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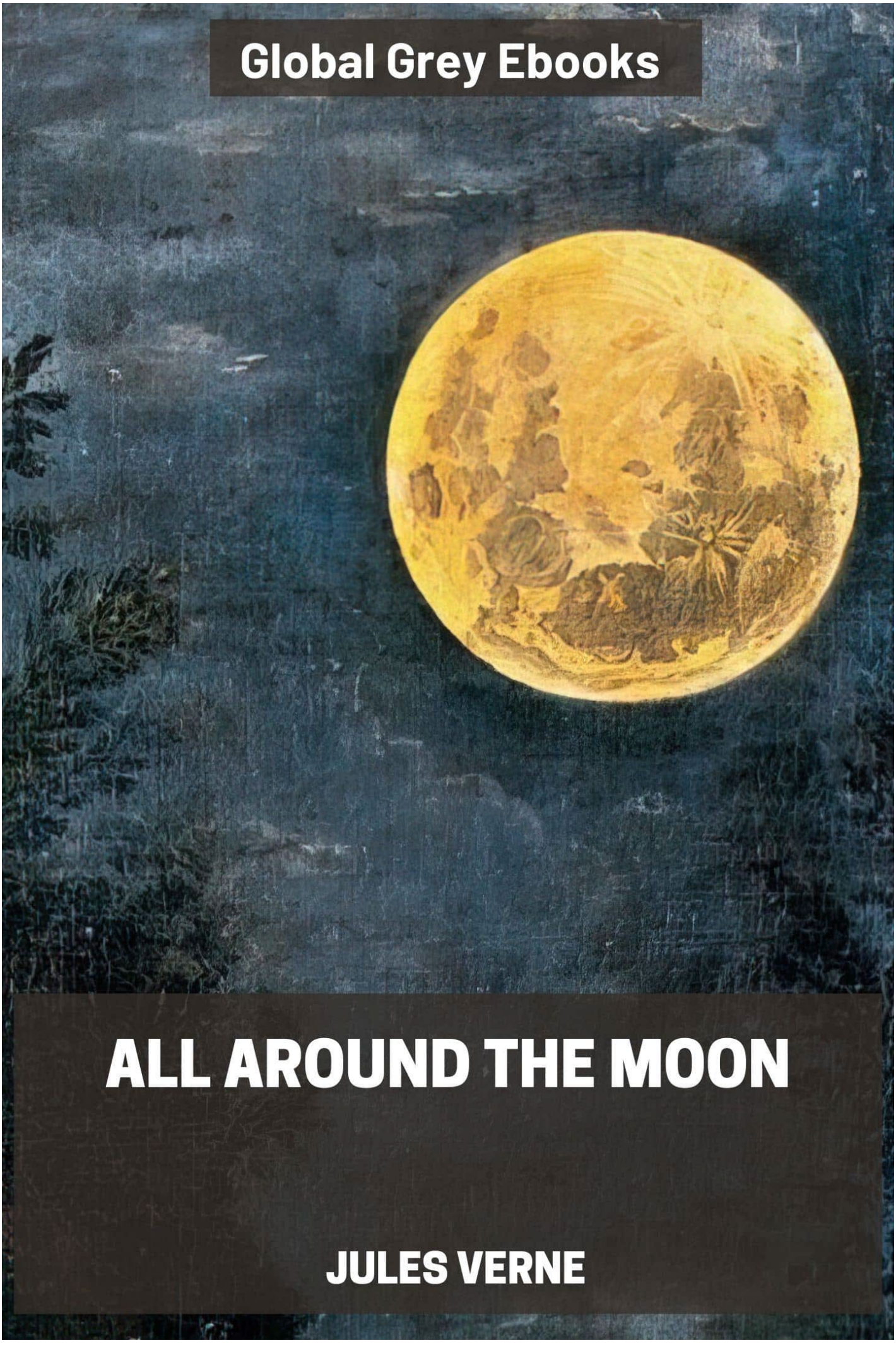

ALL AROUND THE MOON

JULES VERNE

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Preliminary Chapter

THE FIRST PART OF THIS WORK, AND SERVING AS A PREFACE TO THE SECOND.

During the year 186—, the whole world was greatly excited by a scientific experiment unprecedented in the annals of science. The members of the Gun Club, a circle of artillerymen formed at Baltimore after the American war, conceived the idea of putting themselves in communication with the moon! — yes, with the moon— by sending to her a projectile. Their president, Barbicane, the promoter of the enterprise, having consulted the astronomers of the Cambridge Observatory upon the subject, took all necessary means to ensure the success of this extraordinary enterprise, which had been declared practicable by the majority of competent judges. After setting on foot a public subscription, which realized nearly thirty million francs , he began his gigantic works.

According to the advice forwarded from the members of the Observatory, the gun destined to launch the projectile had to be fixed in a country situated between the 0 and 28th degrees of north or south latitude, in order to aim at the moon when at the zenith; and its initiatory velocity was fixed at twelve thousand yards to the second. Launched on the 1st of December, at 10hrs. 46m. 40s. P.M., it ought to reach the moon four days after its departure, that is on the 5th of December, at midnight precisely, at the moment of her attaining her perigee, that is her nearest distance from the earth, which is exactly 86,410 leagues .

The principal members of the Gun Club, President Barbicane, Major Elphinstone, the secretary J . T. Maston, and other learned men, held several meetings, at which the shape and composition of the projectile were discussed, also the position and nature of the gun, and the quality and quantity of powder to be used. It was decided: First, that the projectile should be a shell made of aluminium with a diameter of 108 inches and a thickness of twelve inches to its walls; and should weigh 19,250 pounds. Second, that the gun should be a Columbiad cast in iron, 900 feet long, and run perpendicularly into the earth. Third, that the charge should contain 400,000 pounds of gun-cotton, which, giving out six milliards of litres of gas in rear of the projectile, would easily carry it toward the orb of night.

These questions determined President Barbicane, assisted by Murchison the engineer, to choose a spot situated in Florida, in 27° 7’ North latitude, and 5° 7’ West longitude. It was on this spot, after stupendous labour, that the Columbiad was cast with full success. Things stood thus, when an incident took place which increased the interest attached to this great enterprise a hundredfold.

A Frenchman, an enthusiastic Parisian, as witty as he was bold, asked to be enclosed in the projectile, in order that he might reach the moon, and reconnoiter this terrestrial satellite. The name of this intrepid adventurer was Michel Ardan. He landed in America, was received with enthusiasm, held meetings, saw himself carried in triumph, reconciled President Barbicane to his mortal enemy, Captain Nicholl, and, as a token of reconciliation, persuaded them both to start with him in the projectile. The proposition being accepted, the shape of the projectile was slightly altered. It was made of a cylindro-conical form. This species of aerial car was lined with strong springs and partitions to deaden the shock of departure. It was provided with food for a year, water for some months, and gas for some days. A self-acting apparatus supplied the three travelers with air to breathe. At the same time, on one of the highest points of the Rocky Mountains, the Gun Club had a gigantic telescope erected, in order that they might be able to follow the course of the projectile through space. All was then ready.

On the 30th of November, at the hour fixed upon, from the midst of an extraordinary crowd of spectators, the departure took place, and for the first time, three human beings quitted the terrestrial globe, and launched into inter-planetary space with almost a certainty of reaching their destination. These bold travelers, Michel Ardan, President Barbicane, and Captain Nicholl, ought to make the passage in ninety-seven hours, thirteen minutes, and twenty seconds. Consequently, their arrival on the lunar disc could not take place until the 5th of December at twelve at night, at the exact moment when the moon should be full, and not on the 4th, as some badly informed journalists had announced.

But an unforeseen circumstance, viz., the detonation produced by the Columbiad, had the immediate effect of troubling the terrestrial atmosphere, by accumulating a large quantity of vapour, a phenomenon which excited universal indignation, for the moon was hidden from the eyes of the watchers for several nights.

The worthy J.T. Maston, the staunchest friend of the three travelers, started for the Rocky Mountains, accompanied by the Hon. J. Belfast, director of the Cambridge Observatory, and reached the station of Long's Peak, where the telescope was erected which brought the moon within an apparent distance of two leagues. The honorable secretary of the Gun Club wished himself to observe the vehicle of his daring friends.

The accumulation of the clouds in the atmosphere prevented all observation on the 5th, 6th, 7th, 8th, 9th, and 10th of December. Indeed it was thought that all observations would have to be put off to the 3d of January in the following year; for the moon entering its last quarter on the 11th, would then only present an ever-decreasing portion of her disc, insufficient to allow of their following the course of the projectile.

At length, to the general satisfaction, a heavy storm cleared the atmosphere on the night of the 11th to the 12th of December, and the moon, with half-illuminated disc, was plainly to be seen upon the black sky.

That very night a telegram was sent from the station of Long's Peak by J.T. Maston and Belfast to the staff of the Cambridge Observatory, announcing that on the 11th of December at 8h. 47m. P.M., the projectile launched by the Columbiad of Stones Hill had been detected by Messrs. Belfast and Maston — that it had deviated from its course from some unknown cause, and had not reached its destination; but that it had passed near enough to be retained by the lunar attraction; that its rectilinear movement had been changed to a circular one, and that following an elliptical orbit round the star of night it had become its satellite.

The telegram added that the elements of this new star had not yet been calculated; and indeed three observations made upon a star in three different positions are necessary to determine these elements. Then it showed that the distance separating the projectile from the lunar surface "might" be reckoned at about 2,833 miles", that is 4,500 leagues.

It ended with the double hypothesis: either the attraction of the moon would draw it to herself, and the travelers thus attain their end; or that the projectile, held in one immutable orbit, would gravitate around the lunar disc to all eternity.

With such alternatives, what would be the fate of the travelers? Certainly they had food for some time. But supposing they did succeed in their rash enterprise, how would they return? Could they ever return? Should they hear from them? These questions, debated by the most learned pens of the day, strongly engrossed the public attention.

It is advisable here to make a remark which ought to be well considered by hasty observers. When a purely speculative discovery is announced to the public, it cannot be done with too much prudence. No one is obliged to discover either a planet, a comet, or a satellite; and

whoever makes a mistake in such a case exposes himself justly to the derision of the mass. Far better is it to wait; and that is what the impatient Joseph T. Maston should have done before sending this telegram forth to the world, which, according to his idea, told the whole result of the enterprise.

Indeed this telegram contained two sorts of errors, as was proved eventually. First, errors of observation, concerning the distance of the projectile from the surface of the moon, for on the 11th of December it was impossible to see it; and what Joseph T. Maston had seen, or thought he saw, could not have been the projectile of the Columbiad. Second, errors of theory on the fate in store for the said projectile; for in making it a satellite of the moon, it was putting it in direct contradiction of all mechanical laws.

One single hypothesis of the observers of Long's Peak could ever be realized, that which foresaw the case of the travelers (if still alive) uniting their efforts with the lunar attraction to attain the surface of the disc.

Now these men, as clever as they were daring, had survived the terrible shock consequent on their departure, and it is their journey in the projectile car which is here related in its most dramatic as well as in its most singular details. This recital will destroy many illusions and surmises; but it will give a true idea of the singular changes in store for such an enterprise; it will bring out the scientific instincts of Barbicane, the industrious resources of Nicholl, and the audacious humor of Michel Ardan. Besides this, it will prove that their worthy friend, Joseph T. Maston, was wasting his time, while leaning over the gigantic telescope he watched the course of the moon through the starry space.

I. From Twenty Minutes Past Ten To Forty-Seven Minutes Past Ten P. M.

As ten o'clock struck, Michel Ardan, Barbicane, and Nicholl, took leave of the numerous friends they were leaving on the earth. The two dogs, destined to propagate the canine race on the lunar continents, were already shut up in the projectile. The three travelers approached the orifice of the enormous cast-iron tube, and a crane let them down to the conical top of the projectile.

There, an opening made for the purpose gave them access to the aluminium car. The tackle belonging to the crane being hauled from outside, the mouth of the Columbiad was instantly disencumbered of its last supports.

Nicholl, once introduced with his companions inside the projectile, began to close the opening by means of a strong plate, held in position by powerful screws. Other plates, closely fitted, covered the lenticular glasses, and the travelers, hermetically enclosed in their metal prison, were plunged in profound darkness.

"And now, my dear companions," said Michel Ardan, "let us make ourselves at home; I am a domesticated man and strong in housekeeping. We are bound to make the best of our new lodgings, and make ourselves comfortable. And first let us try and see a little. Gas was not invented for moles."

So saying, the thoughtless fellow lit a match by striking it on the sole of his boot; and approached the burner fixed to the receptacle, in which the carbonized hydrogen, stored at high pressure, sufficed for the lighting and warming of the projectile for a hundred and forty-four hours, or six days and six nights.

The gas caught fire, and thus lighted the projectile looked like a comfortable room with thickly padded walls, furnished with a circular divan, and a roof rounded in the shape of a dome.

The objects it contained, arms, instruments, and utensils securely fastened against the rounds of wadding, could bear the shock of departure with impunity. Humanly speaking, every possible precaution had been taken to bring this rash experiment to a successful termination.

Michel Ardan examined everything, and declared himself satisfied with his installation.

"It is a prison," said he, "but a traveling prison; and, with the right of putting my nose to the window, I could well stand a lease of a hundred years. You smile, Barbicane. Have you any *arriere-pensee*? Do you say to yourself, `This prison may be our tomb?' Tomb, perhaps; still I would not change it for Mahomet's, which floats in space but never advances an inch!"

While Michel Ardan was speaking, Barbicane and Nicholl were making their last preparations.

Nicholl's chronometer marked twenty minutes past ten P.M. when the three travelers were finally enclosed in their projectile. This chronometer was set within the tenth of a second by that of Murchison the engineer. Barbicane consulted it.

"My friends," said he, "it is twenty minutes past ten. At forty- seven minutes past ten Murchison will launch the electric spark on the wire which communicates with the charge of

the Columbiad. At that precise moment we shall leave our spheroid. Thus we still have twenty-seven minutes to remain on the earth."

"Twenty-six minutes thirteen seconds," replied the methodical Nicholl.

"Well!" exclaimed Michel Ardan, in a good-humored tone, "much may be done in twenty-six minutes. The gravest questions of morals and politics may be discussed, and even solved. Twenty-six minutes well employed are worth more than twenty-six years in which nothing is done. Some seconds of a Pascal or a Newton are more precious than the whole existence of a crowd of raw simpletons——"

"And you conclude, then, you everlasting talker?" asked Barbicane.

"I conclude that we have twenty-six minutes left," replied Ardan.

"Twenty-four only," said Nicholl.

"Well, twenty-four, if you like, my noble captain," said Ardan; "twenty-four minutes in which to investigate——"

"Michel," said Barbicane, "during the passage we shall have plenty of time to investigate the most difficult questions. For the present we must occupy ourselves with our departure."

"Are we not ready?"

"Doubtless; but there are still some precautions to be taken, to deaden as much as possible the first shock."

"Have we not the water-cushions placed between the partition- breaks, whose elasticity will sufficiently protect us?"

"I hope so, Michel," replied Barbicane gently, "but I am not sure."

"Ah, the joker!" exclaimed Michel Ardan. "He hopes!—He is not sure!— and he waits for the moment when we are encased to make this deplorable admission! I beg to be allowed to get out!"

"And how?" asked Barbicane.

"Humph!" said Michel Ardan, "it is not easy; we are in the train, and the guard's whistle will sound before twenty-four minutes are over."

"Twenty," said Nicholl.

For some moments the three travelers looked at each other. Then they began to examine the objects imprisoned with them.

"Everything is in its place," said Barbicane. "We have now to decide how we can best place ourselves to resist the shock. Position cannot be an indifferent matter; and we must, as much as possible, prevent the rush of blood to the head."

"Just so," said Nicholl.

"Then," replied Michel Ardan, ready to suit the action to the word, "let us put our heads down and our feet in the air, like the clowns in the grand circus."

"No," said Barbicane, "let us stretch ourselves on our sides; we shall resist the shock better that way. Remember that, when the projectile starts, it matters little whether we are in it or before it; it amounts to much the same thing."

"If it is only `much the same thing,' I may cheer up," said Michel Ardan.

"Do you approve of my idea, Nicholl?" asked Barbicane.

“Entirely,” replied the captain. “We’ve still thirteen minutes and a half.”

“That Nicholl is not a man,” exclaimed Michel; “he is a chronometer with seconds, an escape, and eight holes.”

But his companions were not listening; they were taking up their last positions with the most perfect coolness. They were like two methodical travelers in a car, seeking to place themselves as comfortably as possible. We might well ask ourselves of what materials are the hearts of these Americans made, to whom the approach of the most frightful danger added no pulsation.

Three thick and solidly-made couches had been placed in the projectile. Nicholl and Barbicane placed them in the center of the disc forming the floor. There the three travelers were to stretch themselves some moments before their departure.

During this time, Ardan, not being able to keep still, turned in his narrow prison like a wild beast in a cage, chatting with his friends, speaking to the dogs Diana and Satellite, to whom, as may be seen, he had given significant names.

“Ah, Diana! Ah, Satellite!” he exclaimed, teasing them; “so you are going to show the “moon-dogs” the good habits of the dogs of the earth! That will do honor to the canine race! *Pardieu!* If ever we do come down again, I will bring a cross type of ‘moon-dogs,’ which will make a stir!”

“If there *are* dogs in the moon,” said Barbicane.

“There are,” said Michel Ardan, “just as there are horses, cows, donkeys, and chickens. I bet that we shall find chickens.”

“A hundred dollars we shall find none!” said Nicholl.

“Done, my captain!” replied Ardan, clasping Nicholl’s hand. “But, by the bye, you have already lost three bets with our president, as the necessary funds for the enterprise have been found, as the operation of casting has been successful, and lastly, as the Columbiad has been loaded without accident, six thousand dollars.”

“Yes,” replied Nicholl. “Thirty-seven minutes six seconds past ten.”

“It is understood, captain. Well, before another quarter of an hour you will have to count nine thousand dollars to the president; four thousand because the Columbiad will not burst, and five thousand because the projectile will rise more than six miles in the air.”

“I have the dollars,” replied Nicholl, slapping the pocket of this coat. “I only ask to be allowed to pay.”

“Come, Nicholl. I see that you are a man of method, which I could never be; but indeed you have made a series of bets of very little advantage to yourself, allow me to tell you.”

“And why?” asked Nicholl.

“Because, if you gain the first, the Columbiad will have burst, and the projectile with it; and Barbicane will no longer be there to reimburse your dollars.”

“My stake is deposited at the bank in Baltimore,” replied Barbicane simply; “and if Nicholl is not there, it will go to his heirs.”

“Ah, you practical men!” exclaimed Michel Ardan; “matter-of-fact minds! I admire you the more for not being able to understand you.”

“Forty-two minutes past ten!” said Nicholl.

“Only five minutes more!” answered Barbicane.

“Yes, five little minutes!” replied Michel Ardan; “and we are enclosed in a projectile, at the bottom of a gun 900 feet long! And under this projectile are rammed 400,000 pounds of gun-cotton, which is equal to 1,600,000 pounds of ordinary powder! And friend Murchison, with his chronometer in hand, his eye fixed on the needle, his finger on the electric apparatus, is counting the seconds preparatory to launching us into interplanetary space.”

“Enough, Michel, enough!” said Barbicane, in a serious voice; “let us prepare. A few instants alone separate us from an eventful moment. One clasp of the hand, my friends.”

“Yes,” exclaimed Michel Ardan, more moved than he wished to appear; and the three bold companions were united in a last embrace.

“God preserve us!” said the religious Barbicane.

Michel Ardan and Nicholl stretched themselves on the couches placed in the center of the disc.

“Forty-seven minutes past ten!” murmured the captain.

“Twenty seconds more!” Barbicane quickly put out the gas and lay down by his companions, and the profound silence was only broken by the ticking of the chronometer marking the seconds.

Suddenly a dreadful shock was felt, and the projectile, under the force of six milliards of litres of gas, developed by the combustion of pyroxyle, mounted into space.

II. The First Half-Hour

What had happened? What effect had this frightful shock produced? Had the ingenuity of the constructors of the projectile obtained any happy result? Had the shock been deadened, thanks to the springs, the four plugs, the water-cushions, and the partition-breaks? Had they been able to subdue the frightful pressure of the initiatory speed of 11,000 metres, which was enough to traverse Paris or New York in a second? This was evidently the question suggested to the thousand spectators of this moving scene. They forgot the aim of the journey, and thought only of the travelers. And if one of them— Joseph T. Maston for example— could have cast one glimpse into the projectile, what would he have seen?

Nothing then. The darkness was profound. But its cylindro-conical partitions had resisted wonderfully. Not a rent or a dent anywhere! The wonderful projectile was not even heated under the intense deflagration of the powder, nor liquefied, as they seemed to fear, in a shower of aluminium.

The interior showed but little disorder; indeed, only a few objects had been violently thrown toward the roof; but the most important seemed not to have suffered from the shock at all; their fixtures were intact.

On the movable disc, sunk down to the bottom by the smashing of the partition-breaks and the escape of the water, three bodies lay apparently lifeless. Barbicane, Nicholl, and Michel Ardan— did they still breathe? or was the projectile nothing now but a metal coffin, bearing three corpses into space?

Some minutes after the departure of the projectile, one of the bodies moved, shook its arms, lifted its head, and finally succeeded in getting on its knees. It was Michel Ardan. He felt himself all over, gave a sonorous “Hem!” and then said:

“Michel Ardan is whole. How about the others?”

The courageous Frenchman tried to rise, but could not stand. His head swam, from the rush of blood; he was blind; he was a drunken man.

“Bur-r!” said he. “It produces the same effect as two bottles of Corton, though perhaps less agreeable to swallow.”

Then, passing his hand several times across his forehead and rubbing his temples, he called in a firm voice:

“Nicholl! Barbicane!”

He waited anxiously. No answer; not even a sigh to show that the hearts of his companions were still beating. He called again. The same silence.

“Diable! ” he exclaimed. “They look as if they had fallen from a fifth story on their heads. Bah!” he added, with that imperturbable confidence which nothing could check, “if a Frenchman can get on his knees, two Americans ought to be able to get on their feet. But first let us light up.”

Ardan felt the tide of life return by degrees. His blood became calm, and returned to its accustomed circulation. Another effort restored his equilibrium. He succeeded in rising, drew a match from his pocket, and ignited it by scratching the phosphorous. Then approaching the burner he lighted it. The receiver had not suffered at all. The gas had not escaped. Besides, the smell would have betrayed it; and in that case Michel Ardan could not have carried a

lighted match with impunity through the space filled with hydrogen. The gas mixing with the air would have produced a detonating mixture, and the explosion would have finished what the shock had perhaps begun.

When the burner was lit, Ardan leaned over the bodies of his companions: they were lying one on the other, an inert mass, Nicholl above, Barbicane underneath.

Ardan lifted the captain, propped him up against a divan, and began to rub vigorously. This means, used with judgment, restored Nicholl, who opened his eyes, and instantly recovering his presence of mind, seized Ardan's hand and looked around him.

"And Barbicane?" said he.

"Each in his turn," replied Michel Ardan quietly. "I began with you, Nicholl, because you were on the top. Now let us look to Barbicane." Saying which, Ardan and Nicholl raised the president of the Gun Club and laid him on the divan. He seemed to have suffered more than either of his companions; he was bleeding, but Nicholl was reassured by finding that the hemorrhage came from a slight wound on the shoulder, a mere graze, which he bound up carefully.

Still, Barbicane was a long time coming to himself, which frightened his friends, who did not spare friction.

"He breathes though," said Nicholl, putting his ear to the chest of the wounded man.

"Yes," replied Ardan, "he breathes like a man who has some notion of that daily operation. Rub, Nicholl; let us rub harder." And the two improvised practitioners worked so hard and so well that Barbicane recovered his senses. He opened his eyes, sat up, took his two friends by the hands, and his first words were—

"Nicholl, are we moving?"

Nicholl and Ardan looked at each other; they had not yet troubled themselves about the projectile; their first thought had been for the traveler, not for the car.

"Well, are we really moving?" repeated Michel Ardan.

"Or quietly resting on the soil of Florida?" asked Nicholl.

"Or at the bottom of the Gulf of Mexico?" added Michel Ardan.

"What an idea!" exclaimed the president.

And this double hypothesis suggested by his companions had the effect of recalling him to his senses.

In any case they could not decide on the position of the projectile. Its apparent immovability, and the want of communication with the outside, prevented them from solving the question. Perhaps the projectile was unwinding its course through space. Perhaps after a short rise it had fallen upon the earth, or even in the Gulf of Mexico— a fall which the narrowness of the peninsula of Florida would render not impossible.

The case was serious, the problem interesting, and one that must be solved as soon as possible. Thus, highly excited, Barbicane's moral energy triumphed over physical weakness, and he rose to his feet. He listened. Outside was perfect silence; but the thick padding was enough to intercept all sounds coming from the earth. But one circumstance struck Barbicane, viz., that the temperature inside the projectile was singularly high. The president drew a thermometer from its case and consulted it. The instrument showed 45° C.

“Yes,” he exclaimed, “yes, we are moving! This stifling heat, penetrating through the partitions of the projectile, is produced by its friction on the atmospheric strata. It will soon diminish, because we are already floating in space, and after having nearly stifled, we shall have to suffer intense cold.

“What!” said Michel Ardan. “According to your showing, Barbicane, we are already beyond the limits of the terrestrial atmosphere?”

“Without a doubt, Michel. Listen to me. It is fifty-five minutes past ten; we have been gone about eight minutes; and if our initiatory speed has not been checked by the friction, six seconds would be enough for us to pass through the sixteen leagues of atmosphere which surrounds the globe.”

“Just so,” replied Nicholl; “but in what proportion do you estimate the diminution of speed by friction?”

“In the proportion of one-third, Nicholl. This diminution is considerable, but according to my calculations it is nothing less. If, then, we had an initiatory speed of 11,000 metres, on leaving the atmosphere this speed would be reduced to 7,332 metres. In any case we have already passed through this interval, and——”

“And then,” said Michel Ardan, “friend Nicholl has lost his two bets: four thousand dollars because the Columbiad did not burst; five thousand dollars because the projectile has risen more than six miles. Now, Nicholl, pay up.”

“Let us prove it first,” said the captain, “and we will pay afterward. It is quite possible that Barbicane’s reasoning is correct, and that I have lost my nine thousand dollars. But a new hypothesis presents itself to my mind, and it annuls the wager.”

“What is that?” asked Barbicane quickly.

“The hypothesis that, for some reason or other, fire was never set to the powder, and we have not started at all.”

“*Pardieu!* captain,” exclaimed Michel Ardan, “that hypothesis is worthy of my brain! It cannot be a serious one. For have we not been half annihilated by the shock? Did I not recall you to life? Is not the president’s shoulder still bleeding from the blow it has received?”

“Granted,” replied Nicholl; “but one question.”

“Well, captain?”

“Did you hear the detonation, which certainly ought to be loud?”

“No,” replied Ardan, much surprised; “certainly I did not hear the detonation.”

“And you, Barbicane?”

“Nor I, either.”

“Very well,” said Nicholl.

“Well now,” murmured the president “why did we not hear the detonation?”

The three friends looked at each other with a disconcerted air. It was quite an inexplicable phenomenon. The projectile had started, and consequently there must have been a detonation.

“Let us first find out where we are,” said Barbicane, “and let down this panel.”

This very simple operation was soon accomplished. The nuts which held the bolts to the outer plates of the right-hand scuttle gave way under the pressure of an English wrench. These

bolts were pushed outside, and the buffers covered with India-rubber stopped up the holes which let them through. Immediately the outer plate fell back upon its hinges like a porthole, and the lenticular glass which closed the scuttle appeared. A similar one was let into the thick partition on the opposite side of the projectile, another in the top of the dome, and finally a fourth in the middle of the base. They could, therefore, make observations in four different directions; the firmament by the side and most direct windows, the earth or the moon by the upper and under openings in the projectile.

Barbicane and his two companions immediately rushed to the uncovered window. But it was lit by no ray of light. Profound darkness surrounded them, which, however, did not prevent the president from exclaiming:

“No, my friends, we have not fallen back upon the earth; no, nor are we submerged in the Gulf of Mexico. Yes! we are mounting into space. See those stars shining in the night, and that impenetrable darkness heaped up between the earth and us!”

“Hurrah! hurrah!” exclaimed Michel Ardan and Nicholl in one voice.

Indeed, this thick darkness proved that the projectile had left the earth, for the soil, brilliantly lit by the moon-beams would have been visible to the travelers, if they had been lying on its surface. This darkness also showed that the projectile had passed the atmospheric strata, for the diffused light spread in the air would have been reflected on the metal walls, which reflection was wanting. This light would have lit the window, and the window was dark. Doubt was no longer possible; the travelers had left the earth.

“I have lost,” said Nicholl.

“I congratulate you,” replied Ardan.

“Here are the nine thousand dollars,” said the captain, drawing a roll of paper dollars from his pocket.

“Will you have a receipt for it?” asked Barbicane, taking the sum.

“If you do not mind,” answered Nicholl; “it is more business-like.”

And coolly and seriously, as if he had been at his strong-box, the president drew forth his notebook, tore out a blank leaf, wrote a proper receipt in pencil, dated and signed it with the usual flourish, and gave it to the captain, who carefully placed it in his pocketbook.

Michel Ardan, taking off his hat, bowed to his two companions without speaking. So much formality under such circumstances left him speechless. He had never before seen anything so “American.”

This affair settled, Barbicane and Nicholl had returned to the window, and were watching the constellations. The stars looked like bright points on the black sky. But from that side they could not see the orb of night, which, traveling from east to west, would rise by degrees toward the zenith. Its absence drew the following remark from Ardan:

“And the moon; will she perchance fail at our rendezvous?”

“Do not alarm yourself,” said Barbicane; “our future globe is at its post, but we cannot see her from this side; let us open the other.”

As Barbicane was about leaving the window to open the opposite scuttle, his attention was attracted by the approach of a brilliant object. It was an enormous disc, whose colossal dimension could not be estimated. Its face, which was turned to the earth, was very bright. One might have thought it a small moon reflecting the light of the large one. She advanced with great speed, and seemed to describe an orbit round the earth, which would intersect the

passage of the projectile. Besides the movement of translation the body revolved upon its axis, and therefore exhibited the phenomena of all celestial bodies abandoned in space.

“Ah!” exclaimed Michel Ardan, “What is that? another projectile?”

Barbicane did not answer. The appearance of this enormous body surprised and troubled him. A collision was possible, and might be attended with deplorable results; either the projectile would deviate from its path, or a shock, breaking its impetus, might precipitate it to earth; or, lastly, it might be irresistibly drawn away by the powerful asteroid. The president caught at a glance the consequences of these three hypotheses, either of which would, one way or the other, bring their experiment to an unsuccessful and fatal termination. His companions stood silently looking into space. The object grew rapidly as it approached them, and by an optical illusion the projectile seemed to be throwing itself before it.

“*Mille dieux*!” exclaimed Michel Ardan, “we shall run into one another!”

Instinctively the travelers drew back. Their dread was great, but it did not last many seconds. The asteroid passed several hundred metres from the projectile and disappeared, not so much from the rapidity of its course, as that its face being opposite the moon, it was suddenly merged into the perfect darkness of space.

“A happy journey to you,” exclaimed Michel Ardan, with a sigh of relief. “Surely infinity of space is large enough for a poor little projectile to walk through without fear. Now, what is this portentous globe which nearly struck us?”

“I know,” replied Barbicane.

“ *Parbleu!* you know everything.”

“It is,” said Barbicane, “a simple meteorite, but an enormous one, which the attraction of the earth has retained as a satellite.”

“Is it possible!” exclaimed Michel Ardan; “the earth then has two moons like Neptune?”

“Yes, my friends, two moons, though it passes generally for having only one; but this second moon is so small, and its speed so great, that the inhabitants of the earth cannot see it. It was by noticing disturbances that a French astronomer, M. Petit, was able to determine the existence of this second satellite and calculate its elements. According to his observations, this meteorite will accomplish its revolution around the earth in three hours and twenty minutes, which implies a wonderful rate of speed.”

“Do all astronomers admit the existence of this satellite?” asked Nicholl.

“No,” replied Barbicane; “but if, like us, they had met it, they could no longer doubt it. Indeed, I think that this meteorite, which, had it struck the projectile, would have much embarrassed us, will give us the means of deciding what our position in space is.”

“How?” said Ardan.

“Because its distance is known, and when we met it, we were exactly 8,140 kilometres from the surface of the terrestrial globe.”

“More than 2,000 leagues,” exclaimed Michel Ardan. “That beats the express trains of the pitiful globe called the earth.”

“I should think so,” replied Nicholl, consulting his chronometer; “it is eleven o’clock, and it is only thirteen minutes since we left the American continent.”

“Only thirteen minutes?” said Barbicane.

“Yes,” said Nicholl; “and if our initiatory speed of eleven kilometres has been kept up, we shall have made about ten thousand leagues in the hour.”

“That is all very well, my friends,” said the president, “but the insoluble question still remains. Why did we not hear the detonation of the Columbiad?”

For want of an answer the conversation dropped, and Barbicane began thoughtfully to let down the shutter of the second side. He succeeded; and through the uncovered glass the moon filled the projectile with a brilliant light. Nicholl, as an economical man, put out the gas, now useless, and whose brilliancy prevented any observation of the inter-planetary space.

The lunar disc shone with wonderful purity. Her rays, no longer filtered through the vapoury atmosphere of the terrestrial globe, shone through the glass, filling the air in the interior of the projectile with his reflections. The black curtain of the firmament in reality heightened the moon’s brilliancy, which in this void of ether unfavorable to diffusion did not eclipse the neighboring stars. The heavens, thus seen, presented quite a new aspect, and one which the human eye could never dream of.

One may conceive the interest with which these bold men watched the orb of night, the great aim of their journey. In its motion the earth’s satellite was insensibly nearing the zenith, the mathematical point which it ought to attain ninety-six hours later. Her mountains, her plains, every projection was as clearly discernible to their eyes as if they were observing it from some spot upon the earth; but its light was developed through space with wonderful intensity. The disc shone like a platinum mirror. Of the earth flying from under their feet, the travelers had lost all recollection.

It was captain Nicholl who first recalled their attention to the vanishing globe.

“Yes,” said Michel Ardan, “do not let us be ungrateful to it. Since we are leaving our country, let our last looks be directed to it. I wish to see the earth once more before it is quite hidden from my eyes.”

To satisfy his companion, Barbicane began to uncover the window at the bottom of the projectile, which would allow them to observe the earth direct. The disc, which the force of the projection had beaten down to the base, was removed, not without difficulty. Its fragments, placed carefully against a wall, might serve again upon occasion. Then a circular gap appeared, 50 centimetres in diameter, hollowed out of the lower part of the projectile. A glass cover, fifteen centimetres thick and strengthened with upper fastenings, closed it tightly. Beneath was fixed an aluminium plate, held in place by bolts. The screws being undone, and the bolts let go, the plate fell down, and visible communication was established between the interior and the exterior.

Michel Ardan knelt by the glass. It was cloudy, seemingly opaque.

“Well!” he exclaimed, “and the earth?”

“The earth?” said Barbicane. “There it is.”

“What! that little thread; that silver crescent?”

“Doubtless, Michel. In four days, when the moon will be full, at the very time we shall reach it, the earth will be new, and will only appear to us as a slender crescent which will soon disappear, and for some days will be enveloped in utter darkness.”

“That the earth?” repeated Michel Ardan, looking with all his eyes at the thin slip of his native planet.

The explanation given by President Barbicane was correct. The earth, with respect to the projectile, was entering its last phase. It was in its octant, and showed a crescent finely traced on the dark background of the sky. Its light, rendered bluish by the thick strata of the atmosphere was less intense than that of the crescent moon, but it was of considerable dimensions, and looked like an enormous arch stretched across the firmament. Some parts brilliantly lighted, especially on its concave part, showed the presence of high mountains, often disappearing behind thick spots, which are never seen on the lunar disc. They were rings of clouds placed concentrically round the terrestrial globe.

However, by dint of a natural phenomenon, identical with that produced on the moon when she is in her octants, the contour of the terrestrial globe could be traced. Its entire disc appeared slightly visible through an effect of pale light , less appreciable than that of the moon. The reason of this lessened intensity is easy to understand. When this reflection is produced on the moon it is caused by the solar rays which the earth reflects upon her satellite. Here, by an inverse effect, it was caused by the solar rays reflected from the moon upon the earth. Now terrestrial light is thirteen times more intense than lunar light on account of the difference of volume in the two bodies. Hence it follows that in the phenomenon of the pale light the dark part of the earth's disc is less clearly outlined than that of the moon's disc because the intensity of the phenomenon is in proportion to the lighting power of the two orbs. It must be added that the terrestrial crescent seems to form a more elongated curve than that of the disc—a pure effect of irradiation.

While the travelers were trying to pierce the profound darkness of space, a brilliant cluster of shooting stars burst upon their eyes. Hundreds of meteorites, ignited by the friction of the atmosphere, irradiated the shadow of the luminous train, and lined the cloudy parts of the disc with their fire. At this period the earth was in its perihelion, and the month of December is so propitious to these shooting stars, that astronomers have counted as many as twenty-four thousand in an hour. But Michel Ardan, disdaining scientific reasonings, preferred thinking that the earth was thus saluting the departure of her three children with her most brilliant fireworks.

Indeed this was all they saw of the globe lost in the darkness, inferior orb of the solar world, rising and setting to the great planets like a simple morning or evening star! Imperceptible point in space, this globe, where they had left all their affections, was nothing more than a fugitive crescent!

Long did the three friends look without speaking, though united in heart, while the projectile sped onward with an ever-decreasing speed. Then an irresistible drowsiness crept over their brain. Was it weariness of body and mind? No doubt; for after the over-excitement of those last hours passed upon earth, reaction was inevitable.

"Well," said Nicholl, "since we must sleep, let us sleep."

And stretching themselves on their couches, they were all three soon in a profound slumber.

But they had not forgotten themselves more than a quarter of an hour, when Barbicane sat up suddenly, and rousing his companions with a loud voice, exclaimed——

"I have found it!"

"What have you found?" asked Michel Ardan, jumping from his bed.

"The reason why we did not hear the detonation of the Columbiad."

"And it is——?" said Nicholl.

"Because our projectile traveled faster than the sound!"

III. Their Place Of Shelter

This curious but certainly correct explanation once given, the three friends returned to their slumbers. Could they have found a calmer or more peaceful spot to sleep in? On the earth, houses, towns, cottages, and country feel every shock given to the exterior of the globe. On sea, the vessels rocked by the waves are still in motion; in the air, the balloon oscillates incessantly on the fluid strata of divers densities. This projectile alone, floating in perfect space, in the midst of perfect silence, offered to its inhabitants perfect repose.

Thus the sleep of our adventurous travelers might have been indefinitely prolonged, if an unexpected noise had not awakened them at about seven o'clock in the morning of the 2nd of December, eight hours after their departure.

This noise was a very natural barking.

"The dogs! it is the dogs!" exclaimed Michel Ardan, rising at once.

"They are hungry," said Nicholl.

"*Parbleu!* " replied Michel, "we have forgotten them."

"Where are they?" asked Barbicane.

They looked and found one of the animals crouched under the divan. Terrified and shaken by the initiatory shock, it had remained in the corner till its voice returned with the pangs of hunger. It was the amiable Diana, still very confused, who crept out of her retreat, though not without much persuasion, Michel Ardan encouraging her with most gracious words.

"Come, Diana," said he: "come, my girl! thou whose destiny will be marked in the cynegetic annals; thou whom the pagans would have given as companion to the god Anubis, and Christians as friend to St. Roch! thou, worthy of being cast in bronze by the king of hell, like the puppy which Jupiter gave to the beautiful Europa for the price of a kiss! thou, whose celebrity will eclipse that of the heroes of Montargis and Mount Saint Bernard! thou, who rushing through interplanetary space wilt perhaps be the Eve of all Selenite dogs! thou, who will justify up there the words of Toussenel: "In the beginning God created man, and seeing how feeble he was, gave him the dog!" Come, Diana, come here."

Diana, flattered or not, advanced by degrees, uttering plaintive cries.

"Good," said Barbicane: "I see Eve, but where is Adam?"

"Adam?" replied Michel; "Adam cannot be far off; he is there somewhere; we must call him. Satellite! here, Satellite!"

But Satellite did not appear. Diana would not leave off howling. They found, however, that she was not bruised, and they gave her a pie, which silenced her complaints.

As to Satellite, he seemed quite lost. They had to hunt a long time before finding him in one of the upper compartments of the projectile, whither some unaccountable shock must have violently hurled him. The poor beast, much hurt, was in a piteous state.

"Diable! " said Michel. "Our acclimatisation is in danger!"

They brought the unfortunate dog down with great care. Its skull had been broken against the roof, and it seemed unlikely that he could recover from such a shock. Meanwhile, he was stretched comfortably on a cushion. Once there, he heaved a sigh.

“We will take care of you,” said Michel; “we are responsible for your existence. I would rather lose an arm than a paw of my poor Satellite.”

Saying which, he offered some water to the wounded dog, who swallowed it with avidity.

This attention paid, the travelers watched the earth and the moon attentively. The earth was now only discernible by a cloudy disc ending in a crescent, rather more contracted than that of the previous evening; but its expanse was still enormous, compared with that of the moon, which was approaching nearer and nearer to a perfect circle.

“*Parbleu!* ” said Michel Ardan, “I am really sorry that we did not start when the earth was full, that is to say, when our globe was in opposition to the sun.”

“Why?” said Nicholl.

“Because we should have seen our continents and seas in a new light— the first resplendent under the solar rays, the latter cloudy as represented on some maps of the world. I should like to have seen those poles of the earth on which the eye of man has never yet rested.

“I dare say,” replied Barbicane; “but if the earth had been *full*, the moon would have been *new*; that is to say, invisible, because of the rays of the sun. It is better for us to see the destination we wish to reach, than the point of departure.”

“You are right, Barbicane,” replied Captain Nicholl; “and, besides, when we have reached the moon, we shall have time during the long lunar nights to consider at our leisure the globe on which our likenesses swarm.”

“Our likenesses!” exclaimed Michel Ardan; “They are no more our likenesses than the Selenites are! We inhabit a new world, peopled by ourselves— the projectile! I am Barbicane’s likeness, and Barbicane is Nicholl’s. Beyond us, around us, human nature is at an end, and we are the only population of this microcosm until we become pure Selenites.”

“In about eighty-eight hours,” replied the captain.

“Which means to say?” asked Michel Ardan.

“That it is half-past eight,” replied Nicholl.

“Very well,” retorted Michel; “then it is impossible for me to find even the shadow of a reason why we should not at once go to breakfast.”

Indeed the inhabitants of the new star could not live without eating, and their stomachs were suffering from the imperious laws of hunger. Michel Ardan, as a Frenchman, was declared chief cook, an important function, which raised no rival. The gas gave sufficient heat for the culinary apparatus, and the provision box furnished the elements of this first feast.

The breakfast began with three bowls of excellent soup, thanks to the liquefaction in hot water of those precious cakes of Liebig, prepared from the best parts of the ruminants of the Pampas. To the meat soup succeeded some beefsteaks, compressed by an hydraulic press, as tender and succulent as if brought straight from the kitchen of an English eating-house. Michel, who was imaginative, maintained that they were even “red.”

Preserved vegetables (“fresher than nature,” said the amiable Michel) succeeded the dish of meat; and was followed by some cups of tea with bread and butter, after the American fashion.

The beverage was declared exquisite, and was due to the infusion of the choicest leaves, of which the emperor of Russia had given some chests for the benefit of the travelers.

And lastly, to crown the repast, Ardan had brought out a fine bottle of Nuits, which was found “by chance” in the provision-box. The three friends drank to the union of the earth and her satellite.

And, as if he had not already done enough for the generous wine which he had distilled on the slopes of Burgundy, the sun chose to be part of the party. At this moment the projectile emerged from the conical shadow cast by the terrestrial globe, and the rays of the radiant orb struck the lower disc of the projectile direct occasioned by the angle which the moon’s orbit makes with that of the earth.

“The sun!” exclaimed Michel Ardan.

“No doubt,” replied Barbicane; “I expected it.”

“But,” said Michel, “the conical shadow which the earth leaves in space extends beyond the moon?”

“Far beyond it, if the atmospheric refraction is not taken into consideration,” said Barbicane. “But when the moon is enveloped in this shadow, it is because the centers of the three stars, the sun, the earth, and the moon, are all in one and the same straight line. Then the *nodes* coincide with the *phases* of the full moon, and there is an eclipse. If we had started when there was an eclipse of the moon, all our passage would have been in the shadow, which would have been a pity.”

“Why?”

“Because, though we are floating in space, our projectile, bathed in the solar rays, will receive light and heat. It economizes the gas, which is in every respect a good economy.”

Indeed, under these rays which no atmosphere can temper, either in temperature or brilliancy, the projectile grew warm and bright, as if it had passed suddenly from winter to summer. The moon above, the sun beneath, were inundating it with their fire.

“It is pleasant here,” said Nicholl.

“I should think so,” said Michel Ardan. “With a little earth spread on our aluminium planet we should have green peas in twenty-four hours. I have but one fear, which is that the walls of the projectile might melt.”

“Calm yourself, my worthy friend,” replied Barbicane; “the projectile withstood a very much higher temperature than this as it slid through the strata of the atmosphere. I should not be surprised if it did not look like a meteor on fire to the eyes of the spectators in Florida.”

“But then J.T. Maston will think we are roasted!”

“What astonishes me,” said Barbicane, “is that we have not been. That was a danger we had not provided for.”

“I feared it,” said Nicholl simply.

“And you never mentioned it, my sublime captain,” exclaimed Michel Ardan, clasping his friend’s hand.

Barbicane now began to settle himself in the projectile as if he was never to leave it. One must remember that this aerial car had a base with a *superficies* of fifty-four square feet. Its height to the roof was twelve feet. Carefully laid out in the inside, and little encumbered by instruments and traveling utensils, which each had their particular place, it left the three travelers a certain freedom of movement. The thick window inserted in the bottom could bear any amount of weight, and Barbicane and his companions walked upon it as if it were solid

plank; but the sun striking it directly with its rays lit the interior of the projectile from beneath, thus producing singular effects of light.

They began by investigating the state of their store of water and provisions, neither of which had suffered, thanks to the care taken to deaden the shock. Their provisions were abundant, and plentiful enough to last the three travelers for more than a year. Barbicane wished to be cautious, in case the projectile should land on a part of the moon which was utterly barren. As to water and the reserve of brandy, which consisted of fifty gallons, there was only enough for two months; but according to the last observations of astronomers, the moon had a low, dense, and thick atmosphere, at least in the deep valleys, and there springs and streams could not fail. Thus, during their passage, and for the first year of their settlement on the lunar continent, these adventurous explorers would suffer neither hunger nor thirst.

Now about the air in the projectile. There, too, they were secure. Reiset and Regnaut's apparatus, intended for the production of oxygen, was supplied with chlorate of potassium for two months. They necessarily consumed a certain quantity of gas, for they were obliged to keep the producing substance at a temperature of above 400° C. But there again they were all safe. The apparatus only wanted a little care. It functioned automatically. At that elevated temperature the chlorate of potassium changed into chloride of potassium and gave out all the oxygen it contained. The eighteen pounds of chlorate of potassium gave out the seven pounds of oxygen necessary for the daily consumption of the three travellers.

But it was not enough to renew the oxygen; the carbonic acid gas produced by expiration must also be absorbed. During the last twelve hours the atmosphere of the projectile had become charged with this deleterious gas; the product of the combustion of the elements of blood with the oxygen taken up by the lungs. Nicholl discovered the state of the air by observing Diana panting painfully. The carbonic acid, by a phenomenon similar to that produced in the famous Grotto del Cane, had collected at the bottom of the projectile owing to its weight. Poor Diana, with her head low, would suffer before her masters from the presence of this gas. But Captain Nicholl hastened to remedy this state of things, by placing on the floor several receivers containing caustic potash, which he shook about for a time, and this substance, greedy of carbonic acid, soon completely absorbed it, thus purifying the air.

An inventory of instruments was then begun. The thermometers and barometers had resisted, all but one minimum thermometer, the glass of which was broken. An excellent aneroid was drawn from the wadded box which contained it and hung on the wall. Of course it was only affected by and marked the pressure of the air inside the projectile, but it also showed the quantity of moisture which it contained. At that moment its needle oscillated between 735 and 760 millimetres. It was fine weather.

Barbicane had also brought several compasses, which he found intact. One must understand that under present conditions their needles were acting *wildly*, that is without any *constant* direction. Indeed, at the distance they were from the earth, the magnetic pole could have no perceptible action upon the apparatus; but the box placed on the lunar disc might perhaps exhibit some strange phenomena. In any case it would be interesting to see whether the earth's satellite submitted like the earth herself to magnetic influences.

A hypsometer to measure the height of the lunar mountains, a sextant to take the height of the sun, a theodolite, a geodetic instrument which serves to level the plan and reduce angles to the horizon, glasses which would be useful as they neared the moon, all these instruments were carefully looked over, and pronounced good in spite of the violent shock.

As to the pickaxes, the spades, and different tools which were Nicholl's especial choice; as to the sacks of different kinds of grain and shrubs which Michel Ardan hoped to transplant into

Selenite ground, they were stowed away in the upper part of the projectile. There was a sort of granary there, loaded with things which the extravagant Frenchman had heaped up. What they were no one knew, and the good-tempered fellow did not explain. Now and then he climbed up to the store-room by cramp-irons riveted to the walls, but kept the inspection to himself. He arranged and rearranged, he plunged his hand rapidly into certain mysterious boxes, singing in one of the falsest of voices an old French refrain to enliven the situation.

Barbicane observed with some interest that his rockets and other fire-works had not been damaged. These were important, because, heavily loaded, they were to help lessen the fall of the projectile, when drawn by the lunar attraction (after having passed the point of neutral attraction) on to the moon's surface; a fall which ought to be six times less rapid than it would have been on the earth's surface, thanks to the difference in mass of the two bodies.

The inspection ended with general satisfaction, when each returned to watch space through the side windows and the lower glass coverlid.

There was the same view. The whole extent of the celestial sphere swarmed with stars and constellations of wonderful purity, enough to drive an astronomer out of his mind! On one side the sun, like the mouth of a burning oven, a dazzling disc without a halo, standing out on the dark background of the sky! On the other, the moon returning its fire by reflection, and apparently motionless in the midst of the starry world. Then, a large spot like a hole in the firmament, bordered by a silvery cord; it was the earth! Here and there nebulous masses like large flakes of starry snow; and from the zenith to the nadir, an immense ring formed by an impalpable dust of stars, the "Milky Way," in the midst of which the sun ranks only as a star of the fourth magnitude.

The observers could not take their eyes from this novel spectacle, of which no description could give an adequate idea. What reflections it suggested! What emotions hitherto unknown awoke in their souls! Barbicane wished to begin the relation of his journey while under its first impressions, and hour after hour took notes of all facts happening in the beginning of the enterprise. He wrote quietly, with his large square writing, in a business-like style.

During this time Nicholl, the calculator, looked over his formulæ of trajectories, and worked out figures with unparalleled dexterity. Michel Ardan chatted first with Barbicane, who did not answer him, and then with Nicholl, who did not hear him, with Diana, who understood none of his theories, and lastly with himself, questioning and answering, going and coming, busy with a thousand details; at one time bent over the lower glass, at another roosting in the heights of the projectile, and always singing. In this microcosm he represented French loquacity and excitability, and we beg you to believe that they were well represented.

The day, or rather (for the expression is not correct) the lapse of twelve hours, which forms a day upon the earth, closed with a plentiful supper carefully prepared. No accident of any nature had yet happened to shake the travelers' confidence; so, full of hope, already sure of success, they slept peacefully, while the projectile under an uniformly decreasing speed made its way through the paths of the heavens.

IV. A Little Algebra

The night passed without incident. Strictly speaking, the word “night” is improper.

The position of the projectile with regard to the sun did not change. Astronomically, it was daylight on the lower part, and night on the upper; so when during this narrative these words are used, they represent the lapse of time between rising and setting of the sun upon the earth.

The travelers’ sleep was rendered more peaceful by the projectile’s excessive speed, for it seemed absolutely motionless. Not a motion betrayed its onward course through space. The rate of progress, however rapid it might be, cannot produce any sensible effect on the human frame when it takes place in a vacuum, or when the mass of air circulates with the body which is carried with it. What inhabitant of the earth perceives its speed, which, however, is at the rate of 90,000 kilometres per hour? Every body is indifferent to it. Motion under such conditions is “felt” no more than repose; and when a body is in repose it will remain so as long as no strange force displaces it; if moving, it will not stop unless an obstacle comes in its way. This indifference to motion or repose is called inertia.

Barbicane and his companions might have believed themselves perfectly stationary, being shut up in the projectile; indeed, the effect would have been the same if they had been on the outside of it. Had it not been for the moon, which was increasing above them, they might have sworn that they were floating in complete stagnation.

That morning, the 3rd of December, the travelers were awakened by a joyous but unexpected noise; it was the crowing of a cock which sounded through the car.

Michel Ardan, who was the first on his feet, climbed to the top of the projectile, and shutting a box, the lid of which was partly open, said in a low voice, “Will you hold your tongue? That creature will spoil my design!”

But Nicholl and Barbicane were awake.

“A cock ?” said Nicholl.

“Why no, my friends,” Michel answered quickly; “it was I who wished to awake you by this rural sound.” So saying, he gave vent to a splendid cock-a-doodledoo, which would have done honor to the proudest of poultry-yards.

The two Americans could not help laughing.

“Fine talent that,” said Nicholl, looking suspiciously at his companion.

“Yes,” said Michel; “a joke in my country. It is very Gallic; they play the cock so in the best society.”

Then turning the conversation:

“Barbicane, do you know what I have been thinking of all night?”

“No,” answered the president.

“Of our Cambridge friends. You have already remarked that I am an ignoramus in mathematical subjects; and it is impossible for me to find out how the savants of the observatory were able to calculate what initiatory speed the projectile ought to have on leaving the Columbiad in order to attain the moon.”

“You mean to say,” replied Barbicane, “to attain that neutral point where the terrestrial and lunar attractions are equal; for, starting from that point, situated about nine-tenths of the distance traveled over, the projectile would simply fall upon the moon, on account of its weight.”

“So be it,” said Michel; “but, once more; how could they calculate the initiatory speed?”

“Nothing can be easier,” replied Barbicane.

“And you knew how to make that calculation?” asked Michel Ardan.

“Perfectly. Nicholl and I would have made it, if the observatory had not saved us the trouble.”

“Very well, old Barbicane,” replied Michel; “they might have cut off my head, beginning at my feet, before they could have made me solve that problem.”

“Because you do not know algebra,” answered Barbicane quietly.

“Ah, there you are, you eaters of *x*! ; you think you have said all when you have said ‘Algebra.’ “

“Michel,” said Barbicane, “can you use a forge without a hammer, or a plow without a plowshare?”

“Hardly.”

“Well, algebra is a tool, like the plow or the hammer, and a good tool to those who know how to use it.”

“Seriously?”

“Quite seriously.”

“And can you use that tool in my presence?”

“If it will interest you.”

“And show me how they calculated the initiatory speed of our car?”

“Yes, my worthy friend; taking into consideration all the elements of the problem, the distance from the center of the earth to the center of the moon, of the radius of the earth, of its bulk, and of the bulk of the moon, I can tell exactly what ought to be the initiatory speed of the projectile, and that by a simple formula.”

“Let us see the formula.”

“You shall see it; only I shall not give you the real course drawn by the projectile between the moon and the earth in considering their motion round the sun. No, I shall consider these two orbs as perfectly motionless, which will answer all our purpose.”

“And why?”

“Because it will be trying to solve the problem called ‘the problem of the three bodies,’ for which the integral calculus is not yet far enough advanced to solve.”

“Then,” said Michel Ardan, in his sly tone, “mathematics have not said their last word?”

“Certainly not,” replied Barbicane.

“Well, perhaps the Selenites have carried the integral calculus farther than you have; and, by the bye, what is this ‘integral calculus’ ? “

“It is a calculation the converse of the differential,” replied Barbicane seriously.

“Much obliged.”

“To speak otherwise, it is the calculus by which one searches for the finished quantities of which only the differential is known. “

“At least that is clear,” replied Michel with an air of one not completely satisfied.

“And now,” continued Barbicane, “a slip of paper and a bit of pencil, and before a half-hour is over I will have found the required formula.”

That said, Barbicane absorbed himself in his work, while Nicholl looked into space, leaving the care of preparing breakfast to his companion.

Half an hour had not elapsed before Barbicane, raising his head, showed Michel Ardan a page covered with algebraical signs, in the midst of which stood out this general formula:

$$\frac{1}{2}\left(v^2 - v_0^2\right) = gr\left\{\frac{r}{x} - 1 + \frac{m'}{m}\left(\frac{r}{d-x} - \frac{r}{d-r}\right)\right\}$$

“And what does that mean?” asked Michel.

“That means,” answered Nicholl, “that one half of *v* two minus *v* zero square equals *gr* multiplied by *r* upon *x* minus 1 plus *m* prime upon *m* multiplied by *r* upon *d* minus *x* minus *r*——”

“*X* upon *y* mounted on *z* and riding on *p* ,” cried Michel Ardan, bursting out laughing. “And you understand that, captain?”

“Nothing can be clearer.”

“How then”, said Michel, “it is as plain as high noon, and I want nothing more.”

“Everlasting laughter!” replied Barbicane. “You wanted algebra, and you shall have your fill of it.”

“I would rather be hung.”

“Indeed,” replied Nicholl, who examined the formula as a connoisseur. “It appears a good solution. “It is the integral of the equation of *vis viva*, and I do not doubt it will give us the desired results.

“But I should like to understand!” exclaimed Michel. I would give ten years of Nicholl’s life to understand.”

“Then listen,” resumed Barbicane. “One half of v^2 — v_0^2 is the formula that gives the semi-variation of the ‘*vis viva*’.”

”Well, and does Nicholl understand what that means?”

“Of course, Michel,” replied the captain. “All these signs, which seem cabalistic to you, form the plainest, the clearest, and the most logical language to those who know how to read it.”

“And you pretend, Nicholl,” asked Michel, “that by means of these hieroglyphics, more incomprehensible than the Egyptian Ibis, you can find what initiatory speed it was necessary to give the projectile?”

“Incontestably,” replied Nicholl; “and even by this same formula I can always tell you its speed at any point of its transit.”

“On your word?”

“On my word.”

“Then you are as cunning as our president?”

“No, Michel; the difficult part is what Barbicane has done; that is, to get an equation which shall satisfy all the conditions of the problem. The remainder is only a question of arithmetic, requiring merely the knowledge of the four rules.”

“That is something!” replied Michel Ardan, who for his life could not do addition right, and who defined the rule as a Chinese puzzle, which allowed one to obtain all sorts of totals.

Still, Barbicane maintained that Nicholl, had he thought about it, would certainly have found the formula.

“I don’t know,” said Nicholl, “for the more I study it, the more marvellously derived I find it.”

“Now listen.” said Barbicane to his ignorant comrade, “and you will see that all these letters have a signification.”

“I am listening,” said Michel, with an air of resignation.

“*d* ”, added Barbicane, “is the distance from the center of the earth to the center of the moon, for we must take the centres to calculate the attraction.”

“That I understand.”

“*r* is the radius of the earth.”

“*r*, radius. Admitted.”

“*m* is the mass of the earth; *m’* the mass of the moon. It is necessary to take into account the masses of the two attracting bodies because the attraction is proportional to the masses.”

“It is understood.”

“*g* represents the gravity, the velocity acquired at the end of one second by a body falling to the surface of the earth. Is that clear?”

“Like spring water,” replied Michel.

“Now I represent by *x* the variable distance which separates the projectile from the center of the earth, and by *v* the velocity which the projectile has attained at that distance.”

“Good.”

“Finally, the expression v_0 which figures in the equation is the velocity the projectile will have on leaving the atmosphere.”

“Just so,” said Nicholl; “it is from that point that we must calculate the velocity, since we know already that the velocity at departure was exactly three halves the velocity on leaving the atmosphere.”

“I understand no more,” said Michel.

“It is a very simple calculation,” said Barbicane.

“Not as simple as I am,” retorted Michel.

“That means, that when our projectile reached the limits of the terrestrial atmosphere it had already lost one-third of its initiatory speed.”

“As much as that?”

“Yes, my friend; merely by friction against the atmospheric strata. You understand that the faster it goes the more resistance it meets with from the air.”

“That I admit,” answered Michel; “and I understand it, although your *v* zero two and your *v* zero square , are rattling in my head like nails in a bag.”

“First effects of algebra,” replied Barbicane; “and now, to finish you, we are going to prove the given number of these different expressions, that is, to calculate their numerical value.”

“Finish me!” replied Michel.

“Of these expressions”, said Barbicane, “some are known, and the others have to be calculated.”

“I will undertake the latter, “ said Nicholl.

“Let us see, *r*,” continued Barbicane; “*r* is the radius of the earth, which under the latitude of Florida, our point of departure, is equal to 6,370,000 metres. *d*, —that is to say the distance from the centre of the earth to the centre of the moon, is equal to 56 terrestrial radii, say——.”

Nicholl calculated rapidly.

“That would be,” said he, “356,720,000 metres at the moment when the moon is at its perigee, that is to say at the distance of closest approach to the earth.”

“Good,” said Barbicane. Now *m* prime over *m,* (*m’/m*), that is to say the relationship of the mass of the moon to the mass of the earth is one eighty-first (1/81).

“Perfect,” said Michel.

“And *g*, the gravity, is at Florida nine metres eighty one centimeters (9.81 metres); from which it results that *gr* equals——”

“Sixty-two million four hundred and twenty-six thousand (62,426,000) square meters,” replied Nicholl.

“And now?” asked Michel Ardan.

“Now that the expressions are reduced to figures,” replied Barbicane, “I am going to calculate the velocity *v* zero (v_0)—that is the velocity the projectile must have on leaving the atmosphere in order to reach the point of equal attraction with no velocity. Since at that moment the velocity will be null, I put it down equal to zero and *x*, the point where the neutral point is to be found will be represented by nine-tenths of *d*—that is to say the distance which separates the two centres.”

“I have a vague idea that it ought to be so,” said Michel.

“I shall then have *x* equals nine-tenths of *d*, and *v* equals zero, and my formula will become—”

Barbicane wrote rapidly on the paper—.

$$v_0^2 = 2gr\left\{1 - \frac{10r}{9d} - \frac{1}{81}\left(\frac{10r}{d} - \frac{r}{d-r}\right)\right\}$$

Nicholl scanned it greedily.

“That’s it! that’s it!” at last he cried.

“Is it clear?” asked Barbicane.

“It is written in letters of fire,” said Nicholl.

“Wonderful fellows!” muttered Ardan.

“Do you understand it at last?” asked Barbicane.

“Do I understand it?” cried Michel Ardan; “why my head is bursting with it.”

“Thus,” replied Barbicane, “*v* zero two equals two *gr* multiplied by one minus ten *r* upon nine *d*, minus one eighty-first multiplied by ten *r* upon *d* less *r* upon *d* minus *r*.

“And now,” said Nicholl, “to find out the speed of the projectile when it leaves the atmosphere, we have only to calculate that.”

The captain, as a practical man equal to all difficulties, began to write with frightful rapidity. Divisions and multiplications grew under his fingers; the figures were like hail on the white page. Barbicane watched him, while Michel Ardan nursed a growing headache with both hands.

“Very well?” asked Barbicane, after some minutes’ silence.

“Well!” replied Nicholl; every calculation made, *v* zero, that is to say, the speed necessary for the projectile on leaving the atmosphere, to enable it to reach the equal point of attraction, ought to be——”

“Yes?” said Barbicane.

“Eleven thousand fifty-one (11,051) metres in the first second”.

“What!” exclaimed Barbicane, starting; “you say——”

“Eleven thousand fifty-one metres.”

“*Malediction!*” cried the president, making a gesture of despair.

“What is the matter?” asked Michel Ardan, much surprised.

“What is the matter! why, if at this moment our speed had already diminished one-third by friction, the initiatory speed ought to have been——”

“Sixteen thousand five hundred seventy six (16,576) metres,” replied Nicholl.

“And the Cambridge Observatory declared that eleven thousand metres was enough at starting; and our projectile, which only started with that speed——”

“Well?” asked Nicholl.

“Well, it will not be enough.”

“Good.”

“We shall not be able to reach the neutral point.”

“Sacrebleu!”

“We shall not even get halfway.”

“In the name of the projectile!” exclaimed Michel Ardan, jumping as if it was already on the point of striking the terrestrial globe.

“And we shall fall back upon the earth!”

V. The Cold Of Space

This revelation came like a thunderbolt. Who could have expected such an error in calculation? Barbicane would not believe it. Nicholl revised his figures: they were exact. As to the formula which had determined them, they could not suspect its truth and verification; it was evident that an initiatory velocity of 16,576 metres in the first second was necessary to enable them to reach the neutral point.

The three friends looked at each other silently. There was no thought of breakfast. Barbicane, with clenched teeth, knitted brows, and hands clasped convulsively, was watching through the window. Nicholl had crossed his arms, and was examining his calculations. Michel Ardan was muttering:

“That is just like these scientific men: they never do anything else. I would give twenty pistoles if we could fall upon the Cambridge Observatory and crush it, together with the whole lot of dabblers in figures which it contains.”

Suddenly a thought struck the captain, which he at once communicated to Barbicane.

“Ah!” said he; “it is seven o’clock in the morning; we have already been gone thirty-two hours; more than half our passage is over, and we are not falling that I am aware of.”

Barbicane did not answer, but after a rapid glance at the captain, took a compass wherewith to measure the angular distance of the terrestrial globe; then from the lower window he took a very exact observation thanks to the apparent immobility of the projectile. Then rising and wiping his forehead, on which large drops of perspiration were standing, he put some figures on paper. Nicholl understood that the president was deducting from the terrestrial diameter the projectile’s distance from the earth. He watched him anxiously.

“No,” exclaimed Barbicane, after some moments, “no, we are not falling! no, we are already more than 50,000 leagues from the earth. We have passed the point at which the projectile would have stopped if its speed had only been 11,000 metres at starting. We are still going up.”

“That is evident,” replied Nicholl; “and we must conclude that our initial speed, under the power of the 400,000 pounds of gun-cotton, must have exceeded the required 11,000 metres. Now I can understand how, after thirteen minutes only, we met the second satellite, which gravitates round the earth at more than 2,000 leagues’ distance.”

“And this explanation is the more probable,” added Barbicane, “Because, in throwing off the water enclosed between its partition-breaks, the projectile found itself lightened of a considerable weight.”

“Just so,” said Nicholl.

“Ah, my brave Nicholl, we are saved!”

“Very well then,” said Michel Ardan quietly; “as we are safe, let us have breakfast.”

Nicholl was not mistaken. The initial speed had been, very fortunately, much above that estimated by the Cambridge Observatory; but the Cambridge Observatory had nevertheless made a mistake.

The travelers, recovered from this false alarm, took their seats and breakfasted merrily. If they ate a good deal, they talked more. Their confidence was greater after than before “the incident of the algebra.”

“Why should we not succeed?” repeated Michel Ardan; “why should we not arrive safely? We are launched; we have no obstacle before us, no stones in the way; the road is open, more so than that of a ship battling with the sea; more open than that of a balloon battling with the wind! And if a ship can reach where it wishes, if a balloon can ascend where it pleases, why cannot our projectile attain its end and aim?”

“It *will* attain it,” said Barbicane.

“If only to do honor to the American people,” added Michel Ardan, “the only people who could bring such an enterprise to a happy termination, and the only one which could produce a President Barbicane. Ah, now we are no longer uneasy, I begin to think, What will become of us? We shall get right royally bored ”

Barbicane and Nicholl made a gesture of denial.

“But I have provided for the contingency, my friends,” replied Michel; “you have only to speak, and I have chess, draughts, cards, and dominoes at your disposal; nothing is wanting but a billiard-table.”

“What!” exclaimed Barbicane; “you brought away such trifles?”

“Certainly,” replied Michel, “and not only to distract ourselves, but also with the laudable intention of endowing the Selenite smoking divans with them.”

“My friend,” said Barbicane, “if the moon is inhabited, its inhabitants must have appeared some thousands of years before those of the earth, for we cannot doubt that their star is much older than ours. If then these Selenites have existed their hundreds of thousands of years, and if their brain is of the same organization of the human brain, they have already invented all that we have invented, and even what we may invent in future ages. They have nothing to learn from *us*, and we have everything to learn from *them*.”

“What!” said Michel; “you believe that they have artists like Phidias, Michael Angelo, or Raphael?”

“Yes.”

“Poets like Homer, Virgil, Milton, Lamartine, and Hugo?”

“I am sure of it.”

“Philosophers like Plato, Aristotle, Descartes, Kant?”

“I have no doubt of it.”

“Scientific men like Archimedes, Euclid, Pascal, Newton?”

“I could swear it.”

“Comic writers like Arnal, and photographers like— like Nadar?”

“Certain.”

“Then, friend Barbicane, if they are as strong as we are, and even stronger— these Selenites— why have they not tried to communicate with the earth? why have they not launched a lunar projectile to our terrestrial regions?”

“Who told you that they have never done so?” said Barbicane seriously.

“Indeed,” added Nicholl, “it would be easier for them than for us, for two reasons; first, because the attraction on the moon’s surface is six times less than on that of the earth, which would allow a projectile to rise more easily; secondly, because it would be enough to send such a projectile only at 8,000 leagues instead of 80,000, which would require the force of projection to be ten times less strong.”

“Then,” continued Michel, “I repeat it, why have they not done it?”

“And I repeat,” said Barbicane; “who told you that they have not done it?”

“When?”

“Thousands of years ago; before man appeared on earth ,” replied Barbicane.

“And the projectile— where is the projectile? I demand to see the projectile.”

“My friend,” replied Barbicane, “the sea covers five-sixths of our globe. From that we may draw five good reasons for supposing that the lunar projectile, if ever launched, is now at the bottom of the Atlantic or the Pacific, unless it sped into some crevasse at that period when the crust of the earth was not yet hardened.”

“Old Barbicane,” said Michel, “you have an answer for everything, and I bow before your wisdom. But there is one hypothesis that would suit me better than all the others, which is, the Selenites, being older than we, are wiser, and have not invented gunpowder.”

At this moment Diana joined in the conversation by a sonorous barking. She was asking for her breakfast.

“Ah!” said Michel Ardan, “in our discussion we have forgotten Diana and Satellite.”

Immediately a good-sized pie was given to the dog, which devoured it hungrily.

“Do you see, Barbicane,” said Michel, “we should have made a second Noah’s ark of this projectile, and borne with us to the moon a couple of every kind of domestic animal.”

“I dare say; but room would have failed us.”

“Oh!” said Michel, “we might have squeezed a little.”

“The fact is,” replied Nicholl, “that oxen, cows, bulls, and horses, and all ruminants, would have been very useful on the lunar continent, but unfortunately the car could neither have been made a stable nor a shed.”

“Well, ” said Michel Ardan, “we might have at least brought a donkey, only a little donkey; that courageous and patient beast which old Silenus loved to mount. I love those old donkeys; they are the least favored animals in creation; they are not only beaten while alive, but even after they are dead.”

“How do you make that out?” asked Barbicane.

“*Dame!* ” said Michel, “they make their skins into drums.”

Barbicane and Nicholl could not help laughing at this ridiculous remark. But a cry from their merry companion stopped them. The latter was leaning over the spot where Satellite lay. He rose, saying:

“My good Satellite is no longer ill.”

“Ah!” said Nicholl.

“No,” answered Michel, “he is dead . There,” added he, in a piteous tone, “that is embarrassing. I much fear, my poor Diana, that you will leave no progeny in the lunar regions!”

Indeed the unfortunate Satellite had not survived its wound. It was quite dead. Michel Ardan looked at his friends with a rueful countenance.

“One question presents itself,” said Barbicane. “We cannot keep the dead body of this dog with us for the next forty-eight hours.”

“No! certainly not,” replied Nicholl; “but our scuttles are fixed on hinges; they can be let down. We will open one, and throw the body out into space.”

The president thought for some moments, and then said:

“Yes, we must do so, but at the same time taking very great precautions.”

“Why?” asked Michel.

“For two reasons which you will understand,” answered Barbicane. “The first relates to the air shut up in the projectile, and of which we must lose as little as possible.”

“But we manufacture the air?”

“Only in part. We make only the oxygen, my worthy Michel; and with regard to that, we must watch that the apparatus does not furnish the oxygen in too great a quantity; for an excess would bring us very serious physiological troubles. But if we make the oxygen, we do not make the azote, that medium which the lungs do not absorb, and which ought to remain intact; and that azote will escape rapidly through the open scuttles.”

“Oh! the time for throwing out poor Satellite?” said Michel.

“Agreed; but we must act quickly.”

“And the second reason?” asked Michel.

“The second reason is that we must not let the outer cold, which is excessive, penetrate the projectile or we shall be frozen to death.”

“But the sun?”

“The sun warms our projectile, which absorbs its rays; but it does not warm the vacuum in which we are floating at this moment. Where there is no air, there is no more heat than diffused light; and the same with darkness; it is cold where the sun’s rays do not strike direct. This temperature is only the temperature produced by the radiation of the stars; that is to say, what the terrestrial globe would undergo if the sun disappeared one day.”

“Which is not to be feared,” replied Nicholl.

“Who knows?” said Michel Ardan. “But, in admitting that the sun does not go out, might it not happen that the earth might move away from it?”

“There!” said Barbicane, “there is Michel with his ideas.”

“And,” continued Michel, “do we not know that in 1861 the earth passed through the tail of a comet? Or let us suppose a comet whose power of attraction is greater than that of the sun. The terrestrial orbit will bend toward the wandering star, and the earth, becoming its satellite, will be drawn such a distance that the rays of the sun will have no action on its surface.”

“That *might* happen, indeed,” replied Barbicane, “but the consequences of such a displacement need not be so formidable as you suppose.”

“And why not?”

“Because the heat and cold would be equalized on our globe. It has been calculated that, had our earth been carried along in its course by the comet of 1861, at it would have not undergone a heat at its greatest distance from the sun but sixteen times greater than that sent to us by the moon — a heat which focussed by the strongest lens produces no appreciable effect.”

“How so?”

“Wait a minute,” replied Barbicane. It has also been calculated that at its perihelium, that is at its nearest approach to the sun, it would have undergone a heat 28,000 times greater than that of summer. But this heat, capable of vitrifying terrestrial matter and vapourizing water,

would have formed a thick ring of clouds, which would have tempered that excessive temperature. Hence, compensation between the cold of the apehelium and the heat of the periheliun, and an average probably supportable. ”

“At how many degrees,” asked Nicholl, “is the temperature of the planetary spaces estimated?”

“Formerly,” replied Barbicane, ” it was believed that this temperature was excessively low. By calculating its thermometric decrease, one arrived at a figure millions of degrees below zero. It is Fourier, a compatriot of Michel, an illustrious *savant* of the *Academy of Sciences*, who reduced these numbers to a more just estimation. According to him, the temperature of space does not descend below 60° C.” “Pooh!” said Michel.

“It is very much,” replied Barbicane; “the temperature which was observed in the polar regions, at Melville Island or at Fort Reliance, that is 56 degrees Centigrade below zero.”

“It remains to be proved,” said Nicholl, “that Fourier was not mistaken in his calculations. ”If “I mistake not,” said Nicholl, “M. Pouillet, another French *savant*, estimates the temperature of space at 160°C. below zero. We shall, however, be able to verify these calculations for ourselves.”

“Not at the present moment,” replied Barbicane, “ because the solar rays, beating directly upon our thermometer, would give, on the contrary, a very high temperature. But, when we arrive in the moon, during its fifteen days of night which either face experiences alternately, we shall have leisure to make the experiment, for our satellite lies in a vacuum.”

“What do you mean by a vacuum?” asked Michel. “Is it absolute vacuum?”

“It is absolutely void of air.”

“And is the air replaced by nothing whatever?”

“By the ether only,” replied Barbicane.

“And pray what is the ether?”

“The ether, my friend, is an agglomeration of imponderable atoms, which, say the works on molecular physics, relatively to their dimensions, are as far removed from each other as the celestial bodies in space. Their separation however is less than one three-millionth of a millimetre. It is these atoms which, by their vibratory movement, produce light and heat by making, in each second, four hundred thirty trillion (430×10^{12}) undulations, each of which is but four to six ten thousandth parts ($4 \text{ to } 6 \times 10^{-4}$) of a millimetre in amplitude. “

“Milliards and milliards!” cried Michel Ardan. “Have they measured and counted these oscillations? All these figures, friend Barbicane, are figures of *savants* which frighten the ear and say nothing to the mind.”

“However, one must calculate. . . “

“No, it is better to compare. A trillion signifies nothing. An object of comparison says all. Example: When you tell me that the volume of Uranus is 76 times as large as the Earth; the volume of Saturn 900 times as large, the volume of Jupiter 1,300 times greater, the Sun’s volume 1,300,000 times as large, I am not much the wiser. So I much prefer the old comparisons of the *Double Liégeois* that simply tells you: “The sun is a pumpkin two feet in diameter, Jupiter an orange, Saturn an appian apple Neptune a black cherry, Uranus a large cherry, the Earth a pea, Venus a green pea, Mars the head of a large pin, Mercury a grain of mustard, and Juno, Ceres, Vesta, and Pallas mere grains of sand! One knows at least what to make of it.

After this tirade of Michel Ardan against the *savants* and their trillions which he delivered without blinking an eyelid, they now proceeded to the burial of Satellite. They had merely to drop him into space, in the same way that sailors drop a body into the sea; but, as President Barbicane suggested, they must act quickly, so as to lose as little as possible of that air whose elasticity would rapidly have spread it into space. The bolts of the right scuttle, the opening of which measured about thirty centimetres across, were carefully drawn, while Michel, quite grieved, prepared to launch his dog into space. The glass, raised by a powerful lever, which enabled it to overcome the pressure of the inside air on the walls of the projectile, turned rapidly on its hinges, and Satellite was thrown out. Scarcely a particle of air could have escaped, and the operation was so successful that later on Barbicane did not fear to dispose of the rubbish which encumbered the car.

VI. Question And Answer

On the 4th of December, when the travelers awoke after fifty-four hours' journey, the chronometer marked five o'clock of the terrestrial morning. In time it was just over five hours and forty minutes past the half of that assigned to their sojourn in the projectile; but they had already accomplished nearly seven-tenths of the way. This peculiarity was due to their regularly decreasing speed.

Now when they observed the earth through the lower window, it looked like nothing more than a dark spot, drowned in the solar rays. No more crescent, no more cloudy light! The next day, at midnight, the earth would be *new*, at the very moment when the moon would be *full*. Above, the orb of night was nearing the line followed by the projectile, so as to meet it at the given hour. All around the black vault was studded with brilliant points, which seemed to move slowly; but, at the great distance they were from them, their relative size did not seem to change. The sun and stars appeared exactly as they do to us upon earth. As to the moon, she was considerably larger; but the travelers' glasses, not very powerful, did not allow them as yet to make any useful observations upon her surface, or reconnoiter her topographically or geologically.

Thus the time passed in never-ending conversations all about the moon. Each one brought forward his own contingent of particular facts; Barbicane and Nicholl always serious, Michel Ardan always enthusiastic. The projectile, its situation, its direction, incidents which might happen, the precautions necessitated by their fall on to the moon, were inexhaustible matters of conjecture.

As they were breakfasting, a question of Michel's, relating to the projectile, provoked rather a curious answer from Barbicane, which is worth repeating.

Michel, supposing it to be roughly stopped, while still under its formidable initial speed, wished to know what the consequences of the stoppage would have been.

"But," said Barbicane, "I do not see how it could have been stopped."

"But let us suppose so," said Michel.

"It is an impossible supposition," said the practical Barbicane; "unless that impulsive force had failed; but even then its speed would diminish by degrees, and it would not have stopped suddenly."

"Admit that it had struck a body in space."

"What body?"

"Why that enormous meteor which we met."

"Then," said Nicholl, "the projectile would have been broken into a thousand pieces, and we with it."

"More than that," replied Barbicane; "we should have been burned to death."

"Burned?" exclaimed Michel, " *Pardieu!* I am sorry it did not happen, 'just to see.' "

"And you would have seen," replied Barbicane. "It is known now that heat is only a modification of motion. When water is warmed— that is to say, when heat is added to it—its particles are set in motion."

“Well,” said Michel, “that is an ingenious theory!”

“And a true one, my worthy friend; for it explains every phenomenon of caloric. Heat is but the motion of atoms a simple oscillation of the particles of a body. When they apply the brake to a train, the train comes to a stop; but what becomes of the motion which it had previously possessed? It is transformed into heat, and the brake becomes hot. Why do they grease the axles of the wheels? To prevent their heating, because this heat would be generated by the motion which is thus lost by transformation. Do you understand? ”

“Yes, I understand,” replied Michel, “perfectly. For example, when I have run a long time, when I am rowing , when I am perspiring in large drops, why am I obliged to stop? Simply because my motion is changed into heat.”

Barbicane could not help smiling at Michel’s reply; then, returning to his theory, said:

“Thus, in case of a shock, it would have been with our projectile as with a ball which falls in a burning state after having struck the metal plate; it is its motion which is turned into heat. Consequently I affirm that, if our projectile had struck the meteor, its speed thus suddenly checked would have raised a heat great enough to turn it into vapour instantaneously.”

“Then,” asked Nicholl, “what would happen if the earth’s motion of translation were to stop suddenly?”

“Her temperature would be raised to such a pitch,” said Barbicane, “that she would be at once reduced to vapour.”

“Well,” said Michel, “that is a way of ending the world which will greatly simplify things.”

“And if the earth fell upon the sun?” asked Nicholl.

“According to calculation,” replied Barbicane, “the fall would develop a heat equal to that produced by 1,600 globes of coal, each equal in bulk to our terrestrial globe.”

“A nice increase of temperature for the sun,” replied Michel Ardan, “of which the inhabitants of Uranus or Neptune would doubtless not complain; they must be perished with cold on their planets.”

“Thus, my friends,” said Barbicane, “all motion suddenly stopped produces heat. And this theory allows us to infer that the heat of the solar disc is fed by a hail of meteors falling incessantly on its surface. They have even calculated——”

“ Defend us!” murmured Michel, “the figures are coming.”

“They have even calculated,” continued the imperturbable Barbicane, “that the shock of each meteor on the sun ought to produce a heat equal to that of 4,000 masses of coal of an equal bulk.”

“And what is the solar heat?” asked Michel.

“It is equal to that produced by the combustion of a stratum of coal surrounding the sun to a depth of twenty seven kilometres .”

“And that heat——”

“Would be able to boil two milliards nine hundred millions (2.9×10^{9}) of cubic myriameters of water per hour .”

“And it does not roast us!” exclaimed Michel.

“No,” replied Barbicane, “because the terrestrial atmosphere absorbs four-tenths of the solar heat; besides, the quantity of heat intercepted by the earth is but one ($1/2 \times 10^9$) part in two milliards of the entire radiation.”

“I see that all is for the best,” said Michel, “and that this atmosphere is a useful invention; for it not only allows us to breathe, but it prevents us from roasting.”

“Yes!” said Nicholl, “unfortunately, it will not be the same in the moon.”

“Bah!” said Michel, always hopeful. “If there are inhabitants, they must breathe. If there are no longer any, they must have left enough oxygen for three people, if only at the bottom of ravines, where its own weight will cause it to accumulate, and we will not climb the mountains; that is all.”

And Michel, rising, went to look at the lunar disc, which shone with intolerable brilliancy.

“ *Sapristi!*” said he, “it must be hot up there!”

“Without considering,” replied Nicholl, “that the day lasts 360 hours!”

“And to compensate that,” said Barbicane, “the nights have the same length; and as heat is restored by radiation, their temperature can only be that of the planetary space.”

“A pretty country, that!” exclaimed Michel. “Never mind! I wish I was there! Ah! my dear comrades, it will be rather curious to have the earth for our moon, to see it rise on the horizon, to recognize the shape of its continents, and to say to oneself, `There is America, there is Europe;’ then to follow it when it is about to lose itself in the sun’s rays! By the bye, Barbicane, have the Selenites eclipses?”

“Yes, eclipses of the sun,” replied Barbicane, “when the centers of the three orbs are on a line, the earth being in the middle. But they are only partial, during which the earth, cast like a screen upon the solar disc, allows the greater portion to be seen.”

“And why,” asked Nicholl, “is there no total eclipse? Does not the cone of the shadow cast by the earth extend beyond the moon?”

“Yes, if we do not take into consideration the refraction produced by the terrestrial atmosphere. No, if we take that refraction into consideration. Thus let delta prime (δ’) be the horizontal parallax and *p* prime the apparent semi-diameter——”

“*Ouf!*” cried Michel. “Half of *v zero square.* Do speak plainly, you man of algebra!”

“Very well, replied Barbicane; “in popular language the mean distance from the moon to the earth being sixty terrestrial radii, the length of the cone of the shadow, on account of refraction, is reduced to less than forty-two radii. The result is that when there are eclipses, the moon finds itself beyond the cone of pure shadow, and that the sun sends her its rays, not only from its edges, but also from its center.”

“Then,” said Michel, in a merry tone, “why are there eclipses, when there ought not to be any?”

“Simply because the solar rays are weakened by this refraction, and the atmosphere through which they pass extinguished the greater part of them!”

“That reason satisfies me,” replied Michel. “Besides we shall see when we get there.”

“Now, tell me, Barbicane, do you believe that the moon is an old comet?”

“There’s an idea!”

“Yes,” replied Michel, with an amiable swagger, “I have a few ideas of that sort.”

“But that idea does not spring from Michel,” answered Nicholl.

“Well, then, I am a plagiarist.”

“No doubt about it ,” replied Nicholl. ”According to the ancients, the Arcadians pretend that their ancestors inhabited the earth before the moon became her satellite. Starting from this fact, some scientific men have seen in the moon a comet whose orbit did one day bring it so near to the earth that it was held there by its attraction.”

“Is there any truth in this hypothesis?” asked Michel.

“None whatever,” said Barbicane, “and the proof is, that the moon has preserved no trace of the gaseous envelope which always accompanies comets.”

“But,” continued Nicholl, “Before becoming the earth’s satellite, could not the moon, when in her perihelion, pass so near the sun as by evaporation to get rid of all those gaseous substances?”

“It is possible, friend Nicholl, but not probable.”

“Why not?”

“Because— Faith I do not know.”

“Ah!” exclaimed Michel, “what hundreds of volumes we might make of all that we do not know!”

“Ah! indeed. What time is it?” asked Barbicane.

“Three o’clock,” answered Nicholl.

“How time goes,” said Michel, “in the conversation of scientific men such as we are! Certainly, I feel I know too much! I feel that I am becoming a well of knowledge!”

Saying which, Michel hoisted himself to the roof of the projectile, “to observe the moon better,” he pretended. During this time his companions were watching through the lower glass. Nothing new to note!

When Michel Ardan came down, he went to the side scuttle; and suddenly they heard an exclamation of surprise!

“What is it?” asked Barbicane.

The president approached the window, and saw a sort of flattened sack floating some metres from the projectile. This object seemed as motionless as the projectile, and was consequently animated with the same ascending movement.

“What is that machine?” continued Michel Ardan. “Is it one of the corpuscles of space which our projectile keeps within its attraction, and which will accompany it to the moon?”

“What astonishes me,” said Nicholl, “is that the specific weight of the body, which is certainly less than that of the projectile, allows it to keep so perfectly on a level with it.”

“Nicholl,” replied Barbicane, after a moment’s reflection, “I do not know what the object is, but I do know why it maintains our level.”

“And why?”

“Because we are floating in space, my dear captain, and in space bodies fall or move (which is the same thing) with equal speed whatever be their weight or form; it is the air, which by its resistance creates these differences in weight. When you create a vacuum in a tube, the

objects you send through it, grains of dust or grains of lead, fall with the same rapidity. Here in space is the same cause and the same effect."

"Just so," said Nicholl, "and everything we throw out of the projectile will accompany it until it reaches the moon."

"Ah! fools that we are!" exclaimed Michel.

"Why that expletive?" asked Barbicane.

"Because we might have filled the projectile with useful objects, books, instruments, tools, etc. We could have thrown them all out, and all would have followed in our train. But happy thought! Why cannot we walk outside like the meteor? Why cannot we launch into space through the scuttle? What enjoyment it would be to feel oneself thus suspended in ether, more favored than the birds who must use their wings to keep themselves up!"

"Granted," said Barbicane, "but how to breathe?"

"Hang the air, to fail so inopportunely!"

"But if it did not fail, Michel, your density being less than that of the projectile, you would soon be left behind."

"Then it is a vicious circle."

"All that is most vicious."

"Then we must remain imprisoned in our car?"

"We must!"

"Ah!" exclaimed Michel, in a loud voice.

"What is the matter," asked Nicholl.

"I know,— I guess, what this pretended meteor is! It is no asteroid which is accompanying us! It is not a piece of a planet."

"What is it then?" asked Barbicane.

"It is our unfortunate dog! It is Diana's husband!"

Indeed, this deformed, unrecognizable object, reduced to nothing, was the body of Satellite, flattened like a bagpipe without wind, and ever mounting, mounting!

VII. A Moment Of Intoxication

Thus a phenomenon, curious but logical, bizarre but explicable, was happening under these strange conditions.

Every object thrown from the projectile would follow the same course and never stop until it did. There was a subject for conversation which the whole evening could not exhaust.

Besides, the excitement of the three travelers increased as they drew near the end of their journey. They expected unforseen incidents, and new phenomena; and nothing would have astonished them in the frame of mind they then were in. Their overexcited imagination went faster than the projectile, whose speed was evidently diminishing, though insensibly to themselves. But the moon grew larger to their eyes, and they fancied if they stretched out their hands they could seize it.

The next day, the 5th of December , at five in the morning, all three were on foot. That day was to be the last of their journey, all calculations were true. That very night, at twelve o'clock, in eighteen hours, exactly at the full moon, they would reach its brilliant disc. The next midnight would see that journey ended, the most extraordinary of ancient or modern times. Thus from the first of the morning, through the scuttles silvered by its rays, they saluted the orb of night with a confident and joyous hurrah.

The moon was advancing majestically along the starry firmament. A few more degrees, and she would reach the exact point where her meeting with the projectile was to take place.

According to his own observations, Barbicane reckoned that they would land on her northern hemisphere, where stretch immense plains, and where mountains are rare. A favorable circumstance if, as they thought, the lunar atmosphere was stored only in its depths.

"Besides," observed Michel Ardan, "a plain is easier to disembark upon than a mountain. A Selenite, deposited in Europe on the summit of Mont Blanc, or in Asia on the top of the Himalayas, would not be quite in the right place."

"And," added Captain Nicholl, "on a flat ground, the projectile will remain motionless when it has once touched; whereas on a declivity it would roll like an avalanche, and not being squirrels we should not come out safe and sound. So it is all for the best."

Indeed, the success of the audacious attempt no longer appeared doubtful. But Barbicane was preoccupied with one thought; but not wishing to make his companions uneasy, he kept silence on this subject.

"What is more," added Nicholl, "on a plain the projectile will remain motionless after it has touched the ground, whilst it would roll down a hill like an avalanche, and as we are not squirrels, we should not come out safe and sound."

In fact, the success of the audacious enterprise no longer appeared doubtful. Still one reflection occupied Barbicane; but not wishing to make his two companions uneasy, he kept silence upon it.

The direction the projectile was taking toward the moon's northern hemisphere, showed that her course had been slightly altered. The aim of the discharge, mathematically calculated, ought to carry the projectile to the very center of the lunar disc. If it did not land there, there must have been some deviation. What had caused it? Barbicane could neither imagine nor determine the importance of the deviation, for there were no points to go by. He

hoped, however, that it would have no other result than that of bringing them nearer the upper border of the moon, a region more suitable for landing.

Without imparting his uneasiness to his companions, Barbicane contented himself with constantly observing the moon, in order to see whether the course of the projectile would not be altered; for the situation would have been terrible if it failed in its aim, and being carried beyond the disc should be launched into interplanetary space.

At that moment, the moon, instead of appearing flat like a disc, already showed its convexity. If the sun's rays had struck it obliquely, the shadow thrown would have brought out the high mountains, which would have been clearly distinguished. The eye might have gazed into the crater's gaping abysses, and followed the capricious fissures which wound through the immense plains. But all relief was as yet leveled in intense brilliancy. They could scarcely distinguish those large spots which give the moon the appearance of a human face.

"Face, indeed!" said Michel Ardan; "but I am sorry for the amiable sister of Apollo. A pockmarked face! "

But the travelers, now so near the end, were incessantly observing this new world. They imagined themselves walking through its unknown countries, climbing its highest peaks, descending into the bottom of the broad cirques. Here and there they fancied they saw vast seas, scarcely kept together under so rarefied an atmosphere, and water-courses emptying the mountain tributaries. Leaning over the abyss, they hoped to catch some sounds from that orb forever mute in the solitude of space.

That last day left them the liveliest rembrances. They took down the most trifling details. A vague uneasiness took possession of them as they neared the end. This uneasiness would have been doubled had they felt how their speed had decreased. It would have seemed to them quite insufficient to carry them to the end. It was because the projectile then "weighed" almost nothing. Its weight was ever decreasing, and would be entirely annihilated on that line where the lunar and terrestrial attractions would neutralize each other , causing such surprising effects.

But in spite of his preoccupation, Michel Ardan did not forget to prepare the morning repast with his accustomed punctuality. They ate with a good appetite. Nothing was so excellent as the soup liquefied by the heat of the gas; nothing better than the preserved meat. Some glasses of good French wine crowned the repast, causing Michel Ardan to remark that the lunar vines, warmed by that ardent sun, ought to distill even more generous wines; that is, if they existed. In any case, the far-seeing Frenchman had taken care not to forget in his collection some precious cuttings of the Médoc and Côte d'Or, upon which he counted particularly.

Reiset and Regnault's apparatus worked with great regularity. The air maintained itself in a state of perfect purity. Not a molecule of carbonic acid resisted the potash; and as to the oxygen, Captain Nicholl said "it was certainly of the first quality." The little watery vapour enclosed in the projectile mixing with the air tempered the dryness; and many apartments in Paris, London, or New York, and many theatres, were certainly not in such a healthy condition.

But that it might act with regularity, the apparatus must be kept in perfect order; so each morning Michel visited the escape regulators, tried the taps, and regulated the heat of the gas by the pyrometer. Everything had gone well up to that time, and the travelers, imitating the worthy J.T. Maston, began to acquire a degree of embonpoint which would have rendered them unrecognizable if their imprisonment had been prolonged to some months. In a word, they behaved like chickens in a coop; they were getting fat.

In looking through the scuttle Barbicane saw the spectre of the dog, and other divers objects which had been thrown from the projectile, obstinately following them. Diana howled lugubriously on seeing the remains of Satellite . These fragments seemed as motionless as if they reposed on solid earth.

“Do you know, my friends,” said Michel Ardan, “that if one of us had succumbed to the shock consequent on departure, we should have had a great deal of trouble to bury him? What am I saying? to *etherize* him, as here ether takes the place of earth. You see the accusing body would have followed us into space like a remorse.”

“That would have been sad,” said Nicholl.

“Ah!” continued Michel, “what I regret is not being able to take a walk outside. What voluptuousness to float amid this radiant ether, to bathe oneself in it, to wrap oneself in the sun’s pure rays. If Barbicane had only thought of furnishing us with a diving apparatus and an air-pump, I could have ventured out and assumed fanciful attitudes of a chimera and a hypogriffon on the top of the projectile.”

“Well, old Michel,” replied Barbicane, “you would not have made a hypogriffon long, for in spite of your diver’s dress, swollen by the expansion of air within you, you would have burst like a shell, or rather like a balloon which has risen too high. So do not regret it, and do not forget this— as long as we float in space, all sentimental walks beyond the projectile are forbidden.”

Michel Ardan allowed himself to be convinced to a certain extent. He admitted that the thing was difficult but not impossible, a word which he never uttered.

The conversation passed from this subject to another, not failing him for an instant. It seemed to the three friends as though, under present conditions, ideas shot up in their brains as leaves shoot at the first warmth of spring. They felt bewildered.

In the middle of the questions and answers which crossed each other during the evening , Nicholl put one question which did not find an immediate solution.

“Ah, indeed!” said he; “it is all very well to go to the moon, but how to get back again?”

His two interlocutors looked surprised. One would have thought that this possibility now occurred to them for the first time.

“What do you mean by that, Nicholl?” asked Barbicane gravely.

“To ask for means to leave a country,” added Michel, “When we have not yet arrived there, seems to me rather inopportune.”

“I do not say that, wishing to draw back,” replied Nicholl; “but I repeat my question, and I ask, `How shall we return?’”

“I know nothing about it,” answered Barbicane.

“And I,” said Michel, “if I had known how to return, I would never have started.”

“There’s an answer!” cried Nicholl.

“I quite approve of Michel’s words,” said Barbicane; “and add, that the question has no real interest. Later, when we think it is advisable to return, we will take counsel together. If the Columbiad is not there, the projectile will be.”

“That is a step certainly. A ball without a gun!”

“The gun,” replied Barbicane, “can be manufactured. The powder can be made. Neither metals, saltpeter, nor coal can fail in the depths of the moon . Besides, in order to return you have only the lunar attraction to conquer and it suffices to go only 8,000 leagues in order to fall upon the terrestrial globe by virtue of the mere laws of weight.”

“Enough,” said Michel with animation. “Let it be no longer a question of returning: we have already entertained it too long. As to communicating with our former earthly colleagues, that will not be difficult.”

“And how?”

“By means of meteors launched by lunar volcanoes.”

“Well thought of, Michel,” said Barbicane in a convinced tone of voice. “Laplace has calculated that a force five times greater than that of our cannons would suffice to send a meteor from the moon to the earth, and there is not one volcano which has not a greater power of propulsion than that.”

“Hurrah!” exclaimed Michel; “these meteors are handy postmen, and cost nothing. And how we shall be able to laugh at the post-office administration! But now I think of it——”

“What do you think of?”

“A capital idea. Why did we not fasten a wire to our projectile, and we could have exchanged telegrams with the earth?”

“ *Mille diables !*” answered Nicholl. “Do you consider the weight of a wire eighty-six thousand leagues long nothing?”

“As nothing. They could have trebled the Columbiad’s charge; they could have quadrupled or quintupled it!” exclaimed Michel, with whom the verb took a higher intonation each time.

“There is but one little objection to make to your proposition,” replied Barbicane, “which is that, during the rotary motion of the globe, our wire would have wound itself round it like a chain on a capstan, and that it would inevitably have brought us to the ground.”

“By the thirty-nine stars of the Union!” said Michel, “I have nothing but impracticable ideas to-day; ideas worthy of J.-T. Maston. But I have a notion that, if we do not return to earth, J.-T. Maston will be able to come to us.”

“Yes, he’ll come,” replied Barbicane; “he is a worthy and a courageous comrade. Besides, what is easier? Is not the Columbiad still buried in the soil of Florida? Is cotton and nitric acid wanted wherewith to manufacture the pyroxyle? Will not the moon pass the zenith of Florida? In eighteen years’ time will she not occupy exactly the same place as to-day?”

“Yes,” continued Michel, “yes, Maston will come, and with him our friends Elphinstone, Blomsberry, all the members of the Gun Club, and they will be well received. And by and by they will run trains of projectiles between the earth and the moon! Hurrah for J.T. Maston!”

It is probable that, if the Hon. J.T. Maston did not hear the hurrahs uttered in his honor, his ears at least tingled. What was he doing then? Doubtless, posted in the Rocky Mountains, at the station of Long’s Peak, he was trying to find the invisible projectile gravitating in space. If he was thinking of his dear companions, we must allow that they were not far behind him; and that, under the influence of a strange excitement, they were devoting to him their best thoughts.

But whence this excitement, which was evidently growing upon the tenants of the projectile? Their sobriety could not be doubted. This strange irritation of the brain, must it be attributed to the peculiar circumstances under which they found themselves, to their proximity to the

orb of night, from which only a few hours separated them, to some secret influence of the moon acting upon their nervous system? Their faces were as rosy as if they had been exposed to the roaring flames of an oven; their respiration became more active; their lungs played like forge-bellows; their eyes shone with extraordinary flame; their voices resounded in loud accents; their words escaped like a champagne cork driven out by carbonic acid; their gestures became annoying, they wanted so much room to perform them; and, strange to say, they none of them noticed this great tension of the mind.

“Now,” said Nicholl, in a short tone, “now that I do not know whether we shall ever return from the moon, I want to know what we are going to do there?”

“What we are going to do there?” replied Barbicane, stamping with his foot as if he was in a fencing saloon; “I do not know.”

“You do not know!” exclaimed Michel, with a bellow which provoked a sonorous echo in the projectile.

“No, I have not even thought about it,” retorted Barbicane, in the same loud tone.

“Well, I know,” replied Michel.

“Speak, then,” cried Nicholl, who could no longer contain the growling of his voice.

“I shall speak if it suits me,” exclaimed Michel, seizing his companions’ arms with violence.

“*It must* suit you,” said Barbicane, with an eye on fire and a threatening hand. “It was you who drew us into this frightful journey, and we want to know what for.”

“Yes,” said the captain, “now that I do not know *where* I am going, I want to know *why* I am going.”

“Why?” exclaimed Michel, jumping to the height of a metre , “why? To take possession of the moon in the name of the United States; to add a fortieth State to the Union; to colonize the lunar regions; to cultivate them, to people them, to transport thither all the prodigies of art, of science, and industry; to civilize the Selenites, unless they are more civilized than we are; and to constitute them a republic, if they are not already one!”

“And if there are no Selenites?” retorted Nicholl, who, under the influence of this unaccountable intoxication, was very contradictory.

“Who said that there were no Selenites?” exclaimed Michel in a threatening tone.

“I do,” howled Nicholl.

“Captain,” said Michel, “do not repeat that insolence, or I will knock your teeth down your throat!”

The two adversaries were going to fall upon each other, and the incoherent discussion threatened to merge into a fight, when Barbicane intervened with one bound.

“Stop, miserable men,” said he, separating his two companions; “if there are no Selenites, we will do without them.”

“Yes,” exclaimed Michel, who was not particular; “yes, we will do without them. We have only to make Selenites. Down with the Selenites!”

“The empire of the moon belongs to us,” said Nicholl.

“Let us three constitute the republic.”

“I will be the congress,” cried Michel.

“And I the senate,” retorted Nicholl.

“And Barbicane, the president,” howled Michel.

“Not a president elected by the nation,” replied Barbicane.

“Very well, a president elected by the congress,” cried Michel; “and as I am the congress, you are unanimously elected!”

“Hurrah! hurrah! hurrah! for President Barbicane,” exclaimed Nicholl.

“Hip! hip! hip!” vociferated Michel Ardan.

Then the president and the senate struck up in a tremendous voice the popular song “Yankee Doodle,” while from the congress resounded the masculine tones of the “Marseillaise.”

Then they struck up a frantic dance, with maniacal gestures, idiotic stampings, and somersaults like those of the boneless clowns in the circus. Diana, joining in the dance, and howling in her turn, jumped to the top of the projectile. An unaccountable flapping of wings was then heard amid most fantastic cock-crows, while five or six hens fluttered like bats against the walls.

Then the three traveling companions, whose lungs were disorganized by some unaccountable influence above that of intoxication, inflamed by the air which had set their respiratory apparatus on fire, fell motionless to the bottom of the projectile.

VIII. At Seventy-Eight Thousand One Hundred And Fourteen Leagues

What had happened? Whence the cause of this singular intoxication, the consequences of which might have been very disastrous? A simple blunder of Michel's, which, fortunately, Nicholl was able to correct in time.

After a perfect swoon, which lasted some minutes, the captain, recovering first, soon collected his scattered senses.

Although he had breakfasted only two hours before, he felt a gnawing hunger, as if he had not eaten anything for several days. Everything about him, stomach and brain, were overexcited to the highest degree.

He got up and demanded from Michel a supplementary repast. Michel, utterly done up, did not answer. Nicholl then tried to prepare some tea destined to help the absorption of a dozen sandwiches. He first tried to get some fire, and struck a match sharply.

What was his surprise to see the sulphur shine with so extraordinary a brilliancy as to be almost unbearable to the eye. From the gas-burner which he lit rose a flame equal to a jet of electric light.

A revelation dawned on Nicholl's mind. That intensity of light, the physiological troubles which had arisen in him, the over-excitement of all his moral and quarrelsome faculties— he understood all.

"The oxygen!" he exclaimed.

And leaning over the air apparatus, he saw that the tap was allowing the odourless, tasteless, colourless gas to escape freely, life-giving, but in its pure state producing the gravest disorders in the system. Michel had blunderingly opened the tap of the apparatus to the full.

Nicholl hastened to stop the escape of oxygen with which the atmosphere was saturated, which would have been the death of the travelers, not by suffocation, but by combustion.

An hour later, the air less charged with it restored the lungs to their normal condition. By degrees the three friends recovered from their intoxication; but they were obliged to sleep themselves sober over their oxygen as a drunkard does over his wine.

When Michel learned his share of the responsibility of this incident, he was not much disconcerted. This unexpected drunkenness broke the monotony of the journey. Many foolish things had been said while under its influence, but also quickly forgotten as soon as said.

"And then," added the merry Frenchman, "I am not sorry to have tasted a little of this heady gas. Do you know, my friends, that a curious establishment might be founded with rooms of oxygen, where people whose system is weakened could for a few hours live a more active life. Fancy parties where the room was saturated with this heroic fluid, theatres where it should be supplied in ample abundance by the state; what passion in the souls of the actors and spectators! what fire, what enthusiasm! And if, instead of an assembly only a whole people could be saturated, what activity in its functions, what a supplement to life it would derive. From an exhausted nation they might make a great and strong one, and I know more

than one state in old Europe which ought to put itself under the regime of oxygen for the sake of its health!"

Michel spoke with so much animation that one might have fancied that the tap was still too open. But a few words from Barbicane soon shattered his enthusiasm.

"That is all very well, friend Michel," said he, "but will you inform us where these chickens came from which have mixed themselves up in our concert?"

"Those chickens?"

"Yes."

Indeed, half a dozen chickens and a fine cock were walking about, flapping their wings and chattering.

"Ah, the awkward things!" exclaimed Michel. "The oxygen has made them revolt."

"But what do you want to do with these chickens?" asked Barbicane.

"To acclimatize them in the moon, *parbleu!* "

"Then why did you hide them?"

"A joke, my worthy president, a simple joke, which has proved a miserable failure. I wanted to set them free on the lunar continent, without saying anything. Oh, what would have been your amazement on seeing these earthly-winged animals pecking in your lunar fields!"

"You rascal, you unmitigated rascal," replied Barbicane, "you do not want oxygen to mount to the head. You are always what we were under the influence of the gas; you are always foolish!"

"Ah, who says that we were not wise then?" replied Michel Ardan.

After this philosophical reflection, the three friends set about restoring the order of the projectile. Chickens and cock were reinstated in their coop. But while proceeding with this operation, Barbicane and his two companions had a most desired perception of a new phenomenon.

From the moment of leaving the earth, their own weight, that of the projectile, and the objects it enclosed, had been subject to an increasing diminution. If they could not prove this loss of the projectile, a moment would arrive when it would be sensibly felt upon themselves and the utensils and instruments they used.

It is needless to say that a scale would not show this loss; for the weight destined to weight the object would have lost exactly as much as the object itself; but a spring steelyard for example, the tension of which was independent of the attraction, would have given a just estimate of this loss.

We know that the attraction, otherwise called the weight, is in proportion to the masses of the bodies, and inversely as the squares of the distances. Hence this effect: If the earth had been alone in space, if the other celestial bodies had been suddenly annihilated, the projectile, according to Newton's laws, would weigh less as it got farther from the earth, but without ever losing its weight entirely, for the terrestrial attraction would always have made itself felt, at whatever distance.

But, in reality, a time must come when the projectile would no longer be subject to the law of weight, after allowing for the other celestial bodies whose effect could not be set down as zero.

Indeed, the projectile's course was being traced between the earth and the moon. As it distanced the earth, the terrestrial attraction diminished in inverse proportion to the square of the distances, but also the lunar attraction rose in proportion. There must come a point where these two attractions would neutralize each other: the projectile would possess weight no longer. If the moon's and the earth's masses had been equal, this point would have been at an equal distance between the two orbs. But taking the different masses into consideration, it was easy to reckon that this point would be situated at 47/52nds of the whole journey, *i.e.*, at 78,114 leagues from the earth. At this point, a body having no principle of speed or displacement in itself, would remain immovable forever, being attracted equally by both orbs, and not being drawn more toward one than toward the other.

Now if the projectile's impulsive force had been correctly calculated, it would attain this point without speed, having lost all trace of weight, as well as all the objects within it. What would happen then? Three hypotheses presented themselves.

1. Either it would retain a certain amount of motion, and pass the point of equal attraction, and fall upon the moon by virtue of the excess of the lunar attraction over the terrestrial.

2. Or, its speed failing, and unable to reach the point of equal attraction, it would fall upon the moon by virtue of the excess of the lunar attraction over the terrestrial.

3. Or, lastly, animated with sufficient speed to enable it to reach the neutral point, but not sufficient to pass it, it would remain forever suspended in that spot like the pretended tomb of Mahomet, between the zenith and the nadir.

Such was their situation; and Barbicane clearly explained the consequences to his traveling companions, which greatly interested them. But how should they know when the projectile had reached this neutral point situated at 78,114 leagues?

Precisely when neither themselves, nor the objects enclosed in the projectile, would be any longer subject to the laws of weight.

Up to this time, the travelers, while admitting that this action was constantly decreasing, had not yet become sensible to its total absence. But that day, about eleven o'clock in the morning, Nicholl having accidentally let a glass slip from his hand, the glass, instead of falling, remained suspended in the air.

"Ah!" exclaimed Michel Ardan, "that is rather an amusing piece of natural philosophy."

And immediately divers other objects, firearms and bottles, abandoned to themselves, held themselves up as by a miracle. Diana too, placed in space by Michel, reproduced, but without any trick, the wonderful suspension practiced by Caston and Robert Houdin. Indeed the dog did not seem to know that she was floating in air.

The three adventurous companions were surprised and stupefied, despite their scientific reasonings. They felt themselves being carried into the domain of wonders! they felt that weight was really wanting to their bodies. If they stretched out their arms, they did not attempt to fall. Their heads shook on their shoulders. Their feet no longer clung to the floor of the projectile. They were like drunken men having no stability in themselves. Fancy has depicted men without reflection, others without shadow. But here reality, by the neutralizations of attractive forces, produced men in whom nothing had any weight, and who weighed nothing themselves.

Suddenly Michel, taking a spring, left the floor and remained suspended in the air, like Murillo's monk of the *Cuisine des Anges*.

The two friends joined him instantly, and all three formed a miraculous “Ascension” in the center of the projectile.

“Is it to be believed? is it probable? is it possible?” exclaimed Michel; “and yet it is so. Ah! if Raphael had seen us thus, what an ‘Assumption’ he would have thrown upon his canvas!”

“The ‘Assumption’ cannot last,” replied Barbicane. “If the projectile passes the neutral point, the lunar attraction will draw us to the moon.”

“Then our feet will be upon the roof,” replied Michel.

“No,” said Barbicane, “because the projectile’s center of gravity is very low; it will only turn by degrees.”

“Then all our portables will be upset from top to bottom, that is a fact.”

“Calm yourself, Michel,” replied Nicholl; “no upset is to be feared; not a thing will move, for the projectile’s evolution will be imperceptible.”

“Just so,” continued Barbicane; “and when it has passed the point of equal attraction, its base, being the heavier, will draw it perpendicularly to the moon; but, in order that this phenomenon should take place, we must have passed the neutral line.”

“Pass the neutral line,” cried Michel; “then let us do as the sailors do when they cross the equator. Let us celebrate a toast to our passage!”

A slight side movement brought Michel back toward the padded side; thence he took a bottle and glasses, placed them “in space” before his companions, and, drinking merrily, they saluted the line with a triple hurrah.

The influence of these attractions scarcely lasted an hour; the travelers felt themselves insensibly drawn toward the floor, and Barbicane fancied that the conical end of the projectile was varying a little from its normal direction toward the moon. By an inverse motion the base was approaching first; the lunar attraction was prevailing over the terrestrial; the fall toward the moon was beginning, almost imperceptibly as yet; it would only be one and one-third millimetre in the first second or 590-1000ths of a line, but by degrees the attractive force would become stronger, the fall would be more decided, the projectile, drawn by its base, would turn its cone to the earth, and fall with ever-increasing speed on to the surface of the Selenite continent; their destination would then be attained. Now nothing could prevent the success of their enterprise, and Nicholl and Michel Ardan shared Barbicane’s joy.

Then they chatted of all the phenomena which had astonished them one after the other, particularly the neutralization of the laws of weight. Michel Ardan, always enthusiastic, drew conclusions which were purely fanciful.

“Ah, my worthy friends,” he exclaimed, “what progress we should make if on earth we could throw off some of that weight, some of that chain which binds us to her; it would be the prisoner set at liberty; no more fatigue of either arms or legs. Or, if it is true that in order to fly on the earth’s surface, to keep oneself suspended in the air merely by the play of the muscles, there requires a strength a hundred and fifty times greater than that which we possess, a simple act of volition, a caprice, would bear us into space, if attraction did not exist.”

“Just so,” said Nicholl, smiling; “if we could succeed in suppressing weight as they suppress pain by anaesthesia, that would change the face of modern society!”

“Yes,” cried Michel, full of his subject, “destroy weight, and no more burdens! No more cranes, jacks, capstans, winches or other machines; they will not be needed.”

“Well said,” replied Barbicane; “but if nothing had any weight, nothing would keep in its place, not even your hat on your head, worthy Michel; nor your house, whose stones only adhere by weight; nor a boat, whose stability on the waves is only caused by weight; not even the ocean, whose waves would no longer be equalized by terrestrial attraction; and lastly, not even the atmosphere, whose atoms, being no longer held in their places, would disperse in space!”

“That is tiresome,” retorted Michel; “nothing like these matter-of-fact people for bringing one back to the brutal reality.”

“But console yourself, Michel,” continued Barbicane, “for if no orb exists from whence all laws of weight are banished, you are at least going to visit one where it is much less than on the earth.”

“The moon?”

“Yes, the moon, on whose surface objects weigh six times less than on the earth, a phenomenon easy to prove.”

“And we shall feel it?” asked Michel.

“Evidently, since two hundred kilogrammes will weigh but thirty on the surface of the moon.”

“And our muscular strength will not diminish?”

“Not at all; instead of jumping one metre , you will rise eighteen feet high.”

“But we shall be regular Herculeans on the moon!” exclaimed Michel.

“Yes,” replied Nicholl; “for if the height of the Selenites is in proportion to the mass of their globe, they will be scarcely a foot high.”

“Lilliputians!” ejaculated Michel; “I shall play the part of Gulliver. We are going to realize the fable of the giants. This is the advantage of leaving one’s own planet and coursing through the solar world.”

“One moment, Michel,” answered Barbicane; “if you wish to play the part of Gulliver, only visit the inferior planets, such as Mercury, Venus, or Mars, whose mass is a little less than that of the earth; but do not venture into the great planets, Jupiter, Saturn, Uranus, Neptune; for there the order will be changed, and you will become Lilliputian.”

“And in the sun?”

“In the sun, though its density is four times less than that of the earth, its volume is thirteen hundred and twenty-four thousand (1,324,000) times greater, and the attraction is twenty-seven times greater than on the surface of our globe; keeping everything in proportion, the inhabitants ought to be at least two hundred feet high.”

“*Mille diables!* ” exclaimed Michel; “I should be nothing more than a pigmy, a shrimp!”

“Gulliver with the giants,” said Nicholl.

“Just so,” replied Barbicane.

“And it would not be quite useless to carry some pieces of artillery to defend oneself.”

“Good,” replied Nicholl; “your projectiles would have no effect on the sun; they would fall back upon the earth after some metres. ”

“That is a strong remark.”

“It is certain,” replied Barbicane; “the attraction is so great on this enormous orb, that an object weighing 70 kilogrammes on the earth would weigh 1,930 on the surface of the sun. Your hat, half a score of kilogrammes! Your cigar, half a pound. Lastly, if you were to fall upon the solar continent, you would weigh— let me see— about 2,500 kilogrammes a weight which you would never be able to raise again.”

“*Diable!* ” said Michel; “one would want a portable crane. However, we will be satisfied with the moon for today; there at least we shall cut a great figure. Later on, we shall see whether we shall go to the sun, where one cannot drink without a capstan to raise a glass to his mouth! ”

IX. The Consequences Of A Deviation

Barbicane had now no fear of the issue of the journey, at least as far as the projectile's impulsive force was concerned; its inherent speed would carry it beyond the neutral line; it would certainly not return to earth; it would certainly not remain motionless on the line point of attraction. One single hypothesis remained to be realized, the arrival of the projectile at its destination by the action of the lunar attraction.

It was in reality a fall of 8,296 leagues on an orb, it is true, where weight could only be reckoned at one sixth of terrestrial weight; a formidable fall, nevertheless, and one against which every precaution must be taken without delay.

These precautions were of two sorts, some to deaden the shock when the projectile should touch the lunar soil, others to delay the fall, and consequently make it less violent.

To deaden the shock, it was a pity that Barbicane was no longer able to employ the means which had so ably weakened the shock at departure, that is to say, by water used as springs and the partition breaks.

The partitions still existed, but water failed, for they could not use their reserve, which was precious, in case during the first days the liquid element should be found wanting on lunar soil.

And indeed this reserve would have been quite insufficient for a spring. The layer of water stored in the projectile at the time of starting upon their journey and on which lay the water-tight disc occupied no less than three feet in depth, and spread over a surface of not less than fifty-four square feet. It measured six cubic metres in volume and in weight 5,750 kilogrammes. Thus the cistern did not contain one-fifth part of it; they must therefore give up this efficient means of deadening the shock of arrival.

Happily, Barbicane, not content with employing water, had furnished the movable disc with strong spring plugs, destined to lessen the shock against the base after the breaking of the horizontal partitions. These plugs still existed; they had only to readjust them and replace the movable disc; every piece, easy to handle, as their weight was now scarcely felt, was quickly mounted.

The different pieces were fitted without trouble, it being only a matter of bolts and screws; tools were not wanting, and soon the reinstated disc lay on steel plugs, like a table on its legs. One inconvenience resulted from the replacing of the disc, the lower window was blocked up; thus it was impossible for the travelers to observe the moon from that opening while they were being precipitated perpendicularly upon her; but they were obliged to give it up; even by the side openings they could still see vast lunar regions, as an aeronaut sees the earth from his car.

This replacing of the disc was at least an hour's work. It was past noon when all preparations were finished. Barbicane took fresh observations on the inclination of the projectile, but to his annoyance it had not turned over sufficiently for its fall; it seemed to take a curve parallel to the lunar disc. The orb of night shone splendidly into space, while opposite, the orb of day blazed with fire.

Their situation began to make them uneasy.

"Are we reaching our destination?" said Nicholl.

“Let us act as if we were about reaching it,” replied Barbicane.

“You are a timid lot ,” retorted Michel Ardan. “We shall arrive, and that, too, quicker than we like.”

This answer brought Barbicane back to his preparations, and he occupied himself with placing the contrivances intended to break their descent.

We may remember the scene of the meeting held at Tampa Town, in Florida, when Captain Nicholl came forward as Barbicane’s enemy and Michel Ardan’s adversary. To Captain Nicholl’s maintaining that the projectile would smash like glass, Michel replied that he would break their fall by means of rockets properly placed.

Thus, powerful fireworks, taking their starting-point from the base and bursting outside, could, by producing a recoil, check to a certain degree the projectile’s speed. These rockets were to burn in vacuum , it is true; but oxygen would not fail them, for they could supply themselves with it, like the lunar volcanoes, the burning of which has never yet been stopped by the want of atmosphere round the moon.

Barbicane had accordingly supplied himself with these fireworks, enclosed in little steel guns, which could be screwed on to the base of the projectile. Inside, these guns were flush with the bottom; outside, they protruded about half a foot . There were twenty of them. An opening left in the disc allowed them to light the match with which each was provided. All the effect was felt outside. The burning mixture had already been rammed into each gun. They had, then, nothing to do but raise the metallic buffers fixed in the base, and replace them by the guns, which fitted closely in their places.

This new work was finished about three o’clock, and after taking all these precautions there remained but to wait.

Meanwhile the projectile was perceptibly nearing the moon, and evidently succumbed to her influence to a certain degree; though its own velocity also drew it in an oblique direction. From these conflicting influences resulted a line which might become a tangent. But it was certain that the projectile would not fall directly on the moon; for its lower part, by reason of its weight, ought to be turned toward her.

Barbicane’s uneasiness increased as he saw his projectile resist the influence of gravitation. The Unknown was opening before him, the Unknown in interplanetary space. The man of science thought he had foreseen the only three hypotheses possible— the return to the earth, the return to the moon, or stagnation on the neutral line; and here a fourth hypothesis, replete with all the terrors of the Infinite, surged up inopportunely. To face it without flinching, one must be a resolute *savant* like Barbicane, a phlegmatic being like Nicholl, or an audacious adventurer like Michel Ardan.

Conversation was started upon this subject. Other men would have considered the question from a practical point of view; they would have asked themselves whither their projectile carriage was carrying them. Not so with these; they sought for the cause which produced this effect.

“So we have run off the rails ,” said Michel; “but why?”

“I very much fear,” answered Nicholl, “that, in spite of all precautions taken, the Columbiad was not fairly pointed. An error, however small, would be enough to throw us out of the moon’s attraction.”

“Then they must have aimed badly?” asked Michel.

“I do not think so,” replied Barbicane. “The perpendicularity of the gun was exact, its direction to the zenith of the spot incontestible; and the moon passing to the zenith of the spot, we ought to reach it at the full. There is another reason, but it escapes me.”

“Are we not arriving too late?” asked Nicholl.

“Too late?” said Barbicane.

“Yes,” continued Nicholl. “The Cambridge Observatory’s note says that the transit ought to be accomplished in ninety-seven hours thirteen minutes and twenty seconds; which means to say, that *sooner* the moon will *not* be at the point indicated, and *later* it will have passed it.”

“True,” replied Barbicane. “But we started the 1st of December, at thirteen minutes and twenty-five seconds to eleven at night; and we ought to arrive on the 5th at midnight, at the exact moment when the moon would be full; and we are now at the 5th of December. It is now half-past three in the evening; eight and a half hours ought to see us at the end of our journey. Why do we not arrive?”

“Might it not be an excess of speed?” answered Nicholl; “for we know now that its initial velocity was greater than they supposed.”

“No! a hundred times, no!” replied Barbicane. “An excess of speed, if the direction of the projectile had been right, would not have prevented us reaching the moon. No, there has been a deviation. We have been turned out of our course.”

“By whom? by what?” asked Nicholl.

“I cannot say,” replied Barbicane.

“Very well, then, Barbicane,” said Michel, “do you wish to know my opinion on the subject of finding out this deviation?”

“Speak.”

“I would not give half a dollar to know it. That we have deviated is a fact. Where we are going matters little; we shall soon see. *Diable!* Since we are being borne along in space we shall end by falling into some center of attraction or other.”

Michel Ardan’s indifference did not content Barbicane. Not that he was uneasy about the future, but he wanted to know at any cost *why* his projectile had deviated.

But the projectile continued its course sideways to the moon, and with it the mass of things thrown out. Barbicane could even prove, by some landmarks upon the moon, which was only two thousand leagues distant, that its speed was becoming uniform— fresh proof that there was no fall. Its impulsive force still prevailed over the lunar attraction, but the projectile’s course was certainly bringing it nearer to the moon, and they might hope that at a nearer point the weight, predominating, would cause a decided fall.

The three friends, having nothing better to do, continued their observations; but they could not yet determine the topographical disposition of the satellite; every relief was leveled under the reflection of the solar rays.

They watched thus through the side windows until eight o’clock at night. The moon had grown so large in their eyes that it filled half of the firmament. The sun on one side, and the orb of night on the other, flooded the projectile with light.

At that moment Barbicane thought he could estimate the distance which separated them from their aim at no more than 700 leagues. The speed of the projectile seemed to him to be more than 200 metres per second , or about 170 leagues an hour . Under the centripetal force, the

base of the projectile tended toward the moon; but the centrifugal still prevailed; and it was probable that its rectilineal course would be changed to a curve of some sort, the nature of which they could not at present determine.

Barbicane was still seeking the solution of his insoluble problem.

Hours passed without any result. The projectile was evidently nearing the moon, but it was also evident that it would never reach her. As to the nearest distance at which it would pass her, that must be the result of two forces, attraction and repulsion, affecting its motion.

“I ask but one thing,” said Michel; “that we may pass near enough to penetrate her secrets.”

“Cursed be the thing that has caused our projectile to deviate from its course,” cried Nicholl.

And, as if a light had suddenly broken in upon his mind, Barbicane answered, “Then cursed be the meteor which crossed our path.”

“What?” said Michel Ardan.

“What do you mean?” exclaimed Nicholl.

“I mean,” said Barbicane in a decided tone, “I mean that our deviation is owing solely to our meeting with this erring body.”

“But it did not even brush us as it passed,” said Michel.

“What does that matter? Its mass, compared to that of our projectile, was enormous, and its attraction was enough to influence our course.”

“So little?” cried Nicholl.

“Yes, Nicholl; but however little it might be,” replied Barbicane, “in a distance of 84,000 leagues, it wanted no more to make us miss the moon.”

X. The Observers Of The Moon

Barbicane had evidently hit upon the only plausible reason of this deviation. However slight it might have been, it had sufficed to modify the course of the projectile. It was a fatality. The bold attempt had miscarried by a fortuitous circumstance; and unless by some exceptional event, they could now never reach the moon's disc.

Would they pass near enough to be able to solve certain physical and geological questions until then insoluble? This was the question, and the only one, which occupied the minds of these bold travelers. As to the fate in store for themselves, they did not even dream of it.

But what would become of them amid these infinite solitudes, these who would soon want air? A few more days, and they would fall stifled in this wandering projectile. But some days to these intrepid fellows was a century; and they devoted all their time to observe that moon which they no longer hoped to reach.

The distance which had then separated the projectile from the satellite was estimated at about two hundred leagues. Under these conditions, as regards the visibility of the details of the disc, the travelers were farther from the moon than are the inhabitants of earth with their powerful telescopes.

Indeed, we know that the instrument mounted by Lord Rosse at Parsonstown, which magnifies 6,500 times, brings the moon to within an apparent distance of sixteen leagues. And more than that, with the powerful one set up at Long's Peak, the orb of night, magnified 48,000 times, is brought to within less than two leagues, and objects having a diameter of ten metres are seen very distinctly.

So that, at this distance, the topographical details of the moon, observed without glasses, could not be determined with precision. The eye caught the vast outline of those immense depressions inappropriately called "seas," but they could not recognize their nature. The prominence of the mountains disappeared under the splendid irradiation produced by the reflection of the solar rays. The eye, dazzled as if it was leaning over a bath of molten silver, turned from it involuntarily.

But the oblong form of the orb was quite clear. It appeared like a gigantic egg, with the small end turned toward the earth. Indeed the moon, liquid and pliable in the first days of its formation, was originally a perfect sphere; but being soon drawn within the attraction of the earth, it became elongated under the influence of gravitation. In becoming a satellite, she lost her native purity of form; her center of gravity was in advance of the center of her figure; and from this fact some *savants* draw the conclusion that the air and water had taken refuge on the opposite surface of the moon, which is never seen from the earth.

This alteration in the primitive form of the satellite was only perceptible for a few moments. The distance of the projectile from the moon diminished very rapidly under its speed, though that was much less than its initial velocity— but eight or nine times greater than that which propels our express trains. The oblique course of the projectile, from its very obliquity, gave Michel Ardan some hopes of striking the lunar disc at some point or other. He could not think that they would never reach it. No! he could not believe it; and this opinion he often repeated. But Barbicane, who was a better judge, always answered him with merciless logic.

“No, Michel, no! We can only reach the moon by a fall, and we are not falling. The centripetal force keeps us under the moon’s influence, but the centrifugal force draws us irresistibly away from it.”

This was said in a tone which quenched Michel Ardan’s last hope.

The portion of the moon which the projectile was nearing was the northern hemisphere, that which the selenographic maps place below; for these maps are generally drawn after the outline given by the glasses, and we know that they reverse the objects. Such was the *Mappa Selenographica* of Beer and Mädler which Barbicane consulted. This northern hemisphere presented vast plains, dotted with isolated mountains.

At midnight the moon was full. At that precise moment the travelers should have alighted upon it, if the mischievous meteor had not diverted their course. The orb had arrived exactly in the conditions rigorously determined by the Cambridge Observatory. It was mathematically at its perigee, and at the zenith of the twenty-eighth parallel. An observer placed at the bottom of the enormous Columbiad, pointed perpendicularly to the horizon, would have framed the moon in the mouth of the gun. A straight line drawn through the axis of the piece would have passed through the center of the orb of night.

It is needless to say, that during the night of the 5th-6th of December, the travelers took not an instant’s rest. Could they close their eyes when so near this new world? No! All their feelings were concentrated in one single thought:— See! Representatives of the earth, of humanity, past and present, all centered in them! It is through their eyes that the human race look at these lunar regions, and penetrate the secrets of their satellite! A strange emotion filled their hearts as they went silently from one window to the other. Their observations, reproduced by Barbicane, were rigidly determined. To take them, they had glasses; to verify them, maps.

The first observer of the moon was Galileo. His poor telescopes only magnified thirty times. Never-the-less in the spots that pitted the lunar disc “like eyes in a peacock’s tail”, he was the first who recognized mountains and measured some heights to which he attributed an exaggerated elevation equal to the 20th part of the diameter of the disc, or 8,800 metres. Galileo did not draw up any map of his observations.

A few years later an astronomer from Dantzig, Hevelius—by operations which were only exact twice a month, at the first and second quadratures—reduced the heights of Galileo to one-twenty-sixth of the lunar diameter. This was an exaggeration in the opposite direction. But it is to this *savant* that the first map of the moon is due. The light round spots there form circular mountains, and the dark spots indicate vast seas which in reality are plains. To these mountains and extents of sea he gave terrestrial denominations. There is a Sinai in the midst of Arabia, Etna in the center of Sicily, the Alps, Apennines, Carpathians, then the Mediterranean, the Palus-Méotide, the Euxine, the Caspian Sea. ; names badly applied for neither the mountains nor the seas recalled the configuration of their namesakes on the globe. That large white spot, joined on the south to vaster continents and terminated in a point could hardly be recognised as the inverted image of the Indian Peninsula, the Bay of Bengal, and Cochin-China. So these names were not kept. Another cartographer, knowing human nature better, proposed a fresh nomenclature, which human vanity made haste to accept.

This observer was Father Riccioli, a contemporary of Helvelius. He drew up a rough map full of errors. But he gave to lunar mountains the names of the great men of antiquity and *savants* of his epoch, a usage followed since then.

A third map of the moon was executed in the seventeenth century by Dominique Cassini; superior to that of Riccioli in execution, it is inexact in the measurements. Several smaller

copies were published, but his copper plate, long kept in the *Imprimerie Nationale*, was sold by weight as old brass.

La Hire, a celebrated mathematician and designer, drew up a map of the moon four metres high, but it was never engraved.

After him, a German astronomer, Tobie Mayer, toward the middle of the XVIIIth century, began the publication of a magnificent selenographic map, according to lunar measures which he rigorously verified, but his death, which took place in 1762 prevented the termination of this beautiful work.

Next came Schroeter, of Lilienthal, who sketched numerous maps of the moon, then a certain Lohrman, of Dresden, to whom we are indebted for a plate divided into twenty five sections, of which four have been engraved.

It was in 1830 that Messers. Beer and Mädler composed their celebrated *Mappa Selenographica*, according to an orthographic projection. This map reproduces exactly the lunar disc, such as it appears, but the configurations of the mountains and plains are only correct in the central part, everywhere else—in the northern and southern portions, eastern or western—the configurations foreshortened, cannot be compared to those of the centre. This topographical map, 95 centimetres high and divided into four parts, is a masterpiece of lunar cartography.

After these *savants* may be cited the selenographic reliefs of the German astronomer, Julius Schmidt, the topographical works of Father Secchi, the magnificent sheets of the English amateur Warren de la Rue, and lastly a map on orthographical projection of Messers. Lecouturier and Chapuis, a fine model set up in 1860, of very clear design and clear outlines.

Such is the nomenclature of the different maps relating to the lunar world. Barbicane possessed two, that of Messrs. Beer and Mädler and that of Messers. Chapuis and Lecouturier. They were to make his work as observer easier.

As regards the optical instruments at their disposal, they had excellent marine glasses specially constructed for this journey. They possessed magnifying powers of 100. They would thus have brought the moon to within a distance (apparent) of less than a thousand leagues from the earth. But then, at a distance which toward three o’clock in the morning did not exceed 120 kilometres , and in a medium free from all atmospheric disturbances, these instruments could reduce the lunar surface to within less than 1,500 metres!

XI. Fancy And Reality

“Have you ever seen the moon?” asked a professor, ironically, of one of his pupils.

“No, sir!” replied the pupil, still more ironically, “but I must say I have heard it spoken of.”

In one sense, the pupil’s witty answer might be given by a large majority of sublunary beings. How many people have heard speak of the moon who have never seen it— at least through a glass or a telescope! How many have never examined the map of their satellite!

In looking at a selenographic map, one peculiarity strikes us. Contrary to the arrangement followed for that of the Earth and Mars, the continents occupy more particularly the southern hemisphere of the lunar globe. These continents do not show such decided, clear, and regular boundary lines as South America, Africa, and the Indian peninsula. Their angular, capricious, and deeply indented coasts are rich in gulfs and peninsulas. They remind one of the confusion in the islands of the Sound, where the land is excessively indented. If navigation ever existed on the surface of the moon, it must have been wonderfully difficult and dangerous; and we may well pity the Selenite sailors and hydrographers; the former when navigating these dangerous parts , the latter when making a survey of these dangerous coasts .

We may also notice that, on the lunar sphere, the south pole is much more continental than the north pole. On the latter, there is but one slight strip of land separated from other continents by vast seas. Toward the south, continents clothe almost the whole of the hemisphere. It is even possible that the Selenites have already planted the flag on one of their poles, while Franklin, Ross, Kane, Dumont d’Urville, and Lambert have never yet been able to attain that unknown point of the terrestrial globe.

As to islands, they are numerous on the surface of the moon. Nearly all oblong or circular, and as if traced with the compass, they seem to form one vast archipelago, equal to that charming group lying between Greece and Asia Minor, and which mythology in ancient times adorned with most graceful legends. Involuntarily the names of Naxos, Tenedos, Milo, and Carpathos, rise before the mind, and we seek vainly for Ulysses’ vessel or the “clipper” of the Argonauts. So at least it was in Michel Ardan’s eyes. To him it was a Grecian archipelago that he saw on the map. To the eyes of his matter-of-fact companions, the aspect of these coasts recalled rather the parceled-out land of New Brunswick and Nova Scotia, and where the Frenchman discovered traces of the heroes of fable, these Americans were marking the most favorable points for the establishment of outposts in the interests of lunar commerce and industry.

In order to conclude the description of the continental part of the moon, we must say some words about her orographical disposition. We can distinguish very well chains of mountains, isolated mountains, cirques, and gorges. The whole lunar relief belongs to that division. It is extraordinarily irregular. The moon is like an immense Switzerland—a continual Norway, where Plutonic influence has done everything. This surface so profoundly rugged, is the result of the successive contractions of the crust while the orb was being formed. The lunar disc is consequently propitious for the study of great geological phenomena. According to the remarks of some astronomers, its surface, although more ancient than the surface of the earth, has remained newer. There is no water to deteriorate the primitive relief, the continuous action of which produces a sort of general levelling. No air, the decomposing influence of which modifies orographical profiles. There Pluto’s work, unaltered by Neptune’s, is in all its

native purity. It is the earth as she was before tides and currents covered her with sedimentary strata.

After wandering over these vast continents, the eye is attracted by the still greater seas. Not only their formation, but their situation and aspect remind one of the terrestrial oceans; but again, as on earth, these seas occupy the greater portion of the globe. But in point of fact, these are not liquid spaces, but plains, the nature of which the travelers soon hoped to determine.

Astronomers, we must allow, have graced these pretended seas with the most extraordinary names, which science has respected up to the present time. Michel Ardan was right when he compared this map to a “Tendre card,” got up by a Scudéry or a Cyrano de Bergerac.

“Only,” said he, “it is no longer the sentimental ”map” of the XVIIth century, it is the ”map” of life, very neatly divided into two parts, one feminine, the other masculine; the right hemisphere for woman , the left for man .”

In speaking thus, Michel made his prosaic companions shrug their shoulders. Barbicane and Nicholl looked upon the lunar map from a very different point of view to that of their fantastic friend. Nevertheless, their fantastic friend was a little in the right. Judge for yourselves.

In this left hemisphere stretches the “Sea of Clouds,” where human reason is so often drowned . Not far off lies the “Sea of Rains,” fed by all the worries of existence. Near this is the “Sea of Storms,” where man is ever fighting against his passions, which too often gain the victory. Then, worn out by deceit, treasons, infidelity, and the whole body of terrestrial misery, what does he find at the end of his career? that vast “Sea of Humors,” barely softened by some drops of the waters from the “Gulf of Dew!” Clouds, rain, storms, and humors— does the life of man contain aught but these? and is it not summed up in these four words?

The right hemisphere, “dedicated to the ladies,” encloses smaller seas, whose significant names contain every incident of a feminine existence. There is the “Sea of Serenity,” over which the young girl bends; “The Lake of Dreams,” reflecting a joyous future; “The Sea of Nectar,” with its waves of tenderness and breezes of love; “The Sea of Fruitfulness;” “The Sea of Crises;” then the “Sea of Vapours,” whose dimensions are perhaps a little too confined; and lastly, that vast “Sea of Tranquillity,” in which every false passion, every useless dream, every unsatisfied desire is at length absorbed, and whose waves emerge peacefully into the “Lake of Death!”

What a strange succession of names! What a singular division of the moon’s two hemispheres, joined to one another like man and woman, and forming that sphere of life carried into space! And was not the fantastic Michel right in thus interpreting the fancies of the ancient astronomers?

But while his imagination thus roved over “the seas,” his grave companions were considering things more geographically. They were learning this new world by heart. They were measuring angles and diameters.

To Barbicane and Nicholl the “Sea of Clouds” was an immense depression of ground, with circular mountains scattered about on it; covering a great part of the western side of the southern hemisphere, it covered 184,800 square leagues, and its centre was in south latitude 15°, and west longitude 20°. The Ocean of Tempests, *Oceanus Procellarum,* the largest plain on the lunar disc, covered a surface of 328,300 square leagues, its centre being in north

latitude 10°, and east longitude 45°. From its bosom emerge the admirable shining mountains of Kepler and Aristarchus.

More to the north, and separated from the Sea of Clouds by high chains of mountains, extends the Sea of Rains, *Mare Imbrium,* having its central point in north latitude 35° and east longitude 20° , it is of a nearly circular form, and covers a space of 193,000 leagues. Not far distant the Sea of Humours, *Mare Humorum,* a little basin of 44,200 square leagues only, was situated in south latitude 25°, and east longitude 40°. Lastly, three gulfs lie on the coast of this hemisphere-the Torrid Gulf, the Gulf of Dew, and the Gulf of Iris, little plains inclosed by high chains of mountains.

The "Feminine" hemisphere, naturally more capricious, was distinguished by smaller and more numerous seas. These were, towards the north, the Sea of Cold, the *Mare Frigoris,* in north latitude 55° and longitude 0°, with 86,000 square leagues of surface, which joined the Lake of Death and Lake of Dreams; the Sea of Serenity, *Mare Serenitatis,* by north latitude 25° and west longitude 20°, comprising a surface of 80,000 square leagues; the Sea of Crises, *Mare Crisium,* round and very compact, in north latitude 17° and west longitude 55°, a surface of 40,000 leagues, a veritable Caspian buried in a girdle of mountains. Then on the equator, in north latitude 5° and west longitude 25°, appeared the Sea of Tranquillity, *Mare Tranquillitatis,* occupying 121,509 square leagues of surface; this sea communicated on the south with the Sea of Nectar, *Mare Nectaris,* an extent of 28,800 square leagues, in south latitude 15° and west longitude 35°, and on the east with the Sea of Fecundity, *Mare Fecunditatis,* the vastest in this hemisphere, occupying 219,300 square leagues, in south latitude 3° and west longitude 50°. Lastly, quite to the north and quite to the south lie two more seas, the Sea of Humboldt, *Mare Humboldtianum,* with a surface of 6,500 square leagues, and the Southern Sea, *Mare Australe,* with a surface of 26,000.

In the centre of the lunar disc, across the equator and on the zero meridian, lies the centre gulf, *Sinus Medii, a* sort of hyphen between the two hemispheres.

Thus appeared to the eyes of Nicholl and Barbicane the surface always visible of the earth's satellite. When they added up these different figures they found that the surface of this hemisphere measured 4,738,160 square leagues, 3,317,600 of which go for volcanoes, chains of mountains, cirques, islands—in a word, all that seems to form the solid portion of the globe-and 1,410,400 leagues for the seas, lakes, marshes, and all that seems to form the liquid portion, all of which was perfectly indifferent to the worthy Michel.

It will be noticed that this hemisphere is thirteen and a-half times smaller than the terrestrial hemisphere. And yet upon it selonographers have already counted more than 50,000 craters. It is a bloated surface full of crevasses, a veritable *écumoire*, worthy of the unpoetical qualification of "green cheese" which the English have given it.

When Barbicane pronounced this disobliging name Michel Ardan gave a bound.

"That is how the Anglo-Saxons of the XIXth century treat the beautiful Diana, the blonde Phœbe, the amiable Isis, the charming Astarte, the Queen of Night, the daughter of Latona and Jupiter, the younger sister of the radiant Apollo!"

XII. Orographic Details

The course taken by the projectile, as we have before remarked, was bearing it toward the moon's northern hemisphere. The travelers were far from the central point which they would have struck, had their course not been subject to an irremediable deviation.

It was half past midnight; and Barbicane then estimated the distance at 1,400 kilometres, which was a little greater than the length of the lunar radius, and which would diminish as it advanced nearer to the North Pole. The projectile was then not at the altitude of the equator; but across the tenth parallel, and from that latitude, carefully taken on the map to the pole, Barbicane and his two companions were able to observe the moon under the most favorable conditions.

Indeed, by means of glasses, the distance of 1400 kilometres was reduced to 14, that is three leagues and a half. The telescope of the Rocky Mountains brought the moon much nearer; but the terrestrial atmosphere singularly lessened its optical power. Thus Barbicane, posted in his projectile, with the glasses to his eyes, could seize upon details which were almost imperceptible to earthly observers.

"My friends," said the president, in a serious voice, "I do not know whither we are going; I do not know if we shall ever see the terrestrial globe again. Nevertheless, let us proceed as if our work would one day be useful to our fellow-men. Let us keep our minds free from every other consideration. We are astronomers; and this projectile is a room in the Cambridge Observatory , carried into space. Let us make our observations!"

This said, work was begun with great exactness; and they faithfully reproduced the different aspects of the moon, at the different distances which the projectile reached with respect to that orb.

At the time that the projectile was as high as the tenth parallel, north latitude, it seemed rigidly to follow the twentieth degree, east longitude.

We must here make one important remark with regard to the map by which they were taking observations. In the selenographical maps where, on account of the reversing of the objects by the glasses, the south is above and the north below, it would seem natural that, on account of that inversion, the east should be to the left hand, and the west to the right. But it is not so. If the map were turned upside down, showing the moon as we see her, the east would be to the left, and the west to the right, contrary to that which exists on terrestrial maps. The following is the reason of this anomaly. Observers in the northern hemisphere (say in Europe) see the moon in the south— according to them. When they take observations, they turn their backs to the north, the reverse position to that which they occupy when they study a terrestrial map. As they turn their backs to the north, the east is on their left, and the west to their right. To observers in the southern hemisphere (Patagonia for example), the moon's west would be quite to their left, and the east to their right, as the south is behind them. Such is the reason of the apparent reversing of these two cardinal points, and we must bear it in mind in order to be able to follow President Barbicane's observations.

With the help of Beer and Mädler's *Mappa Selenographica*, the travelers were able at once to recognize that portion of the disc enclosed within the field of their glasses.

"What are we looking at, at this moment?" asked Michel.

“At the northern part of the ‘Sea of Clouds,’ “ answered Barbicane. “We are too far off to recognize its nature. Are these plains composed of arid sand, as the first astronomers maintained? Or are they nothing but immense forests, according to M. Warren de la Rue’s opinion, who gives the moon an atmosphere, though a very low and a very dense one? That we shall know by and by. We must affirm nothing until we are in a position to do so.”

This “Sea of Clouds” is rather doubtfully marked out upon the maps. It is supposed that this vast plain is strewn with blocks of lava from the neighboring volcanoes on its right, Ptolemy, Purbach, Arzachel. But the projectile was advancing, and sensibly nearing it. Soon there appeared the heights which bound this sea at this northern limit. Before them rose a mountain radiant with beauty, the top of which seemed lost in an eruption of solar rays.

“That is—?” asked Michel.

“Copernicus,” replied Barbicane.

“Let us see Copernicus.”

This mount, situated in 9° north latitude and 20° east longitude, rose to a height of 3,438 metres feet above the surface of the moon. It is quite visible from the earth; and astronomers can study it with ease, particularly during the phase between the last quarter and the new moon, because then the shadows are thrown lengthways from east to west, allowing them to measure the heights.

This Copernicus forms the most important radiating system of the disk after Tycho, which is situated in the southern hemisphere. It rises isolated like a gigantic lighthouse on that portion of the “Sea of Clouds,” which is bounded by the “Sea of Tempests,” thus lighting by its splendid rays two oceans at a time. It was a sight without an equal, those long luminous trains , so dazzling in the full moon, and which, passing the boundary chain on the north, extends to the “Sea of Rains.” At one o’clock of the terrestrial morning, the projectile, like a balloon borne into space, overlooked the top of this superb mount.

Barbicane could recognize perfectly its chief features. Copernicus is comprised in the series of annular mountains of the first order, in the division of great cirques . Like Kepler and Aristarchus, which overlook the “Ocean of Tempests,” sometimes it appeared like a brilliant point through the cloudy light, and was taken for a volcano in activity. But it is only an extinct one— like all on that side of the moon. Its circumference showed a diameter of about twenty-two leagues. The glasses discovered traces of stratification produced by successive eruptions, and the neighborhood was strewn with volcanic remains some of which still could be seen in the interior of the crater.

“There exist,” said Barbicane, “several kinds of cirques on the surface of the moon, and it is easy to see that Copernicus belongs to the radiating class. If we were nearer, we should see the cones bristling on the inside, which in former times were so many fiery mouths. A curious arrangement, and one without an exception on the lunar disc, is that the interior surface of these cirques is remarkably lower down than the exterior plain, and contrary to the form taken by terrestrial craters. It follows, then, that the general curve of the bottom of these cirques gives a sphere of a smaller diameter than that of the moon.”

“And why this peculiar disposition?” asked Nicholl.

“We do not know,” replied Barbicane.

“What splendid radiation!” repeated Michel. “One could hardly see a finer spectacle, I think.”

“What would you say, then,” replied Barbicane, “if chance should bear us toward the southern hemisphere?”

“Well, I should say that it was still more beautiful,” retorted Michel Ardan.

At this moment the projectile hung perpendicularly over the cirque . The circumference of Copernicus formed almost a perfect circle, and its steep escarpments were clearly defined. They could even distinguish a second ringed enclosure. Around spread a grayish plain, of a wild aspect, on which every relief was marked in yellow. At the bottom of the cirque , as if enclosed in a jewel case, sparkled for one instant two or three eruptive cones, like enormous dazzling gems. Toward the north the escarpments were lowered by a depression which would probably have given access to the interior of the crater.

In passing over the surrounding plains, Barbicane noticed a great number of less important mountains; and among others a little ringed one called Gay-Lussac, the breadth of which measured twenty-three kilometres.

Toward the south, the plain was very flat, without one elevation, without one projection. Toward the north, on the contrary, till where it was bounded by the “Sea of Storms,” it resembled a liquid surface agitated by a storm, of which the hills and hollows formed a succession of waves suddenly congealed. Over the whole of this, and in all directions, lay the luminous lines, all converging to the summit of Copernicus. Some of these were 30 kilometres wide and inestimably long.

The travelers discussed the origin of these strange rays; but they could not determine their nature any more than terrestrial observers.

“But why,” said Nicholl, “should not these rays be simply spurs of mountains which reflect more vividly the light of the sun?”

“No,” replied Barbicane; “if it was so, under certain conditions of the moon, these ridges would cast shadows, and they do not cast any.”

And indeed, these rays only appeared when the orb of day was in opposition to the moon, and disappeared as soon as its rays became oblique.

“But how have they endeavored to explain these lines of light?” asked Michel; “for I cannot believe that *savants* would ever be stranded for want of an explanation.”

“Yes,” replied Barbicane; “Herschel has put forward an opinion, but he did not venture to affirm it.”

“Never mind. What was the opinion?”

“He thought that these rays might be streams of cooled lava which shone when the sun beat straight upon them. It may be so; but nothing can be less certain. Besides, if we pass nearer to Tycho, we shall be in a better position to find out the cause of this radiation.”

“Do you know, my friends, what that plain, seen from the height we are at, resembles?” said Michel.

“No,” replied Nicholl.

“Very well; with all those pieces of lava lengthened like spindles , it resembles an immense game of spelikans thrown pellmell. There wants but the hook to pull them out one by one.”

“Do be serious,” said Barbicane.

“Well, let us be serious,” replied Michel quietly; “and instead of spelikans, let us put bones. This plain, would then be nothing but an immense cemetery, on which would repose the

mortal remains of thousands of extinct generations. Do you prefer that high-flown comparison?"

"One is as good as the other," retorted Barbicane.

" *Diable!* you are difficult to please," answered Michel.

"My worthy friend," continued the matter-of-fact Barbicane, "it matters but little what it *resembles*, when we do not know what it *is*."

"Well answered," exclaimed Michel. "That will teach me to reason with savants!"

Meanwhile the projectile continued to advance with almost uniform speed around the lunar disc. The travelers, we may easily imagine, did not dream of taking a moment's rest. Every minute changed the landscape which fled from beneath their gaze. About half past one o'clock in the morning, they caught a glimpse of the tops of another mountain. Barbicane, consulting his map, recognized Eratosthenes.

It was an annular mountain 4,500 metres high, and one of those cirques so numerous on this satellite. With regard to this, Barbicane related to his friends Kepler's singular opinion on the formation of cirques . According to that celebrated mathematician, these crater-like cavities had been dug by the hand of man.

"For what purpose?" asked Nicholl.

"For a very natural one," replied Barbicane. "The Selenites might have undertaken these immense works and dug these enormous holes for a refuge and shield from the solar rays which beat upon them during fifteen consecutive days."

"Not fools, the Selenites!," said Michel.

"A singular idea," replied Nicholl; "but it is probable that Kepler did not know the true dimensions of these cirques , for the digging of them would have been the work of giants quite impossible for the Selenites."

"Why? if weight on the moon's surface is six times less than on the earth?" said Michel.

"But if the Selenites are six times smaller?" retorted Nicholl.

"And if there are *no* Selenites?" added Barbicane.

This put an end to the discussion.

Soon Eratosthenes disappeared under the horizon without the projectile being sufficiently near to allow close observation. This mountain separated the Apennines from the Carpathians.

In the lunar orography they have discerned some chains of mountains, which are chiefly distributed over the northern hemisphere. Some, however, occupy certain portions of the southern hemisphere also.

The following is a table of these different chains, listed from south to north, with their latitudes and the height of their highest summits:—

		deg	deg	metres
Mounts	Dœrfel	84	S. lat	7603

	Leibniz	65			“	7600
	Rook	20	to	30	“	1600
	Altai	17	“	28	“	4047
	Cordilleres	10	“	20	“	3898
	Pyrenees	8	“	18	“	3631
	Ural	5	“	13	“	838
	Alembert	4	“	10	“	5847
	Hœmus	8	“	21	N. Lat	2021
	Carpathians	15	“	19	“	1939
	Apennines	14	“	27	“	5501
5	Taurus	21	“	28	“	2746
	Riphees	25	“	33	“	4171
	Hercynians	17	“	29	“	1170
	Caucasia	32	“	41	“	5567
	Alps	42	“	49	“	3617

The most important of these different chains is that of the Apennines, the development of which extends 150 leagues, and is yet inferior to that of the great orographical movements of the earth. The Apennines run along the eastern border of the Sea of Rains, and are continued on the north by the Carpathians, the profile of which measures about 100 leagues.

The travellers could only catch a glimpse of the summit of these Apennines which lie between west long. 10° and east long. 16° ; but the chain of the Carpathians was visible from 18° to 30° east longitude, and they could see how they were distributed.

One hypothesis seemed to them very justifiable. Seeing that this chain of the Carpathians was here and there circular in form and with high peaks, they concluded that it anciently formed important cirques. These mountainous cirques must have been broken up by the vast cataclysm to which the Sea of Rains was due. These Carpathians looked then what the cirques of Purbach, Arzachel, and Ptolemy would if some cataclysm were to throw down their left ramparts and transform them into continuous chains. They present an average height of 3,200 metres, a height comparable to certain of the Pyrenees such as at the port of Pinède. Their southern slopes fall straight into the immense Sea of Rains.

About two o'clock in the morning Barbicane found that they were above the twentieth lunar parallel . , not far from that little mountain, 1,559 metres high, which bears the name of Pythias. The distance of the projectile from the moon was not more than twelve hundred (1200) kilometres reduced to three leagues by means of telescopes.

The *Mare Imbrium* lay before the eyes of the travellers like an immense depression of which the details were not very distinct. Near them on the left rose Mount Lambert, the altitude of which is estimated at 1,813 metres, and farther on, upon the borders of the Ocean of Tempests, in north lat. 23° and east longitude 29°, rose the shining mountain of Euler. This mountain, which rises only 1,815 metres above the lunar surface, has been the object of an interesting work by the astronomer Schroeter. This savant, trying to find out the origin of the lunar mountains asked himself whether the volume of the crater always looked equal to the volume of the ramparts that formed it. Now this be found to be generally the case, and he hence concluded that a single eruption of volcanic matter had sufficed to form these ramparts, for successive eruptions would have destroyed the connection. Mount Euler alone was an exception to this general law, and it must have taken several successive eruptions to form it, for the volume of its cavity is double that of its inclosure.

All of these hypotheses were allowable to terrestrial observers whose instruments were incomplete; but Barbicane was no longer content to accept them and perceiving that the projectile was steadily approaching the lunar disc, did not despair; if not of reaching her, at least of discovering the secrets of her formation.

XIII. Lunar Landscapes

At half-past two in the morning, the projectile was over the thirtieth lunar parallel and at the effective distance of a thousand kilometres , reduced by the glasses to ten . It still seemed impossible, however, that it could ever touch any part of the disc. Its motive speed, comparatively so moderate, was inexplicable to President Barbicane. At that distance from the moon it must have been considerable, to enable it to bear up against her attraction. Here was a phenomenon the cause of which escaped them again. Besides, time failed them to investigate the cause. All lunar relief was defiling under the eyes of the travelers, and they would not lose a single detail.

Under the glasses the disc appeared at the distance of two leagues and a half . What would an aeronaut, borne to this distance from the earth, distinguish on its surface? We cannot say, since the greatest ascension has not been more than eight thousand metres. .

This, however, is an exact description of what Barbicane and his companions saw at this height.

Large patches of different colours appeared on the disc. Selenographers are not agreed upon the nature of these colours. There are several, and rather vividly marked. Julius Schmidt pretends that, if the terrestrial oceans were dried up, a Selenite observer could not distinguish on the globe a greater diversity of shades between the oceans and the continental plains than those on the moon present to a terrestrial observer. According to him, the colour common to the vast plains known by the name of “seas” is a dark gray mixed with green and brown. Some of the large craters present the same appearance.

Barbicane knew this opinion of the German selenographer, an opinion shared by Beer and Mädler . His observation proved that right was on their side, and not on that of some astronomers who admit the existence of only gray on the moon’s surface. In some parts green was very distinct, such as springs, according to Julius Schmidt, from the seas of Serenity and Humors. Barbicane also noticed large craters, without any interior cones, which shed a bluish tint similar to the reflection of a sheet of steel freshly polished. These colours belonged really to the lunar disc, and did not result, as some astronomers say, either from the imperfection in the objective of the glasses or from the interposition of the terrestrial atmosphere.

Not a doubt existed in Barbicane’s mind with regard to it, as he observed it through space, and so could not commit any optical error. He considered the establishment of these diverse colourations as an acquisition to science. Now, were these shades of green, belonging to tropical vegetation, kept up by a low dense atmosphere? He could not yet say.

Farther on, he noticed a reddish tint, quite defined. The same shade had before been observed at the bottom of an isolated enclosure, known by the name of Lichtenberg’s cirque, which is situated near the Hercynian mountains, on the borders of the moon; but they could not tell the nature of it.

He was not more fortunate with regard to another peculiarity of the disc, for he could not decide upon the cause of it. Here is the peculiarity.

Michel Ardan was watching near the president, when he noticed long white lines, vividly lighted up by the direct rays of the sun. It was a succession of luminous furrows, very different from the radiation of Copernicus not long before; they ran parallel with each other.

Michel, with his usual nerve , hastened to exclaim:

“Look there! cultivated fields!”

“Cultivated fields ? ” replied Nicholl, shrugging his shoulders.

“Plowed, at all events,” retorted Michel Ardan; “but what labourers those Selenites must be, and what giant oxen they must harness to their plow to cut such furrows!”

“They are not furrows,” said Barbicane; “they are *rifts*.”

“Rifts? stuff!” replied Michel mildly; “but what do you mean by `rifts’ in the scientific world?”

Barbicane immediately enlightened his companion as to what he knew about lunar rifts. He knew that they were a kind of furrow found on every part of the disc which was not mountainous; that these furrows, generally isolated, measure from four to fifty leagues in length; that their breadth varied from 1,000 to 1,500 metres , and that their borders were strictly parallel; but he knew nothing more either of their formation or their nature.

Barbicane, through his glasses, observed these rifts with great attention. He noticed that their borders were formed of steep declivities; they were long parallel ramparts, and with some small amount of imagination he might have admitted the existence of long lines of fortifications, raised by Selenite engineers.

Of these different rifts some were perfectly straight, as if cut by a line; others were slightly curved, though still keeping their borders parallel; some crossed each other, some cut through craters; here they wound through ordinary cavities, such as Posidonius or Petavius; there they wound through the seas, such as the Sea of Serenity.

These natural accidents naturally excited the imaginations of the terrestrial astronomers. The first observations had not discovered these rifts. Neither Hevelius, Cassini, La Hire, nor Herschel seemed to have known them. It was Schroeter who in 1789 first drew attention to them. Others followed who studied them, as Pastorff, Gruithuysen, Beer, and Mädler . At this time their number amounts to seventy; but, if they have been counted, their nature has not yet been determined; they are certainly *not* fortifications, any more than they are the ancient beds of dried-up rivers; for, on one side, the waters, so slight on the moon’s surface, could never have worn such drains for themselves; and, on the other, they often cross craters of great elevation.

We must, however, allow that Michel Ardan had “an idea,” and that, without knowing it, he coincided in that respect with Julius Schmidt.

“Why,” said he, “should not these unaccountable appearances be simply phenomena of vegetation?”

“What do you mean?” asked Barbicane quickly.

“Do not excite yourself, my worthy president,” replied Michel; “might it not be possible that the dark lines forming that bastion were rows of trees regularly placed?”

“You stick to your vegetation, then?” said Barbicane.

“I like,” retorted Michel Ardan, “to explain what you savants cannot explain; at least my hypotheses has the advantage of indicating why these rifts disappear, or seem to disappear, at certain seasons.”

“And for what reason?”

“For the reason that the trees become invisible when they lose their leaves, and visible again when they regain them.”

“Your explanation is ingenious, my dear companion,” replied Barbicane, “but inadmissible.”

“Why?”

“Because, so to speak, there are no seasons on the moon’s surface, and that, consequently, the phenomena of vegetation of which you speak cannot occur.”

Indeed, the slight obliquity of the lunar axis keeps the sun at an almost equal height in every latitude. Above the equatorial regions the radiant orb almost invariably occupies the zenith, and does not pass the limits of the horizon in the polar regions; thus, according to each region, there reigns a perpetual winter, spring, summer, or autumn, as in the planet Jupiter, whose axis is but little inclined upon its orbit.

What origin do they attribute to these rifts? That is a question difficult to solve. They are certainly posterior to the formation of craters and cirques , for several have introduced themselves by breaking through their circular ramparts. Thus it may be that, contemporary with the later geological epochs, they are due to the expansion of natural forces.

Meanwhile the projectile had now attained the fortieth degree of lunar latitude, at a distance not exceeding eight hundred (800) kilometres . Through the glasses objects appeared to be only two leagues distant. At this point, under their feet, rose Mount Helicon, 505 metres high, and round about the left rose moderate elevations, enclosing a small portion of the Sea of Rains, under the name of the Gulf of Iris.

The terrestrial atmosphere would have to be one hundred and seventy times more transparent than it is, to allow astronomers to make perfect observations on the moon’s surface; but in the void in which the projectile floated no fluid interposed itself between the eye of the observer and the object observed. And more, Barbicane found himself carried to a greater distance than the most powerful telescopes had ever done before, either that of Lord Rosse or that of the Rocky Mountains. He was, therefore, under extremely favorable conditions for solving that great question of the habitability of the moon; but the solution still escaped him; he could distinguish nothing but the deserted bed of immense plains, and toward the north, arid mountains. Not a work betrayed the hand of man; not a ruin marked his course; not a group of animals was to be seen indicating life, even in an inferior degree. In no part was there motion, in no part was there an appearance of vegetation. Of the three kingdoms which share the terrestrial globe between them, one alone was represented on the lunar and that the mineral.

“Ah, indeed!” said Michel Ardan, a little out of countenance; “then you see no one?”

“No,” answered Nicholl; “up to this time, not a man, not an animal, not a tree! After all, whether the atmosphere has taken refuge at the bottom of cavities, in the midst of the cirques , or even on the opposite face of the moon, we cannot decide.”

“Besides,” added Barbicane, “even to the most piercing eye a man cannot be distinguished farther than seven kilometres off; so that, if there are any Selenites, they can see our projectile, but we cannot see them.”

Toward four in the morning, at the height of the fiftieth parallel, the distance was reduced to six hundred (600) kilometres .To the left ran a line of mountains capriciously shaped, lying in the full light. To the right, on the contrary, lay a black hollow resembling a vast well, unfathomable and gloomy, drilled into the lunar soil.

This hole was the “Black Lake”; it was Plato, a deep cirque which can be conveniently studied from the earth, between the last quarter and the new moon, when the shadows fall from west to east.

This black colour is rarely met with on the surface of the satellite. As yet it has only been recognized in the depths of the cirque of Endymion, to the east of the “Cold Sea,” in the northern hemisphere, and at the bottom of Grimaldi’s cirque , on the equator, toward the eastern border of the orb.

Plato is an annular mountain, situated in 51° north latitude, and 9° east longitude. Its circuit is ninety-two (92) kilometres long and sixty-one (61) broad.

Barbicane regretted that they were not passing directly above this vast opening. There was an abyss to fathom, perhaps some mysterious phenomenon to surprise; but the projectile’s course could not be altered. They must rigidly submit. They could not guide a balloon, still less a projectile, when once enclosed within its walls.

Toward five in the morning the northern limits of the Sea of Rains was at length passed. The mounts of Condamine and Fontenelle remained— one on the right, the other on the left. That part of the disc beginning with 60° was becoming quite mountainous. The glasses brought them to within a league , a distance less than that separating the summit of Mont Blanc from the level of the sea. The whole region was bristling with peaks and cirques . Toward the 70° Philolaus stood predominant at a height of 3,700 metres disclosing an elliptical crater sixteen leagues long and four wide.

Seen from this distance, the disc showed a very fantastical appearance. Landscapes were presented to the eye under very different conditions from those on the earth, and also very inferior to them.

The moon having no atmosphere, the consequences arising from the absence of this gaseous envelope have already been shown. No twilight on her surface; night following day and day following night with the suddenness of a lamp which is extinguished or lighted amid profound darkness— no transition from cold to heat, the temperature falling in an instant from boiling point of water to the cold of space.

Another consequence of this want of air is that absolute darkness reigns where the sun’s rays do not penetrate. That which on earth is called diffusion of light, that luminous matter which the air holds in suspension, which creates the twilight and the daybreak, which produces the *umbrae* and *penumbrae*, and all the magic of *chiaro-oscuro*, does not exist on the moon. Hence the harshness of contrasts, which only admit of two colours, black and white. If a Selenite were to shade his eyes from the sun’s rays, the sky would seem absolutely black, and the stars would shine to him as on the darkest night.

Judge of the impression produced on Barbicane and his three friends by this strange scene! Their eyes were confused. They could no longer grasp the respective distances of the different plains. A lunar landscape without the softening of the phenomena of *chiaro-oscuro* could not be rendered by an earthly landscape painter; it would be spots of ink on a white page— nothing more.

This aspect was not altered even when the projectile, at the height of 80°, was only separated from the moon by a distance of one hundred kilometres (100) ; nor even when, at five in the morning, it passed at less than fifty kilometres from the mountain of Gioja, a distance reduced by the glasses to an eighth of a league . It seemed as if the moon might be touched by the hand! It seemed impossible that, before long, the projectile would not strike her, if only at the north pole, the brilliant arch of which was so distinctly visible on the black sky.

Michel Ardan wanted to open one of the scuttles and throw himself on to the moon’s surface ; a fall of twelve (12) leagues. He did not care. A very useless attempt; for if the

projectile could not attain any point whatever of the satellite, Michel, carried along by its motion, could not attain it either.

At that moment, at six o’clock, the lunar pole appeared. The disc only presented to the travelers’ gaze one half brilliantly lit up, while the other disappeared in the darkness. Suddenly the projectile passed the line of demarcation between intense light and absolute darkness, and was plunged in profound night!

XIV. The Night Of Three Hundred And Fifty-Four Hours And A Half

At the moment when this phenomenon took place so rapidly, the projectile was skirting the moon's north pole at less than 50 kilometres' distance. Some seconds had sufficed to plunge it into the absolute darkness of space. The transition was so sudden, without shade, without gradation of light, without attenuation of the luminous waves, that the orb seemed to have been extinguished by a powerful blow.

"Melted, disappeared!" Michel Ardan exclaimed, aghast.

Indeed, there was neither reflection nor shadow. Nothing more was to be seen of that disc, formerly so dazzling. The darkness was complete and rendered even more so by the rays from the stars. It was "that blackness" in which the lunar nights are insteeped, which last three hundred and fifty-four hours and a half at each point of the disc, a long night resulting from the equality of the translatory and rotary movements of the moon the one about itself, the other about the earth. The projectile, immerged in the conical shadow of the satellite, experienced the action of the solar rays no more than any point of its invisible half .

In the interior, the obscurity was complete. They could not see each other. Hence the necessity of dispelling the darkness. However desirous Barbicane might be to husband the gas, the reserve of which was small, he was obliged to ask from it a factitious light, an expensive brilliancy which the sun then refused.

"Devil take the radiant orb!" exclaimed Michel Ardan, "which forces us to expend gas, instead of giving us his rays gratuitously."

"Do not let us accuse the sun," said Nicholl, "it is not his fault, but that of the moon, which has come and placed herself like a screen between us and it."

"It is the sun!" continued Michel.

"It is the moon!" retorted Nicholl.

An idle dispute, which Barbicane put an end to by saying:

"My friends, it is neither the fault of the sun nor of the moon; it is the fault of the *projectile*, which, instead of rigidly following its course, has awkwardly missed it. To be more just, it is the fault of that unfortunate meteor which has so deplorably altered our first direction."

"Very well, ," replied Michel Ardan, "as the matter is settled, let us have breakfast. After a whole night of watching it is fair to build ourselves up a little."

This proposal meeting with no contradiction, Michel prepared the repast in a few minutes. But they ate for eating's sake, they drank without toasts, without hurrahs. The bold travelers being borne away into gloomy space, without their accustomed *cortege* of rays, felt a vague uneasiness arise in their hearts. The "strange wild shadow" so dear to Victor Hugo's pen bound them on all sides.

Meanwhile they talked over the interminable night of three hundred and fifty-four hours and a half, nearly fifteen days, which the laws of physics have imposed on the inhabitants of the moon. Barbicane gave his friends some explanation of the causes and the consequences of this curious phenomenon.

“Curious indeed,” said he ; “for, if each hemisphere of the moon is deprived of solar light for fifteen days, that above which we now float does not even enjoy during its long night any view of the earth so beautifully lit up. In a word she has no moon (applying this designation to our spheroid) but on one side of her disc. Now if this were the case with the earth— if, for example, Europe never saw the moon, and she was only visible at the antipodes, imagine to yourself the astonishment of a European on arriving in Australia.”

“They would make the voyage for nothing but to see the moon!” replied Michel.

“Very well!” continued Barbicane, “that astonishment is reserved for the Selenites who inhabit the face of the moon opposite to the earth, a face which is ever invisible to our countrymen of the terrestrial globe.”

“And which we should have seen,” added Nicholl, “if we had arrived here when the moon was new, that is to say fifteen days later.”

“I will add, to make amends,” continued Barbicane, “that the inhabitants of the visible face are singularly favored by nature, to the detriment of their brethren on the invisible face. The latter, as you see, have dark nights of 354 hours, without one single ray to break the darkness. The other, on the contrary, when the sun which has given its light for fifteen days sinks below the horizon, see a splendid orb rise on the opposite horizon. It is the earth, which is thirteen times greater than the diminutive moon that we know— the earth which develops itself at a diameter of two degrees, and which sheds a light thirteen times
greater untempered by any atmospheric strata— the earth which only disappears at the moment when the sun reappears in its turn!”

“Nicely worded!” said Michel, “slightly academical perhaps.”

“It follows, then,” continued Barbicane, without knitting his brows, “that the visible face of the disc must be very agreeable to inhabit, since it always looks on either the sun when the moon is full, or on the earth when the moon is new.”

“But,” said Nicholl, “that advantage must be well compensated by the insupportable heat which the light brings with it.”

“The inconvenience, in that respect, is the same for the two faces, for the earth’s light is evidently deprived of heat. But the invisible face is still more searched by the heat than the visible face. I say that for *you*, Nicholl, because Michel will probably not understand.”

“Thank you,” said Michel.

“Indeed,” continued Barbicane, “when the invisible face receives at the same time light and heat from the sun, it is because the moon is new; that is to say , she is in conjunction situated between the sun and the earth. It follows, then, considering the position which she occupies in opposition when full, that she is nearer to the sun by twice her distance from the earth; and that distance may be estimated at the two-hundredth part of that which separates the sun from the earth, or in round numbers 200,000 leagues . So that invisible face is so much nearer to the sun by 200,000 leagues when she receives its rays.”

“Quite right,” replied Nicholl.

“On the contrary,” continued Barbicane.

“One moment,” said Michel, interrupting his grave companion.

“What do you want?”

“I ask to be allowed to continue the explanation.”

“And why?”

“To prove that I understand.”

“Get along with you,” said Barbicane, smiling.

“On the contrary,” said Michel, imitating the tone and gestures of president Barbicane, “on the contrary, when the visible face of the moon is lit by the sun, it is because the moon is full, that is to say, opposite the sun with regard to the earth. The distance separating it from the radiant orb is then increased in round numbers to 200,000 leagues , and the heat which she receives must be a little less.”

“Very well said!” exclaimed Barbicane. “Do you know, Michel, that, for an amateur, you are intelligent.”

“Yes,” replied Michel coolly, “we are all so on the Boulevard des Italiens.”

Barbicane gravely grasped the hand of his amiable companion, and continued to enumerate the advantages reserved for the inhabitants of the visible face.

Among others, he mentioned eclipses of the sun, which only take place on this side of the lunar disc; since, in order that they may take place, it is necessary for the moon to be *in opposition*. These eclipses, caused by the interposition of the earth between the moon and the sun, can last *two hours*; during which time, by reason of the rays refracted by its atmosphere, the terrestrial globe can appear as nothing but a black point upon the sun.

“So,” said Nicholl, “there is a hemisphere, that invisible hemisphere which is very ill supplied, very ill treated, by nature.”

“Yes,” answered Barbicane, “but not entirely so. Indeed, by a certain movement of libration, by a certain oscillation on its centre, the Moon presents to the earth a little more than the half of her disc. She is like a pendulum whose centre of gravity is directed to the terrestrial globe and which oscillates regularly. From whence comes this oscillation? Because its movement of rotation on its axis is animated with a uniform velocity, while its movement of translation following an elliptic orbit around the earth, is not. At perigee, the speed of translation prevails and the moon shows a certain portion of its western edge. At apogee the speed of rotation is more important on the other hand, and a portion of the eastern rim appears. It is a strip of about eight degrees which appears, sometimes on the west, sometimes on the east. As a result out of a thousand parts the moon lets five hundred sixty-nine (569) be viewed.

“Never mind,” replied Michel; “if we ever become Selenites, we will inhabit the visible face. I like the light.”

“Unless, by any chance,” answered Nicholl, “the atmosphere should be condensed on the other side, as certain astronomers pretend.”

“That would be a consideration,” said Michel simply.

Breakfast over, the observers returned to their post. They tried to see through the darkened scuttles by extinguishing all light in the projectile; but not a luminous particle made its way through the darkness.

One inexplicable fact preoccupied Barbicane. Why, having passed within such a short distance of the moon— fifty kilometres only—, why the projectile had not fallen? If its speed had been enormous, he could have understood that the fall would not have taken place; but, with a relatively moderate speed, that resistance to the moon’s attraction could not be explained. Was the projectile under some foreign influence? Did some kind of body retain it in the ether? It was quite evident that it could never reach any point of the moon. Whither

was it going? Was it going farther from, or nearing, the disc? Was it being borne in that profound night through the infinity of space? How could they learn, how calculate, in the midst of this darkness ? All these questions made Barbicane uneasy, but he could not solve them.

Certainly, the invisible orb was *there*, perhaps only some few leagues, some miles off; but neither he nor his companions could see it. If there was any noise on its surface, they could not hear it. Air, that medium of sound, was wanting to transmit the groanings of that moon which the Arabic legends call “a man already half granite, and still breathing!”

One must allow that that was enough to aggravate the most patient observers. It was just that unknown hemisphere which was stealing from their sight. That face which fifteen days sooner, or fifteen days later, had been, or would be, splendidly illuminated by the solar rays, was then being lost in utter darkness. In fifteen days where would the projectile be? Where would the chances of conflicting attractions have drawn it to? Who could say?

It is generally admitted, according to selenographic observations, that the invisible hemisphere of the moon is, in its constitution, absolutely similar to the visible hemisphere. In fact one-seventh of it is disclosed by the movements of libration of which Barbican had spoken. Now on the visible surfaces there were nothing but plains and mountains, cirques, and craters, analogous to those already revealed on the maps. One could therefore predict the same nature, the same world, arid and dead. However, what if the atmosphere had taken refuge on this face? If, with air, water had given life to regenerated continents? If vegetation still persisted? If animals populated the continents and seas? If man, under these conditions of habitability, lives there already? How many questions it would have been interesting to solve! What solutions might have been drawn from the contemplation of this hemisphere! What delight to have a glance on the world which no human eye has ever seen!

The disappointment of the travelers in the midst of this utter darkness may be imagined. All observation of the lunar disc was impossible. The constellations alone claimed all their attention; and we must allow that the astronomers Faye, Charconac, and Secchi, never found themselves in circumstances so favorable for their observation.

Indeed, nothing could equal the splendor of this starry world, bathed in limpid ether. Its diamonds set in the celestial vault sparkled magnificently. The eye took in the firmament from the Southern Cross to the North Star, those two constellations which in 12,000 years, by reason of the precession of equinoxes, will resign their part of the polar stars, the one to Canopus in the southern hemisphere, the other to Vega in the northern. Imagination loses itself in this sublime Infinity, amid which the projectile was gravitating, like a new star created by the hand of man. From a natural cause, these constellations shone with a soft luster; they did not twinkle, for there was no atmosphere which, by the intervention of its layers unequally dense and of different degrees of humidity, produces this scintillation. These stars were soft eyes, looking out into the dark night, amid the absolute silence of space.

Long did the travelers stand mute, watching the constellated firmament, upon which the moon, like a vast screen, made an enormous black hole. But at length a painful sensation drew them from their watchings. This was an intense cold, which soon covered the inside of the glass of the scuttles with a thick coating of ice. The sun was no longer warming the projectile with its direct rays, and thus it was losing the heat stored up in its walls by degrees. This heat was rapidly evaporating into space by radiation, and a considerably lower temperature was the result. The humidity of the interior was changed into ice upon contact with the glass, preventing all observation.

Nicholl consulted the thermometer, and saw that it had fallen to seventeen degrees (Centigrade) below zero. So that, in spite of the many reasons for economizing, Barbicane, after having begged light from the gas, was also obliged to beg for heat. The projectile's low temperature was no longer endurable. Its tenants would have been frozen to death.

"Well!" observed Michel, "we cannot reasonably complain of the monotony of our journey! What variety we have had, at least in temperature. Now we are blinded with light and saturated with heat, like the Indians of the Pampas! now plunged into profound darkness, amid the boreal cold, like the Esquimaux of the pole. No, indeed! we have no right to complain; nature does wonders in our honor."

"But," asked Nicholl, "what is the temperature outside?"

"Exactly that of the planetary space," replied Barbicane.

"Then," continued Michel Ardan, "would not this be the time to make the experiment which we dared not attempt when we were drowned in the sun's rays?

"It is now or never," replied Barbicane, "for we are in a good position to verify the temperature of space, and see if Fourier or Pouillet's calculations are exact."

"In any case it is cold," said Michel. "See! the steam of the interior is condensing on the glasses of the scuttles. If the fall continues, the vapour of our breath will fall in snow around us."

"Let us prepare a thermometer," said Barbicane.

We may imagine that an ordinary thermometer would afford no result under the circumstances in which this instrument was to be exposed. The mercury would have been frozen in its ball, as below 42° C. below zero it is no longer liquid. But Barbicane had furnished himself with a spirit thermometer on Walferdin's system, which gives the minima of excessively low temperatures.

Before beginning the experiment, this instrument was compared with an ordinary one, and then Barbicane prepared to use it.

"How shall we set about it?" asked Nicholl.

"Nothing is easier," replied Michel Ardan, who was never at a loss. "We open the scuttle rapidly; throw out the instrument; it follows the projectile with exemplary docility; and a quarter of an hour after, draw it in."

"With the hand?" asked Barbicane.

"With the hand," replied Michel.

"Well, then, my friend, do not expose yourself," answered Barbicane, "for the hand that you draw in again will be nothing but a stump frozen and deformed by the frightful cold."

"Really!"

"You will feel as if you had had a terrible burn, like that of iron at a white heat; for whether the heat leaves our bodies briskly or enters briskly, it is exactly the same thing. Besides, I am not at all certain that the objects we have thrown out are still following us."

"Why not?" asked Nicholl.

"Because, if we are passing through an atmosphere of the slightest density, these objects will be retarded. Again, the darkness prevents our seeing if they still float around us. But in order

not to expose ourselves to the loss of our thermometer, we will fasten it, and we can then more easily pull it back again."

Barbicane's advice was followed. Through the scuttle rapidly opened, Nicholl threw out the instrument, which was held by a short cord, so that it might be more easily drawn up. The scuttle had not been opened more than a second, but that second had sufficed to let in a most intense cold.

" *Mille diables !*" exclaimed Michel Ardan, "it is cold enough to freeze white bears."

Barbicane waited until half an hour had elapsed, which was more than time enough to allow the instrument to fall to the level of the surrounding temperature. Then, after that interval, the thermometer was rapidly pulled in.

Barbicane calculated the quantity of spirits of wine overflowed into the little vial soldered to the lower part of the instrument, and said:

"A hundred and forty degrees Centigrade below zero!"

M. Pouillet was right and Fourier wrong. That was the redoubted temperature of the starry space. Such is, perhaps, that of the lunar continents, when the orb of night has lost by radiation all the heat which fifteen days of sun have poured into her.

XV. Hyperbola Or Parabola

We may, perhaps, be astonished to find Barbicane and his companions so little occupied with the future reserved for them in their metal prison which was bearing them through the infinity of the ether . Instead of asking where they were going, they passed their time making experiments, as if they had been quietly installed in their own study.

We might answer that men so strong-minded were above such anxieties — that they did not trouble themselves about such trifles — and that they had something else to do than to occupy their minds with the future.

The truth was that they were not masters of their projectile; they could neither check its course, nor alter its direction. A sailor can change the head of his ship as he pleases; an aeronaut can impart a vertical motion to his balloon. They, on the contrary, had no power over their vehicle. Every maneuver was forbidden. Hence the inclination to let things alone, or as the sailors say, “let her run.”

Where did they find themselves at this moment, at eight o’clock in the morning of the day called upon the earth the 6th of December? Very certainly in the neighborhood of the moon, and even near enough for her to look to them like an enormous black screen upon the firmament. As to the distance which separated them, it was impossible to estimate it. The projectile, held by some unaccountable forces, had been within 50 kilometres of grazing the satellite’s north pole. But since entering the cone of shadow these last two hours, had the distance increased or diminished? Every point of mark was wanting by which to estimate both the direction and the speed of the projectile. Perhaps it was rapidly leaving the disc, so that it would soon quit the pure shadow. Perhaps, again, on the other hand, it might be nearing it so much that in a short time it might strike some high point on the invisible hemisphere, which would doubtlessly have ended the journey much to the detriment of the travelers.

A discussion arose on this subject, and Michel Ardan, always ready with an explanation, gave it as his opinion that the projectile, held by the lunar attraction, would end by falling on the moon like an aerolite on the surface of the terrestrial globe .

“First of all, my friend,” answered Barbicane, “every aerolite does not fall to the earth; it is only a small proportion which do so; and if we had passed into an aerolite, it does not necessarily follow that we should ever reach the surface of the moon.”

“But how if we get near enough?” replied Michel.

“ Error ,” replied Barbicane. “Have you not seen shooting stars rush through the sky by thousands at certain seasons?”

“Yes.”

“Well, these stars, or rather corpuscles, only shine when they are heated by gliding over the atmospheric layers. Now, if they enter the atmosphere, they pass at least within sixteen leagues of the earth, but they seldom fall upon it. The same with our projectile. It may approach very near to the moon, and not yet fall upon it.”

“But then,” asked Michel, “I shall be curious to know how our erring vehicle will act in space?”

“I see but two hypotheses,” replied Barbicane, after some moments’ reflection.

“What are they?”

“The projectile has the choice between two mathematical curves, and it will follow one or the other according to the speed with which it is animated, and which at this moment I cannot estimate.”

“Yes,” said Nicholl, “it will follow either a parabola or a hyperbola.”

“Just so,” replied Barbicane. “With a certain speed it will assume the parabola, and with a greater the hyperbola.”

“I like those grand words,” exclaimed Michel Ardan; “one knows directly what they mean. And pray what is your parabola, if you please?”

“My friend,” answered the captain, “the parabola is a curve of the second order, the result of the section of a cone intersected by a plane parallel to one of the sides.”

“Ah! ah!” said Michel, in a satisfied tone.

“It is very nearly,” continued Nicholl, “the course described by a bomb launched from a mortar.”

“Perfect! And the hyperbola?”

“The hyperbola, Michel, is a curve of the second order, produced by the intersection of a conic surface and a plane parallel to its axis, and constitutes two branches separated one from the other, both tending indefinitely in the two directions.”

“Is it possible!” exclaimed Michel Ardan in a serious tone, as if they had told him of some serious event. “Then remember this, Captain Nicholl. What I particularly like in your definition of the hyperbola (I was going to say hyperhumbug) is that it is still more obscure than the word you pretend to define.”

Nicholl and Barbicane cared little for Michel Ardan’s fun. They were deep in a scientific discussion. What curve would the projectile follow? That was what excited their attention. One maintained the hyperbola, the other the parabola. They gave each other reasons bristling with *x*. Their arguments were couched in language which made Michel jump. The discussion was hot, and neither would give up his chosen curve to his adversary.

This scientific dispute prolonged so long, ended by making Michel impatient, who said:”

“Now, gentlemen of the cosines, will you cease to throw parabolas and hyperbolas at each other’s heads? I want to understand the only interesting question in the whole affair. We shall follow one or the other of these curves. Good. But where will they lead us to?”

“Nowhere,” replied Nicholl.

“How, nowhere?”

“Evidently,” said Barbicane, “they are open curves, which may be prolonged indefinitely.”

“Ah, savants!” cried Michel; “I take you to my heart! And what matters to us parabola or hyperbola at the moment where either the one or the other equally lead us into infinite space?”

Barbicane and Nicholl could not forbear smiling. They had just been creating “art for art’s sake.” Never had so idle a question been raised at such an inopportune moment. The sinister truth remained that, whether hyperbolically or parabolically borne away, the projectile would never again meet either the earth or the moon.

What would become of these bold travelers in the immediate future? If they did not die of hunger, if they did not die of thirst, in some days, when the gas failed, they would die from want of air, unless the cold had killed them first.

Still, important as it was to economize the gas, the excessive lowness of the surrounding temperature obliged them to consume a certain quantity. Strictly speaking, they could do without its *light*, but not without its *heat*. Fortunately the caloric generated by Reiset's and Regnaut's apparatus raised the temperature of the interior of the projectile a little, and without much expenditure they were able to keep it bearable.

But observations had now become very difficult through the port lights. The dampness of the projectile was condensed on the windows and congealed immediately. This cloudiness had to be dispersed continually by repeated rubbing. In any case they might hope to be able to discover some phenomena of the highest interest.

In fact, if the invisible disc was provided with any atmosphere, ought not one see shooting stars streaking through it? If the projectile itself was passing through these fluid strata could not one intercept some noise repercussed by lunar echoes—the growling of a storm, for instance, the crash of an avalanche, the detonations of volcanic activity? And if some invigomous mountain flashed forth its lightnings, would not their intense fulgurations be perceived? Such facts, carefully noted, would have singularly elucidated the obscure question of the lunar constitution. So Barbicane and Nicholl, posted at their port lights like astronomers, observed with scrupulous patience.

But up to this time the disc remained dumb and dark. It did not answer the multiplicity of questions put by these ardent minds; a matter which drew this reflection from Michel, apparently a just one:

"If ever we begin this journey over again, we shall do well to choose the time when the moon is at the full."

"Certainly," said Nicholl, "that circumstance will be more favorable. I allow that the moon, immersed in the sun's rays, will not be visible during the transit, but instead we should see the earth, which would be full. And what is more, if we were drawn round the moon, as at this moment, we should at least have the advantage of seeing the invisible part of her disc magnificently lit."

"Well said, Nicholl," replied Michel Ardan. "What do you think, Barbicane?"

"I think this," answered the grave president: "If ever we begin this journey again, we shall start at the same time and under the same conditions. Suppose we had attained our end, would it not have been better to have found continents in broad daylight than a country plunged in utter darkness? Would not our first installation have been made under better circumstances? Yes, evidently. As to the invisible side, we could have visited it in our exploring expeditions on the lunar globe. So that the time of the full moon was well chosen. But we ought to have arrived at the end; and in order to have so arrived, we ought to have suffered no deviation on the road."

"I have nothing to say to that," answered Michel Ardan. "Here is, however, a good opportunity lost of observing the other side of the moon. Who knows if the inhabitants of the other planets are not more advanced than the savants of the earth in the subject of their satellites?

One could easily make the following response to that remark by Michel Ardan: Yes, other satellites, by their greater proximity, have made their study easier. The inhabitants of Saturn, Jupiter, and Uranus, if they exist, may have been able to establish communications with their

satellites much more easily. The four satellites of Jupiter gravitate at a distance of 108,260 leagues, 172,200 leagues, 274,700 leagues, and 480,130 leagues. But these distances are reckoned from the centre of the planet, and by taking away the radius, which is 17,000 to 18,000 leagues, it will be seen that the first satellite is at a much less distance from the surface of Jupiter than the moon is from the surface of the earth. Of the eight moons of Saturn, four are also nearer; Dione is 84,600 leagues distant, Téthys 62,966 leagues, Enceladus, 48,191 leagues, and lastly Mimas at an average distance of only 34,500 leagues. Of the eight satellites of Uranus, the first, Ariel, is only 51,520 leagues from the planet.

Therefore, at the surface of these three planets, an experiment analogous to that of President Barbicane would have presented fewer difficulties. If therefore their inhabitants have attempted the enterprise, they have perhaps discovered the constitution of that part of the disc which their satellite hides eternally from their eyes. But if they have never quitted their planet, they are no further advanced than the astronomers of the earth.

Meanwhile the projectile was now describing in the shadow that incalculable course which no sight-mark would allow them to ascertain. Had its direction been altered, either by the influence of the lunar attraction, or by the action of some unknown star? Barbicane could not say. But a change had taken place in the relative position of the vehicle; and Barbicane verified it about four in the morning.

The change consisted in this, that the base of the projectile had turned toward the moon's surface, and was so held by a perpendicular passing through its axis. The attraction, that is to say the weight, had brought about this alteration. The heaviest part of the projectile inclined toward the invisible disc as if it would fall upon it.

Was it falling? Were the travelers attaining that much desired end? No. And the observation of a sign-point, quite inexplicable in itself, showed Barbicane that his projectile was not nearing the moon, and that it had shifted by following an almost concentric curve.

This point of mark was a luminous brightness, which Nicholl sighted suddenly, on the limit of the horizon formed by the black disc. This point could not be confounded with a star. It was a reddish incandescence which increased by degrees, a decided proof that the projectile was shifting toward it and not falling normally on the surface of the moon.

"A volcano! it is a volcano in action!" cried Nicholl; "a disemboweling of the interior fires of the moon! That world is not quite extinguished."

"Yes, an eruption," replied Barbicane, who was carefully studying the phenomenon through his night glass. "What should it be, if not a volcano?"

"But, then," said Michel Ardan, "in order to maintain that combustion, there must be air. So the atmosphere does surround that part of the moon."

"Perhaps so," replied Barbicane, "but not necessarily. The volcano, by the decomposition of certain substances, can provide its own oxygen, and thus throw flames into a vacuum . It seems to me that the deflagration has the intensity and brilliancy of substances whose combustion is produced in pure oxygen. We must not be in a hurry to proclaim the existence of a lunar atmosphere."

The ignivomous mountain must have been situated about the 45° south latitude on the invisible part of the disc; but, to Barbicane's great displeasure, the curve which the projectile was describing was taking it far from the point indicated by the eruption. Thus he could not determine its nature exactly. Half an hour after being sighted, this luminous point had disappeared behind the dark horizon; but the verification of this phenomenon was of considerable consequence in their selenographic studies. It proved that all heat had not yet

disappeared from the bowels of this globe; and where heat exists, who can affirm that the vegetable kingdom, nay, even the animal kingdom itself, has not up to this time resisted all destructive influences? The existence of this volcano in eruption, if unmistakably acknowledged by earthly savants, would doubtless have given rise to many theories favourable to the grave question of the habitability of the moon.

Barbicane allowed himself to be carried away by these reflections. He forgot himself in a mute reverie in which stirred the mysterious destinies of the lunar world. He was seeking to combine together the facts observed up to that time, when a new incident recalled him briskly to reality.

This incident was more than a cosmical phenomenon; it was a threatening danger, the consequence of which might be disastrous.

Suddenly, in the midst of the ether, in the profound darkness, an enormous mass had appeared. It was like a moon, but an incandescent moon whose brilliancy was all the more intolerable as it cut sharply on the frightful darkness of space. This mass, of a circular form, threw a light which filled the projectile. The faces of Barbicane, Nicholl, and Michel Ardan, bathed in its white sheets, assumed that livid wan spectral appearance which physicists produce with the factitious light of alcohol impregnated with salt.

"*Mille diables!* " cried Michel Ardan, "we are hideous. What is that ill-conditioned moon?"

"A meteor," replied Barbicane.

"A meteor burning in space?"

"Yes."

This globe of fire was indeed a meteor. Barbicane was not mistaken. But if these cosmic meteors, seen from the earth, present generally a light inferior to that of the moon, here in the dark ether they shone magnificently. These wandering bodies carry in themselves the principle of their own incandescence. Ambient air is not necessary for their deflagration. And indeed, if certain of these bolides pass through our atmosphere at two or three leagues from the earth, others describe their trajectory at a distance the atmosphere cannot reach. Some of these meteors, the one of the 27th of October 1844, appeared at a height of 128 leagues, the other of the 18th of August 1841, disappeared at a distance of 182 leagues. Some of these meteors are three to four kilometres wide and possess a speed up to 75 kilometres per second, following a direction inverse to the movement of the earth.

This shooting globe suddenly appearing in shadow at a distance of at least 100 leagues, ought, according to the estimate of Barbicane, to have a diameter of 2,000 metres It advanced at a speed of about two kilometres per second, that is thirty leagues a minute. It cut the projectile's path and must reach it in some minutes. As it approached it grew to enormous proportions.

Imagine, if possible, the situation of the travelers! It is impossible to describe it. In spite of their courage, their *sang-froid*, their carelessness of danger, they were mute, motionless with stiffened limbs, a prey to frightful terror. Their projectile, the course of which they could not alter, was rushing straight on this ignited mass, more intense than the open mouth of a reverberatory furnace . It seemed as though they were being precipitated toward an abyss of fire.

Barbicane had seized the hands of his two companions, and all three looked through their half-open eyelids upon that asteroid heated to a white heat. If thought was not destroyed

within them, if their brains still worked amid all this awe, they must have given themselves up for lost.

Two minutes after the sudden appearance of the meteor (to them two centuries of anguish) the projectile seemed almost about to strike it, when the globe of fire burst like a bomb, but without making any noise in that void where sound, which is but the agitation of the layers of air, could not be generated.

Nicholl uttered a cry, and he and his companions rushed to the scuttle. What a sight! What pen can describe it? What palette is rich enough in colours to reproduce so magnificent a spectacle?

It was like the opening of a crater, like the scattering of an immense conflagration. Thousands of luminous fragments lit up and irradiated space with their fires. Every size, every colour, was there intermingled. There were rays of yellow and pale yellow, red, green, gray— a crown of fireworks of all colours. Of the enormous and much-dreaded globe there remained nothing but these fragments carried in all directions, now become asteroids in their turn, some flaming like a sword, some surrounded by a whitish cloud, and others leaving behind them trains of brilliant cosmical dust.

These incandescent blocks crossed and struck each other, scattering still smaller fragments, some of which struck the projectile. Its left scuttle was even cracked by a violent shock. It seemed to be floating amid a hail of howitzer shells, the smallest of which might destroy it instantly.

The light which saturated the ether was of an incomparable intensity, for these asteroids dispersed it in all directions. At a certain moment is was so wonderfully intense, that Michel, drawing Barbicane and Nicholl to his window, exclaimed, “The invisible moon, visible at last!”

And through a luminous emanation, which lasted some seconds, the whole three caught a glimpse of that mysterious disc which the eye of man now perceived for the first time.

What could they distinguish at a distance which they could not estimate? Some lengthened bands along the disc, real clouds formed in the midst of a very confined atmosphere, from which emerged not only all the mountains, but also projections of less importance; its cirques , its yawning craters, as capriciously placed as on the visible surface. Then immense spaces, no longer arid plains, but real seas, oceans, widely distributed, reflecting on their liquid surface all the dazzling magic of the fires of space; and, lastly, on the surface of the continents, large dark masses, looking like immense forests under the rapid illumination of a flash of lightning . . .

Was it an illusion, a mistake, an optical illusion? Could they give a scientific assent to an observation so superficially obtained? Dared they pronounce upon the question of its habitability after so slight a glimpse of the invisible disc?

Meanwhile the fulgurations in space subsided by degrees; its accidental brilliancy died away; the asteroids dispersed in their different trajectories and were extinguished in the distance. The ether returned to its accustomed darkness; the stars, eclipsed for a moment, again twinkled in the firmament, and the disc, so hastily discerned, was again buried in impenetrable night.

XVI. The Southern Hemisphere

The projectile had just escaped a terrible danger, and a very unforseen one. Who would have thought of such an encounter with meteors? These erring bodies might create serious perils for the travelers. They were to them so many reefs upon that etherian sea which, less fortunate than sailors, they could not escape. But did they complain, these adventurers of space? No, not since nature had given them the splendid sight of a cosmical meteor bursting from expansion, since this inimitable firework, which no Ruggieri could imitate, had lit up for some seconds the invisible nimbus of the moon. In that rapid flash, continents, seas, and forests had become visible to them. Did an atmosphere, then, bring to this unknown face its life-giving molecules ? Questions still insoluble, and forever posed to human curiosity!

It was then half-past three in the afternoon. The projectile was following its curvilinear direction round the moon. Had its course again been altered by the meteor? It was to be feared so. But the projectile must describe a curve unalterably determined by the laws of rational mechanics. Barbicane was inclined to believe that this curve would be rather a parabola than a hyperbola. But admitting the parabola, the projectile must quickly have passed through the cone of shadow projected into space opposite the sun. This cone, indeed, is very narrow, the angular diameter of the moon being so little when compared with the diameter of the orb of day; and up to this time the projectile had been floating in this deep shadow. Whatever had been its speed (and it could not have been insignificant), its period of occultation continued. That was evident, but perhaps that would not have been the case in a supposedly rigidly parabolical trajectory— a new problem which tormented Barbicane's brain, imprisoned as he was in a circle of unknowns which he could not unravel.

Neither of the travelers thought of taking an instant's repose. Each one watched for an unexpected fact, which might throw some new light on uranographical studies. About five o'clock, Michel Ardan distributed, under the name of dinner, some pieces of bread and cold meat, which were quickly swallowed without either of them abandoning their scuttle, the glass of which was incessantly encrusted by the condensation of vapour.

About forty-five minutes past five in the evening, Nicholl, armed with his glass, sighted toward the southern border of the moon, and in the direction followed by the projectile, some bright points cut upon the dark shield of the sky. They looked like a succession of sharp points lengthened into a tremulous line. They were very bright. Such appears the terminal line of the moon when in one of her octants.

They could not be mistaken. It was no longer a simple meteor. This luminous ridge had neither colour nor motion. Nor was it a volcano in eruption. And Barbicane did not hesitate to pronounce upon it.

"The sun!" he exclaimed.

"What! the sun?" answered Nicholl and Michel Ardan.

"Yes, my friends, it is the radiant orb itself lighting up the summit of the mountains situated on the southern borders of the moon. We are evidently nearing the south pole."

"After having passed the north pole," replied Michel. "We have made the circuit of our satellite, then?"

"Yes, my good Michel."

"Then, no more hyperbolas, no more parabolas, no more open curves to fear?"

“No, but a closed curve.”

“Which is called——”

“An ellipse. Instead of losing itself in interplanetary space, it is probable that the projectile will describe an elliptical orbit around the moon.”

“Indeed!”

“And that it will become *her* satellite.”

“Moon of the moon!” cried Michel Ardan.

“Only, I would have you observe, my worthy friend,” replied Barbicane, “that we are none the less lost for that.”

“Yes, in another manner, and much more pleasantly,” answered the careless Frenchman with his most amiable smile.

President Barbicane was right. By describing this elliptical orbit the projectile was undoubtedly going to gravitate eternally round the moon like a sub-satellite. It was a new star added to the solar world, a microcosm peopled by three inhabitants, whom want of air would kill before long. Barbicane, therefore, could not rejoice at the position imposed on the projectile by the double influence of the centripetal and centrifugal forces. His companions and he were again going to see the visible face of the lunar disc. Perhaps their existence would last long enough for them to perceive for the last time the full earth superbly lighted up by the rays of the sun. Perhaps they might threw a last adieu to the globe they were never more to see again. Then their projectile would be nothing but an extinct mass, dead like those inert asteroids which circulate in the ether. A single consolation remained to them: it was that of leaving at last that unfathomable darkness and returning to light, it was that of again entering the zones bathed by solar irradiation.

In the meantime the mountains recognised by Barbicane stood out more and more from the dark mass. They were Mounts Dœrfel and Leibnitz, which stand on the southern circumpolar region of the moon.

All the mountains of the visible hemisphere have been measured with perfect exactitude. This perfection will, no doubt, seem astonishing, and yet the hypsometric methods are rigorous. The altitude of the lunar mountains maybe no less exactly determined than that of the mountains of the earth.

The method generally employed is that of measuring the shadow thrown by the mountains, whilst taking into account the altitude of the sun at the moment of observation. This measurement is easily obtained, by means of a lunette, supplied with a reticule having two parallel threads — it being admitted that the real diameter of the lunar disc is accurately known. This method also allows the calculating of the depth of craters and cavities on the moon. Galileo used it, and since Messrs. Beer and Mädler have employed it with the greatest success.

Another method, called the tangent rays, may also be used for measuring lunar reliefs. It is applied at the moment when the mountains form luminous points on the line of separation between light and darkness which shine on the dark part of the disc.

These luminous points are produced by the solar rays above those which determine the limit of the phase. Therefore the measure of the dark interval which the luminous point and the luminous part of the closest phase leave between them gives exactly the height of the point.

But it will be seen that this method can only be applied to the mountains near the line of separation of darkness and light.

A third method consists in measuring the profile of the lunar mountains outlined on the background by means of a micrometer; but it is only applicable to the heights near the border of the orb.

In any case it will be remarked that this measurement of shadows, intervals, or profiles can only be made when the solar rays strike the moon obliquely in relation to the observer. When they strike her directly — in a word, when she is full — all shadow is imperiously banished from her disc, and observation is no longer possible.

Galileo, after recognising the existence of the lunar mountains, was the first to employ the method of calculating their heights by the shadows they throw. He attributed to them, as it has already been shown, an average of 4,500 toise. Hevelius singularly reduced these figures, which Riccioli, on the contrary, doubled. All these measures were exaggerated. Herschel, with his more perfect instruments, approached nearer the hypsometric truth. But it must be finally sought in the accounts of modern observers.

Messrs. Beer and Mädler, the most perfect selenographers in the whole world, have measured 1,095 lunar mountains. It results from their calculations that 6 of these mountains rise above 5,800 metres, and 22 above 4,800. The highest summit of the moon measures 7,603 metres; it is, therefore, inferior to those of the earth, of which some are five or six hundred toise higher. But one remark must be made. If they are compared with the respective volumes of the two orbs, the lunar mountains are relatively higher than the terrestrial. The lunar ones form 1/470 of the diameter of the moon, and the terrestrial only form 1/1440 of the diameter of the earth. For a terrestrial mountain to attain the relative proportions of a lunar mountain, its perpendicular height ought to be 6 1/2 leagues. Now the highest is not nine kilometres.

Thus, then, to proceed by comparison, the chain of the Himalayas counts three peaks higher than the lunar ones: Mount Everest 8,837 metres, Kunchinjuga (Kimchinjuga) 8,588 metres, and Dwalagiri 8,187 metres high. Mounts Dœrfel and Leibnitz, on the moon, are as high as Jewahir (Yewahir) in the same chain, say 7,603 metres. Newton, Casatus, Curtius, Short, Tycho, Clavius, Blancanus, Endymion, the principal summits of Caucasus and the Apennines, are higher than Mount Blanc which measures 4,810 metres. The mountains equal to Mount Blanc are Moret, Theophylus (Theophyles), and Catharina; to Mount Rosa or 4,636 metres: Piccolomini, Werner, and Harpalus ; to Mount Cervin, 4,522 metres: Macrobius, Eratosthenes, Albategne (Albatecus), Delambre; to the peak of Teneriffe which rises to 3,710 metres: Bacon, Cysatus, Philolaus , and the Alps; to Mount Perdu, in the Pyrenees, 3,351 metres: Rømer and Boguslawski; to Etna, 3,237 metres: Hercules, Atlas, and Furnerius.

Such are the points of comparison that allow the appreciation of the altitude of lunar mountains. Now the trajectory followed by the projectile dragged it precisely towards that mountainous region of the southern hemisphere where rise the finest specimens of lunar orography.

XVII. Tycho

At six in the evening the projectile passed the south pole at less than sixty kilometres off, a distance equal to that already reached at the north pole. The elliptical curve was being rigidly carried out.

At this moment the travelers once more entered the beneficial effluvium of the solar rays. They saw once more those stars which move slowly from east to west. The radiant orb was saluted by a triple hurrah. With its light it also sent heat, which soon pierced the metal walls. The glass resumed its accustomed appearance. The layers of ice melted as if by enchantment; and immediately, for economy's sake, the gas was put out, the air apparatus alone consuming its usual quantity.

"Ah!" said Nicholl, "these rays of heat are good. With what impatience after a night so long must the Selenites await the reappearance of the orb of day."

"Yes," replied Michel Ardan, imbibing as it were the brilliant ether, "light and heat, all life is contained in them."

At this moment the bottom of the projectile deviated somewhat from the lunar surface, in order to follow the somewhat lengthened elliptical orbit. From this point, had the earth been at the full, Barbicane and his companions could have seen it, but immersed in the sun's irradiation she remained quite invisible. Another spectacle attracted their attention, that of the southern part of the moon, brought by the glasses to within an eighth of a league . They did not again leave the scuttles, and noted every detail of this fantastical continent.

Mounts Dœrfel and Leibnitz formed two separate groups very near the south pole. The first group extended from the pole to the eighty-fourth parallel, on the eastern part of the orb; the second occupied the eastern border, extending from the 65° of latitude to the pole.

On their capriciously formed ridge appeared dazzling sheets, as mentioned by Father Secchi. With more certainty than the illustrious Roman astronomer, Barbicane was enabled to recognize their nature.

"They are snow," he exclaimed.

"Snow?" repeated Nicholl.

"Yes, Nicholl, snow; the surface of which is deeply frozen. See how they reflect the luminous rays. Cooled lava would never give out such intense reflection. There must then be water, there must be air on the moon. As little as you please, but the fact can no longer be contested." No, it could not be. And if ever Barbicane should see the earth again, his notes will bear witness to this great fact in selenographic observations.

These mountains of Dœrfel and Leibnitz rose in the midst of plains of a medium extent, which were bounded by an indefinite succession of cirques and annular ramparts. These two chains are the only ones met with in this region of cirques . Comparatively but slightly marked, they throw up here and there some sharp points, the highest summit of which attains an altitude of 7,603 metres .

But the projectile was high above all this landscape, and the projections disappeared in the intense brilliancy of the disc. And to the eyes of the travelers there reappeared that original aspect of the lunar landscapes, raw in tone, without gradation of colours, and without degrees of shadow, roughly black and white, from the want of diffusion of light.

But the sight of this desolate world did not fail to captivate them by its very strangeness. They were moving over this chaotic region as if they had been borne on the breath of some storm, watching heights defile under their feet, piercing the cavities with their eyes, going down into the rifts, climbing the ramparts, sounding these mysterious holes, and leveling all cracks. But no trace of vegetation, no appearance of cities; nothing but stratification, beds of lava, overflowings polished like immense mirrors, reflecting the sun's rays with overpowering brilliancy. Nothing belonging to a *living* world— everything to a dead world, where avalanches, rolling from the summits of the mountains, would disperse noiselessly at the bottom of the abyss, retaining the motion, but wanting the sound.

Barbicane established the fact , by reiterated observation, that the reliefs on the borders of the disc, although they had been acted upon by different forces to those of the central region, presented a uniform conformation. There was the same circular aggregation, the same accidents of ground. Still it might be supposed that their arrangements were not completely analogous. In the centre the still malleable crust of the moon suffered the double attraction of the moon and the earth acting in inverse ways according to a radius prolonged from one to the other. On the borders of the disc, on the contrary, the lunar attraction has been, thus to say, perpendicular with the terrestrial attraction. It seems, therefore, that the reliefs on the soil produced under these conditions ought to have takes a different form. Yet they had not, therefore the moon had found in herself alone the principle of her formation and constitution. She owed nothing to foreign influences, which justified the remarkable proposition of Arago's, "No action exterior to the moon has contributed to the production of her relief."

In any case and in its present state this world was the image of death, without its being possible even to say that life had ever existed there.

Michel Ardan, however, thought he recognized a heap of ruins, to which he drew Barbicane's attention. It was about the 80th parallel, in 30° longitude. This heap of stones, rather regularly placed, represented a vast fortress, overlooking a long rift, which in former days had served as a bed to the rivers of prehistorical times. Not far from that, rose to a height of 5,646 metres the annular mountain of Short, equal to the Asiatic Caucasus. Michel Ardan, with his accustomed ardor, maintained "the evidences" of his fortress. Beneath it he discerned the dismantled ramparts of a town; here the still intact arch of a portico, there two or three columns lying under their base; farther on, a succession of arches which must have supported the conduit of an aqueduct; in another part the sunken pillars of a gigantic bridge, run into the thickest parts of the rift. He distinguished all this, but with so much imagination in his glance, and through glasses so fantastical, that we must mistrust his observation. But who could affirm, who would dare to say, that the amiable fellow did not really see that which his two companions would not see ?

Moments were too precious to be sacrificed in idle discussion. The selenite city, whether imaginary or not, had already disappeared afar off. The distance of the projectile from the lunar disc was on the increase, and the details of the soil were being lost in a confused jumble. The reliefs, the cirques , the craters, and the plains alone remained, and still showed their boundary lines distinctly.

At this moment, to the left, lay extended one of the finest cirques of lunar orography, one of the curiosities of this continent. It was Newton, which Barbicane recognized without trouble, by referring to the *Mappa Selenographica*.

Newton is situated in exactly 77° south latitude, and 16° east longitude. It forms an annular crater, the ramparts of which, rising to a height of 7,264 metres , seemed to be impassable.

Barbicane made his companions observe that the height of this mountain above the surrounding plain was far from equaling the depth of its crater. This enormous hole was beyond all measurement, and formed a gloomy abyss, the bottom of which the sun's rays could never reach. There, according to Humboldt, reigns utter darkness, which the light of the sun and the earth cannot break. Mythologists could well have made it the mouth of hell.

"Newton," said Barbicane, "is the most perfect type of these annular mountains, of which the earth possesses no sample. They prove that the moon's formation, by means of cooling, is due to violent causes; for while, under the pressure of internal fires the reliefs rise to considerable height, the depths withdraw far below the lunar level."

"I do not dispute the fact," replied Michel Ardan.

Some minutes after passing Newton, the projectile directly overlooked the annular mountains of Moret. It skirted at some distance the summits of Blancanus, and at about half-past seven in the evening reached the cirque of Clavius.

This circle, one of the most remarkable of the disc, is situated in 58° south latitude, and 15° east longitude. Its height is estimated at 7,091 metres . The travelers, at a distance of 400 kilometres (reduced to four by their glasses) could admire this vast crater in its entirety.

"Terrestrial volcanoes," said Barbicane, "are but mole-hills compared with those of the moon. Measuring the old craters formed by the first eruptions of Vesuvius and Etna, we find them little more than 6,000 metres in breadth. In France the cirque of Cantal measures ten kilometres across; at Ceyland the cirque of the island is seventy kilometres , which is considered the largest on the globe. What are these diameters against that of Clavius, which we overlook at this moment?"

"What is its breadth?" asked Nicholl.

"It is 227 kilometres ," replied Barbicane. "This cirque is certainly the most important on the moon, but many others measure 200, 150, or 100 kilometres! "

"Ah! my friends," exclaimed Michel, "can you picture to yourselves what this now peaceful orb of night must have been when its craters, filled with thunderings, vomited all at the same time rivers of lava, showers of stones, clouds of smoke and sheets of flame! What a wonderful spectacle then, and now what decay! This moon is nothing more than a thin carcase of fireworks, whose crackers, squibs, rockets, and Catharine wheels , after a superb brilliancy, have left but sadly broken cases. Who can say the cause, the reason, the motive force of these cataclysms?"

Barbicane was not listening to Michel Ardan; he was contemplating these ramparts of Clavius, formed by large mountains spread over several leagues . At the bottom of the immense cavity burrowed hundreds of small extinguished craters, riddling the soil like an *écumoire*, and overlooked by a peak 5,000 metres high.

Around the plain appeared desolate. Nothing so arid as these reliefs, nothing so sad as these ruins of mountains, and (if we may so express ourselves) these fragments of peaks and mountains which strewed the soil. The satellite seemed to have burst at this spot.

The projectile was still advancing, and this chaos did not subside. Cirques , craters, and uprooted mountains succeeded each other incessantly. No more plains; no more seas. A never ending Switzerland and Norway. And lastly, in the center of this region of crevasses, at its culminating point, the most splendid mountain on the lunar disc, the dazzling Tycho, in which posterity will ever preserve the name of the illustrious Danish astronomer.

In observing the full moon in a cloudless sky no one has failed to remark this brilliant point of the southern hemisphere. Michel Ardan used every metaphor that his imagination could supply to designate it by. To him this Tycho was a focus of light, a center of irradiation, a crater vomiting rays. It was the tire of a brilliant wheel, an *asteria* enclosing the disc with its silver tentacles, an enormous eye filled with flames, a glory carved for Pluto's head, a star launched by the Creator's hand, and crushed against the face of the moon!

Tycho forms such a concentration of light that the inhabitants of the earth can see it without glasses, though at a distance of 100,000 leagues ! Imagine, then, its intensity to the eye of observers placed at a distance of only 150 leagues ! Seen through this pure ether, its brilliancy was so intolerable that Barbicane and his friends were obliged to blacken the eyepieces of their glasses with the gas smoke before they could bear the splendor. Then silent, scarcely uttering an interjection of admiration, they gazed, they contemplated. All their feelings, all their impressions, were concentrated in that look, as under any violent emotion all life is concentrated at the heart.

Tycho belongs to the system of radiating mountains, like Aristarchus and Copernicus; but it is of all the most complete and decided, showing unquestionably the frightful volcanic action to which the formation of the moon is due.

Tycho is situated in 43° south latitude, and 12° east longitude. Its center is occupied by a crater eighty-seven kilometres broad. It assumes a slightly elliptical form, and is surrounded by an enclosure of annular ramparts, which on the east and west overlook the outer plain from a height of 5,000 metres . It is a group of Mont Blancs, placed round one common center and crowned by radiating beams.

What this incomparable mountain really is, with all the projections converging toward it, and the interior excrescences of its crater, photography itself could never represent. Indeed, it is during the full moon that Tycho is seen in all its splendor. Then all shadows disappear, the foreshortening of perspective disappears, and all proofs become white— a disagreeable fact: for this strange region would have been marvelous if reproduced with photographic exactness. It is but a group of hollows, craters, cirques , a vertiginous network of crests; then, as far as the eye could see, a whole volcanic network cast upon this encrusted soil. One can then understand that the bubbles of this central eruption have kept their first form. Crystallized by cooling, they have stereotyped that aspect which the moon formerly presented when under the Plutonian forces.

The distance which separated the travelers from the annular summits of Tycho was not so great but that they could catch the principal details. Even on the causeway forming the fortifications of Tycho, the mountains hanging on to the interior and exterior sloping flanks rose in stories like gigantic terraces. They appeared to be higher by 300 or 400 feet to the west than to the east. No system of terrestrial encampment could equal these natural fortifications. A town built at the bottom of this circular cavity would have been utterly inaccessible.

Inaccessible and wonderfully extended over this soil covered with picturesque projections! Indeed, nature had not left the bottom of this crater flat and empty. It possessed its own peculiar orography, a mountainous system, making it a world in itself. The travelers could distinguish clearly cones, central hills, remarkable positions of the soil, naturally placed to receive the *chefs-d'oeuvre* of Selenite architecture. There was marked out the place for a temple, here the ground of a forum, on this spot the plan of a palace, in another the plateau for a citadel; the whole overlooked by a central mountain of 1,500 feet. A vast circle, in which ancient Rome could have been held in its entirety ten times over.

“Ah!” exclaimed Michel Ardan, enthusiastic at the sight; “what a grand town might be constructed within that ring of mountains! A quiet city, a peaceful refuge, beyond all human misery. How calm and isolated those misanthropes, those haters of humanity might live there, and all who have a distaste for social life!”

“All! It would be too small for them,” replied Barbicane simply.

XVIII. Grave Questions

Meanwhile the projectile had passed the *enceinte* of Tycho, and Barbicane and his two companions watched with scrupulous attention the brilliant rays which the celebrated mountain shed so curiously over the horizon.

What was this radiant glory? What geological phenomenon had designed these ardent beams? This question rightly occupied Barbicane's mind.

Under his eyes ran in all directions luminous furrows, raised at the edges and concave in the center, some twenty kilometres , others fifty kilometres broad. These brilliant trains extended in some places to within 300 leagues of Tycho, and seemed to cover, particularly toward the east, the northeast and the north, the half of the southern hemisphere. One of these jets extended as far as the cirque of Neander, situated on the 40th meridian. Another, by a slight curve, furrowed the "Sea of Nectar," breaking against the chain of Pyrenees, after a circuit of 400 leagues . Others, toward the west, covered the "Sea of Clouds" and the "Sea of Humors" with a luminous network.

What was the origin of these sparkling rays, which shone on the plains as well as on the reliefs, at whatever height they might be? All started from a common center, the crater of Tycho. They sprang from him. Herschel attributed their brilliancy to ancient currents of lava congealed by the cold; an opinion, however, which has not been generally adopted. Other astronomers have seen in these inexplicable rays a kind of moraines, rows of erratic blocks, which had been thrown up at the period of Tycho's formation.

"And why not?" asked Nicholl of Barbicane, who was relating and rejecting these different opinions.

"Because the regularity of these luminous lines, and the violence necessary to carry volcanic matter to such distances, is inexplicable."

"Eh! *par bleu!* " replied Michel Ardan, "it seems easy enough to me to explain the origin of these rays."

"Indeed?" said Barbicane.

"Indeed," continued Michel. "It is enough to say that it is a vast star, similar to that produced by a ball or a stone thrown at a square of glass!"

"Well!" replied Barbicane, smiling. "And what hand would be powerful enough to throw a stone to give such a shock as that?"

"The hand is not necessary," answered Nicholl, not at all confounded; "and as to the stone, let us suppose it to be a comet."

"Ah! those much-abused comets!" exclaimed Barbicane. "My brave Michel, your explanation is not bad; but your comet is useless. The shock which produced that rent must have some from the inside of the star. A violent contraction of the lunar crust, while cooling, might suffice to imprint this gigantic star."

"A contraction! something like a lunar stomach-ache." said Michel Ardan.

"Besides," added Barbicane, "this opinion is that of an English savant, Nasmyth, and it seems to me to sufficiently explain the radiation of these mountains."

"That Nasmyth was no fool!" replied Michel.

Long did the travelers, whom such a sight could never weary, admire the splendors of Tycho. Their projectile, saturated with luminous gleams in the double irradiation of sun and moon, must have appeared like an incandescent globe. They had passed suddenly from excessive cold to intense heat. Nature was thus preparing them to become Selenites.

Become Selenites! That idea brought up once more the question of the habitability of the moon. After what they had seen, could the travelers solve it? Would they decide for or against it? Michel Ardan persuaded his two friends to form an opinion, and asked them directly if they thought that men and animals were represented in the lunar world.

“I think that we can answer,” said Barbicane; “but according to my idea the question ought not to be put in that form. I ask it to be put differently.”

“Put it your own way,” replied Michel.

“Here it is,” continued Barbicane. “The problem is a double one, and requires a double solution. Is the moon *habitable*? Has the moon ever been *inhabitable*?”

“Good!” replied Nicholl. “First let us see whether the moon is habitable.”

“To tell the truth, I know nothing about it,” answered Michel.

“And I answer in the negative,” continued Barbicane. “In her actual state, with her surrounding atmosphere certainly very much reduced, her seas for the most part dried up, her insufficient supply of water, her restricted vegetation, sudden alternations of cold and heat, her days and nights of 354 hours — the moon does not seem habitable to me, nor does she seem propitious to animal development, nor sufficient for the wants of existence as we understand it.”

“Agreed,” replied Nicholl. “But is not the moon habitable for creatures differently organized from ourselves?”

“That question”, replied Barbicane, ”is more difficult to answer, but I will try; and I ask Nicholl if *motion* appears to him to be a necessary result of *life*, whatever be its organization?”

“Without a doubt!” answered Nicholl.

“Then, my worthy companion, I would answer that we have observed the lunar continents at a distance of 500 metres at most, and that nothing seemed to us to move on the moon’s surface. The presence of any kind of humanity would have been betrayed by its attendant marks, such as divers buildings, and even by ruins. And what have we seen? Everywhere and always the geological works of nature, never the work of man. If, then, there exist representatives of the animal kingdom on the moon, they must have fled to those unfathomable cavities which the eye cannot reach; which I cannot admit, for they must have left traces of their passage on those plains which the atmosphere must cover, however slightly raised it may be. These traces are nowhere visible. There remains but one hypothesis, that of a living race to which motion, which is life, is foreign.”

“One might as well say, living creatures which do not live,” replied Michel.

“Just so,” said Barbicane, “which for us has no meaning.”

“Then we may form our opinion?” said Michel.

“Yes,” replied Nicholl.

“Very well,” continued Michel Ardan, “the Scientific Commission assembled in the projectile of the Gun Club, after having founded their argument on facts recently observed,

decide unanimously upon the question of the habitability of the moon— `*No!* the moon is not habitable.'"

This decision was consigned by President Barbicane to his notebook, where the process of the sitting of the 6th of December may be seen.

"Now," said Nicholl, "let us attack the second question, an indispensable complement of the first. I ask the honorable commission, if the moon is not habitable, has she ever been inhabited?"

"Citizen Barbicane to speak," said Michel Ardan.

"My friends," replied Barbicane, "I did not undertake this journey in order to form an opinion on the past habitability of our satellite; but I will add that our personal observations only confirm me in this opinion. I believe, indeed I affirm, that the moon has been inhabited by a human race organized like our own; that she has produced animals anatomically formed like the terrestrial animals: but I add that these races, human and animal, have had their day, and are now forever extinct!"

"Then," asked Michel, "the moon must be older than the earth?"

"No!" said Barbicane decidedly, "but a world which has grown old quicker, and whose formation and deformation have been more rapid. Relatively, the organizing force of matter has been much more violent in the interior of the moon than in the interior of the terrestrial globe. The actual state of this cracked, twisted, and burst disc abundantly proves this. The moon and the earth were nothing but gaseous masses originally. These gases have passed into a liquid state under different influences, and the solid masses have been formed later. But most certainly our sphere was still gaseous or liquid, when the moon was solidified by cooling, and had become habitable."

"I believe it," said Nicholl.

"Then," continued Barbicane, "an atmosphere surrounded it, the waters contained within this gaseous envelope could not evaporate. Under the influence of air, water, light, solar heat, and central heat, vegetation took possession of the continents prepared to receive it, and certainly life showed itself about this period, for nature does not expend herself in vain; and a world so wonderfully formed for habitation must necessarily be inhabited."

"But," said Nicholl, "many phenomena inherent in the motion of our satellite might cramp the expansion of the animal and vegetable kingdom. For example, its days and nights of 354 hours?"

"At the terrestrial poles they last six months," said Michel.

"An argument of little value, since the poles are not inhabited."

"Let us observe, my friends," continued Barbicane, "that if in the actual state of the moon its long nights and long days created differences of temperature insupportable to organization, it was not so at the historical period of time. The atmosphere enveloped the disc with a fluid mantle; vapour deposited itself in the shape of clouds; this natural screen tempered the ardor of the solar rays, and retained the nocturnal radiation. Light, like heat, can diffuse itself in the air; hence an equality between the influences which no longer exists, now that atmosphere has almost entirely disappeared. And now I am going to astonish you."

"Astonish us , " said Michel Ardan.

"I firmly believe that at the period when the moon was inhabited, the nights and days did not last 354 hours!"

“And why?” asked Nicholl quickly.

“Because most probably then the rotary motion of the moon upon her axis was not equal to her revolution, an equality which presents each part of her disc during fifteen days to the action of the solar rays.”

“Granted,” replied Nicholl, “but why should not these two motions have been equal, as they are really so?”

“Because that equality has only been determined by terrestrial attraction. And who can say that this attraction was powerful enough to alter the motion of the moon at that period when the earth was still fluid?”

“Just so,” replied Nicholl; “and who can say that the moon has always been a satellite of the earth?”

“And who can say,” exclaimed Michel Ardan, “that the moon did not exist before the earth?”

Their imaginations carried them away into an indefinite field of hypothesis. Barbicane sought to restrain them.

“Those speculations are too high,” said he; “problems utterly insoluble. Do not let us enter upon them. Let us only admit the insufficiency of the primordial attraction; and then by the inequality of the two motions of rotation and revolution, the days and nights could have succeeded each other on the moon as they succeed each other on the earth. Besides, even without these conditions, life was possible.”

“And so,” asked Michel Ardan, “humanity has disappeared from the moon?”

“Yes,” replied Barbicane, “after having doubtless remained persistently for thousands of centuries; by degrees the atmosphere becoming rarefied, the disc became uninhabitable, as the terrestrial globe will one day become by cooling.”

“By cooling?”

“Certainly,” replied Barbicane; “as the internal fires became extinguished, and the incandescent matter concentrated itself, the lunar crust cooled. By degrees the consequences of these phenomena showed themselves in the disappearance of organized beings, and by the disappearance of vegetation. Soon the atmosphere was rarefied, probably withdrawn by terrestrial attraction; then aerial departure of respirable air, and disappearance of water by means of evaporation. At this period the moon becoming uninhabitable, was no longer inhabited. It was a dead world, such as we see it to-day.”

“And you say that the same fate is in store for the earth?”

“Most probably.”

“But when?”

“When the cooling of its crust shall have made it uninhabitable.”

“And have they calculated the time which our unfortunate sphere will take to cool?”

“Certainly.”

“And you know these calculations?”

“Perfectly.”

“But speak, then, my clumsy savant,” exclaimed Michel Ardan, “for you make me boil with impatience!”

“Very well, my good Michel,” replied Barbicane quietly; “we know what diminution of temperature the earth undergoes in the lapse of a century. And according to certain calculations, this mean temperature will after a period of 400,000 years, be brought down to zero!”

“Four hundred thousand years!” exclaimed Michel. “Ah! I breathe again. Really I was frightened to hear you; I imagined that we had not more than 50,000 years to live.”

Barbicane and Nicholl could not help laughing at their companion’s uneasiness. Then Nicholl, who wished to end the discussion, put the second question, which had just been considered again.

“Has the moon been inhabited?” he asked.

The answer was unanimously in the affirmative.

But during this discussion, fruitful in somewhat hazardous theories, although it resuméd the general ideas of science on the subject, the projectile had run rapidly toward the lunar equator, at the same time it distanced itself steadily from the lunar disc. It had passed the cirque of Wilhelm and the 40th parallel, at a distance of 800 kilometres. Then leaving Pilatus to the right, on the 30th degree, it passed over the south of the Sea of Clouds, the northern portion of which it had already surveyed. Diverse cirques appeared confusedly under the shining whiteness of the full moon: Bouillaud, Purbach, almost square with a central crater, then Arzachel, whose interior mountain shone with indescribable brilliance.

At last the projectile was rapidly leaving the moon: the lineaments faded away from the travelers’ eyes, mountains were confused in the distance; and of all the wonderful, strange, and fantastical form of the earth’s satellite, there soon remained nothing but the imperishable remembrance.

XIX. A Struggle Against The Impossible

For a long time Barbicane and his companions looked silently and pensively upon that world which they had only seen from a distance, as Moses saw the land of Canaan, and which they were leaving without a possibility of ever returning to it. The projectile's position with regard to the moon had altered, and the base was now turned to the earth.

This change, which Barbicane verified, did not fail to surprise them. If the projectile was to gravitate round the satellite in an elliptical orbit, why was not its heaviest part turned toward it, as the moon turns hers to the earth? That was a difficult point.

In watching the course of the projectile they could see that on leaving the moon it followed a course analogous to that traced in approaching her. It was describing a very long ellipse, which would most likely extend to the point of equal attraction, where the influences of the earth and its satellite are neutralized.

Such was the conclusion which Barbicane very justly drew from facts already observed, a conviction which his two friends shared with him.

Suddenly questions began to rain down —

"And when arrived at this dead point, what will become of us?" asked Michel Ardan.

"We don't know," replied Barbicane.

"But one can draw some hypotheses, I suppose?"

"Two," answered Barbicane; "either the projectile's speed will be insufficient, and it will remain forever immovable on this line of double attraction——"

"I prefer the other hypothesis, whatever it may be," interrupted Michel.

"Or," continued Barbicane, "its speed will be sufficient, and it will continue its elliptical course, to gravitate forever around the orb of night."

"A revolution not at all consoling," said Michel, "to pass to the state of humble servants to a moon whom we are accustomed to look upon as our own handmaid. So that is the fate in store for us?"

Neither Barbicane nor Nicholl answered.

"You do not answer," continued Michel impatiently.

"There is nothing to answer," said Nicholl.

"Is there nothing to try?"

"No," answered Barbicane. "Do you pretend to fight against the impossible?"

"Why not? Do one Frenchman and two Americans shrink from such a word?"

"But what would you do?"

"Subdue this motion which is bearing us away."

"Subdue it?"

"Yes," continued Michel, getting animated, "or else slow or alter it, and employ it to the accomplishment of our own ends."

“And how?”

“That is your affair. If artillerymen are not masters of their projectile they are not artillerymen. If the projectile is to command the gunner, we had better ram the gunner into the gun. My faith! fine savants! who do not know what is to become of us after inducing me——”

“Inducing you!” cried Barbicane and Nicholl. “Inducing you! What do you mean by that?”

“No recrimination,” said Michel. “I do not complain, the trip has pleased me, and the projectile agrees with me; but let us do all that is humanly possible to do the fall somewhere, even if not on the moon.”

“We ask no better, my worthy Michel,” replied Barbicane, “but means fail us.”

“We cannot alter the motion of the projectile?”

“No.”

“Nor diminish its speed?”

“No.”

“Not even by lightening it, as they lighten an overloaded vessel?”

“What would you throw out?” said Nicholl. “We have no ballast on board; and indeed it seems to me that if lightened it would go much quicker.”

“Slower,” said Michel.

“Quicker,” replied Nicholl.

“Neither slower nor quicker,” said Barbicane, wishing to make his two friends agree; “for we float in space, and must no longer consider specific weight.”

“Very well,” cried Michel Ardan in a decided voice; “then their remains but one thing to do.”

“What is it?” asked Nicholl.

“Breakfast,” calmly answered the audacious Frenchman , who always brought up this solution at the most difficult juncture.

In any case, if this operation had no influence on the projectile’s course, it could at least be tried without inconvenience, and even with success from a stomachic point of view. Certainly Michel had none but good ideas.

They breakfasted then at two in the morning; the hour mattered little. Michel served his usual repast, crowned by a glorious bottle drawn from his private cellar. If ideas did not crowd on their brains, we must despair of the Chambertin of 1863 . The repast finished, observation began again. Around the projectile, at an invariable distance, were the objects which had been thrown out. Evidently, in its translatory motion round the moon, it had not passed through any atmosphere, for the specific weight of these different objects would have checked their relative speed.

On the side of the terrestrial sphere nothing was to be seen. The earth was but a day old, having been new the night before at twelve; and two days must elapse before its crescent, freed from the solar rays, would serve as a clock to the Selenites, as in its rotary movement each of its points after twenty-four hours repasses the same lunar meridian.

On the moon’s side the sight was different; the orb shone in all her splendor amid innumerable constellations, whose purity could not be troubled by her rays. On the disc, the

plains were already returning to the dark tint which is seen from the earth. The other part of the nimbus remained brilliant, and in the midst of this general brilliancy Tycho shone prominently like a sun.

Barbicane had no means of estimating the projectile's speed, but reasoning showed that it must uniformly decrease, according to the laws of rational mechanics .

Having admitted that the projectile was describing an orbit around the moon, this orbit must necessarily be elliptical; science proves that it must be so. No motive body circulating round an attracting body fails in this law. Every orbit described in space is elliptical, those of satellites around planets, those of planets around the Sun, such as the Sun around an unknown star serving as a central pivot. And why should the projectile of the Gun Club escape this natural arrangement?

In elliptical orbits, the attracting body always occupies one of the foci; so that at one moment the satellite is nearer, and at another farther from the orb around which it gravitates. When the earth is nearest the sun she is in her perihelion; and in her aphelion at the farthest point. Speaking of the moon, she is nearest to the earth in her perigee, and farthest from it in her apogee. To use analogous expressions, with which the astronomers' language is enriched, if the projectile remains as a satellite of the moon, we must say that it is in its "aposelene" at its farthest point, and in its "periselene" at its nearest.

In the latter case, the projectile would attain its maximum of speed; and in the former its minimum. It was evidently moving toward its aposelenitical point; and Barbicane had reason to think that its speed would decrease up to this point, and then increase by degrees as it neared the moon. This speed would even become *nil*, if this point joined that of equal attraction. Barbicane studied the consequences of these different situations, and thinking what inference he could draw from them, when he was roughly disturbed by a cry from Michel Ardan.

"*Pardieu!* " he exclaimed, "I must admit we are down-right simpletons!"

"I do not say we are not," replied Barbicane; "but why?"

"Because we have a very simple means of checking this speed which is bearing us from the moon, and we do not use it!"

"And what is the means?"

"To use the recoil contained in our rockets."

" Indeed!" said Nicholl.

"We have not used this force yet," said Barbicane, "it is true, but we will do so."

"When?" asked Michel.

"When the time comes. Observe, my friends, that in the position occupied by the projectile, an oblique position with regard to the lunar disc, our rockets, in slightly altering its direction, might turn it from the moon instead of drawing it nearer?"

"Just so," replied Michel.

"Let us wait, then. By some inexplicable influence, the projectile is turning its base toward the earth. It is probable that at the point of equal attraction, its conical cap will be directed rigidly toward the moon; at that moment we may hope that its speed will be *nil*; then will be the moment to act, and with the influence of our rockets we may perhaps provoke a fall directly on the surface of the lunar disc. Now I suppose it is the moon you want to reach? "

“Essentially, “ answered Michel.

“Wait then. Through some inexplicable influence the projectile has a tendency to turn its lower end toward the earth. It is probable that at the point of equal attraction its conical top will be directed rigourously toward the moon. At that moment it may be hoped that its speed will be *nil*. That will be the moment to act, and under the effort of our rockets we can, perhaps, provoke a direct fall onto the surface of the lunar disc.

“Bravo!” said Michel. “What we did not do, what we could not do on our first passage at the dead point, because the projectile was then endowed with too great a speed.”

“Very well reasoned,” said Nicholl.

“Let us wait patiently,” continued Barbicane. “Putting every chance on our side, and after having so much despaired, I may say I think we shall gain our end.”

This conclusion was a signal for Michel Ardan’s hips and hurrahs. And none of the audacious boobies remembered the question that they themselves had solved in the negative. No! the moon is not inhabited; no! the moon is probably not habitable. And yet they were going to try everything to reach her.

One single question remained to be solved. At what precise moment the projectile would reach the point of equal attraction, on which the travelers must play their last card. In order to calculate this to within a few seconds, Barbicane had only to refer to his notes, and to reckon the different heights taken on the lunar parallels. Thus the time necessary to travel over the distance between the dead point and the south pole would be equal to the distance separating the north pole from the dead point. The hours representing the time traveled over were carefully noted, and the calculation was easy. Barbicane found that this point would be reached at one in the morning on the night of the 7th–8th of December — at this time it was 3 A.M. in the night of the 6th–7th of December — so that, if nothing interfered with its course, it would reach the given point in twenty-two hours.

The rockets had primarily been placed to check the fall of the projectile upon the moon, and now the bold adventurers were going to employ them for a directly contrary purpose. In any case they were ready, and they had only to wait for the moment to set fire to them.

“Since there is nothing else to be done,” said Nicholl, “I make a proposition.”

“What is it?” asked Barbicane.

“I propose to go to sleep.”

“What a notion !” exclaimed Michel Ardan.

“It is forty hours since we closed our eyes,” said Nicholl. “Some hours of sleep will restore our strength.”

“Never,” interrupted Michel.

“Well,” continued Nicholl, “every one to his taste; I shall go to sleep.” And stretching himself on the divan, he soon snored like a forty-eight pounder.

“That Nicholl has a good deal of sense,” said Barbicane; “presently I shall follow his example.” Some moments after his continued bass supported the captain’s baritone.

“Certainly,” said Michel Ardan, finding himself alone, “these practical people have sometimes most opportune ideas.”

And with his long legs stretched out, and his great arms folded under his head, Michel slept in his turn.

But this sleep could be neither peaceful nor lasting, the minds of these three men were too much occupied, and some hours after, about seven in the morning, all three were on foot at the same instant.

The projectile was still leaving the moon, and turning its conical part more and more toward her. An inexplicable phenomenon until then, but one which happily served Barbicane's ends.

Seventeen hours more, and the moment for action would have arrived.

The day seemed long. However bold the travelers might be, they were greatly impressed by the approach of that moment which would decide all — either precipitate their fall on to the moon, or forever chain them in an immutable orbit. They counted the hours as they passed too slow for their wish; Barbicane and Nicholl were obstinately plunged in their calculations, Michel going and coming between the narrow walls, and watching that impassive moon with a longing eye.

At times recollections of the earth crossed their minds. They saw once more their friends of the Gun Club, and the dearest of all, J.T. Maston. At that moment, the honorable secretary must be filling his post on the Rocky Mountains. If he could see the projectile through the glass of his gigantic telescope, what would he think? After seeing it disappear behind the moon's south pole, he would see them reappear by the north pole! They must therefore be a satellite of a satellite! Had J.T. Maston given this unexpected news to the world? Was this the *denouement* of this great enterprise?

But the day passed without incident. The terrestrial midnight arrived. The 8th of December was beginning. One hour more, and the point of equal attraction would be reached. What speed would then animate the projectile? They could not estimate it. But no error could vitiate Barbicane's calculations. At one in the morning this speed ought to be and would be *nil*.

Besides, another phenomenon would mark the projectile's stopping-point on the neutral line. At that spot the two attractions, lunar and terrestrial, would be annulled. Objects would "weigh" no more. This singular fact, which had surprised Barbicane and his companions so much in going, would be repeated on their return under the very same conditions. At this precise moment they must act.

Already the projectile's conical top was sensibly turned toward the lunar disc, presented in such a way as to utilize the whole of the recoil produced by the pressure of the rocket apparatus. The chances were in favor of the travelers. If its speed was utterly annulled on this dead point, a decided movement toward the moon would suffice, however slight, to determine its fall.

"Five minutes to one," said Nicholl.

"All is ready," replied Michel Ardan, directing a prepared match to the flame of the gas.

"Wait!" said Barbicane, holding his chronometer in his hand.

At that moment weight had no effect. The travelers felt in themselves the entire disappearance of it. They were very near the neutral point, if they did not touch it.

"One o'clock," said Barbicane.

Michel Ardan applied the lighted match to a train placing it in instant communication with the rockets. No detonation was heard in the inside, for there was no air. But, through the scuttles, Barbicane saw a prolonged smoke, the flames of which were immediately extinguished.

The projectile sustained a certain shock, which was sensibly felt in the interior.

The three friends looked and listened without speaking, and scarcely breathing. One might have heard the beating of their hearts amid this perfect silence.

“Are we falling?” asked Michel Ardan, at length.

“No,” said Nicholl, “since the bottom of the projectile is not turning to the lunar disc!”

At this moment, Barbicane, quitting his scuttle, turned to his two companions. He was frightfully pale, his forehead wrinkled, and his lips contracted.

“We are falling!” said he.

“Ah!” cried Michel Ardan, “on to the moon?”

“On to the earth!”

“*Diable!* ” exclaimed Michel Ardan, adding philosophically, “well, when we came into this projectile we were very doubtful as to the ease with which we should get out of it!”

And now this fearful fall had begun. The speed retained had borne the projectile beyond the dead point. The explosion of the rockets could not slow it down . This speed in going had carried it over the neutral line, and in returning had done the same thing. The laws of physics condemned it, in its elliptical orbit, *to pass through every point which it had already gone through*. It was a terrible fall, from a height of 78,000 leagues , and no springs to break it. According to the laws of gunnery, the projectile must strike the earth with a speed equal to that with which it left the mouth of the Columbiad, a speed of 16,000 metres in the last second!

But to give some figures of comparison, it has been reckoned that an object thrown from the top of the towers of Notre Dame, the height of which is only 200 feet, will arrive on the pavement at a speed of 120 leagues per hour. Here the projectile must strike the earth with a speed of 57,600 leagues per hour.

“We are lost!” said Nicholl coolly.

“Very well! if we die,” answered Barbicane, with a sort of religious enthusiasm, “the results of our travels will be magnificently spread. It is His own secret that God will tell us! In the other life the soul, for knowledge, will need nothing, either of machines or engines! It will be identified with eternal wisdom!”

“In fact,” interrupted Michel Ardan, “the whole of the other world may well console us for the loss of that inferior orb called the moon!”

Barbicane crossed his arms on his breast, with a motion of sublime resignation, saying at the same time:

“The will of heaven be done!”

XX. The Soundings Of The Susquehanna

Well, lieutenant, and our soundings?"

"I think, sir, that the operation is nearing its completion," replied Lieutenant Bronsfield. "But who would have thought of finding such a depth so near in shore, and only a hundred leagues from the American coast?"

"Certainly, Bronsfield, there is a great depression," said Captain Blomsberry. "In this spot there is a submarine valley worn by Humboldt's current, which skirts the coast of America as far as the Straits of Magellan."

"These great depths," continued the lieutenant, "are not favorable for laying telegraphic cables. A level plateau , like that supporting the American cable between Valentia and Newfoundland, is much better."

"I agree with you, Bronsfield. With your permission, lieutenant, where are we now?"

"Sir," replied Bronsfield, "at this moment we have 21,500 feet of line out, and the ball which draws the sounding lead has not yet touched the bottom; for if so, it would have come up of itself."

"Brooke's apparatus is very ingenious," said Captain Blomsberry; "it gives us very exact soundings."

"Touch!" cried at this moment one of the men at the forewheel, who was superintending the operation.

The captain and the lieutenant mounted the quarterdeck.

"What depth have we?" asked the captain.

" Twenty-one thousand seven hundred and sixty-two feet (21,762) ," replied the lieutenant, entering it in his notebook.

"Well, Bronsfield," said the captain, "I will take down the result in my chart. Now haul in the sounding line. It will be the work of some hours. In that time the engineer can light the furnaces, and we shall be ready to start as soon as you have finished. It is ten o'clock, and with your permission, lieutenant, I will turn in."

"Do so, sir; do so!" replied the lieutenant obligingly.

The captain of the Susquehanna, as brave a man as need be, and the humble servant of his officers, returned to his cabin, took a brandy-grog, which earned for the steward no end of praise, and turned in, not without having complimented his servant upon his making beds, and slept a peaceful sleep.

It was then ten at night. The eleventh day of the month of December was drawing to a close in a magnificent night.

The *Susquehanna*, a corvette of 500 horse-power, of the United States navy, was occupied in taking soundings in the Pacific Ocean about a hundred leagues off the American coast, following that long peninsula which stretches down the coast of Mexico.

The wind had dropped by degrees. There was no disturbance in the air. The pennant hung motionless from the maintop-gallant- mast truck.

Captain Jonathan Blomsberry (cousin-german of Colonel Blomsberry, one of the most ardent supporters of the Gun Club, who had married a Horschbidden, an aunt of the captain and daughter of an honorable Kentucky merchant)— Captain Blomsberry could not have wished for finer weather in which to bring to a close his delicate operations of sounding. His corvette had not even felt the great tempest, which by sweeping away the groups of clouds on the Rocky Mountains, had allowed them to observe the course of the famous projectile.

Everything went well, and with all the fervor of a Presbyterian, he did not forget to thank heaven for it. The series of soundings taken by the *Susquehanna*, had for its aim the finding of a favorable spot for the laying of a submarine cable to connect the Hawaiian Islands with the coast of America.

It was a great undertaking, due to the instigation of a powerful company. Its managing director, the intelligent Cyrus Field, purposed even covering all the islands of Oceanica with a vast electrical network, an immense enterprise, and one worthy of American genius.

To the corvette Susquehanna had been confided the first operations of sounding. It was on the night of the 11th-12th of December, she was in exactly 27° 7’ north latitude, and 41° 37’ west longitude, on the meridian of Washington.

The moon, then in her last quarter, was beginning to rise above the horizon.

After the departure of Captain Blomsberry, the lieutenant Bronsfield and some officers were standing together on the poop. On the appearance of the moon, their thoughts turned to that orb which the eyes of a whole hemisphere were contemplating. The best naval glasses could not have discovered the projectile wandering around its hemisphere, and yet all were pointed toward that brilliant disc which millions of eyes were looking at the same moment.

“They have been gone ten days,” said Lieutenant Bronsfield at last. “What has become of them?”

“They have arrived, lieutenant,” exclaimed a young midshipman, “and they are doing what all travelers do when they arrive in a new country, taking a walk!”

“Oh! I am sure of that, if you tell me so, my young friend,” said Lieutenant Bronsfield, smiling. “But,” continued another officer, “their arrival cannot be doubted. The projectile was to reach the moon when full on the 5th at midnight. We are now at the 11th of December, which makes six days. And in six times twenty-four hours, without darkness, one would have time to settle comfortably. I fancy I see my brave countrymen encamped at the bottom of some valley, on the borders of a Selenite stream, near a projectile half-buried by its fall amid volcanic rubbish, Captain Nicholl beginning his leveling operations, President Barbicane writing out his notes, and Michel Ardan embalming the lunar solitudes with the perfume of his-Londrès—-”

“Yes! it must be so, it is so!” exclaimed the young midshipman, worked up to a pitch of enthusiasm by this ideal description of his superior officer.

“I should like to believe it,” replied the lieutenant Bronsfield, who was quite unmoved. “Unfortunately direct news from the lunar world is still wanting.”

“Beg pardon, lieutenant,” said the midshipman, “but cannot President Barbicane write?”

A burst of laughter greeted this answer.

“No letters!” continued the young man quickly. “The postal administration has nothing to see to there.”

“Might it not be the telegraphic service that is at fault?” asked one of the officers ironically.

“Not necessarily,” replied the midshipman, not at all confused. “But it is very easy to set up a graphic communication with the earth.”

“And how?”

“By means of the telescope at Long’s Peak. You know it brings the moon to within two leagues of the Rocky Mountains, and that it shows objects on its surface of only nine feet in diameter. Very well; let our industrious friends construct a giant alphabet; let them write words a hundred toises long, and sentences the length of a league, and then they can send us news of themselves.”

The young midshipman, who had a certain amount of imagination, was loudly applauded. Lieutenant Bronsfield himself was convinced that the idea could have been carried out. He added that by sending luminous rays, grouped by means of parabolical mirrors, direct communication could be established—in fact, these rays would be visible on the surface of Venus or Mars as the planet Neptune is on Earth. He ended by saying that the brilliant points already observed on the nearest planets might be signals made to Earth. But he observed that if by these means they could receive news from the lunar world they could not send any from the terrestrial, unless the Selenites had instruments fit for taking distant observations at their disposal.

“Evidently,” said one of the officers; “but what has become of the travelers? what they have done, what they have seen, that above all must interest us. Besides, if the experiment has succeeded (which I do not doubt), they will try it again. The Columbiad is still sunk in the soil of Florida. It is now only a question of powder and shot; and every time the moon is at her zenith a cargo of visitors may be sent to her.”

“It is clear,” replied Lieutenant Bronsfield, “that J.T. Maston will one day join his friends.”

“If he will have me,” cried the midshipman, “I am ready!”

“Oh! volunteers will not be wanting,” answered Bronsfield; “and if it were allowed, half of the earth’s inhabitants would emigrate to the moon!”

This conversation between the officers of the *Susquehanna* was kept up until nearly one in the morning. We cannot say what blundering systems were broached, what inconsistent theories advanced by these bold spirits. Since Barbicane’s attempt, nothing seemed impossible to the Americans. They had already designed an expedition, not only of savants, but of a whole colony toward the Selenite shores , and a complete army, consisting of infantry, artillery, and cavalry, to conquer the lunar world.

At one in the morning, the hauling in of the sounding-line was not yet completed; 10,000 feet were still out, which would entail some hours’ work. According to the commander’s orders, the fires had been lighted, and steam was being got up. The *Susquehanna* could have started that very instant.

At that moment (it was seventeen minutes past one in the morning) Lieutenant Bronsfield was preparing to leave the watch and return to his cabin, when his attention was attracted by a distant hissing noise, completely unexpected.

His comrades and himself first thought that this hissing was caused by the letting off of steam; but lifting their heads, they found that the noise was produced in the highest regions of the air. They had not time to question each other before the hissing became frightfully intense, and suddenly there appeared to their dazzled eyes an enormous meteor, ignited by the rapidity of its course and its friction through the atmospheric strata.

This fiery mass grew larger to their eyes, and fell, with the noise of thunder, upon the bowsprit, which it smashed close to the stem, and buried itself in the waves with a deafening roar!

A few feet nearer, and the *Susquehanna* would have foundered with all on board!

At this instant Captain Blomsberry appeared, half-dressed, and rushing on to the forecastle-deck, whither all the officers had hurried, exclaimed, “With your permission, gentlemen, what has happened?”

And the midshipman, making himself as it were the echo of the body, cried, “Commander, it is “they” come back again!”

XXI. J.T. Maston Recalled

Emotion was great on board the Susquehanna. Officers and sailors forgot the terrible danger they had just been in, the possibility of being crushed and sunk. They did not think of anything but the catastrophe which terminated this voyage. Thus, therefore the most audacious enterprise of ancient and modern times cost the life of those bold adventurers who had attempted it.

“It is ‘they’ come back again!” the young midshipman had said, and every one had understood him. No one doubted but that the meteor was the projectile of the Gun Club. As to the travelers which it enclosed, opinions were divided regarding their fate.

“They are dead!” said one.

“They are alive!” said another; “the water is deep, and the shock was deadened.”

“But they must have wanted air,” continued a third speaker; “they must have died of suffocation.”

“Burned!” replied a fourth; “the projectile was nothing but an incandescent mass as it crossed the atmosphere.”

“What does it matter!” they exclaimed unanimously; “living or dead, we must pull them out!”

Meanwhile Captain Blomsberry had assembled his officers, and “with their permission,” was holding a council. They must decide upon something to be done immediately. The more hasty ones were for fishing up the projectile. A difficult operation, though not an impossible one. But the corvette had no proper machinery, which must be both fixed and powerful; so it was resolved that they should put in at the nearest port, and give information to the Gun Club of the projectile’s fall.

This determination was unanimous. The choice of the port had to be discussed. The neighboring coast had no anchorage on 27° latitude. Higher up, above the peninsula of Monterey, stands the important town from which it takes its name; but, seated on the borders of a perfect desert, it was not connected with the interior by a network of telegraphic wires, and electricity alone could spread these important news fast enough.

Some degrees above opened the bay of San Francisco. Through the capital of the gold country communication would be easy with the heart of the Union. And in less than two days the *Susquehanna*, by putting on high pressure, could arrive in that port. She must therefore start at once.

The fires were made up; they could set off immediately. Two thousand fathoms of line were still out, which Captain Blomsberry, not wishing to lose precious time in hauling in, resolved to cut.

“We will fasten the end to a buoy,” said he, “and that buoy will show us the exact spot where the projectile fell.”

“Besides,” replied Lieutenant Bronsfield, “we have our situation exact— 27° 7’ north latitude and 41° 37’ west longitude.”

“Well, Mr. Bronsfield,” replied the captain, “now, with your permission, we will have the line cut.”

A strong buoy, strengthened by a couple of spars, was thrown into the ocean. The end of the rope was carefully lashed to it; and, left solely to the rise and fall of the billows, the buoy would not sensibly deviate from the spot.

At this moment the engineer sent to inform the captain that steam was up and they could start, for which agreeable communication the captain thanked him. The course was then given north-northeast, and the corvette, wearing, steered at full steam direct for the bay of San Francisco . It was three in the morning.

Two hundred twenty leagues to cross; it was nothing for a good vessel like the *Susquehanna*. In thirty-six hours she had covered that distance; and on the 14th of December, at twenty-seven minutes past one in the afternoon , she entered the bay of San Francisco.

At the sight of a ship of the national navy arriving at full speed, with her bowsprit broken and her main-mast propped up, public curiosity was greatly roused. A dense crowd soon assembled on the quay, waiting for them to disembark.

After casting anchor, Captain Blomsberry and Lieutenant Bronsfield entered an eight-oared cutter, which soon brought them to land.

They jumped on to the quay.

“The telegraph ! ” they asked, without answering one of the thousand questions addressed to them.

The officer of the port conducted them himself to the telegraph office through a concourse of spectators. Blomsberry and Bronsfield entered, while the crowd crushed each other at the door.

Some minutes later a fourfold telegram was sent out—the first to the Naval Secretary at Washington; the second to the vice-president of the Gun Club, Baltimore; the third to the Hon. J.T. Maston, Long’s Peak, Rocky Mountains; and the fourth to the sub-director of the Cambridge Observatory, Massachusetts.

It was worded as follows:

In 20° 7’ north latitude, and 41° 37’ west longitude, on the 12th of December, at seventeen minutes past one in the morning, the projectile of the Columbiad fell into the Pacific. Send instructions.— BLOMSBERRY, Commander *Susquehanna*.

Five minutes afterward the whole town of San Francisco learned the news. Before six in the evening the different States of the Union had heard the great catastrophe; and after midnight, by the cable, the whole of Europe knew the result of the great American experiment. We will not attempt to picture the effect produced on the entire world by that unexpected denouement.

On receipt of the telegram the Naval Secretary telegraphed to the *Susquehanna* to wait in the bay of San Francisco without extinguishing her fires. Day and night she must be ready to put to sea.

The Cambridge Observatory called a special meeting; and, with that composure which distinguishes learned bodies in general, peacefully discussed the scientific bearings of the question. At the Gun Club there was an explosion. All the gunners were assembled. Vice-President the Hon. Wilcome was in the act of reading the premature dispatch, in which J.T. Maston and Belfast announced that the projectile had just been seen in the gigantic reflector of Long’s Peak, and also that it was held by lunar attraction, and was playing the part of sub-satellite in the solar world.

We know the truth on that point.

But on the arrival of Blomsberry's dispatch, so decidedly contradicting J.T. Maston's telegram, two parties were formed in the bosom of the Gun Club. On one side were those who admitted the fall of the projectile, and consequently the return of the travelers; on the other, those who believed in the observations of Long's Peak, concluded that the commander of the *Susquehanna* had made a mistake. To the latter the pretended projectile was nothing but a meteor! nothing but a meteor, a shooting globe, which in its fall had smashed the bows of the corvette. It was difficult to answer this argument, for the speed with which it was animated must have made observation very difficult. The commander of the *Susquehanna* and her officers might have made a mistake in all good faith; one argument however, was in their favor, namely, that if the projectile had fallen on the earth, its place of meeting with the terrestrial globe could only take place on this 27° north latitude, and (taking into consideration the time that had elapsed, and the rotary motion of the earth) between the 41° and the 42° of west longitude. In any case, it was decided in the Gun Club that Blomsberry's brother, Bilsby, and Major Elphinstone should go straight to San Francisco, and consult as to the means of raising the projectile from the depths of the ocean.

These devoted men set off at once; and the railroad, which will soon cross the whole of Central America, took them as far as St. Louis, where the swift mail-coaches awaited them.

Almost at the same moment in which the Naval Secretary , the vice-president of the Gun Club, and the sub-director of the Observatory received the dispatch from San Francisco, the Honorable J.T. Maston was undergoing the greatest excitement he had ever experienced in his life, an excitement which even the bursting of his celebrated cannon had not caused him, and which once more nearly cost him his life.

We may remember that the secretary of the Gun Club had started soon after the projectile (and almost as quickly) for the station on Long's Peak, in the Rocky Mountains, J. Belfast, director of the Cambridge Observatory, accompanying him. Arrived there, the two friends had installed themselves at once, never quitting the summit of their enormous telescope. We know that this gigantic instrument had been set up according to the reflecting system, called by the English "front view." This arrangement subjected all objects to but one reflection, making the view consequently much clearer; the result was that, when they were taking observation, J.T. Maston and Belfast were placed in the *upper* part of the instrument and not in the lower, which they reached by a circular staircase, a masterpiece of lightness, while below them opened a metal well terminated by the metallic mirror, which measured two hundred and eighty feet in depth.

It was on a narrow platform placed above the telescope that the two savants passed their existence, execrating the day which hid the moon from their eyes, and the clouds which obstinately veiled her during the night.

What, then, was their delight when, after some days of waiting, on the night of the 5th of December, they saw the vehicle which was bearing their friends into space! To this delight succeeded a great deception, when, trusting to a cursory observation, they launched their first telegram to the world, erroneously affirming that the projectile had become a satellite of the moon, gravitating in an immutable orbit.

From that moment it had never shown itself to their eyes — a disappearance all the more easily explained, as it was then passing behind the moon's invisible disc; but when it was time for it to reappear on the visible disc, one may imagine the impatience of the fuming J.T. Maston and his not less impatient companion. Each minute of the night they thought they saw the projectile once more, and they did not see it. Hence constant discussions and violent

disputes between them, Belfast affirming that the projectile could not be seen, J.T. Maston maintaining that “it had put his eyes out.”

“It is the projectile!” repeated J.T. Maston.

“No,” answered Belfast; “it is an avalanche detached from a lunar mountain.”

“Well, we shall see it to-morrow.”

“No, we shall not see it any more. It is carried into space.”

“Yes!”

“No!”

And at these moments, when contradictions rained like hail, the well-known irritability of the secretary of the Gun Club constituted a permanent danger for the Honorable Belfast. The existence of these two together would soon have become impossible; but an unforseen event cut short their everlasting discussions.

During the night, from the 14th to the 15th of December, the two irreconcilable friends were busy observing the lunar disc, J.T. Maston abusing the learned Belfast as usual, who was mounted by his side; the secretary of the Gun Club maintaining for the thousandth time that he had just seen the projectile, and adding that he could see Michel Ardan’s face looking through one of the scuttles, at the same time enforcing his argument by a series of gestures which his formidable hook rendered very unpleasant.

At this moment Belfast’s servant appeared on the platform (it was ten at night) and gave him a dispatch. It was the commander of the Susquehanna’s telegram.

Belfast tore the envelope and read, and uttered a cry.

“What!” said J.T. Maston.

“The projectile!”

“Well!”

“Has fallen to the earth!”

Another cry, this time a perfect howl, answered him. He turned toward J.T. Maston. The unfortunate man, imprudently leaning over the metal tube, had disappeared in the immense telescope. A fall of two hundred and eighty feet! Belfast, dismayed, rushed to the orifice of the reflector.

He breathed. J.T. Maston, caught by his metal hook, was holding on by one of the rings which bound the telescope together, uttering fearful cries.

Belfast called. His assistants rushed up, tackle was let down, and they hoisted up, not without some trouble, the imprudent secretary of the Gun Club.

He reappeared at the upper orifice without hurt.

“Ah!” said he, “if I had broken the mirror?”

“You would have paid for it,” replied Belfast severely.

“And that cursed projectile has fallen?” asked J.T. Maston.

“Into the Pacific!”

“Let us go!”

A quarter of an hour after the two savants were descending the declivity of the Rocky Mountains; and two days after, at the same time as their friends of the Gun Club, they arrived at San Francisco, having totally exhausted five horses on the road.

Elphinstone, Blomsberry ’s brother, and Bilsby rushed toward them on their arrival.

“What shall we do?” they exclaimed.

“Fish up the projectile,” replied J.T. Maston, “and the sooner the better.”

XXII. The Rescue

The spot where the projectile sank under the waves was exactly known; but the machinery to grasp it and bring it to the surface of the ocean was still wanting. It must first be invented, then made. American engineers could not be troubled with such trifles. The grappling-irons once fixed and helped by steam, they were sure to raise it in spite of its weight, which was lessened by the density of the liquid in which it was plunged.

But fishing-up the projectile was not the only thing to be thought of. They must act promptly in the interest of the travelers. No one doubted that they were still living.

“Yes,” repeated J.T. Maston incessantly, whose confidence gained over everybody, “our friends are clever people, and they cannot have fallen like simpletons. They are alive, quite alive; but we must make haste if we wish to find them so. Food and water do not trouble me; they have enough for a long while. But air, air, that is what they will soon want; so quick, quick!”

And they did go quick. They fitted up the *Susquehanna* for her new destination. Her powerful machinery was brought to bear upon the hauling-chains. The aluminium projectile only weighed 19,250 pounds, a weight very inferior to that of the transatlantic cable which had been drawn up under similar conditions. The only difficulty was in fishing up a cylindro-conical projectile, the walls of which were so smooth as to offer no hold for the hooks.

On that account Engineer Murchison hastened to San Francisco, and had some enormous grappling-irons fixed on an automatic system, which would never let the projectile go if it once succeeded in seizing it in its powerful claws. Diving-dresses were also prepared, which under their impervious and resisting covering allowed the divers to reconnoitre the bottom of the sea. He also had put on board apparatuses of compressed air very cleverly designed. There were perfect chambers pierced with scuttles, which, with water let into certain compartments, could draw it down into great depths. These apparatuses were at San Francisco, where they had been used in the construction of a submarine breakwater; and very fortunately it was so, for there was no time to construct any.

But in spite of the perfection of the machinery, in spite of the ingenuity of the savants entrusted with the use of them, the success of the operation was far from being certain. How great were the chances against them, the projectile being 20,000 feet under the water! And if even it was brought to the surface, how would the travelers have borne the terrible shock which 20,000 feet of water had perhaps not sufficiently broken? At any rate they must act quickly. J.T. Maston hurried the workmen day and night. He was ready to don the diving-dress himself, or try the air apparatus, in order to reconnoiter the situation of his courageous friends.

But in spite of all the diligence displayed in preparing the different engines, in spite of the considerable sum placed at the disposal of the Gun Club by the Government of the Union, five long days (five centuries!) elapsed before the preparations were complete. During this time public opinion was excited to the highest pitch. Telegrams were exchanged incessantly throughout the entire world by means of wires and electric cables. The saving of Barbicane, Nicholl, and Michel Ardan was an international affair. Every one who had subscribed to the Gun Club was directly interested in the welfare of the travelers.

At length the hauling-chains, the air-chambers, and the automatic grappling-irons were put on board the *Susquehanna*. J.T. Maston, Engineer Murchison, and the delegates of the Gun

Club, were already in their cabins. They had but to start . On the 21st of December, at eight o'clock at night, the corvette got under way with a beautiful sea, a northeasterly wind, and a rather sharp cold. The whole population of San Francisco was gathered on the quay, greatly excited but silent, reserving their hurrahs for the return. Steam was fully up to its maximum tension, and the screw of the *Susquehanna* carried them briskly out of the bay.

It is needless to relate the conversations on board between the officers, sailors, and passengers. All these men had but one thought. All these hearts beat under the same emotion. While they were hastening to help them, what were Barbicane and his companions doing? What had become of them? Were they able to attempt any bold maneuver to regain their liberty? None could say. The truth is that every attempt must have failed! Immersed nearly two leagues under the ocean, this metal prison defied every effort of its prisoners.

On the 23rd inst., at eight in the morning, after a rapid passage, the *Susquehanna* was due at the fatal spot. They must wait 'till noon to take the reckoning exactly. The buoy to which the sounding line had been lashed had not yet been recognized.

At twelve, Captain Blomsberry, assisted by his officers who superintended the observations, took the reckoning in the presence of the delegates of the Gun Club. Then there was a moment of anxiety. Her position determined , the *Susquehanna* was found to be some minutes westward of the spot where the projectile had disappeared beneath the waves.

The ship's course was then given so as to reach this exact point.

At forty-seven minutes past twelve they reached the buoy; it was in perfect condition, and must have shifted but little.

"At last!" exclaimed J.T. Maston.

"Shall we begin?" asked Captain Blomsberry.

"Without losing a second , " answered J.-T. Maston.

Every precaution was taken to keep the corvette completely motionless. Before trying to seize the projectile, Engineer Murchison wanted to find its exact position at the bottom of the ocean. The submarine apparatus destined for this expedition was supplied with air. The working of these engines was not without danger, for at 20,000 feet below the surface of the water, and under such great pressure, they were exposed to fracture, the consequences of which would be dreadful.

J.T. Maston, Blomsberry's brother, and Engineer Murchison, without heeding these dangers, took their places in the air-chamber. The commander, posted on his bridge, superintended the operation, ready to stop or haul in the chains on the slightest signal. The screw had been shipped, and the whole power of the machinery collected on the capstan would have quickly drawn the apparatus on board. The descent began at twenty-five minutes past one in the afternoon, and the chamber, drawn under by the reservoirs full of water, disappeared from the surface of the ocean.

The emotion of the officers and sailors on board was now divided between the prisoners in the projectile and the prisoners in the submarine apparatus. As to the latter, they forgot themselves, and, glued to the windows of the scuttles, attentively watched the liquid mass through which they were passing.

The descent was rapid. At seventeen minutes past two, J.T. Maston and his companions had reached the bottom of the Pacific; but they saw nothing but an arid desert, no longer animated by either fauna or flora. By the light of their lamps, furnished with powerful reflectors, they

could observe the dark layers of water for a considerable extent of view, but the projectile remained invisible to their eyes.

The impatience of these bold divers cannot be described, and having an electrical communication with the corvette, they made a signal already agreed upon, and for the space of a mile the *Susquehanna* moved their chamber along some metres above the bottom.

Thus they explored the whole submarine plain, deceived at every turn by optical illusions which almost broke their hearts. Here a rock, there a *extumescence* from the ground, seemed to be the much-sought-for projectile; but their mistake was soon discovered, and then they were in despair.

“But where are they? where are they?” cried J.T. Maston. And the poor man called loudly upon Nicholl, Barbicane, and Michel Ardan, as if his unfortunate friends could either hear or answer him through such an impenetrable medium! The search continued under these conditions until the vitiated air in the apparatus compelled the divers to ascend.

The hauling in began about six in the evening, and was not ended before midnight.

“ ’Til to-morrow ,” said J.T. Maston, as he set foot on the bridge of the corvette.

“Yes,” answered Captain Blomsberry.

“And on another spot. ”

“Yes.”

J.T. Maston did not doubt of their final success, but his companions, no longer upheld by the excitement of the first hours, understood all the difficulty of the enterprise. What seemed easy at San Francisco, seemed here in the wide ocean almost impossible. The chances of success diminished in rapid proportion; and it was from chance alone that the meeting with the projectile might be expected.

The next day, the 24th, in spite of the fatigue of the previous day, the operation was renewed. The corvette advanced some minutes to westward, and the apparatus, provided with air, bore the same explorers to the depths of the ocean.

The whole day passed in fruitless research; the bed of the sea was a desert. The 25th brought no other result, nor the 26th.

It was disheartening. They thought of those unfortunates shut up in the projectile for twenty-six days. Perhaps at that moment they were experiencing the first approach of suffocation; that is, if they had escaped the dangers of their fall. The air was spent, and doubtless with the air all their courage, their *morale*!

“The air, possibly,” answered J.T. Maston resolutely, “but their *morale* never!”

On the 28th, after two more days of search, all hope was gone. This projectile was but an atom in the immensity of the ocean. They must give up all idea of finding it.

But J.T. Maston would not hear of going away. He would not abandon the place without at least discovering the tomb of his friends. But Commander Blomsberry could no longer persist, and in spite of the protestations of the worthy secretary, was obliged to give the order to sail.

On the 29th of December, at nine A.M., the *Susquehanna*, heading northeast, resumed her course to the bay of San Francisco.

It was ten in the morning; the corvette was under half-steam, as it was regretting to leave the spot where the catastrophe had taken place, when a sailor, perched on the main-top-gallant crosstrees, watching the sea, cried suddenly:

“A buoy on the lee bow!”

The officers looked in the direction indicated, and by the help of their glasses saw that the object signalled had the appearance of one of those buoys which are used to mark the passages of bays or rivers. But, singularly to say, a flag floating on the wind surmounted its cone, which emerged five or six feet out of water. This buoy shone under the rays of the sun as if its sides had been made of plates of silver. Commander Blomsberry, J.T. Maston, and the delegates of the Gun Club were mounted on the bridge, examining this object straying at random on the waves.

All looked with feverish anxiety, but in silence. None dared give expression to the thoughts which came to the minds of all.

The corvette approached to within two cables’ lengths of the object.

A shudder ran through the whole crew. That flag was the American flag!

At this moment a perfect howling was heard; it was the brave J.T. Maston who had just fallen all in a heap. Forgetting on the one hand that his right arm had been replaced by an iron hook, and on the other that a simple gutta-percha cap covered his brain-box, he had given himself a formidable blow.

They hurried toward him, picked him up, restored him to life. And what were his first words?

“Ah! trebly brutes! quadruply idiots! quintuply boobies that we are!”

“What is it?” exclaimed everyone around him.

“What is it?”

“Come, speak!”

“It is, simpletons,” howled the terrible secretary, “it is that the projectile only weighs 19,250 pounds!”

“Well?”

“And that it displaces twenty-eight tons, or in other words 56,000 pounds, and that consequently *it floats*!”

Ah! what stress the worthy man had laid on the verb “float!” And it was true! All, yes! all these savants had forgotten this fundamental law, namely, that on account of its specific lightness, the projectile, after having been drawn by its fall to the greatest depths of the ocean, must naturally return to the surface. And now it was floating quietly at the mercy of the waves.

The boats were put to sea. J.T. Maston and his friends had rushed into them! Excitement was at its height! Every heart beat loudly while the boats advanced to the projectile. What did it contain? Living or dead?

Living, yes! living, at least unless death had struck Barbicane and his two friends since they had hoisted the flag. Profound silence reigned on the boats. All were breathless. Eyes no longer saw. One of the scuttles of the projectile was open. Some pieces of glass remained in the frame, showing that it had been broken. This scuttle was actually five feet above the water.

A boat came alongside, that of J.T. Maston, and J.T. Maston rushed to the broken window.

At that moment they heard a clear and merry voice, the voice of Michel Ardan, exclaiming in an accent of triumph:

“White all, Barbicane, white all!”

Barbicane, Michel Ardan, and Nicholl were playing at dominoes!

XXIII. To Conclude

We may remember the intense sympathy which had accompanied the three travelers on their departure. If at the beginning of the enterprise they had excited such emotion both in the old and new world, with what enthusiasm would they be received on their return! The millions of spectators which had beset the peninsula of Florida, would they not rush to meet these sublime adventurers? Those legions of strangers, hurrying from all parts of the globe toward the American shores, would they leave the Union without having seen Barbicane, Nicholl, and Michel Ardan? No! and the ardent passion of the public was bound to respond worthily to the greatness of the enterprise. Human creatures who had left the terrestrial sphere, and returned after this strange voyage into celestial space, could not fail to be received as the prophet Elias would be if he came back to earth. To see them first, and then to hear them, such was the universal longing.

This desire was to be realised by almost all the inhabitants of the Union.

Barbicane, Michel Ardan, Nicholl, and the delegates of the Gun Club, returning without delay to Baltimore, were received with indescribable enthusiasm. The travel notes of President Barbicane were ready to be given to the public. The *New York Herald* bought the manuscript at a price not yet known, but which must have been very high. Indeed, during the publication of *A Journey to the Moon*, the sale of this paper amounted to five millions of copies. Three days after the return of the travelers to the earth, the slightest detail of their expedition was known. There remained nothing more but to see the heroes of this superhuman enterprise.

The expedition of Barbicane and his friends round the moon had enabled them to check the many admitted theories regarding the terrestrial satellite. These savants had observed *de visu*, and under particular circumstances. They knew what systems should be rejected, what retained with regard to the formation of that orb, its origin, its habitability. Its past, present, and future had even given up their last secrets. Who could advance objections against conscientious observers, who at less than forty kilometres distance had marked that curious mountain of Tycho, the strangest system of lunar orography? How answer those savants whose sight had penetrated the abyss of Plato’s cirque? How contradict those bold ones whom the chances of their enterprise had borne over that invisible face of the disc, which no human eye until then had ever seen? It was now their turn to impose some limit on that selenographic science, which had reconstructed the lunar world as Cuvier did the skeleton of a fossil, and say, “The moon *was* this, a habitable world, inhabited before the earth. The moon *is* that, a world uninhabitable, and now uninhabited.”

To celebrate the return of its most illustrious member and his two companions, the Gun Club decided upon giving a banquet, but a banquet worthy of the conquerors, worthy of the American people, and under such conditions that all the inhabitants of the Union could directly take part in it.

All the head lines of railroads in the States were joined by flying rails; and on all the platforms, lined with the same flags, and decorated with the same ornaments, were tables laid and all served alike. At certain hours, successively calculated, marked by electric clocks which beat the seconds at the same time, the population were invited to take their places at the banquet tables. For four days, from the 5th to the 9th of January, the trains were stopped as they are on Sundays on the railways of the United States, and every road was open. One

engine only at full speed, drawing a triumphal carriage, had the right of traveling for those four days on the railroads of the United States.

The engine was manned by a driver and a stoker, and bore, by special favor, the Hon. J.-T. Maston, secretary of the Gun Club. The carriage was reserved for President Barbicane, Captain Nicholl, and Michel Ardan.

At the whistle of the driver, amid the hurrahs, and all the admiring vociferations of the American language, the train left the platform of Baltimore. It traveled at a speed of eighty leagues in the hour. But what was this speed compared with that which had carried the three heroes from the mouth of the Columbiad?

Thus they sped from one town to the other, finding whole populations at table on their road, saluting them with the same acclamations, lavishing the same bravos! They traveled in this way through the east of the Union, Pennsylvania, Connecticut, Massachusetts, Vermont, Maine, and New-Hampshire; the north and west by New York, Ohio, Michigan, and Wisconsin; returning to the south by Illinois, Missouri, Arkansas, Texas, and Louisiana; they went to the southeast by Alabama and Florida, going up by Georgia and the Carolinas, visiting the center by Tennessee, Kentucky, Virginia, and Indiana, and, after quitting the Washington station, re-entered Baltimore, where for four days one would have thought that the United States of America were seated at one immense banquet, saluting them simultaneously with the same hurrahs! The apotheosis was worthy of these three heroes whom fable would have placed in the rank of demigods.

And now will this attempt, unprecedented in the annals of travels, lead to any practical result? Will direct communication with the moon ever be established? Will they ever lay the foundation of a traveling service through the solar world? Will they go from one planet to another, from Jupiter to Mercury, and after awhile from one star to another, from the Polar to Sirius? Will this means of locomotion allow us to visit those suns which swarm in the firmament?

To such questions no answer can be given. But knowing the bold ingenuity of the Anglo-Saxon race, no one would be astonished if the Americans seek to make some use of President Barbicane’s attempt.

Thus, some time after the return of the travelers, the public received with marked favor the announcement of a company, limited, with a capital of a hundred million of dollars, divided into a hundred thousand shares of a thousand dollars each, under the name of the *National Company of Interstellar Communication*. President, Barbicane; vice-president, Captain Nicholl; secretary of administration, J.T. Maston; director of movements, Michel Ardan.

And as it is part of the American temperament to foresee everything in business, even bankruptcy , the Honorable Harry Troloppe, judge commissioner, and Francis Dayton, magistrate, were nominated beforehand!

THE END

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