

met by our Soviet people. I was moved to tears by Nikita Sergeyevich Khrushchev's telegram. . . *

The first "Cosmonaut" is aged 27—the US Astronauts are now aged between 34 and 40—and initially was a pattern-moulder and foundryman by trade, graduating with distinction from the Lyubertsy artisans school near Moscow. Later he went to a technical college in Saratov, and then to a military aviation college at Orenberg. He is married to a medical graduate he met in Orenberg, and has two daughters, Elena and Galina. According to Prof Blagonravov he was a parachute instructor at Smolensk before being picked for Cosmonaut training.

Small chinks of light were permitted to escape through the black-velvet curtain shrouding Soviet spacecraft when Sovnews issued, on April 12, the text of a brief essay on *The First Manned Space Flight: Problems of Fuel, Precision and Re-entry*, by Prof Igor Merkulov. It read as follows:

"A spaceship designed for manned flight must meet stringent scientific and engineering requirements. This is particularly true of the means of propulsion and the instrumentation; that is, the automatic and telemetric systems for accurate orbiting and control of the ship in flight.

Fuel "To place a body in orbit round the Earth, it has to receive more than 3m tonne-metres [21,699m ft-lb—Ed.] of kinetic energy for every tonne [2,205lb] of its weight. The Soviet spaceship weighed nearly four and three-quarter tonnes. What does this mean in terms of actual energy? To perform enough work to get a spaceship into orbit would take a man handling heavy loads seven hours a day about 2,000 years. The rocket engines must do that work in a matter of minutes. These figures show the importance of choosing the correct fuel for the rocket engines.

"A second fuel problem is that of packing the greatest possible amount of fuel into the lightest possible containers. The weight of the fuel is more than one hundred times greater than the weight of the ship finally placed in orbit.* Thus multi-stage carrier rockets must accommodate hundreds of tons of fuel, with their dead-weight remaining as small as possible.

Precision "The launching of the rocket carrying the space vehicle requires great precision. In an orbit such as that flown by Yuri Gagarin, for instance, an error of 1° in direction or one per cent in speed could bring the ship back into the dense layers of the atmosphere on its very first orbit, and it would burn up.

Re-entry "In the three-and-a-half years since the launching of the first Sputnik, scientists all over the world have been discussing the vital question of re-entry. So far there is only one successful method of slowing down for re-entry.

"The braking motor [retro-rocket] is aligned so that, when the engine is switched on, the thrust is in the opposite direction to the ship's movement. In this way the thrust brakes the vehicle. This calls for a lot of additional fuel.

"The theory of rocket flight provides exact figures of fuel expen-

* A high figure, suggesting a relatively low specific impulse; it implies a total launch weight of some 500 tons.

SPACE TRAVELLERS

Date	Nation	Objective	Payload	Result
3.11.57	USSR	Recovery from orbit	Dog Laika	No recovery
13.12.58	USA	Ballistic shot (Jupiter C)	Squirrel monkey	No recovery
28.5.59	USA	Ballistic shot (Jupiter)	Two rhesus monkeys	Success
2.7.59	USSR	Ballistic shot	Two dogs, one rabbit	Success
10.7.59	USSR	Ballistic shot	Two dogs	Success
15.5.60	USSR	Recovery from orbit	Life capsule, dummy man	No recovery
19.8.60	USSR	Recovery from orbit	Two dogs, plus other specimens	Success
13.10.60	USA	Ballistic shot (Atlas)	Three mice, RVX-2A vehicle	Success
1.12.60	USSR	Recovery from orbit	Two dogs, other specimens	No recovery
31.1.61	USA	Ballistic shot (Mercury)	Chimpanzee	Success
9.3.61	USSR	Recovery from orbit	Dog, guinea pigs, etc.	Success
25.3.61	USSR	Recovery from orbit	Dog, other specimens	Success
12.4.61	USSR	Recovery from orbit	Man	Success

Note: The US Project Mercury schedule originally called for a manned ballistic (Redstone) shot in May 1960. In our most recent account of the programme (issue of December 12 last) we gave January as the expected date; today it is put at "April 28 at the earliest." A Mercury orbit is likely late this year.

diture for specific acceleration or deceleration—theoretically there is no difference between the two. For instance, to effect a change of speed of about 300ft/sec, the amount of fuel used would be from three to four per cent of the payload. To reduce the speed by about 3,000ft/sec, the fuel required would be about 30 per cent of the payload, while to halve the speed would require almost four-fifths of the payload. Together with the fuel tanks and motor, this makes up some 90 per cent—leaving only one-tenth of the payload for the passenger and cabin.

"Estimates and experience show that the deceleration required for de-orbiting and safe re-entry is comparatively small, but if the ship should enter the dense layers of the atmosphere at near-cosmic speeds it would disintegrate like a meteorite.

Landing "Re-entry and safe landing pose many problems. A large amount of fuel has to be burnt to brake the vehicle and guide it safely through the atmosphere. But the slower the speed is reduced, the greater is the heat from friction, and the more cumbersome do the ceramic [our italics] heat shield and cooling system have to be. The engineer's task, therefore, is to produce a vehicle which ensures the lowest possible weight for all elements of the landing gear—the braking motors, fuel tanks, heat protection system, and so on.

"One method is the almost complete braking of the spaceship and then its parachuting to Earth, as is done with the geophysical rockets. The fuel expenditure for this, however, would be too great—so great in fact that it would take a multi-stage rocket to decelerate the ship, and that would bring down the weight of the passenger cabin to less than one per cent of the total payload. It has been found that the best results can be achieved by a combination of power deceleration with atmospheric drag, where parachute or wings [our italics] can be used."

There is no reason to doubt the authenticity of these two photographs, which were issued by Tass on April 16. The Russian caption to the picture on the left states that Gagarin is seen waving to the launch crew before entering the lift which carried him up the side of the huge boost rocket to the space capsule probably more than 100ft above. The smaller illustration, which shows details of his pressure helmet and what appears to be either microphones or the nipples of his liquid/solid feeding system, was made as he rode to the launch pad in a lowly bus

