AN INTERNATIONAL MISSION TO THE MOON

I. Wisdom or Madness?

There was a large crowd that day on the Delaware Quay in Philadelphia, on the edge of pier 49, alongside which a steamship, the *Montgomery*, was moored, with a strange object in tow.

About three miles wide at that point, between Philadelphia and Camden—the annex of the great American port—the river was covered with small boats laden with curiosity-seekers, which were hampering the maneuvers of the cargo-ships and ferries.

Everyone was pointing at the bizarre object that the *Montgomery*, whose engines were under pressure, was about to take out to sea. It was somewhat reminiscent of a powerful submarine about a hundred meters long, which, to judge by the superior part emerging from the water, affected the form of a long rectangular parallelepiped, tapered at the rear and terminated at the front by a rounded section like the head of a fish. The surface, entirely smooth, was coated with a kind of blue varnish on which seven capital letters were displayed comprising the word SELENIT. At the front, over about a fifth of the length of the machine, a number of small portholes could be seen, perfectly fitted, with neither hollows nor projections.

To the right and the left of the upper section, the rounded prow broadened out; it formed swellings over the rest of the side wall, which were prolonged at the rear by tubes some fifteen meters long, like large-caliber cannons, slightly oblique relative to the *Selenit*'s axis. The spectators who were close enough, and whose gaze pierced the surface of the river, were able to see other similar tubes disposed over the inferior surface. Those lateral cannons where welded along their entire length to the walls of the vessel by strong metal bulkheads that met the hull at an angle, in such a fashion that the entire apparatus resembled an enormous crossbow bolt.

The flanks of the *Selenit* were, moreover, partly masked by large pieces of wood fixed with cables, to which a series of large cylindrical floats were moored. It was easy to conclude that the machine was too heavy to float unaided and that it needed to be buoyed up to prevent it from sinking.

People endowed with good eyesight were also able to remark a thin circular line on the superior wall toward the front, and four solid handgrips that revealed the presence of a screw-hatch.

On the quay, and in the boats laden with sightseers, conversations were in full swing. Even the most sober individuals could not help feeling a considerable emotion at the thought that ten men would soon be enclosed in the metal monster, in order to attempt the most extraordinary adventure ever: a voyage to the moon.

For more than a year, that great project had occupied the minds of the entire world. Sufficient publicity had been generated by certain clauses in the will of Elie Spruce, the celebrated founder of the naval shipyard at Camden that bears his name.

Elie Spruce had been struck by the studies of certain scientists, which had indicated the possibility of sending a projectile to the moon in conditions such that humans could be enclosed within it without the risk of being killed by shocks either on departure or arrival. He had, in particular, retained the idea of Monsieur Esnault-Pelterie, who had advocated the employment of an apparatus propelled by the recoil of a fulminating powder.[1]

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[1] Author's note: "*Considerations sur les résultats de l'allègement indéfini des moteurs. Journal de Physique*, mars 1913. See also *L'Astronautique*, 1930." The second reference, newly added to the book version, was Robert Esnault-

To tell the truth, Esnault-Pelterie concluded that in the present state of knowledge, the solution to the problem, although theoretically possible, could not yet be realized in practice. He observed that the most powerful modern explosives do not yield, for a given weight, the energy necessary for the propulsion of a vehicle designed to accomplish the journey from the Earth to the Moon.

Elie Spruce, however, did not accept the conclusions of the expert engineer without reservations. He made the observation that the latter limited the consumption of explosive arbitrarily, in admitting that a vehicle weighing one metric ton cannot burn more than three hundred kilograms of powder, less than one third of its weight, because, according to Esnault-Pelterie, at least seven hundred kilos has to be devoted to the construction of a habitable vehicle.

Now, the proportion is notoriously insufficient to oblige the projectile to quit the Earth.

Elie Spruce envisaged the problem in another fashion:

Given a mass of fulminating explosive capable of burning in its entirety and constituted in such a way that the energy disengaged by its deflagration propels it vertically as it draws away from the Earth, at what moment will it have acquired a velocity sufficient to escape the globe's attraction, and what will be, at that moment, the proportion of the mass that has not yet burned?

It is evident that that proportion could be replaced by incombustible materials, and it would be the latter that would constitute the useful weight of the vehicle. It is of little consequence that it is small, or even tiny; that would have no other consequence than obliging the constructors to employ an enormous quantity of explosive. For example, if it were necessary for them to consume nine hundred and ninety-nine kilos to launch a useful weight of one kilo, they would be far from the proportion of three hundred to seven hundred fixed by Monsieur Esnault-Pelterie, but they could nevertheless send a one-ton vehicle to the Moon by attaching it to nine hundred and ninety-nine tons of powder.

Elie Spruce's calculations, established on that basis, had, in fact, demonstrated to him the necessity of using a colossal mass of explosive in order to detach from the Earth a vehicle provided with all the indispensable resources, ensure its return from the moon, and procure, in addition, the energy necessary to decelerate during its descents on the Moon and the Earth.

The great American constructor drew up the plans of a machine capable of undertaking the voyage, but illness had not left him the time to put his project into execution. Feeling that he was nearing his end, he had instituted a legacy of six million dollars destined to finance a mission to the Moon.

That was what René Brifaut, a young French reporter for a major scientific periodical, explained to his wife, with whom he had obtained a passage aboard the *Montgomery*, among other rare privileges.

"Old Spruce had no children who might have complained about his generosity in favor of science. He made a grand gesture in the hope of immortalizing his name."

"You call that a grand gesture?" replied Madeleine Brifaut. "Personally, I think it's more like the act of a madman. After all, what's the purpose of such an enterprise?"

"It's necessary to think that it might be useful for something, since the scientists of the entire world, united in conference, have decided to profit from the Spruce legacy to organize an international mission to the moon. Believe me, it won't be uninteresting to go and see what's happening on our satellite."

"They're doubtless proposing to colonize it," retorted the young woman, ironically.

"It's easy to mock, Madeleine, but suppose they find an abundance of some very precious substance on the Moon, such as radium, which might help to ameliorate the conditions of life on our planet."

"It would be necessary to exploit it."

"It would doubtless be possible to bring back appreciable quantities. A hundred kilos of radium would metamorphose humanity."

"I'd rather leave the care of going to look for it to others."

"Naturally, it's no job for a woman, but I, for example, would be very glad to depart in the *Selenit*."

"It's got you too?"

Pelterie's first book on the subject of space travel; born in 1881, he was one of the most significant French pioneers of aeronautics and an experimenter with liquid-fueled rockets, his research in the latter field obtaining military funding aimed at the development of long-range ballistic missiles.

"You didn't reproach me or my exploratory voyages in Africa and Tibet."

"Well, it's not the same thing."

"No…that was probably more dangerous."

"René, you're not being serious. I greatly admire the ten audacious men who are going to embark in the *Selenit*, but in much the same way that I admire Don Quixote when he charges at windmills."

"Seriously, Madeleine, I think those men, far from being mad, are giving proof of the greatest wisdom. They're going to accomplish a marvelous voyage, and for the price of their bravery, they'll receive a fortune, because Elie Spruce's legacy allows each of them a hundred thousand dollars. I sincerely regret not bring able to join them."

"That's all we need! I wouldn't let you go."

"There's no longer any question of me going, since there are only ten places and they're all taken. But you'll admit that if I'd been able to earn more than three million francs in a month, it wouldn't be a bad deal."

"You really believe, then, that those poor devils will arrive safe and sound on the Moon?"

"Certainly."

"And that, supposing they find the means of living there for a time, they'll succeed in coming back?"

"Yes."

"And that they won't be killed when they fall to Earth?"

"Everything has been anticipated in order to avoid accidents, either going or returning."

"Not everyone can be as convinced as you are, since it appears that they had considerable difficulty finding ten volunteers for the charming excursion in question."

"That only proves that the majority of men have a wife or a mother who doesn't want them to run the risk."

The young people had remained until then slightly isolated at the extremity of the deck of the *Montgomery*, from which, leaning on the bulwark side by side, they were watching the crowd, and the *Selenit*, moored to the flank of the cargo-vessel. There were a hundred people on board, delegates of scientific societies and correspondents of major newspapers. The government of the United States and the diplomatic corps were represented.

There was a movement in the crowd, and the members of the mission were seen arriving, accompanied by a few important people. They were all young and robust men. In spite of what Madeleine Brifaut thought, the number of candidates had been relatively large, but the commission charged with the recruitment of the lunar explorer had proceeded with a severe selection process. The candidates had to satisfy various demands: to possess a physical resistance proof against anything; to be experienced in sports and mountaineering; to have taken part in as many major missions of exploration as possible. They were also required to have superior intellectual faculties and advanced scientific knowledge. In fact, the members that the commission had designated had been nominated by the major scientific institutions of various nations.

The leader of the mission was a Dane named Scherrebek, who had been made famous by several expeditions to the North Pole.

As it had been necessary not to neglect practical details, only English speakers had been accepted, for it was indispensable that all the members of the crew understood one another.

Brifaut identified the explorers to his wife.

"The one marching directly behind Scherrebek is Dessoye, the Frenchman; to his right is the Englishman Galston, and to his left the German Lang.[2] Then comes the American, Garrick, between the Italian, Bojardo and the Spaniard, Espronceda. The dark fellow beside a naval officer in the Brazilian, Dr.

[2] Although the present novella was serialized three years before the completion of Fritz Lang's film *Frau im Mond* (*The Girl in the Moon*) and a year before the foundation of the *Verein für Raumschiffart* [Society for Space Travel], which collaborated in the design of the rocket featured in the film, Willy Ley and Hermann Oberth had already been consulted as advisers for the projected movie, and it was known that it was planned as a follow-up to Lang's *Metropolis* (1926), so the fact that the German representative is named Lang is probably not a coincidence.

Uberaba, Finally there's the smallest of the party, the Japanese Kito, beside the Belgian Goffoël, who is, by contrast, a giant."

Brifaut frayed a passage all the way to his compatriot, Dessoye, in order to congratulate him and introduce him to his young wife.

"I admire your valor, Monsieur," Madeleine declared, "and I have no doubt that you'll succeed in your audacious enterprise."

"Yes, Madame, we'll succeed. In a month, when we return to Earth, people will be able to say that humans have conquered the Moon."

When he found himself alone with his wife again, Brifaut teased her ironically. "Rascal! You paid that fellow compliments of which you don't believe a word."

"Could I tell him that he won't come back? If only I still had some hope of preventing him from running to his death! But I know full well that I wouldn't be able to shake his confidence. Anyway, how could it be admissible that a Frenchman would pass for a coward by recoiling in circumstances where foreigners are marching without a tremor."

The young woman had pronounced the final words with a patriotic pride that brought a smile of satisfaction to her husband's lips.

The members of the mission had stopped, grouped around their leader. The delegate of the President of the Federal Republic, standing facing him with a piece of paper in his hand, was preparing to make a speech. The guests aboard the cargo ship formed a circle.

The officials had, at any rate, decided that the ceremony would be as brief and as simple as possible, for it was necessary to avoid weakening, and bidding the men departing for the Moon farewells like those of men condemned to death.

To tell the truth, apart from the members of the expedition and René Brifaut, no one aboard the *Montgomery* believed that the lunar explorers would ever come back. Even those who had participated in the organization of the mission, however, when they thought that they were sending ten men to their death, had calmed the revolts of their conscience by telling themselves that they were the faithful executors of the last will of Elie Spruce. If the expedition ended in catastrophe, the testator alone would bear the responsibility.

After the speech by the President's delegate, they heard a statement from the director of Mount Wilson Observatory, who had been charged, with two astronomers, to observe the departure of the *Selenit*.

Then, by virtue of a special derogation in favor of the ten heroes, who already no longer belonged to the Earth, bottles of champagne were uncorked and the fact that alcohol was banned in America was forgotten for a few minutes.

The important officials returned to the shore; all that remained aboard the *Montgomery*, with the members of the expedition, were a dozen newspaper correspondents, including Brifaut and his wife, and a small group of scientists.

The ship made ready to sail. The captain had displayed the flags of the ten nations represented in the mission.

The *Montgomery* moved off under the effort of her propellers, while the crowd cheered. Mariners climbing on to the *Selenit* busied themselves with putting it in a good position to be guided in the wake of the ship. A tug, which looked like a dwarf beside the *Montgomery*, had moored its prow to the rear end of the *Selenit*, and was also steering the machine, which, thus maintained at both ends, was running no risk of capsizing.

The banks of the Delaware began to file past before he eyes of the passengers.

"Where are we going, exactly?" Madeleine asked.

"Beyond the Bermudas to the mid-Atlantic Ocean, about the twenty-fifth degree of north latitude, in the abyssal zone were soundings reveal a depth of several thousand meters. It's there that the *Selenit* will be immersed. Copiously ballasted by masses of lead, the apparatus, constructed to withstand enormous pressures, externally and internally, will descend to a great depth. Deballasted, by means of an unhooking mechanism, it will take up a vertical position and rise upwards at an increasing velocity. The reaction

engines will be engaged and when the *Selenit* reaches the surface of the water, it will emerge at a speed of about fifty meters a second."

"Is that all!" said Madeleine. "If it travels at that speed, it won't get anywhere near the Moon."

"So it will accelerate its velocity thereafter. But it can't go faster than the figure I've indicated in the water without having to overcome an enormous resistance, which would require an exaggerated expenditure of energy."

The *Montgomery* and the tug that was following her, with the *Selenit* between them, continued to excite the curiosity of the population. Groups of people were seen here and there, posted on the banks, and boats drew closer. Level with Greenwich Pier, at the point where the river broadens out to form Delaware Bay, a large dirigible of the Federal Army flew over the convoy and released banners that made a multicolored swarm in the sky. At the mouth of the estuary, when the *Montgomery* doubled Cape May, a cruiser saluted her departure with a twenty-one gun salvo.

Madeleine reflected on what her husband had said.

"The fashion in which the *Selenit* will be lifted into space is still an enigma to me," she observed. "I don't understand what force will impel it since it has no propellers and, in any case, won't be able to make use of the terrestrial atmosphere once it's outside it."

"I'll have the time to explain a great many things during the six-day cruise we'll have to accomplish before reaching the *Selenit*'s immersion point. But here's Dessoye coming toward us; we'll ask him to give us a little talk on reaction motors."

The French member of the expedition was, indeed, approaching, glad of the opportunity to talk to compatriots, and he had heard Brifaut's last reflection.

"It's with pleasure, Madame," he said, "that I'll satisfy your curiosity. I was able to remark just now that you're not as convinced as you'd like to be of the success of our enterprise. I don't despair of being able to communicate my confidence to you during the few days of the crossing….

"You were very young fifteen years ago. Perhaps, however you remember an acrobat who carried out some curious jumping exercises in that epoch. Equipped with two dumb-bells, he gathered himself, and leapt, for example, into the middle of a vat filled with water. The spectators had the impression that he was about to take a bath, but at the moment when his feet touched the surface, he threw the dumb-bells forcefully behind him, and was seen, animated by a new impetus, to rise up in order to come down further on, beyond the vat.

"That exploit, which seemed enigmatic to many people, was an application of an elementary principle of mechanics: action is equal to reaction."

"I know that."

"Good. Knowing, on the other hand, that the acceleration imparted by the same force on different masses is inversely proportional to the masses…."

"Wait—I'm no longer following."

"An example will illustrate it more clearly to your imagination. Let's suppose that by deploying a certain effort, I throw a weight of five kilos at a velocity of four meters a second. If, deploying exactly the same force, I then throw a weight of ten kilos, I can only impart a velocity of two meters per second to it. The force remaining the same, and the mass doubled, the initial velocity is reduced by half. Well, when our jumper threw behind him a weight of ten kilos, at a velocity of seven meters a second, for example, his body, which weighed seventy kilos, was, by reaction, propelled forwards with a speed of one meter per second, which permitted him to lift himself up and overshoot the obstacle into which he had been on the point of falling."

"I understand that," said Madeleine, "but it doesn't appear to me to have any connection with your reaction engine."

"You'll see that it does. The recoil of a firearm is a phenomenon of exactly the same order as that of the acrobatic feat of which I've just reminded you. The rifle that launches a ten-gram bullet at an initial velocity of three hundred meters a second is impelled in the opposite direction at a speed that is reduced by as much as its weight is more considerable. If, for example, it weights fifteen kilos, a mass fifteen

hundred times that of a ten-gram bullet, the initial velocity of the recoil will be the fifteen-hundredth part of three hundred meters a second—which is to say, twenty centimeters a second.

"Now imagine a vehicle stationary on a road or a railway track, on which a cannon has been mounted, pointing along the road or track. If the cannon is fired, the vehicle, obedient to the effect of the recoil, will be set in motion in a direction opposite to that of the projectiles."

"Is that how you intend to launch the *Selenit*?"

"Exactly."

"In that case, I think the condition of spectator will be singularly dangerous. You're going to bombard us copiously when you set off for the Moon."

"Don't worry! The tubes of our reaction engine—or, if you prefer, our cannons—don't launch solid projectiles. They only expel the gases of the explosions."

"There won't be any more recoil, then?"

"Yes there will, because it's only the mass of the material that's important. A hundred kilos of gas have exactly the same effect as a hundred kilos of cast iron. Thus, artificial rockets rise into space without ejecting any solid particles. The *Selenit* behaves like an enormous rocket."

"But why so many complications? Why not simply have the *Selenit* launched by a monstrous cannon, as Jules Verne imagined?"

"It's true that the construction of a cannon like Jules Verne's Columbiad, able to fire a projectile with an initial velocity between twelve and fifteen thousand meters a second, would be relatively easy to build with the means of modern industry, but Jules Verne had forgotten one thing, which is that the human organism isn't solid enough to resist an acceleration of more than ten meters a second. A man who was forced to pass abruptly from immobility to a velocity of twelve meters a second would be killed as surely as if a weight of a hundred tons were to be dropped on his head. In reality, Michel Ardan, Barbicane and Nicholl would have been flattened like pancakes on the bottom of their bullet."

"But couldn't one imagine a very long cannon, which would launch the projectile progressively by successive deflagrations?"[3]

"Impracticable, my dear Madame. Do you know how long such a cannon would have to be in order always to remain within that uncrossable limit of ten meters of acceleration per second?"

"Several kilometers no doubt."

"More than seven thousand kilometers[4]—about a sixtieth of the Earth's circumference."

"How has that been calculated?" asked Madeleine, amazed.

"The problem is extremely simple," Dessoye replied, taking a notebook from his pocket. He stated to set out figures in pencil.

"The projectile has to travel ten meters in the first second, twenty in the second, thirty in the third, and so on, increasing by ten meters a second every time until it reaches a velocity of twelve thousand meters a second. It must, therefore, travel in the cannon a number of meters represented by the following sum…."

Dessoye put his notebook before the eyes of the young woman, who read the formula:

$$10 + 20 + 30 + \text{etc}\ldots + 12{,}000.$$

"I've only written the first three terms of the sum and the last," he continued, because there are twelve hundred of them. But you can easily imagine those that I've replaced by the dots, since it's sufficient to increased each on by ten in passing on to the next. Such a sum is what mathematicians call an arithmetical progression—or, at least, the sequence of terms without the plus signs constitutes such a progression. Now, nothing is easier than to calculate the sum of the terms of an arithmetical progression, and, in the particular case in point, the sum of our twelve hundred numbers is given by this formula…."

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[3] This is the modification imagined by "Pierre de Sélènes" for use in *Un Monde inconnu*.

[4] In the feuilleton version this figure is given as fourteen thousand, because of the arithmetical error in the calculation that follows, for which an erratum notice was subsequently issued, after a reader had pointed it out.

Dessoye had inscribed new figures, which he showed to Madeleine.

$$\frac{S + (10 + 12{,}000) \times 1{,}200}{2}$$

"That makes exactly 7,206,000 meters. And the circumference of the Earth is, as you know, forty million meters. You understand now why one has to renounce constructing a cannon or a launch-path."

"But hasn't it been proposed," said René Brifaut, "to launch a hollow projectile to the Moon by means of a huge wheels whose movement is gradually accelerated, and which will act in the fashion of a sling?[5] The projectile would be detached automatically when it had acquired sufficient velocity."

"The idea is ingenious, but it doesn't take account of centrifugal force, and it's sufficient to recall what becomes of substances subjected to the action of industrial centrifuges to anticipate the fate reserved for the passengers in such a projectile."

"I understand," said Madeleine. "All that remains, in fact, is the system of the rocket, which you've just described to me. But it's necessary, in that case, for the *Selenit* to carry a large quantity of explosive."

"An enormous quantity, my dear Madame, and that's what creates all the difficulty of the enterprise, for the *Selenit*, as you see it, is obliged, for a useful weight of about a hundred tons, passengers included, to carry ten thousand tons of explosive. To store such a formidable charge, the *Selenit* had to be given that length of a hundred meters, of which only a fifth is occupied by the accommodation and its dependencies, the control room and the engine room."

"Why that colossal mass of powder? I don't think that such a vast proportion is necessary to launch a shell."

"No—but the shell, which acquires its maximum velocity instantaneously, has no need to carry its explosive with it. The *Selenit*, on the contrary, whose velocity has to be augmented progressively, and which is constructed on the principle of the rocket, has to contain the charge whose progressive deflagration will draw it further on continuously.

"Now, if it requires in these conditions, for example, ten kilos of explosive to bring after twelve hundred seconds, a one-kilo projectile to a velocity of twelve thousand meters a second, one has to add a certain charge to propel those ten kilos of explosive in their turn—but that second charge requires a third, and so on. It's because of that that one is required to employ an enormous quantity of powder to launch a relative small useful weight.

"On the other hand, it's necessary to keep a reserve of explosive to slow down the fall on arrival on the Moon, and to avoid a brutal contact with our satellite. Finally—and this is the most important point of all—enough powder must remain on arrival to permit the projectile to depart again from the Moon and land without encumbrance on our globe, for there wouldn't be any point in going go the Moon if we weren't certain of being able to come back."

"Indeed. I admire you for having that certainty, in spite of the extraordinary difficulties of your expedition, and the risks to which you'll remain exposed, in spite of everything."

"I'll prove to you, Madame, before the departure of the *Selenit*, that we've anticipated the slightest details of our attempt too fully for there to be any shocks to fear."

At that moment Captain Scherrebek, the leader of the mission, approached. He had himself introduced to Madame Brifaut.

"We have superb weather," he said, "and a smooth sea. The conditions are ideal for our departure. I also intend to take advantage of it to allow the few friends who have consented to accompany us in the last week of our sojourn down here to visit the *Selenit*. As there isn't much free space in the *Selenit*, we'll organize several visits, only conducting ten people at a time. The first will be this afternoon after lunch. Would you care, Madame, to do us the honor of taking part, with your husband?"

"With the greatest pleasure, Captain."

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[5] This is the method proposed and illustrated by "André Mas" in *Les Allemands sur Vénus*.