A ROCKET AUTO OPENS VISTAS OF STAR VOYAGES

But First Rocket Planes Must Test the Air Many Miles Up and Leap the Atlantic in an Hour and a Half—A Principle of Vast Possibilities

By WALDEMAR KAEMPFFERT.

On the Avus Speedway of Berlin a queer automobile has made history. "The rocket auto" it is called by the thousands who watch it as it flashes past with Fritz von Opel in the driver's seat. Twelve tubes project from the rear, and out of them dense smoke spouts as he speeds along the track, so that it seems as if a mechanical comet were streaking across the scene. There is no engine in the ordinary sense, with pistons, connecting rods and cranks. As its name indicates the machine is a rocket on wheels. It is literally kicked along by a series of explosions that follow one another in rapid succession.

The acceleration from rest or "pick up," in the parlance of automobile drivers, is something extraordinary. The car shoots forward like a bullet from a gun, leaving a wake of green and purple fumes. At Avus spectators dived under benches and women screamed at the spectacle. Von Opel attained a speed of sixty miles an hour in 200 feet and actually reached 130 miles an hour before his rockets gave out.

How fast the rocket can travel is not known. Speeds on the Avus track are limited. Von Opel believes that he can beat the world's record of 216 miles an hour on a straight, smooth road. He is now making arrangements with the German State Railways for a test with a rocket car which he says will make 300 miles an hour.

Not only automobiles and railway cars are to be experimentally propelled on the rocket principle but flying machines as well. At the works of Raab and Katzenstein in Cassel, Germany, an airplane is now in course of construction which is designed to kick itself and its pilot—none other than Anton Raab himself, one of the best fliers in Europe—to heights which have never been attained by a human being or, for that matter, by unmanned meteorological balloons.

Romantic Possibilities.

There's wild romance in these experiments. Only in a rocket ship can man hope to leap from the earth to the moon, Mars and Venus, and see with his own eyes what conditions prevail on their surfaces. The awful chasm that separates us from the planets is measured by tens of millions of miles. It is airless. Hence engines which are dependent on earthly processes of combustion are useless. So are propellers; for they must screw their way through some such substantial medium as air or water.

There is but one method whereby man can fly to the moon—he must kick himself off the earth. Hence the rocket automobile and the rocket airplane, experimental precursors of the rocket ship which, at some remote day, will enable the inhabitants of the earth to visit their planetary neighbors.

"Astronautics" the French novelist, J.-H. Rosny, has happily called this voyaging from star to star, and the Société Astronomique de France has adopted the term. What was once the dream of the imaginative romancer has become the subject of engineering experiment. We may not reach the moon for many centuries to come, if at all, but already the tests on the Avus speedway indicate that the world is to be enriched with a totally new type of motor for its automobiles, railways and airplanes.

French Experiments.

Just how a man may escape the gravitational clutch of the earth and fly off into space is a problem that has engaged the minds of scientifically trained men and of romancers for centuries. It was an obscure contemporary of Jules Verne, Achille Eyraud, who first proposed the use of a rocket, and this in 1865, the very year when "From the Earth to the Moon" appeared. Verne, it will be remembered, hurled his explorers off the earth by firing them and the comfortably furnished shell in which they were housed from a cannon of colossal dimensions with the aid of an explosive charge weighing tons. Ballistic experts and metallurgical engineers smile incredulously at such a piece of artillery and such a projectile. Eyraud had the right conception.

It was not until 1907 that an engineer took the trouble to calculate the weights that would have to be kicked from the earth and the energy involved. He was Robert Esnault Pelterie, one of the most original technical minds in France, a pioneer builder of fast high-powered airplanes and the designer of wonderful airplane motors. He published his studies in a paper which he presented in 1912 before the Société Française de Physique. The year before Dr. André Bing had been granted a Belgian patent for "an apparatus intended to permit the exploration of high regions of the atmosphere regardless of the rarefication of that atmosphere."

In 1912 and 1913 Professor R. H. Goddard made some theoretical calculations so encouraging that in 1915 and 1916 he conducted experiments at Clark University, Worcester, Mass. He reached the conclusion that it is feasible to fire a rocket at the moon and explode a charge of magnesium powder on its surface with so brilliant a flash that it can be seen with a telescope from the earth. Three German engineers, H. Oberth, W. Hohmann and Max Valier, have been independently studying the possibility of skyrocketing since 1923, with results that are not essentially different from those arrived at by Esnault Pelterie and Goddard.

Esnault Pelterie has returned to the charge. In June, 1927, he presented an elaborated mathematical study of an interplanetary man-carrying rocket. Together with his friend, André Hirsch, he pledges himself to award through the Société Astronomique de France an annual prize of 5,000 francs for the best technical contribution to the advancement of astronautics.

The Goddard Experiments.

The experiments now being made on the Avus Speedway were inspired largely by Max Valier, who seems to have the enthusiasm, the energy and the skill of a first-class press agent. Valier's books are best sellers. His articles are snapped up by German newspapers and magazines. When he lectures the "standing room only" sign is sure to be displayed. Three years of writing and lecturing have so accustomed educated Germans to the possibility of traveling to Venus or Mars a few centuries hence that it no longer seems mad.

First of all consider the rocket transatlantic express of the future. There is nothing fantastic about it. Meteorologists and aeronautic engineers are agreed that flying at a height of eight to ten miles has its technical advantages. To speed along over the sea at a level of a few thousand feet, as transatlantic fliers now do, requires an enormous amount of power. Air resistance must be overcome, and air resistance increases as the square of the speed and the energy required as the cube.

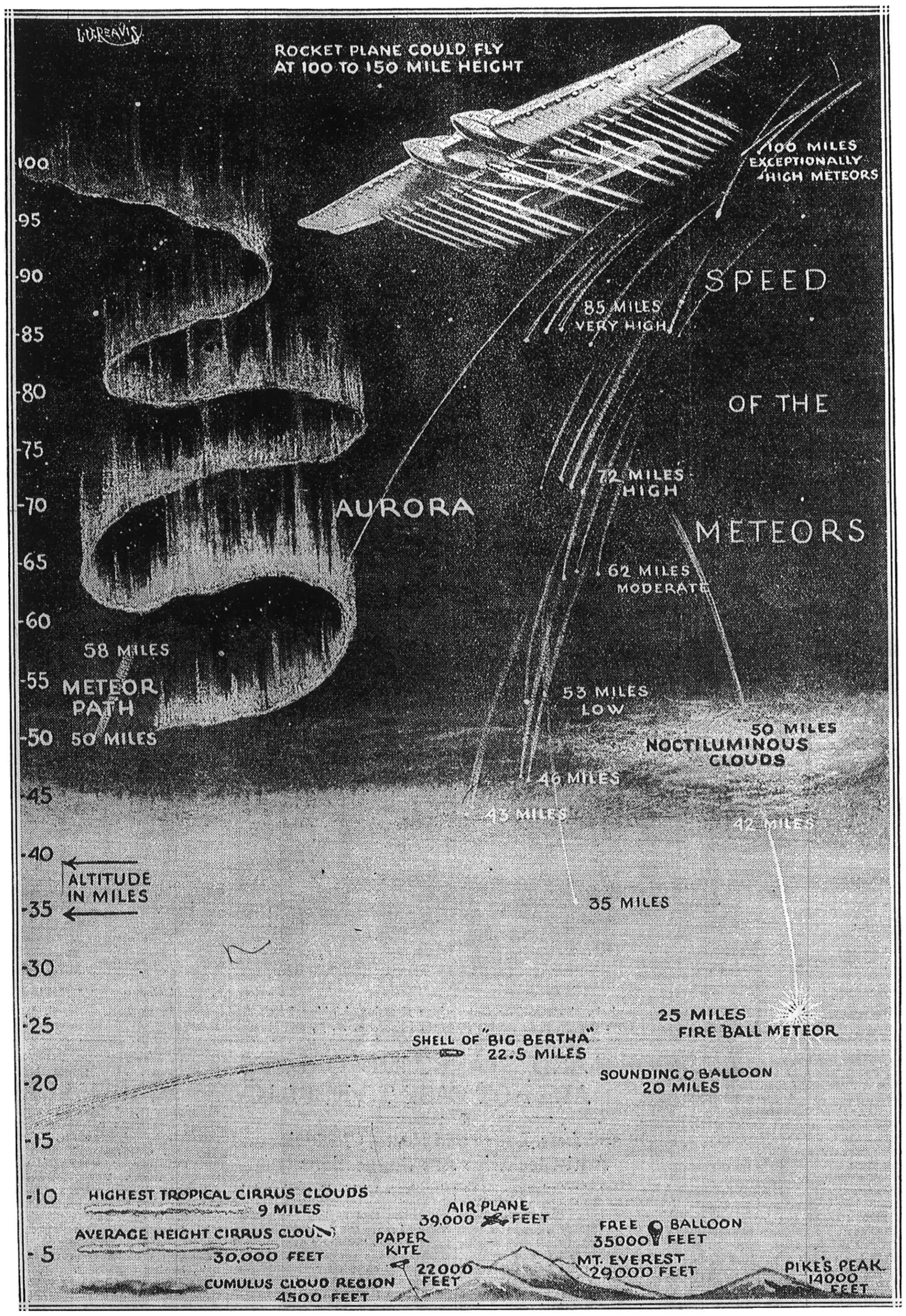
There is only one way in which air resistance can be reduced, and that is to rise to a height of ten miles, where the air is only one-fifth as dense as it is at the surface of the earth. It is easy enough to seal a cabin hermetically, ventilate it properly, heat it and keep the air pressure at the proper value—in a word, to carry with the passengers the kind of climate to which they are accustomed.

Search for a New Engine.

The real difficulty is lack of a suitable propulsive mechanism. So we find engineers trying to build engines which will be fed with compressed air and which will function properly at great heights and to invent propellers with blades which can be adjusted so that the angle of attack is adapted to the density of the air. Whether or not these aids to high flying are provided, Valier always insists that the airplane of today, with its engine and propeller, cannot fly at all without relatively dense air. It is air pressure beneath a wing and suction above it that keep an airplane up; it is air that must be mixed with gasoline vapor to form an explosive mixture; and it is air in which the propeller blades screw their way along.

Climb to a height of ten miles in an airplane of the present type equipped with adjustable propellers and it may be possible to attain average speeds of more than 250 miles an hour in regular commercial practice, Valier concedes. But why stop there? At altitudes of thirty and forty miles, hopelessly unattainable by aircraft of today, speeds of 2,000 to 4,000 miles an hour are possible, he boldly proclaims. An entirely new type of airship must be invented if man is to propel himself in the higher reaches. A rocket is the only vehicle that can propel itself in a vacuum. So, Valier concludes, as did Eyraud, Goddard, Bing and Esnault Pelterie and all the others who preceded him, a suitable rocket must be invented.

Valier has made calculations which enable him to draw a vivid picture of a future crossing of the Atlantic by rocket. Assume that we fly from Berlin to New York in three stages, stops being made at Vigo, Spain, a midocean island or landing platform and New York. The rocket shoots up with a terrific roaring at the steep angle of 70 degrees in order to reach its ceiling with the utmost rapidity. In 17 seconds its speed is 400 meters (1,312 feet) a second and its altitude 3,000 meters (1.86 miles). Another 48 seconds pass and it has attained its ceiling, 50 kilometers, or, roughly, 30 miles, above sea level.



In This Sectional View of the Atmosphere the Heights Thus Far Attained by Man and His Machine Are Indicated. One Hundred Miles Up, Where Auroras Glow and Meteors Burn Up by Mere Friction, a Rocket Plane Is to Conduct Explorations Which Are to Show Whether or Not It Is Possible to Fly at This Height Between Europe and America at Unprecedented Speeds in Hermetically Sealed Machines in Which An Earthly Climate Will Be Made to Order.

At Incredible Speed.

Its distance from the starting field is now 70 kilometers (43.47 miles) and its horizontal cruising speed 2,000 meters a second, or more than 4,530 miles an hour. It takes just 27 minutes to reach Vigo—100 seconds being allowed for starting and 1,500 seconds for gliding horizontally. The distance from Berlin to New York is covered in 93 minutes, or about one hour and a half. With the usual propeller airplane the best time would be 25 hours and 40 minutes.

The only objection that Valier can see to rocketing across the Atlantic is the enormous quantity of combustible or explosive required. He calculates that fully 69 per cent. of the total weight of his ship must be given over to fuel for the Berlin-Vigo stage and 76 per cent. for each of the ocean stretches. For structural reasons the paying load cannot be more than 15 per cent. of the total. To transport a ton of profitable load from Berlin to New York means the consumption of 52 tons of fuel. These estimates are discouraging to prospective incorporators of a transatlantic rocket company.

But Valier points out that if the velocity of the gases which stream from the exhaust tubes can be raised from a technically possible 2,500 meters (7,200 feet) a second to something like 4,000 meters, or 13,120 feet, which is but a mere hope at present, a ton of paying load could be transported from Berlin to New York by consuming not more than 16 tons of combustible. "It is expensive," admits Valier, "but then speed is always expensive."

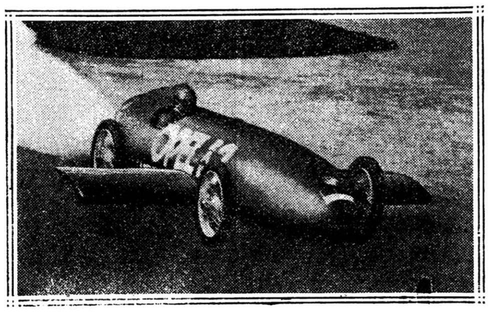
The results of the tests made with the rocket car in Berlin have not been revealed technically, so that it is impossible to pass judgment on Valier's estimates. But at least we have Professor Goddard's published conclusions to guide us. With a special type of steel chamber and nozzle and with smokeless powder he obtained a velocity of nearly 8,000 feet a second. The fastest rifle bullet travels with a speed of only 2,500 to 2,900 feet a second immediately after it leaves the muzzle.

As every marksman knows, the higher the muzzle velocity the harder is the recoil, so that Goddard's 8,000 feet a second would give a kick terrific enough to send a rocket from Berlin to New York quite in accordance with Valier's expectations, in one hour and a half. Incidentally, Goddard obtained an efficiency of 64 per cent., which is far higher than that of the best engines now in use.

On the whole, Valier's rocket must be accepted as an engineering possibility. But the human equation remains to be considered. Passengers will be literally jerked off the ground. Can they stand the jar? Unless they are strapped into their seats they will be flung against the walls of the rocket, and even if they are strapped they will be subjected to forces that the human body may not be able to withstand.

It is reported that when the Opel automobile was first tried the driver was physically unable to endure the sudden jerking from rest to full speed. Indeed, the German sponsors of the rocket plane have expressed some uneasiness on this score. Moreover, the effect of speed on the nervous system is not known. Record-breaking automobiles on the sands of Florida have traveled faster than a nerve impulse can be conducted from a given part of the body to the brain. It may well be that man's nerves are not equal to the strain of rushing through space at any such speed as Valier contemplates.

THE ROCKET CAR IN MOTION



Photograph by Underwood & Underwood.

Fritz von Opel, the Inventor, Is at the Wheel.

Present Exploratory Machines.

Before it is possible to skyrocket from Berlin to New York at a height of forty miles more must be known about the upper atmosphere. Since the greatest height that an unmanned sounding balloon can reach is twenty miles a rocket must be used for further exploration. Hence Raab and Katzenstein are building a rocket plane at Ruesselsheim. It will be equipped with an ordinary engine and propeller in addition to rocket chambers. A speed of 300 or 400 miles an hour (a conservative estimate, according to von Opel and Sanders, his rocket-maker) can easily be made.

After some preliminary exploration of the atmosphere at modest heights with this experimental machine another will be constructed which will have folding wings, an airtight cabin and oxygen tanks and with which altitudes of thirty miles and more, and speeds of the order of 700 or 900 miles an hour will be attained.

By sending up small free balloons carrying automatic recording thermometers and wind registers, the French meterologist, Léon Teisserenc de Bort, made the remarkable discovery that the atmosphere consists of at least two concentric shells. We live in the lower shell, which is about five miles thick in the latitudes of the United States, but somewhat thinner at the poles.

Above this "troposphere," as it is called, lies the "stratosphere," where the temperature is always 50 degrees below the Centigrade zero. With the aid of sounding balloons de Bort, Professor Rotch and Dr. Assmann managed to sound the atmosphere for about twenty miles. What the conditions may be above twenty miles we can only surmise from studies that have been made of auroras and meteors. Aviators have penetrated only to about eight miles—not much more than the height of the loftiest mountains. Even the observations of auroras and meteors have led to discordant conclusions as to the temperatures that prevail in the spaces that Valier holds transatlantic rockets must traverse.

What is wanted is a Columbus of meteorology, who will skyrocket up a hundred miles. There he will certainly see the stars and sun blazing in an inky sky, for the particles in the air that scatter sunlight and make the sky seem a canopy of blue to us will be absent. He will be immersed for a time in the great radio mirror which is known to science as the Kennelly-Heaviside layer, after its discoverers, and which reflects radio signals in such a curious way that a short-wave broadcasting station may be inaudible only fifty miles away, yet carry music a thousand miles to eager listeners.

Collision Dangers.

If the adventurer selects the wrong time of year and actually reaches a height of 100 miles he runs a slight chance of colliding with a meteor. Possibly he will see the aurora in all its shifting, shimmering beauty. One trembles for him. Can he live in those high-tension electrical discharges of which the aurora is the visible evidence? And what of those cosmic X-rays from which our atmosphere shields us to a certain extent, but which, according to Professor Millikan's measurements, are powerful enough to penetrate eighteen feet of lead—the only adequate protection against radiations of that type? The temperature 100 miles up must be near absolute zero. What will be the effect on the metal of the rocket, even if it is heated within? No doubt laboratory experiments will be made in Berlin with liquid gases to settle any doubt. If any man comes back alive after having shot himself to a height at which he will circle with meteors he will have a tale to tell.

But these swift flights across the Atlantic in an hour and a half, this ascension to the auroral layers of the atmosphere do not satisfy such rocketeers as Valier and Esnault Pelterie. The moon must be reached, and Mars and Venus. Gravitation must be conquered. This requires a recoil of a magnitude not even remotely attained. To wrench itself from the grip of gravitation a body must have a velocity of about seven miles a second. And the best that puny man has thus far been able to achieve is Professor Goddard's 8,000 feet or about a mile and a half a second!

Search for an Explosive.

Professor Goddard calculated that to transport a kilogram of flash powder (2.2 pounds) to the moon would require 600 kilograms of explosives. What is needed is a source of energy far more concentrated than the best smokeless powders used in modern artillery. So Esnault Pelterie casts about for a combustible. He considers an explosive mixture of hydrogen and oxygen. Weight for weight it is about three times as energetic as a nitrocellulose powder. One kilogram can be hurled perhaps to the upper limit of the atmosphere with 62 kilograms of such a mixture. A rocket speed of 3,400 meters, or about two miles a second, will be attained. Still not enough.

Esnault Pelterie turns to atomic hydrogen, recently discovered by Dr. Irving Langmuir of Schenectady, N. Y. Unfortunately, it is unstable. If it could only be liquefied it would be nearly ten times as energetic in that state as smokeless powder, so that only 10 kilograms of it would be needed to hurl a kilogram out of the influence of the earth; for a velocity of over 6 miles a second would be attained. But the utilization of the energy is accompanied by the liberation of terrific heat. What metal pipe can conduct gases that have a temperature of 18,000 degrees Fahrenheit?

Since liquid atomic hydrogen is thus rejected, Esnault Pelterie turns to something still more impossible—the energy released when matter is disintegrated. Time and time again physical chemists have assured us that there is enough energy in a spoonful of water to drive the Mauretania across the Atlantic and back. Here is something concentrated enough. There's sufficient power in a man's little finger to perform miracles.

Esnault Pelterie calculates that it would be easy to kick a rocket weighing a ton into space with a 450,000 horsepower subatomic motor. Alas, man has not yet learned to release the energy locked in the atom. And so what Esnault Pelterie calls a "promenade in the universe" must wait until scientists, still unborn, have learned to tear matter apart and build it up again in ways of which our day and generation are still ignorant.

Pelterie's Mathematical Fancies.

And yet the bold Esnualt Pelterie pushes his mathematical inquiry to the limit as a kind of intellectual sport. Theoretically he has energy enough in the atom for any purpose. No longer can the earth hold him back. Off he goes in his mathematical and engineering fancy into the vast cosmos. The moon? He reaches that in 50 hours. Venus? To land there 48 days and 4 hours are required. More distant Mars? A good three months.

The astronomer interposes a few objections. He has seen meteors light up and burn by mere friction with our atmosphere, just as if they were matches rubbed against sandpaper. Here is an artificial meteor What will happen to it as it rubs against the rough atmosphere?

"We are prepared for this," says Valier. "As we ascend the speed of the machine is so regulated by preliminary calculation that it will be low while the dense lower atmosphere is traversed only to increase as we emerge from it. There is more danger in descending. Unless the rocket is retarded in time it will enter the highest and thinnest stratum of air at seven miles a second and burn up."

Both Esnault Pelterie and Valier admit the danger that may be incurred if the human body is suddenly removed from the effect of the earth's pull.

"From the moment the rocket motors are stopped," says Valier, "the ship with its cargo answers the laws of gravitation as if it were a stone thrown into the air. Because the various parts and passengers will not react on one another according to these laws, there must be installed various aids, such as guide ropes, slings on the walls, iron-soled shoes and magnetic floors, which would help voluntary movement."

We must not forget that being without weight a man could stand in midair. Nothing would fall. Hence Valier's magnetic floors.

Unknown Physiological Effects.

The physiological consequences of a flight through space, free from gravitation, are unknown. We can faintly conceive what they must be when we recall the sensation of vertigo produced in a rapidly falling elevator. "We do not know if the lack of gravity will not bring about some new form of dizziness or even cause unconsciousness," Valier confesses. "And herein we see the possibility of disaster. What might happen should the pilot become unconscious may be imagined by any one. It is hardly likely, however, that the heart, except at the start, would be affected, for it would at least have less work to do, though this point must be fully tested."

French and German writers are already wondering what the consequences of the rocket motor may be. It makes the average reader shudder to learn, as he has learned over again within the last twenty years, that the earth is doomed to extinction. Eons hence it will be reduced to a miserable, cold cinder swimming around the sun. Its atmosphere will have disappeared. Its oceans and its lakes will have dried up. What will become of the human race? Must the last man die of starvation and thirst? The rocket ship is mankind's refuge. Colonize Venus, just as Europe once colonized America, cry the astronauts of France. And let the earth drift as it will, an abandoned planetary wreck of its former green self.