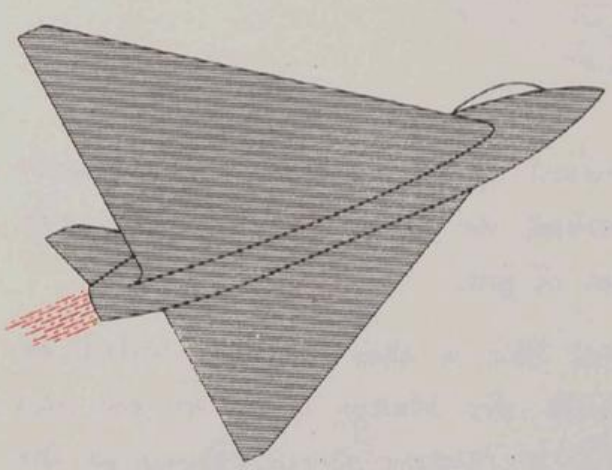


VICKERS SUPERMARINE 510
This fighter can roll easily at high speeds. It can travel almost as fast as sound.

STRATOJET

This six-engined American bomber, much larger than the others, uses eighteen rockets to give it a flying take-off.





AVRO 707

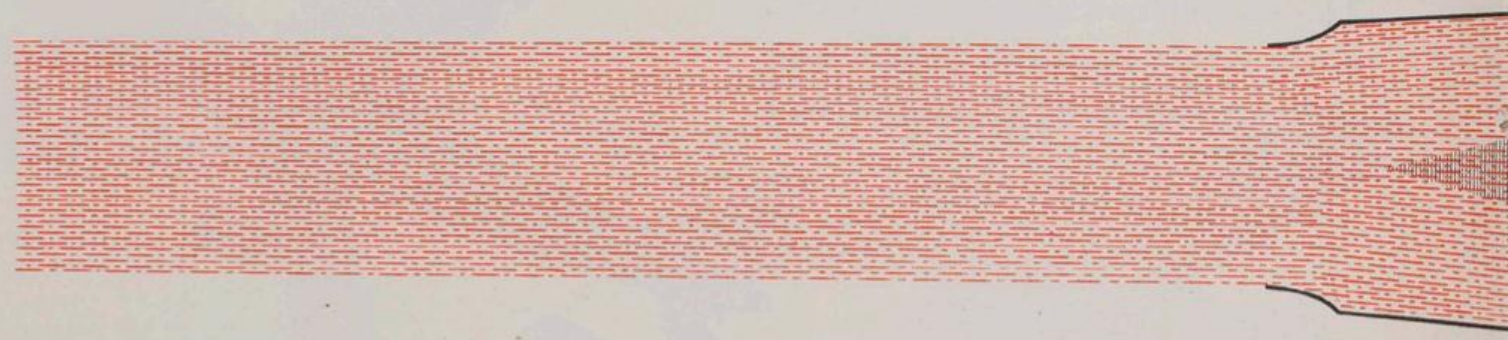
A British plane built with triangular wings. Air enters the jet engine just behind the cockpit.



THUNDERJET

This American fighter carries extra fuel in tanks at the tip of each wing. When in danger, the pilot can drop these to increase speed.

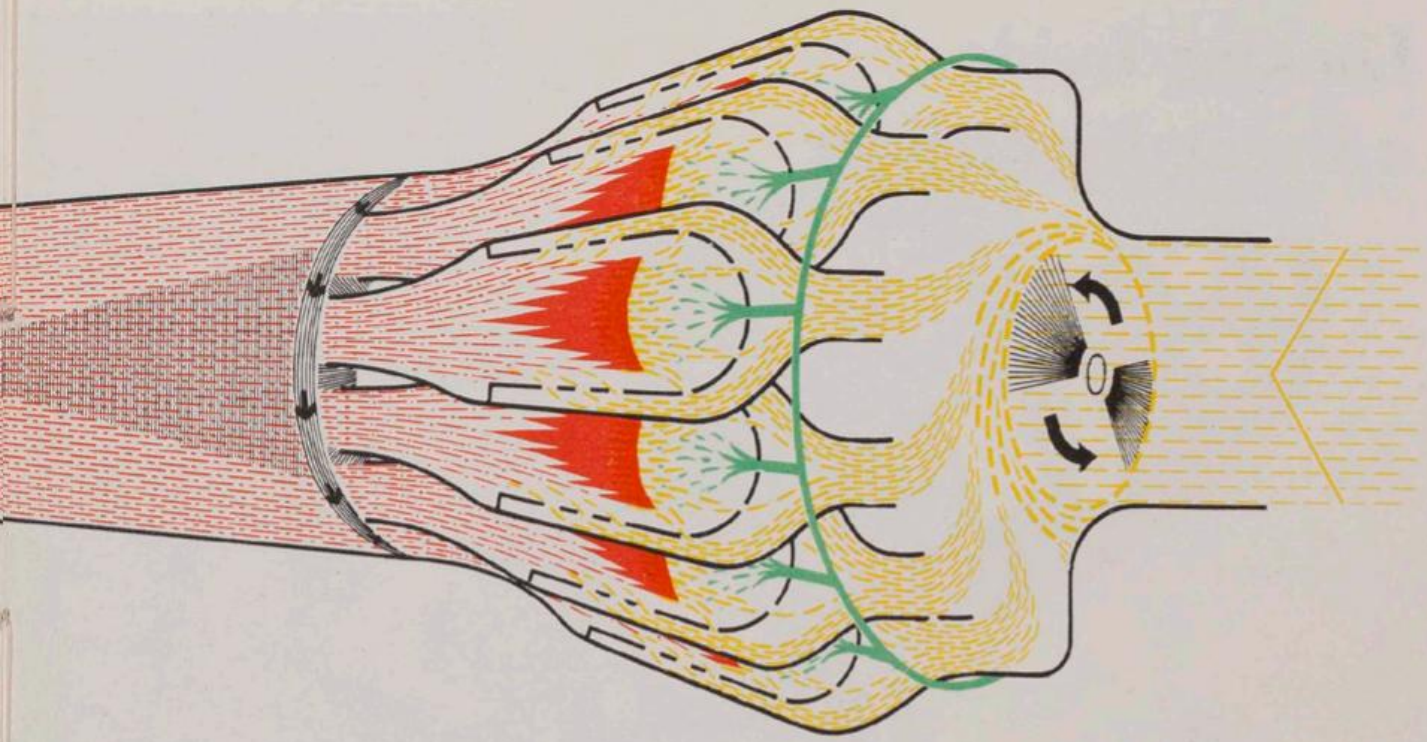
How a Steady Jet Drives the Modern Plane

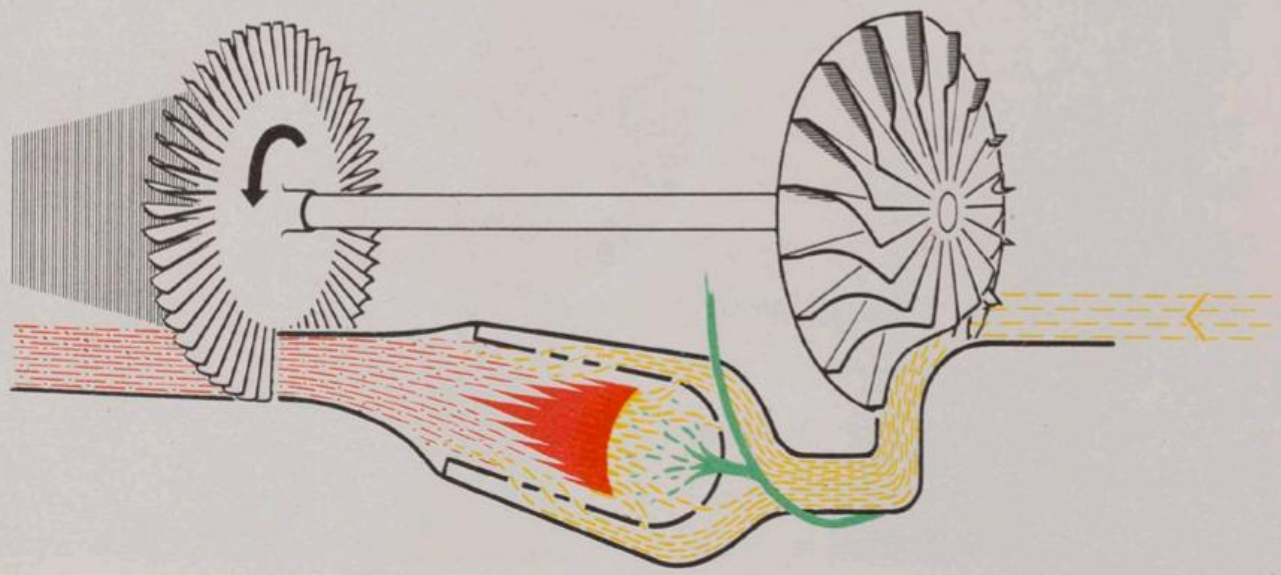


The modern jet plane is not thrust forward by separate puffs of expanding gas, like the plane on page 15. Instead, its engine draws in a steady stream of air and forces out a steady jet of gas.

At the front of the engine is a wheel like a ship's screw, called an impeller. When this wheel whirls round, the blades draw in air and force it back through narrow pipes. The air passes through holes in the pipes, mixes with a spray of fuel and burns furiously. A hot jet of gas and air rushes out.

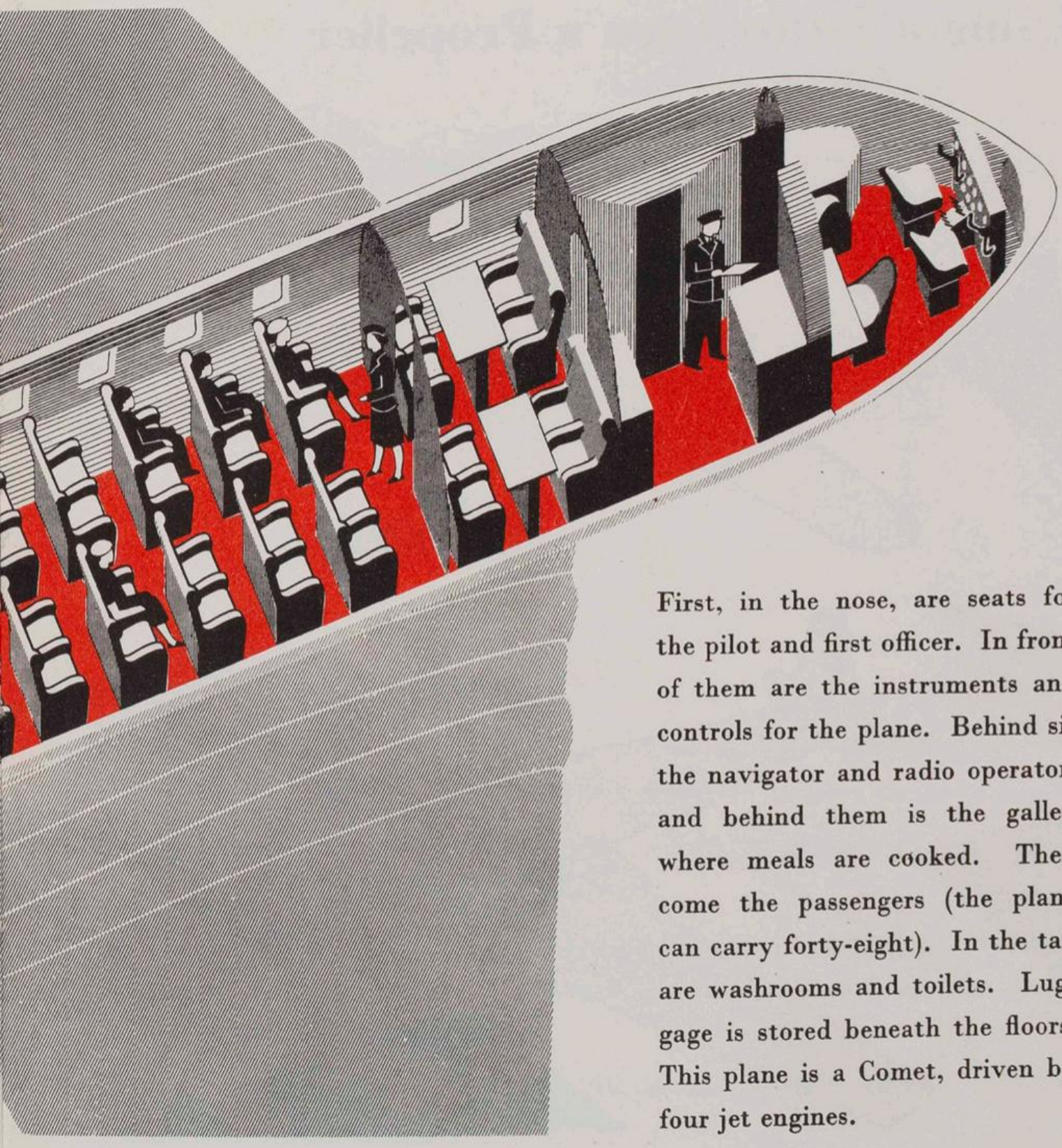
Near the back of the engine is a second wheel called a turbine, shaped like a large electric fan. As the gas rushes backwards it spins the turbine round. But the turbine is fixed to the impeller, and when the turbine spins the impeller must spin with it. So *once the engine is started,* the jet both drives the plane and draws in the air.





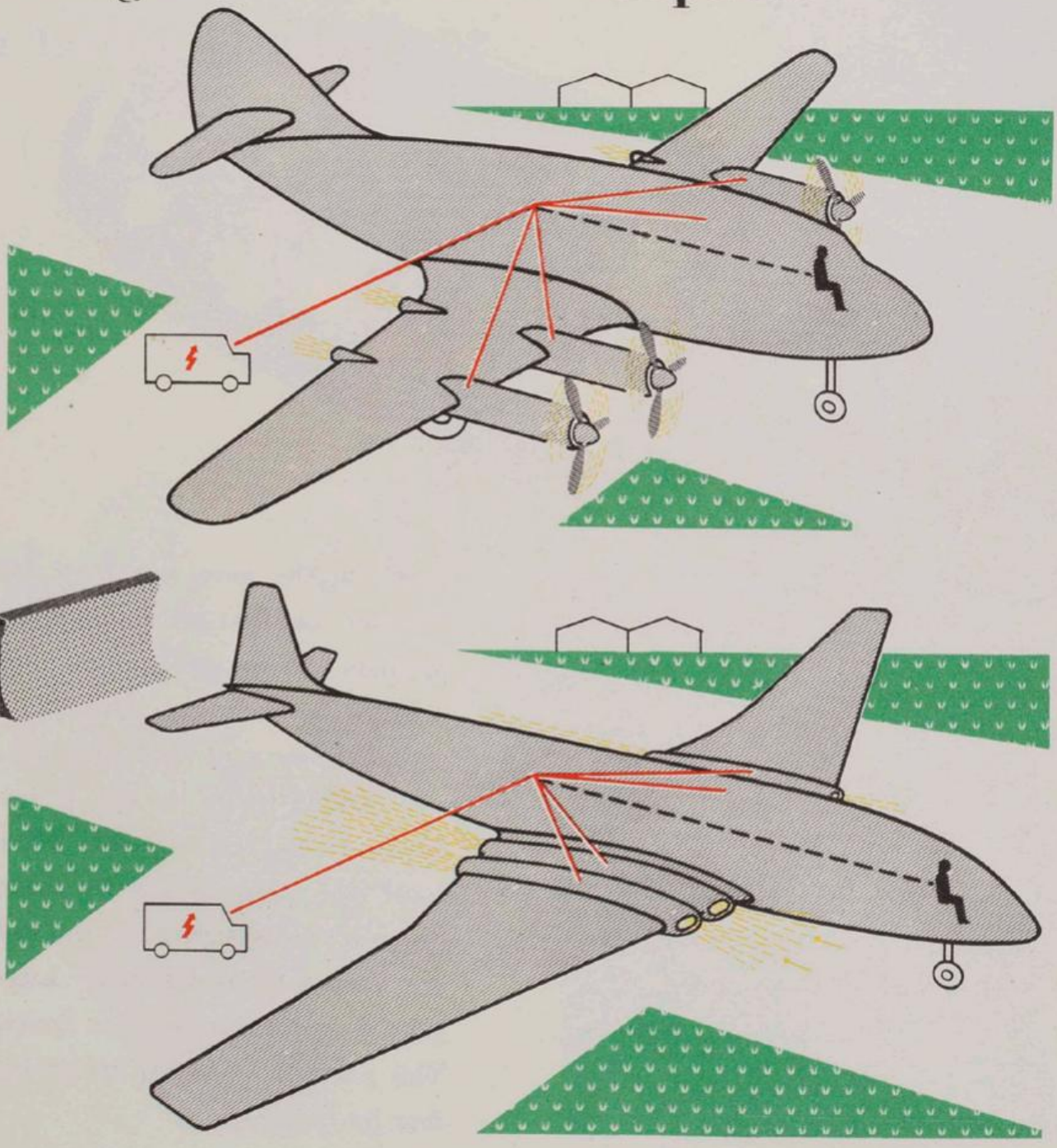
Looking Inside a Great Jet Airliner

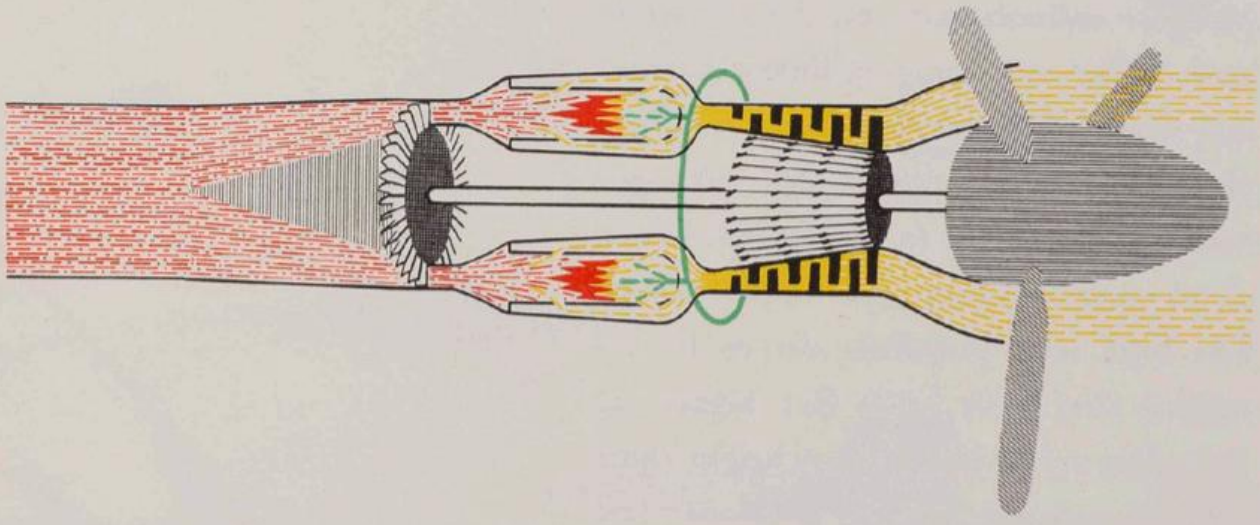




First, in the nose, are seats for the pilot and first officer. In front of them are the instruments and controls for the plane. Behind sit the navigator and radio operator, and behind them is the galley where meals are cooked. Then come the passengers (the plane can carry forty-eight). In the tail are washrooms and toilets. Luggage is stored beneath the floors. This plane is a Comet, driven by four jet engines.

Using a Jet to Turn a Propeller





In the picture above, the turbine drives not only the fan-like wheels which draw in the air, but also a propeller. The fan-like wheels press the air back into the chambers where the fuel burns.

But how do the engines start? For no air is drawn in, and the fuel cannot burn until the turbine turns.

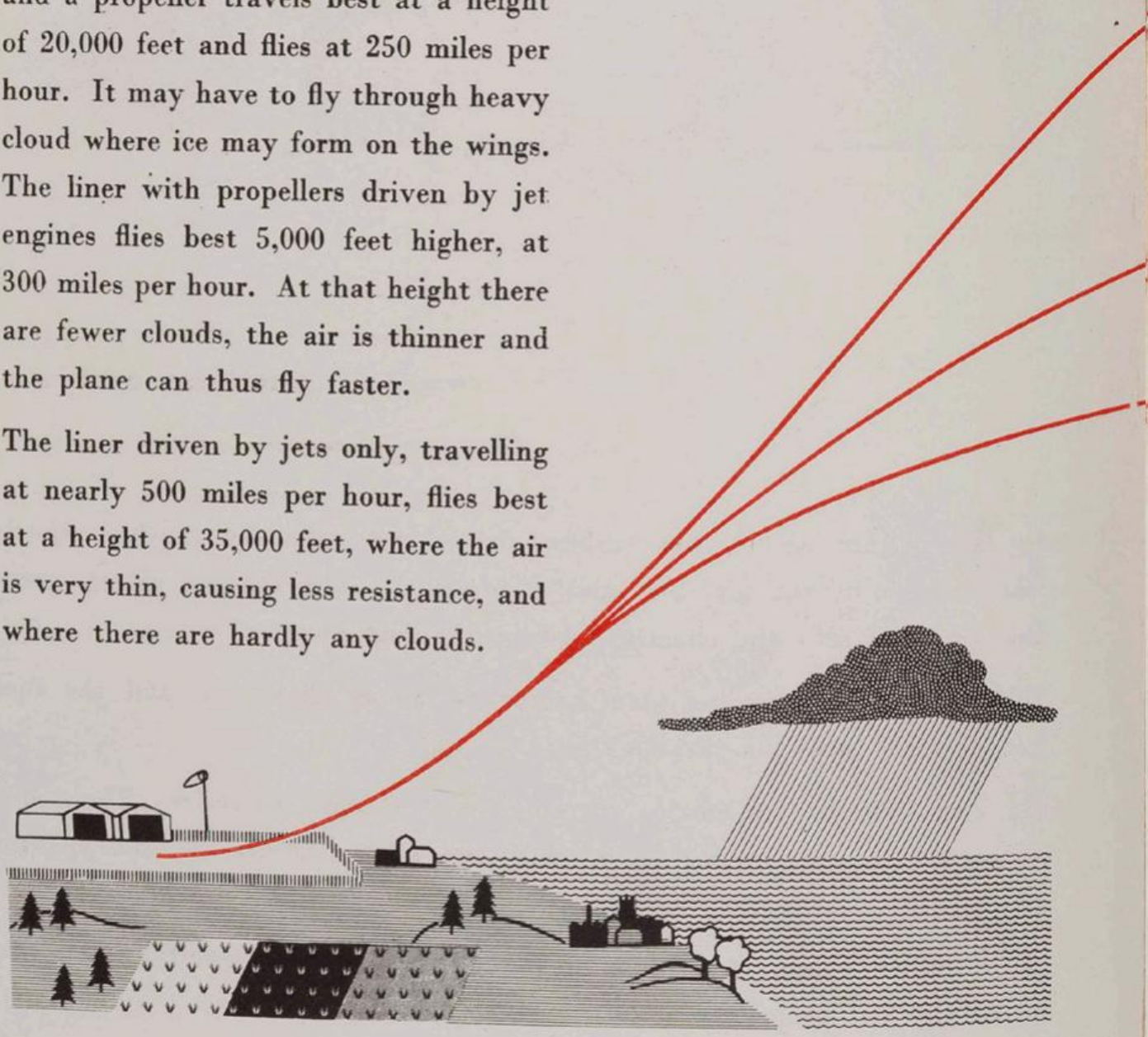
On each airfield are lorries carrying large electric batteries. These are connected to the engines, and when the pilot switches on, the electric power starts the turbine turning.

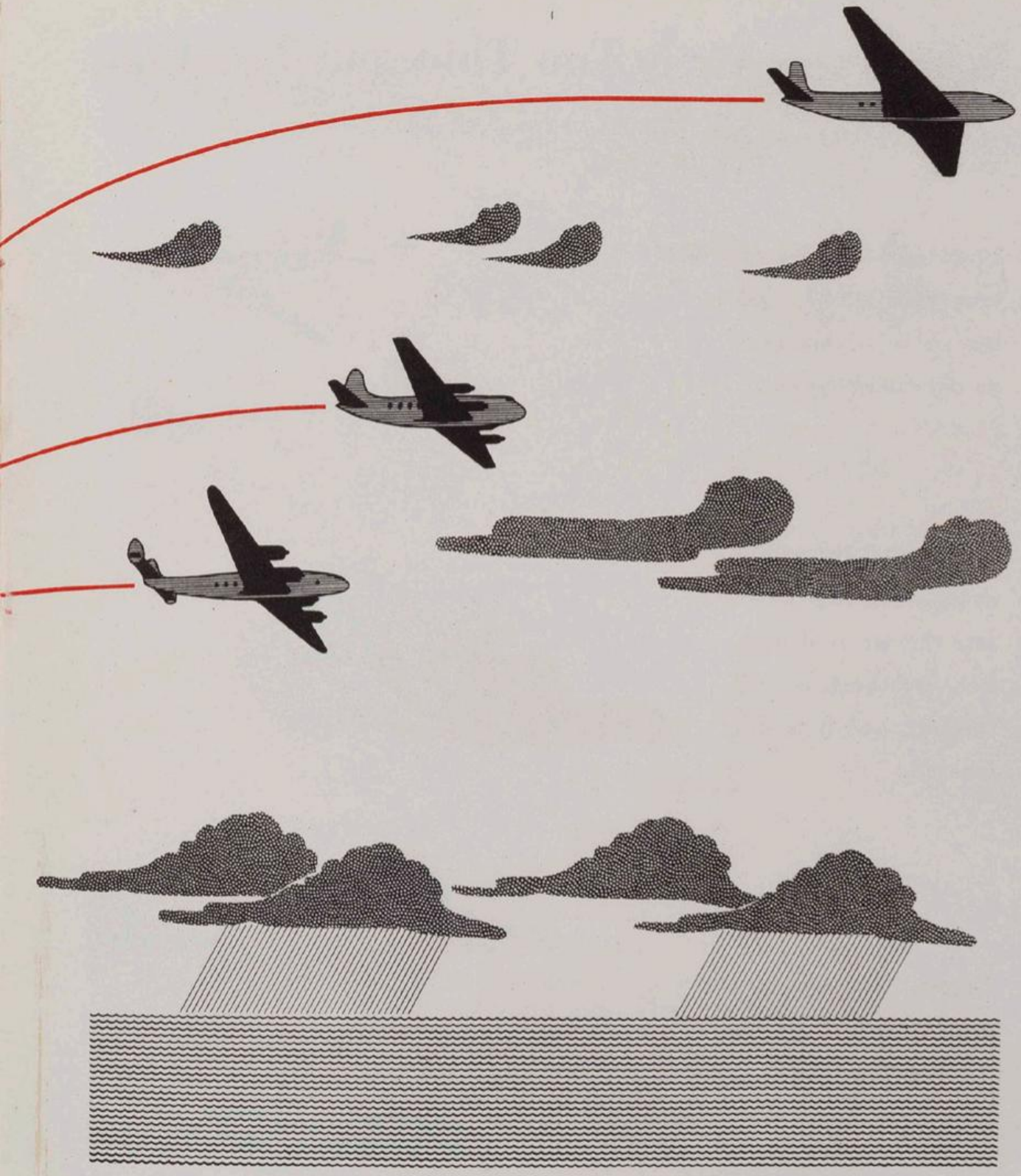
Why do you think the thrust of the jet can be less powerful when the plane also has propellers?

Flying High Above Cloud and Ice

All these airliners carry roughly the same load. The one using ordinary engines and a propeller travels best at a height of 20,000 feet and flies at 250 miles per hour. It may have to fly through heavy cloud where ice may form on the wings. The liner with propellers driven by jet engines flies best 5,000 feet higher, at 300 miles per hour. At that height there are fewer clouds, the air is thinner and the plane can thus fly faster.

The liner driven by jets only, travelling at nearly 500 miles per hour, flies best at a height of 35,000 feet, where the air is very thin, causing less resistance, and where there are hardly any clouds.





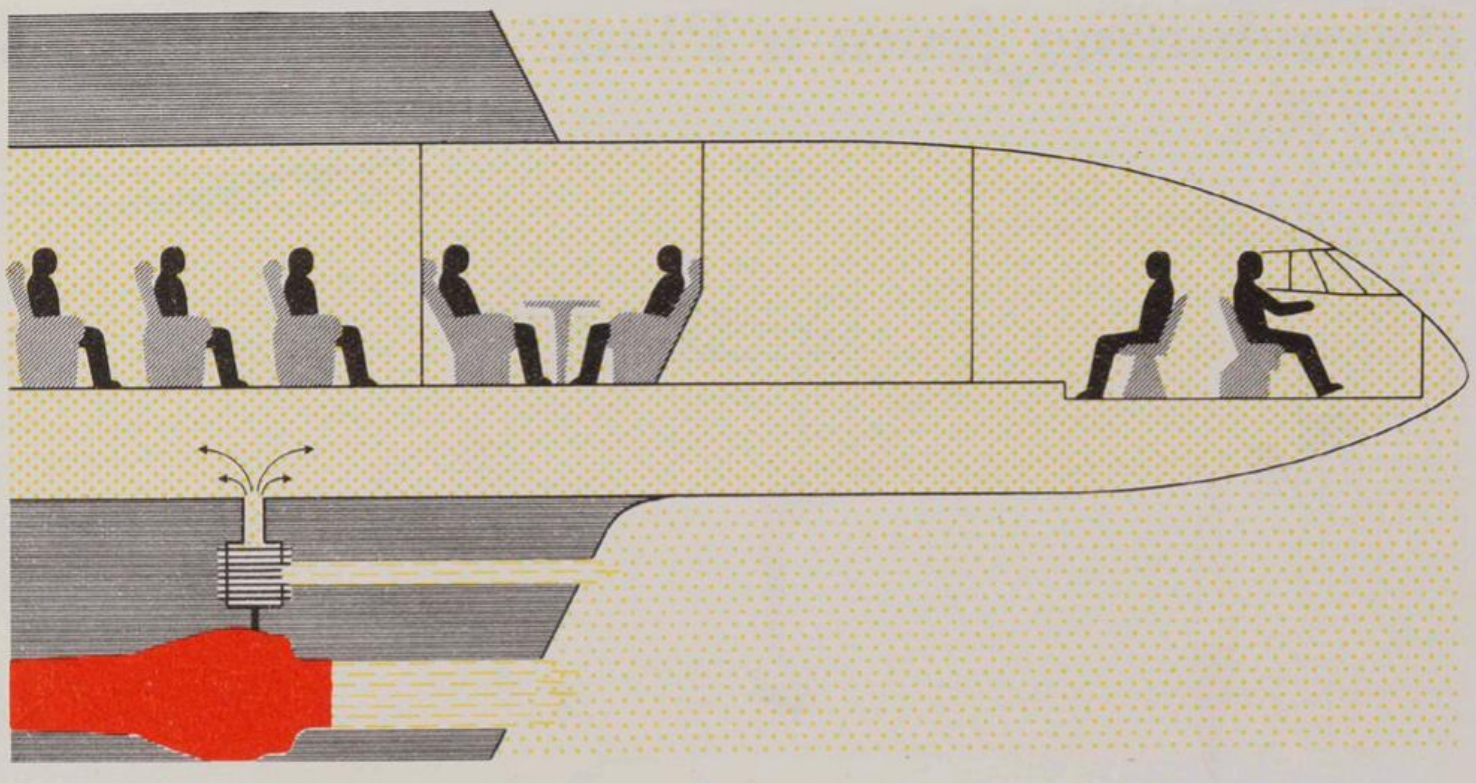
Where the Air is Too Thin and Too Cold

Eight miles up it is very cold indeed, and the air is so thin that no one could live in it.

Four miles up, nearly as high as Mount Everest, the air is denser, but breathing is still difficult, and it is still ice-cold.

On the ground we can breathe easily and the air is warm.





How can we warm and compress the air inside the plane which is flying at a great height ?

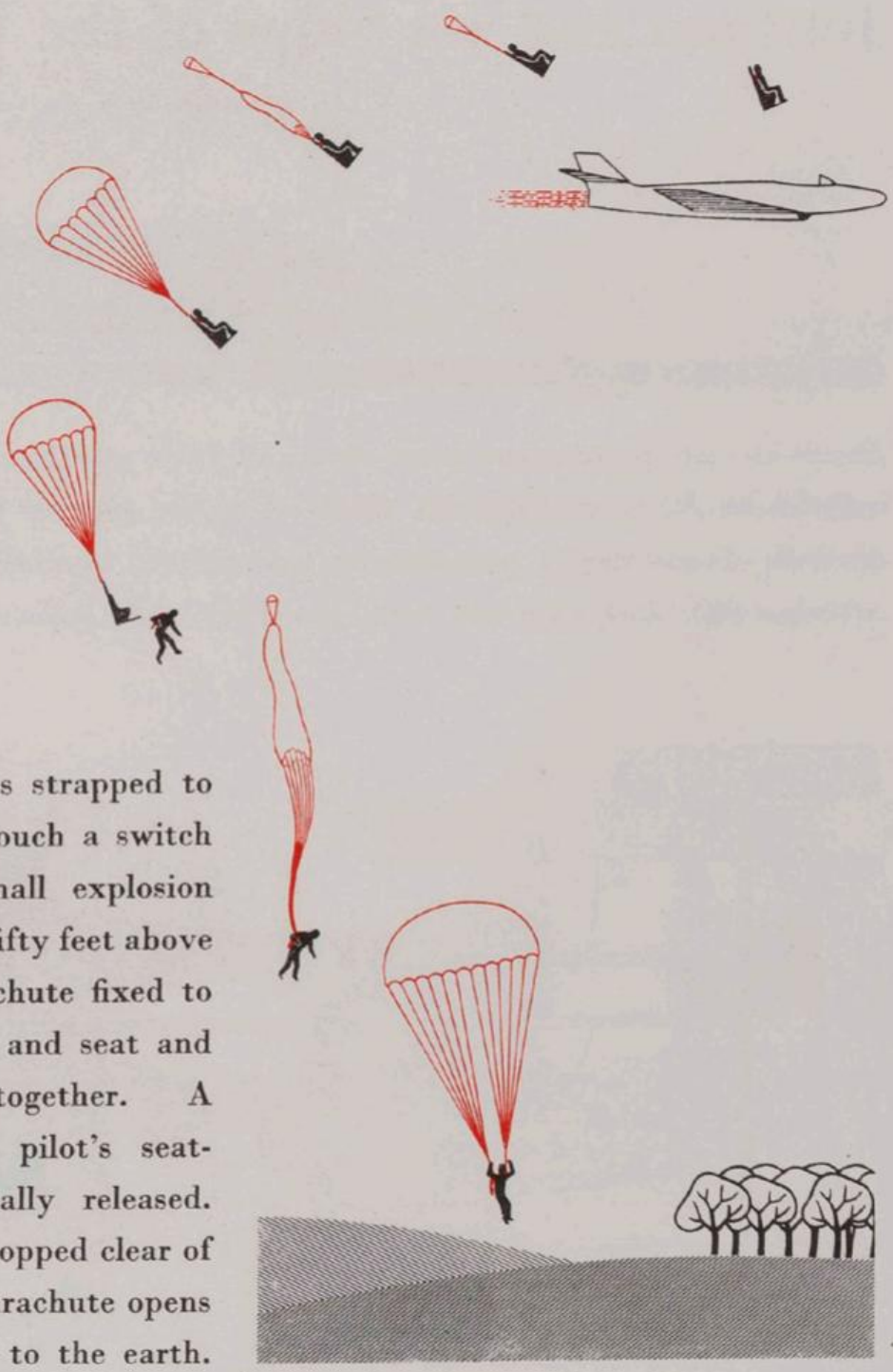
The jet engine drives a small fan-like wheel which draws in air, compresses it until it is as dense as the air near the ground and passes it into the cabins. As the air is compressed it is also warmed.

Air for the cabins is sometimes compressed by the main engines instead.

Parachuting from a Plane at High Speed

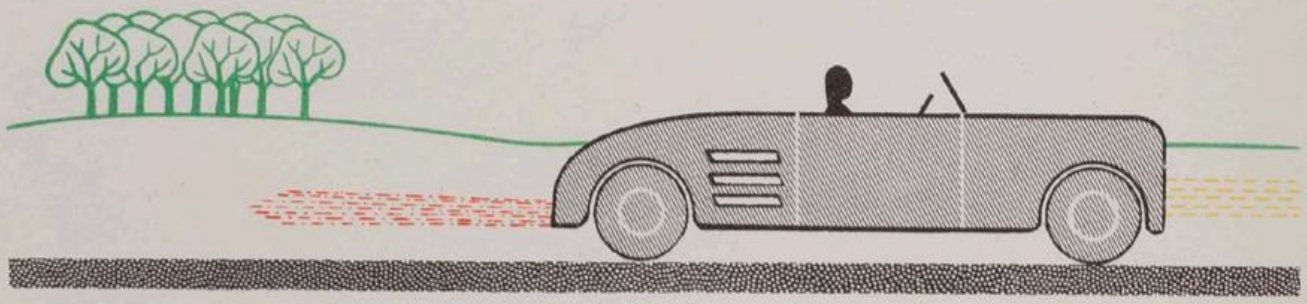


A parachutist can jump easily and safely from the basket of a balloon. To "bale out" from the cockpit of a plane travelling at 250 miles per hour is more difficult but still not very dangerous. But if a pilot tried to jump from a jet fighter flying at 500 miles per hour the force of the wind would send him crashing against the tail of the plane.

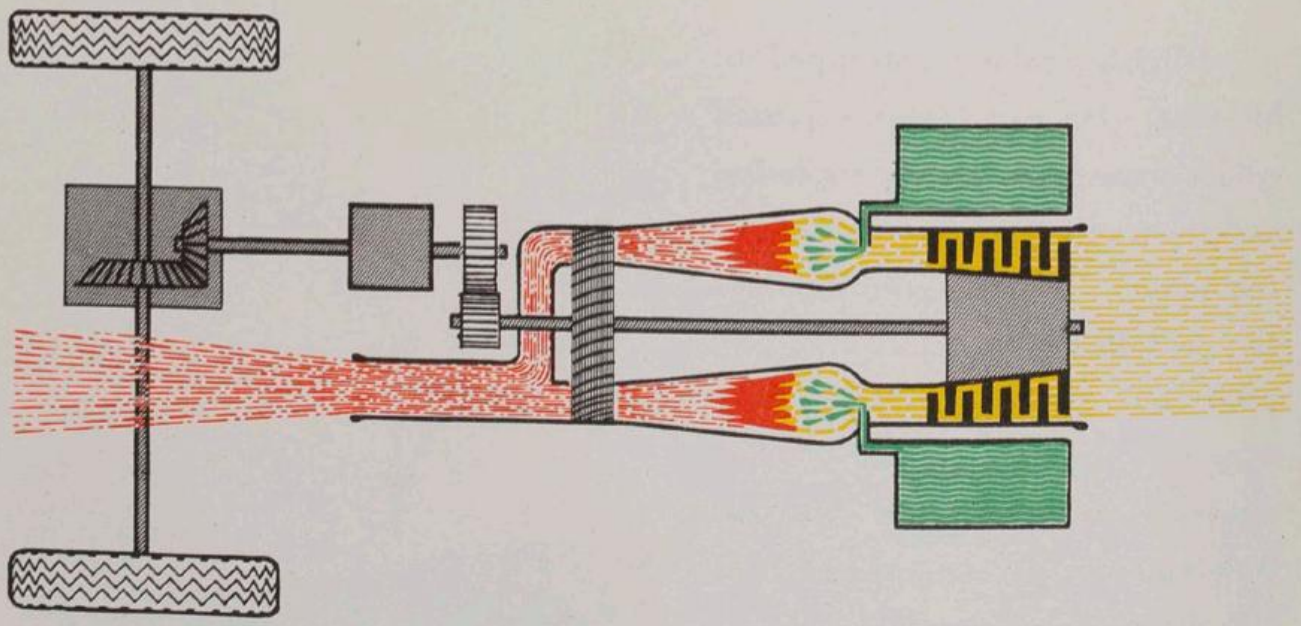


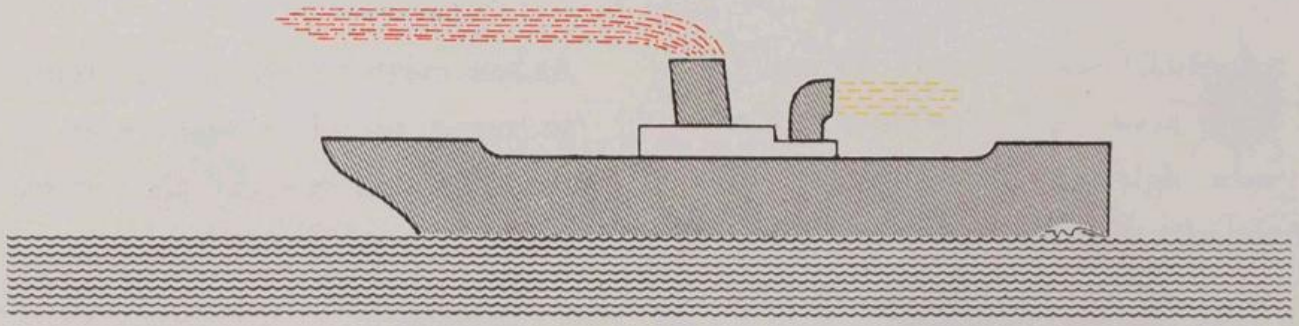
A jet-fighter pilot is strapped to his seat. He can touch a switch which causes a small explosion and shoots the seat fifty feet above the plane. A parachute fixed to the seat flies open, and seat and pilot fall gently together. A moment later the pilot's seat-strap is automatically released. As soon as he has dropped clear of the chair his own parachute opens and he falls slowly to the earth.

Jet Cars and Jet Ships of the Future

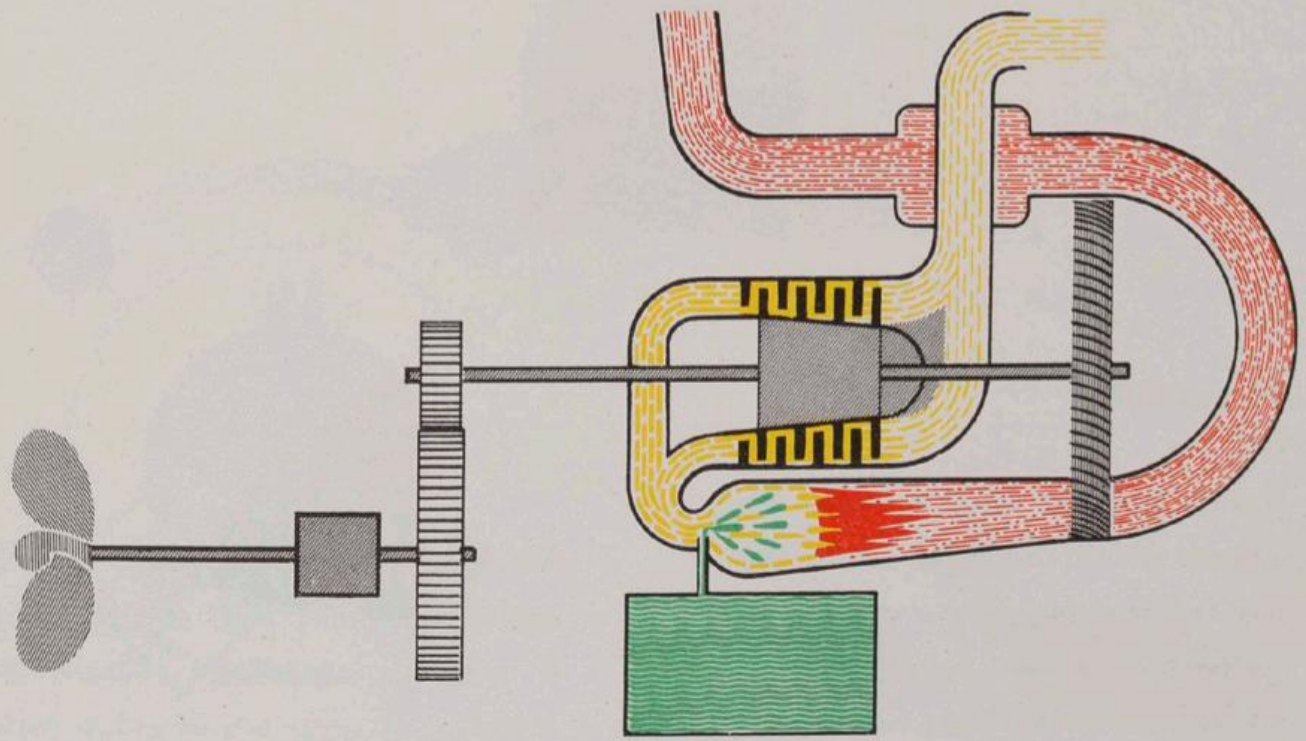


Here we see how a jet may drive the car of the future. The engine will be like that on page 23. But when the jet sets the turbine moving, instead of spinning a propeller, it will turn a number of connected gear-wheels. The last one will turn the back axle and wheels of the car.

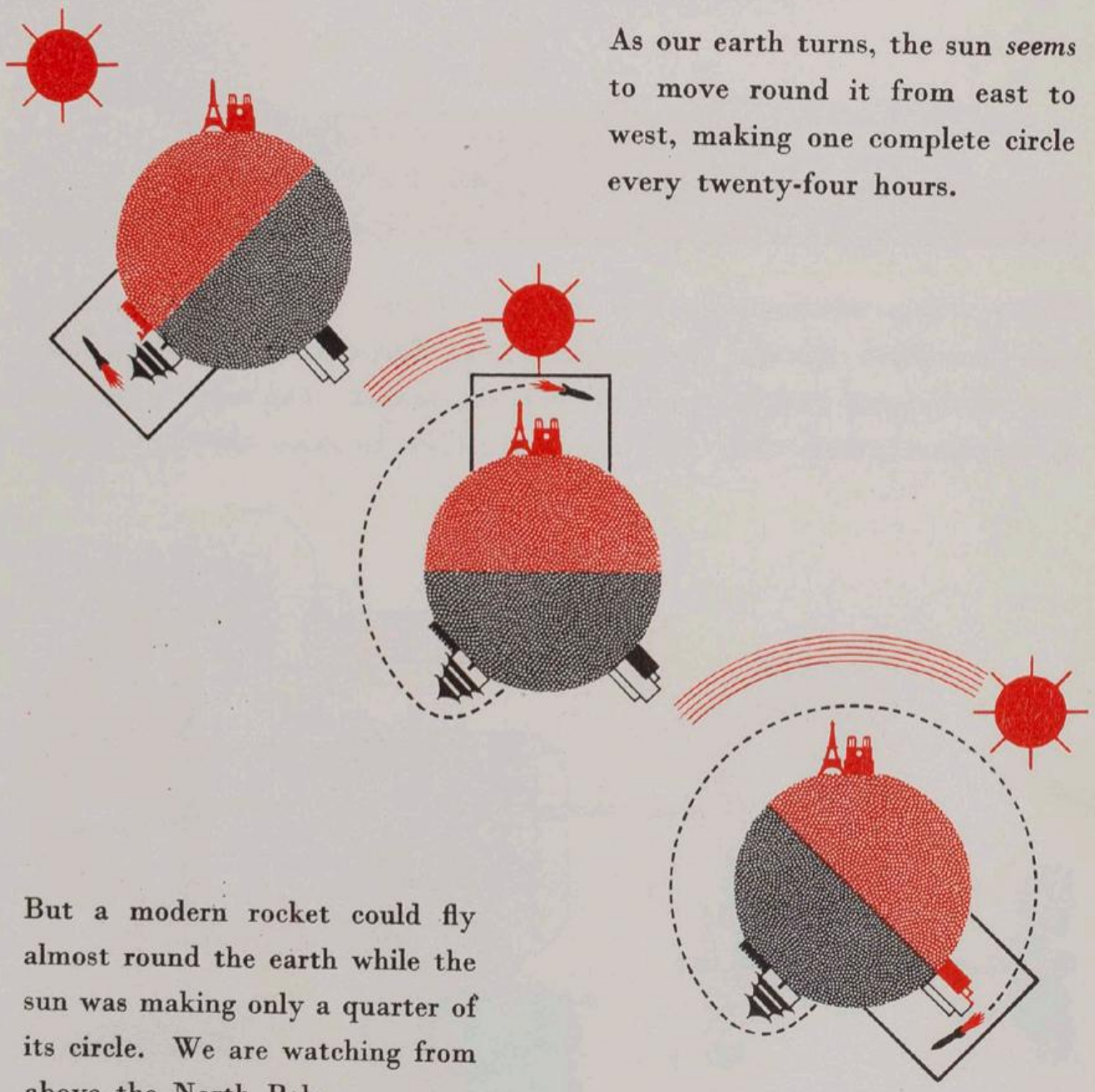




The jet ship of tomorrow will have a similar engine, but, of course, more powerful. Air for the engine will be drawn in through ventilators and waste gases will pass out through the funnel. The turbine (in front of the fans in this case) will turn gear-wheels to drive the ship's screw.



A Modern Rocket can Race the Sun



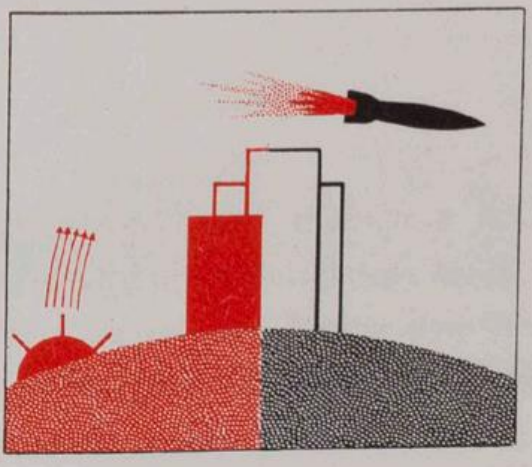
As our earth turns, the sun *seems* to move round it from east to west, making one complete circle every twenty-four hours.

But a modern rocket could fly almost round the earth while the sun was making only a quarter of its circle. We are watching from above the North Pole.



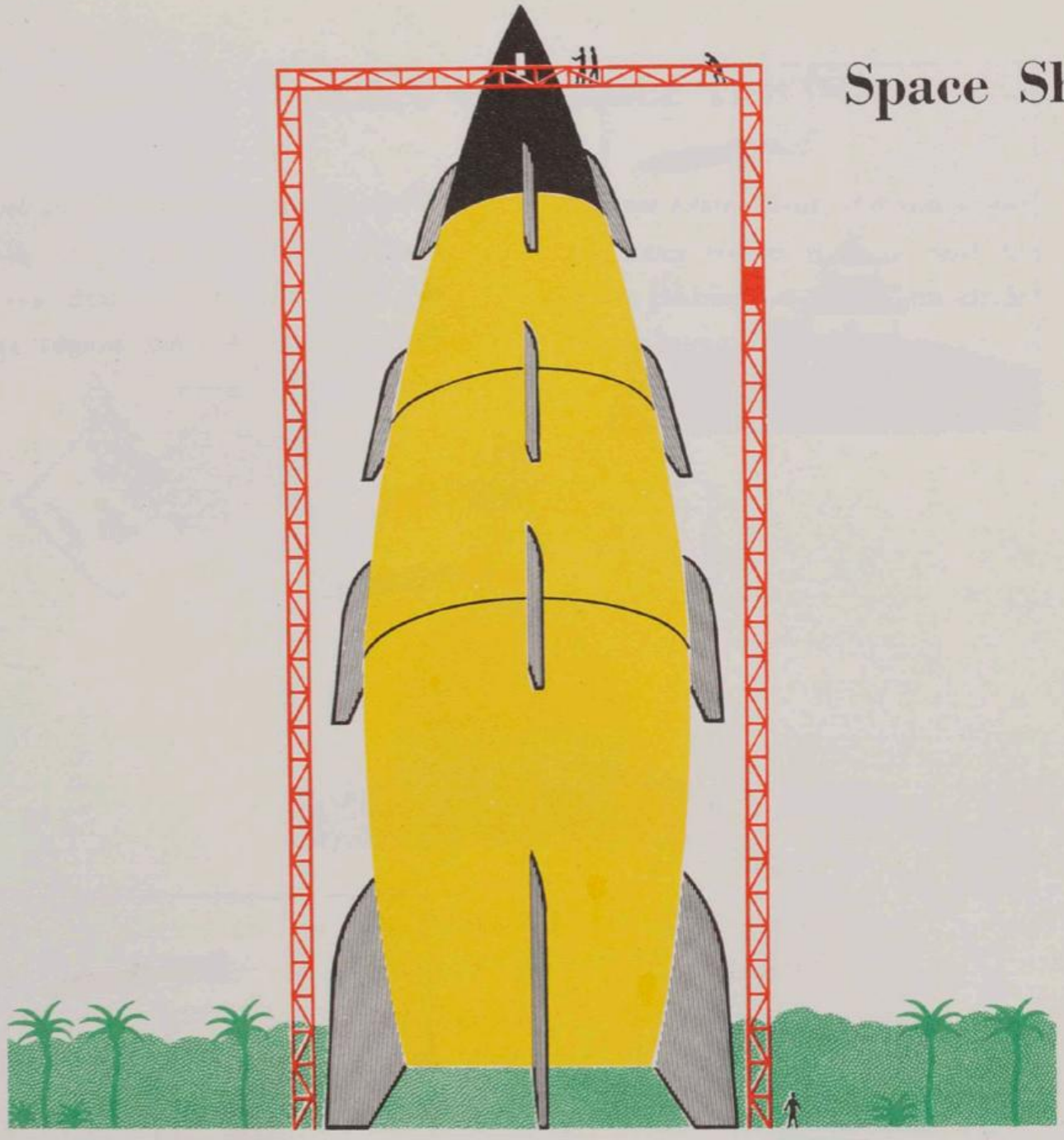
When the rocket leaves China the sun is sinking in the west. By the time the sun is high over Europe the rocket has caught up with it. It is noon.





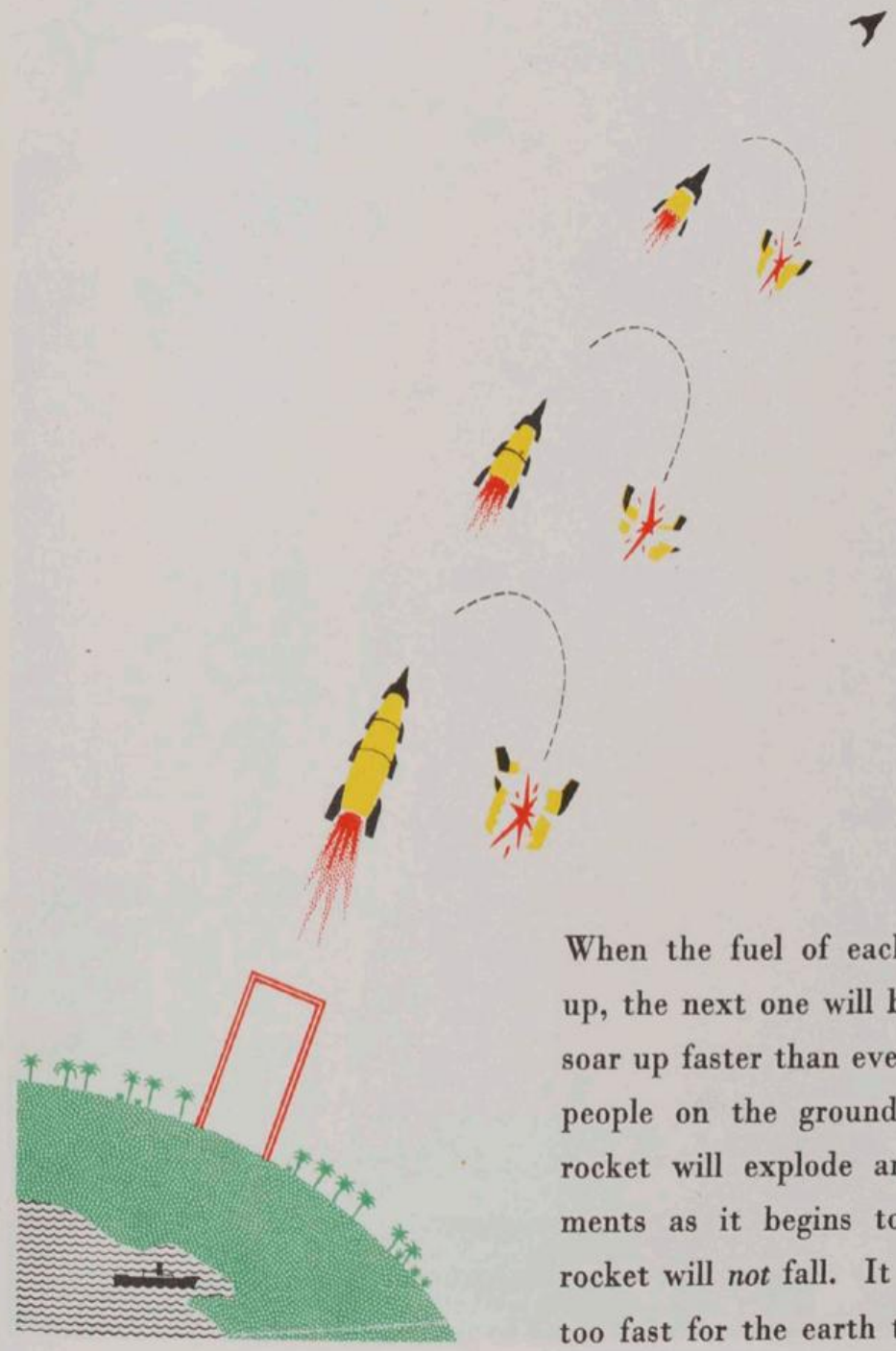
The rocket speeds on towards the west, faster than the sun. When it reaches California the sun is just rising in the east. It is dawn.

Space Ship



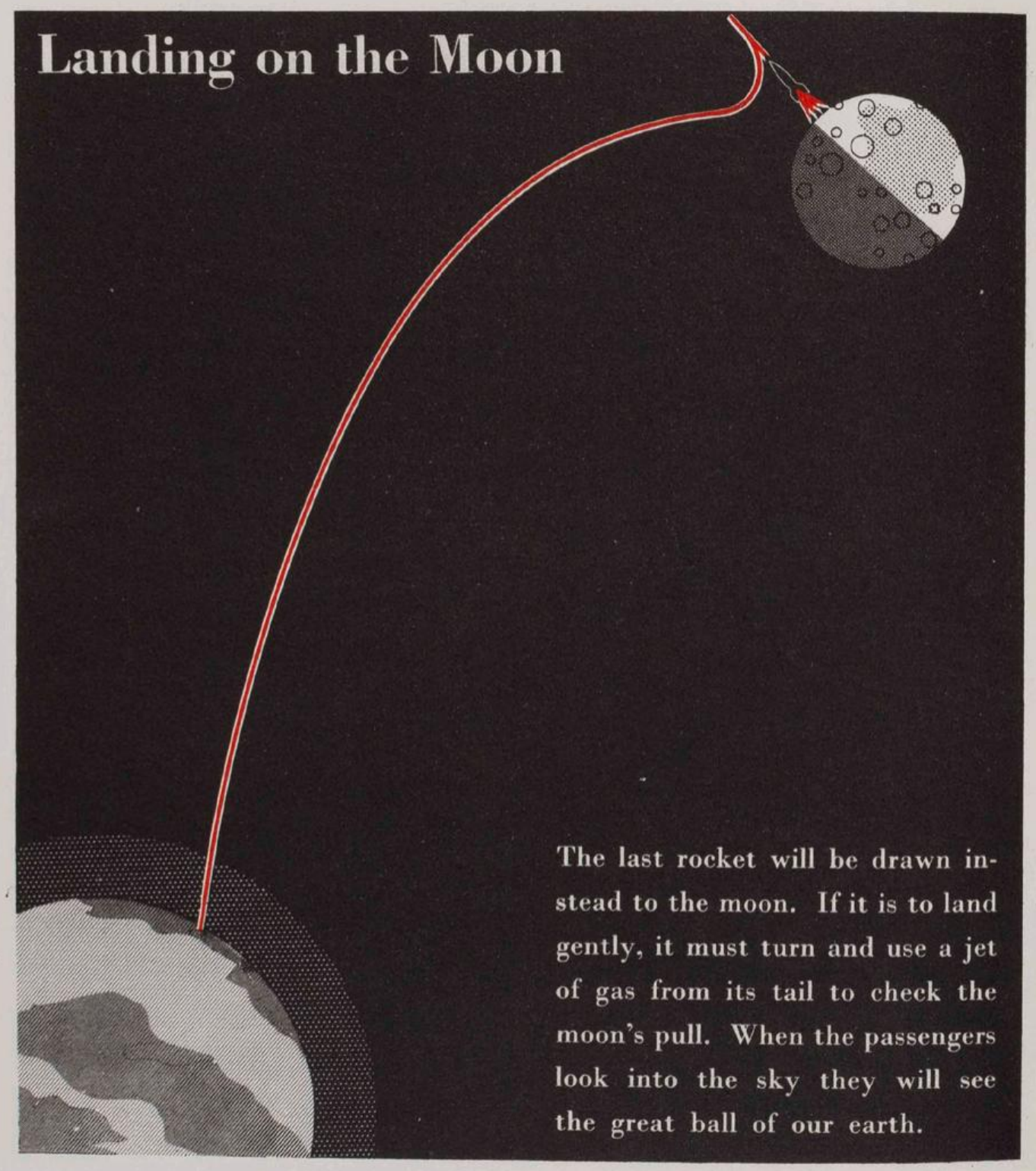
A space ship like this may one day carry passengers to the moon. It is made up of four rockets fitted one above another, and stands half as high as the Eiffel Tower. It will probably take off from some huge steel tower near the Equator.

of the Future



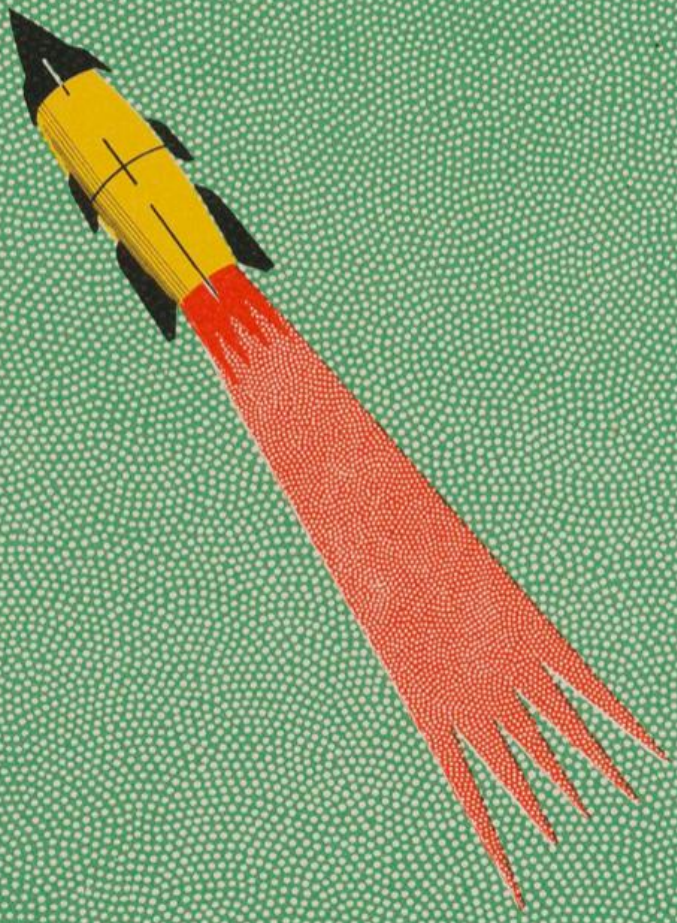
When the fuel of each rocket is burnt up, the next one will be set off and will soar up faster than ever. To protect the people on the ground, each burnt-out rocket will explode and blow to fragments as it begins to fall. The last rocket will *not* fall. It will be travelling too fast for the earth to pull it back.

Landing on the Moon



The last rocket will be drawn instead to the moon. If it is to land gently, it must turn and use a jet of gas from its tail to check the moon's pull. When the passengers look into the sky they will see the great ball of our earth.





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