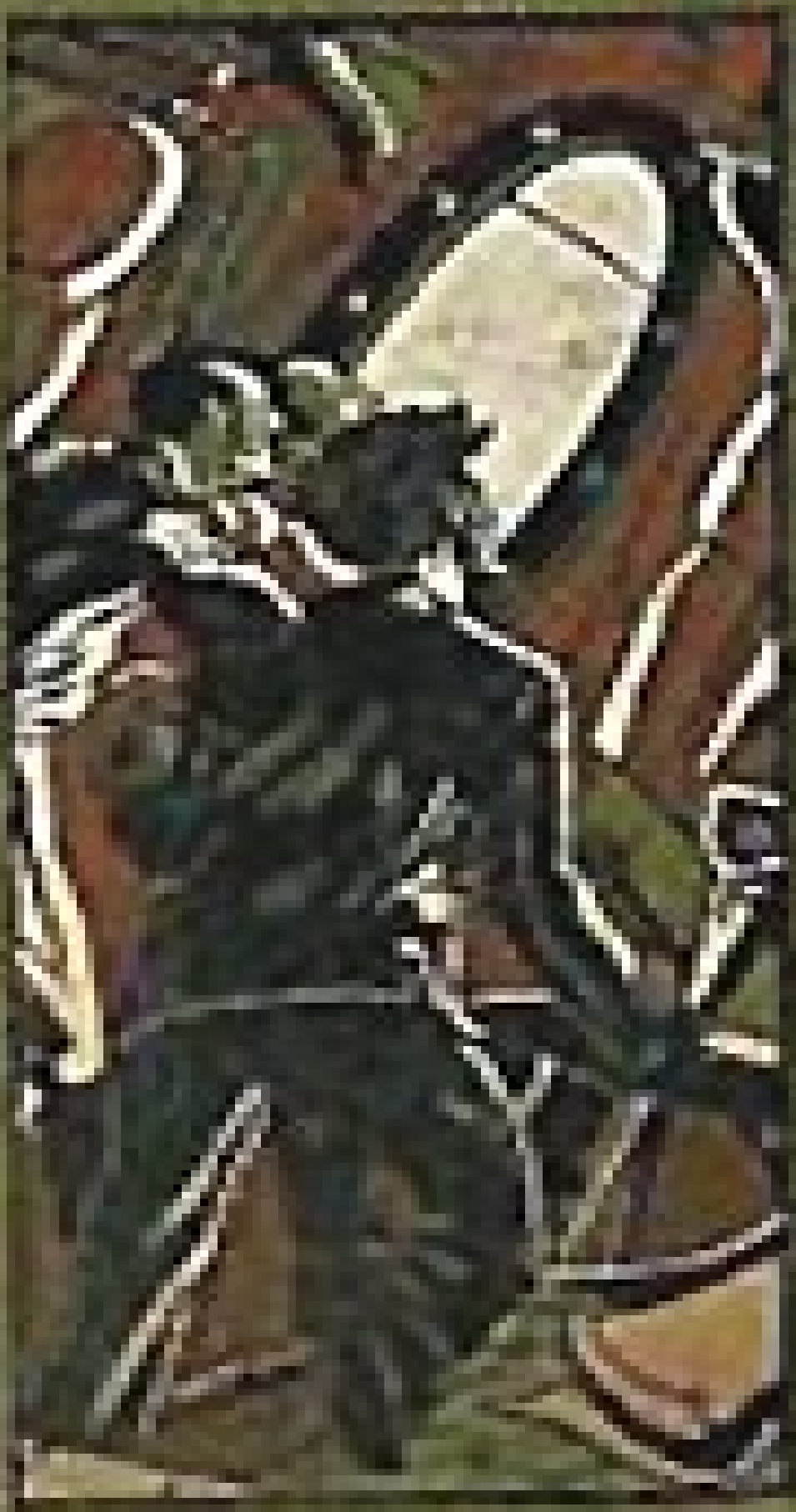
THE MOON VOYAGE



JULES VERNE

The Moon-Voyage

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Title: The Moon-Voyage

Author: Jules Verne

Release Date: July 12, 2004 [EBook #12901]

Language: English

Character set encoding: ISO-8859-1

*** START OF THIS PROJECT GUTENBERG EBOOK THE MOON-VOYAGE ***

Produced by Norm Wolcott, Gregory Margo and PG Distributed Proofreaders

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THE MOON-VOYAGE.

CONTAINING "FROM THE EARTH TO THE MOON," AND "ROUND THE MOON."

BY

JULES VERNE,

AUTHOR OF "TWENTY THOUSAND LEAGUES UNDER THE SEA," "AMONG THE CANNIBALS," ETC.

ILLUSTRATED BY HENRY AUSTIN.

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FROM THE EARTH TO THE MOON.

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CHAPTER I

.

THE GUN CLUB.

During the Federal war in the United States a new and very influential club was established in the city of Baltimore, Maryland. It is well known with what energy the military instinct was developed amongst that nation of shipowners, shopkeepers, and mechanics. Mere tradesmen jumped their counters to become extempore captains, colonels, and generals without having passed the Military School at West Point; they soon rivalled their colleagues of the old continent, and, like them, gained victories by dint of lavishing bullets, millions, and men.

But where Americans singularly surpassed Europeans was in the science of ballistics, or of throwing massive weapons by the use of an engine; not that their arms attained a higher degree of perfection, but they were of unusual dimensions, and consequently of hitherto unknown ranges. The English, French, and Prussians have nothing to learn about flank, running, enfilading, or point-blank firing; but their cannon, howitzers, and mortars are mere pocket-pistols compared with the formidable engines of American artillery.

This fact ought to astonish no one. The Yankees, the first mechanicians in the world, are born engineers, just as Italians are musicians and Germans metaphysicians. Thence nothing more natural than to see them bring their audacious ingenuity to bear on the science of ballistics. Hence those gigantic cannon, much less useful than sewing-machines, but quite as astonishing, and much more admired. The marvels of this style by Parrott, Dahlgren, and Rodman are well known. There was nothing left the Armstrongs, Pallisers, and Treuille de Beaulieux but to bow before their transatlantic rivals.

Therefore during the terrible struggle between Northerners and Southerners, artillerymen were in great request; the Union newspapers published their inventions with enthusiasm, and there was no little tradesman nor _naïf_ "booby" who did not bother his head day and night with calculations about impossible trajectory engines.

Now when an American has an idea he seeks another American to share it. If they are three, they elect a president and two secretaries. Given four, they elect a clerk, and a company is established. Five convoke a general meeting, and the club is formed. It thus happened at Baltimore. The first man who invented a new cannon took into partnership the first man who cast it and the first man that bored it. Such was the nucleus of the Gun Club. One month after its formation it numbered eighteen hundred and thirty-three effective members, and thirty thousand five hundred and seventy-five corresponding members.

One condition was imposed as a _sine quâ non_ upon every one who wished to become a member--that of having invented, or at least perfected, a cannon; or, in default of a cannon, a firearm of some sort. But, to tell the truth, mere inventors of fifteen-barrelled rifles, revolvers, or sword-pistols did not enjoy much consideration. Artillerymen were always preferred to them in every circumstance.

"The estimation in which they are held," said one day a learned orator of the Gun Club, "is in proportion to the size of their cannon, and in direct ratio to the square of distance attained by their projectiles!"

A little more and it would have been Newton's law of gravitation applied to moral order.

Once the Gun Club founded, it can be easily imagined its effect upon the inventive genius of the Americans. War-engines took colossal proportions, and projectiles launched beyond permitted distances cut inoffensive pedestrians to pieces. All these inventions left the timid instruments of European artillery far behind them. This may be estimated by the following figures:--

Formerly, "in the good old times," a thirty-six pounder, at a distance of three hundred feet, would cut up thirty-six horses, attacked in flank, and sixty-eight men. The art was then in its infancy. Projectiles have since made their way. The Rodman gun that sent a projectile weighing half a ton a distance of seven miles could easily have cut up a hundred and fifty horses and three hundred men. There was some talk at the Gun Club of making a solemn experiment with it. But if the horses consented to play their part, the men unfortunately were wanting.

However that may be, the effect of these cannon was very deadly, and at each

discharge the combatants fell like ears before a scythe. After such projectiles what signified the famous ball which, at Coutras, in 1587, disabled twenty-five men; and the one which, at Zorndorff, in 1758, killed forty fantassins; and in 1742, Kesseldorf's Austrian cannon, of which every shot levelled seventy enemies with the ground? What was the astonishing firing at Jena or Austerlitz, which decided the fate of the battle? During the Federal war much more wonderful things had been seen. At the battle of Gettysburg, a conical projectile thrown by a rifle-barrel cut up a hundred and seventy-three Confederates, and at the passage of the Potomac a Rodman ball sent two hundred and fifteen Southerners into an evidently better world. A formidable mortar must also be mentioned, invented by J.T. Maston, a distinguished member and perpetual secretary of the Gun Club, the result of which was far more deadly, seeing that, at its trial shot, it killed three hundred and thirty-seven persons--by bursting, it is true.

What can be added to these figures, so eloquent in themselves? Nothing. So the following calculation obtained by the statistician Pitcairn will be admitted without contestation: by dividing the number of victims fallen under the projectiles by that of the members of the Gun Club, he found that each one of them had killed, on his own account, an average of two thousand three hundred and seventy-five men and a fraction.

By considering such a result it will be seen that the single preoccupation of this learned society was the destruction of humanity philanthropically, and the perfecting of firearms considered as instruments of civilisation. It was a company of Exterminating Angels, at bottom the best fellows in the world.

It must be added that these Yankees, brave as they have ever proved themselves, did not confine themselves to formulae, but sacrificed themselves to their theories. Amongst them might be counted officers of every rank, those who had just made their _début_ in the profession of arms, and those who had grown old on their gun-carriage. Many whose names figured in the book of honour of the Gun Club remained on the field of battle, and of those who came back the greater part bore marks of their indisputable valour. Crutches, wooden legs, articulated arms, hands with hooks, gutta-percha jaws, silver craniums, platinum noses, nothing was wanting to the collection; and the above-mentioned Pitcairn likewise calculated that in the Gun Club there was not quite one arm amongst every four persons, and only two legs amongst six.

But these valiant artillerymen paid little heed to such small matters, and felt justly proud when the report of a battle stated the number of victims at tenfold the quantity of projectiles expended.

One day, however, a sad and lamentable day, peace was signed by the survivors of the war, the noise of firing gradually ceased, the mortars were silent, the howitzers were muzzled for long enough, and the cannon, with muzzles depressed, were stored in the arsenals, the shots were piled up in the parks, the bloody reminiscences were effaced, cotton shrubs grew magnificently on the well-manured fields, mourning garments began to be worn-out, as well as sorrow, and the Gun Club had nothing whatever to do.

Certain old hands, inveterate workers, still went on with their calculations in ballistics; they still imagined gigantic bombs and unparalleled howitzers. But what was the use of vain theories that could not be put in practice? So the saloons were deserted, the servants slept in the antechambers, the newspapers grew mouldy on the tables, from dark corners issued sad snores, and the members of the Gun Club, formerly so noisy, now reduced to silence by the disastrous peace, slept the sleep of Platonic artillery!

"This is distressing," said brave Tom Hunter, whilst his wooden legs were carbonising at the fireplace of the smoking-room. "Nothing to do! Nothing to look forward to! What a tiresome existence! Where is the time when cannon awoke you every morning with its joyful reports?"

"That time is over," answered dandy Bilsby, trying to stretch the arms he had lost. "There was some fun then! You invented an howitzer, and it was hardly cast before you ran to try it on the enemy; then you went back to the camp with an encouragement from Sherman, or a shake of the hands from MacClellan! But now the generals have gone back to their counters, and instead of cannon-balls they expedite inoffensive cotton bales! Ah, by Saint Barb! the future of artillery is lost to America!"

"Yes, Bilsby," cried Colonel Blomsberry, "it is too bad! One fine morning you leave your tranquil occupations, you are drilled in the use of arms, you leave Baltimore for the battle-field, you conduct yourself like a hero, and in two years, three years at the latest, you are obliged to leave the fruit of so many fatigues, to go to sleep in deplorable idleness, and keep your hands in your pockets."

The valiant colonel would have found it very difficult to give such a proof of his want of occupation, though it was not the pockets that were wanting.

"And no war in prospect, then," said the famous J.T. Maston, scratching his gutta-percha cranium with his steel hook; "there is not a cloud on the horizon now that there is so much to do in the science of artillery! I myself finished this very morning a diagram with plan, basin, and elevation of a mortar destined to change the laws of warfare!"

"Indeed!" replied Tom Hunter, thinking involuntarily of the Honourable J.T. Maston's last essay.

"Indeed!" answered Maston. "But what is the use of the good results of such studies and so many difficulties conquered? It is mere waste of time. The people of the New World seem determined to live in peace, and our bellicose *Tribune* has gone as far as to predict approaching catastrophes due to the scandalous increase of population!"

"Yet, Maston," said Colonel Blomsberry, "they are always fighting in Europe to maintain the principle of nationalities!"

"What of that?"

"Why, there might be something to do over there, and if they accepted our services--"

"What are you thinking of?" cried Bilsby. "Work at ballistics for the benefit of foreigners!"

"Perhaps that would be better than not doing it at all," answered the colonel.

"Doubtless," said J.T. Maston, "it would be better, but such an expedient cannot be thought of."

"Why so?" asked the colonel.

"Because their ideas of advancement would be contrary to all our American customs. Those folks seem to think that you cannot be a general-in-chief without having served as second lieutenant, which comes to the same as saying that no one can point a gun that has not cast one. Now that is simply--"

"Absurd!" replied Tom Hunter, whittling the arms of his chair with his bowie-knife; "and as things are so, there is nothing left for us but to plant tobacco or distil whale-oil!"

"What!" shouted J.T. Maston, "shall we not employ these last years of our existence in perfecting firearms? Will not a fresh opportunity present itself to try the ranges of our projectiles? Will the atmosphere be no longer illuminated by the lightning of our cannons? Won't some international difficulty crop up that will allow us to declare war against some transatlantic power? Won't France run down one of our steamers, or won't England, in defiance of the rights of nations, hang up three or four of our countrymen?"

"No, Maston," answered Colonel Blomsberry; "no such luck! No, not one of those incidents will happen; and if one did, it would be of no use to us. American sensitiveness is declining daily, and we are going to the dogs!"

"Yes, we are growing quite humble," replied Bilsby.

"And we are humiliated!" answered Tom Hunter.

"All that is only too true," replied J.T. Maston, with fresh vehemence. "There are a thousand reasons for fighting floating about, and still we don't fight! We economise legs and arms, and that to the profit of folks that don't know what to do with them. Look here, without looking any farther for a motive for war, did not North America formerly belong to the English?"

"Doubtless," answered Tom Hunter, angrily poking the fire with the end of his crutch.

"Well," replied J.T. Maston, "why should not England in its turn belong to the Americans?"

"It would be but justice," answered Colonel Blomsberry.

"Go and propose that to the President of the United States," cried J.T. Maston, "and see what sort of a reception you would get."

"It would not be a bad reception," murmured Bilsby between the four teeth he had saved from battle.

"I'faith," cried J.T. Maston, "they need not count upon my vote in the next elections."

"Nor upon ours," answered with common accord these bellicose invalids.

"In the meantime," continued J.T. Maston, "and to conclude, if they do not furnish me with the opportunity of trying my new mortar on a real battle-field, I shall send in my resignation as member of the Gun Club, and I shall go and bury myself in the backwoods of Arkansas."

"We will follow you there," answered the interlocutors of the enterprising J.T. Maston.

Things had come to that pass, and the club, getting more excited, was menaced with approaching dissolution, when an unexpected event came to prevent so regrettable a catastrophe.

The very day after the foregoing conversation each member of the club received a circular couched in these terms:--

"Baltimore, October 3rd.

"The president of the Gun Club has the honour to inform his colleagues that at the meeting on the 5th ultimo he will make them a communication of an extremely interesting nature. He therefore begs that they, to the suspension of all other business, will attend, in accordance with the present invitation,

"Their devoted colleague,

"IMPEY BARBICANE, P.G.C."

CHAPTER II

.

PRESIDENT BARBICANE'S COMMUNICATION.

On the 5th of October, at 8 p.m., a dense crowd pressed into the saloons of the Gun Club, 21, Union-square. All the members of the club residing at Baltimore

had gone on the invitation of their president. The express brought corresponding members by hundreds, and if the meeting-hall had not been so large, the crowd of *savants* could not have found room in it; they overflowed into the neighbouring rooms, down the passages, and even into the courtyards; there they ran against the populace who were pressing against the doors, each trying to get into the front rank, all eager to learn the important communication of President Barbicane, all pressing, squeezing, crushing with that liberty of action peculiar to the masses brought up in the idea of self-government.

That evening any stranger who might have chanced to be in Baltimore could not have obtained a place at any price in the large hall; it was exclusively reserved to residing or corresponding members; no one else was admitted; and the city magnates, common councillors, and select men were compelled to mingle with their inferiors in order to catch stray news from the interior.

The immense hall presented a curious spectacle; it was marvellously adapted to the purpose for which it was built. Lofty pillars formed of cannon, superposed upon huge mortars as a base, supported the fine ironwork of the arches--real cast-iron lacework.

Trophies of blunderbusses, matchlocks, arquebuses, carbines, all sorts of ancient or modern firearms, were picturesquely enlaced against the walls. The gas, in full flame, came out of a thousand revolvers grouped in the form of lustres, whilst candlesticks of pistols, and candelabra made of guns done up in sheaves, completed this display of light. Models of cannons, specimens of bronze, targets spotted with shot-marks, plaques broken by the shock of the Gun Club, balls, assortments of rammers and sponges, chaplets of shells, necklaces of projectiles, garlands of howitzers--in a word, all the tools of the artilleryman surprised the eyes by their wonderful arrangement, and induced a belief that their real purpose was more ornamental than deadly.

In the place of honour was seen, covered by a splendid glass case, a piece of breech, broken and twisted under the effort of the powder--a precious fragment of J.T. Maston's cannon.

At the extremity of the hall the president, assisted by four secretaries, occupied a wide platform. His chair, placed on a carved gun-carriage, was modelled upon the powerful proportions of a 32-inch mortar; it was pointed at an angle of 90 degs., and hung upon trunnions so that the president could use it as a rocking-

chair, very agreeable in great heat. Upon the desk, a huge iron plate, supported upon six carronades, stood a very tasteful inkstand, made of a beautifully-chased Spanish piece, and a report-bell, which, when required, went off like a revolver. During the vehement discussions this new sort of bell scarcely sufficed to cover the voices of this legion of excited artillerymen.

In front of the desk, benches, arranged in zigzags, like the circumvallations of intrenchment, formed a succession of bastions and curtains where the members of the Gun Club took their seats; and that evening, it may be said, there were plenty on the ramparts. The president was sufficiently known for all to be assured that he would not have called together his colleagues without a very great motive.

Impey Barbicane was a man of forty, calm, cold, austere, of a singularly serious and concentrated mind, as exact as a chronometer, of an imperturbable temperament and immovable character; not very chivalrous, yet adventurous, and always bringing practical ideas to bear on the wildest enterprises; an essential New-Englander, a Northern colonist, the descendant of those Roundheads so fatal to the Stuarts, and the implacable enemy of the Southern gentlemen, the ancient cavaliers of the mother country--in a word, a Yankee cast in a single mould.

Barbicane had made a great fortune as a timber-merchant; named director of artillery during the war, he showed himself fertile in inventions; enterprising in his ideas, he contributed powerfully to the progress of ballistics, gave an immense impetus to experimental researches.

He was a person of average height, having, by a rare exception in the Gun Club, all his limbs intact. His strongly-marked features seemed to be drawn by square and rule, and if it be true that in order to guess the instincts of a man one must look at his profile, Barbicane seen thus offered the most certain indications of energy, audacity, and _sang-froid_.

At that moment he remained motionless in his chair, mute, absorbed, with an inward look sheltered under his tall hat, a cylinder of black silk, which seems screwed down upon the skull of American men.

His colleagues talked noisily around him without disturbing him; they questioned one another, launched into the field of suppositions, examined their

president, and tried, but in vain, to make out the *x* of his imperturbable physiognomy.

Just as eight o'clock struck from the fulminating clock of the large hall, Barbicane, as if moved by a spring, jumped up; a general silence ensued, and the orator, in a slightly emphatic tone, spoke as follows:--

"Brave colleagues,--It is some time since an unfruitful peace plunged the members of the Gun Club into deplorable inactivity. After a period of some years, so full of incidents, we have been obliged to abandon our works and stop short on the road of progress. I do not fear to proclaim aloud that any war which would put arms in our hands again would be welcome--"

"Yes, war!" cried impetuous J.T. Maston.

"Hear, hear!" was heard on every side.

"But war," said Barbicane, "war is impossible under actual circumstances, and, whatever my honourable interrupter may hope, long years will elapse before our cannons thunder on a field of battle. We must, therefore, make up our minds to it, and seek in another order of ideas food for the activity by which we are devoured."

The assembly felt that its president was coming to the delicate point; it redoubled its attention.

"A few months ago, my brave colleagues," continued Barbicane, "I asked myself if, whilst still remaining in our speciality, we could not undertake some grand experiment worthy of the nineteenth century, and if the progress of ballistics would not allow us to execute it with success. I have therefore sought, worked, calculated, and the conviction has resulted from my studies that we must succeed in an enterprise that would seem impracticable in any other country. This project, elaborated at length, will form the subject of my communication; it is worthy of you, worthy of the Gun Club's past history, and cannot fail to make a noise in the world!"

"Much noise?" cried a passionate artilleryman.

"Much noise in the true sense of the word," answered Barbicane.

"Don't interrupt!" repeated several voices.

"I therefore beg of you, my brave colleagues," resumed the president, "to grant me all your attention."

A shudder ran through the assembly. Barbicane, having with a rapid gesture firmly fixed his hat on his head, continued his speech in a calm tone:--

"There is not one of you, brave colleagues, who has not seen the moon, or, at least, heard of It. Do not be astonished if I wish to speak to you about the Queen of Night. It is, perhaps, our lot to be the Columbuses of this unknown world. Understand me, and second me as much as you can, I will lead you to its conquest, and its name shall be joined to those of the thirty-six States that form the grand country of the Union!"

"Hurrah for the moon!" cried the Gun Club with one voice.

"The moon has been much studied," resumed Barbicane; "its mass, density, weight, volume, constitution, movements, distance, the part it plays in the solar world, are all perfectly determined; selenographic maps have been drawn with a perfection that equals, if it does not surpass, those of terrestrial maps; photography has given to our satellite proofs of incomparable beauty--in a word, all that the sciences of mathematics, astronomy, geology, and optics can teach is known about the moon; but until now no direct communication with it has ever been established."

A violent movement of interest and surprise welcomed this sentence of the orator.

"Allow me," he resumed, "to recall to you in few words how certain ardent minds, embarked upon imaginary journeys, pretended to have penetrated the secrets of our satellite. In the seventeenth century a certain David Fabricius boasted of having seen the inhabitants of the moon with his own eyes. In 1649 a Frenchman, Jean Baudoin, published his _Journey to the Moon by Dominique Gonzales, Spanish Adventurer_. At the same epoch Cyrano de Bergerac published the celebrated expedition that had so much success in France. Later on, another Frenchman (that nation took a great deal of notice of the moon), named Fontenelle, wrote his _Plurality of Worlds_, a masterpiece of his time; but science in its progress crushes even masterpieces! About 1835, a pamphlet, translated from the _New York American_, related that Sir John Herschel, sent

to the Cape of Good Hope, there to make astronomical observations, had, by means of a telescope, perfected by interior lighting, brought the moon to within a distance of eighty yards. Then he distinctly perceived caverns in which lived hippopotami, green mountains with golden borders, sheep with ivory horns, white deer, and inhabitants with membraneous wings like those of bats. This treatise, the work of an American named Locke, had a very great success. But it was soon found out that it was a scientific mystification, and Frenchmen were the first to laugh at it."

"Laugh at an American!" cried J.T. Maston; "but that's a _casus belli_!"

"Be comforted, my worthy friend; before Frenchmen laughed they were completely taken in by our countryman. To terminate this rapid history, I may add that a certain Hans Pfaal, of Rotterdam, went up in a balloon filled with a gas made from azote, thirty-seven times lighter than hydrogen, and reached the moon after a journey of nineteen days. This journey, like the preceding attempts, was purely imaginary, but it was the work of a popular American writer of a strange and contemplative genius. I have named Edgar Poe!"

"Hurrah for Edgar Poe!" cried the assembly, electrified by the words of the president.

"I have now come to an end of these attempts which I may call purely literary, and quite insufficient to establish any serious communications with the Queen of Night. However, I ought to add that some practical minds tried to put themselves into serious communication with her. Some years ago a German mathematician proposed to send a commission of *savants* to the steppes of Siberia. There, on the vast plains, immense geometrical figures were to be traced by means of luminous reflectors; amongst others, the square of the hypothenuse, vulgarly called the 'Ass's Bridge.' 'Any intelligent being,' said the mathematician, 'ought to understand the scientific destination of that figure. The Selenites (inhabitants of the moon), if they exist, will answer by a similar figure, and, communication once established, it will be easy to create an alphabet that will allow us to hold converse with the inhabitants of the moon.' Thus spoke the German mathematician, but his project was not put into execution, and until now no direct communication has existed between the earth and her satellite. But it was reserved to the practical genius of Americans to put itself into communication with the sidereal world. The means of doing so are simple, easy, certain, unfailing, and will make the subject of my proposition."

A hubbub and tempest of exclamations welcomed these words. There was not one of the audience who was not dominated and carried away by the words of the orator.

"Hear, hear! Silence!" was heard on all sides.

When the agitation was calmed down Barbicane resumed, in a graver tone, his interrupted speech.

"You know," said he, "what progress the science of ballistics has made during the last few years, and to what degree of perfection firearms would have been brought if the war had gone on. You are not ignorant in general that the power of resistance of cannons and the expansive force of powder are unlimited. Well, starting from that principle, I asked myself if, by means of sufficient apparatus, established under determined conditions of resistance, it would not be possible to send a cannon-ball to the moon!"

At these words an "Oh!" of stupefaction escaped from a thousand panting breasts; then occurred a moment of silence, like the profound calm that precedes thunder. In fact, the thunder came, but a thunder of applause, cries, and clamour which made the meeting-hall shake again. The president tried to speak; he could not. It was only at the end of ten minutes that he succeeded in making himself heard.

"Let me finish," he resumed coldly. "I have looked at the question in all its aspects, and from my indisputable calculations it results that any projectile, hurled at an initial speed of twelve thousand yards a second, and directed at the moon, must necessarily reach her. I have, therefore, the honour of proposing to you, my worthy colleagues, the attempting of this little experiment."

CHAPTER III

.

EFFECT OF PRESIDENT BARBICANE'S COMMUNICATION.

It is impossible to depict the effect produced by the last words of the honourable president. What cries! what vociferations! What a succession of groans, hurrahs,

cheers, and all the onomatopoeia of which the American language is so full. It was an indescribable hubbub and disorder. Mouths, hands, and feet made as much noise as they could. All the weapons in this artillery museum going off at once would not have more violently agitated the waves of sound. That is not surprising; there are cannoneers nearly as noisy as their cannons.

Barbicane remained calm amidst these enthusiastic clamours; perhaps he again wished to address some words to his colleagues, for his gestures asked for silence, and his fulminating bell exhausted itself in violent detonations; it was not even heard. He was soon dragged from his chair, carried in triumph, and from the hands of his faithful comrades he passed into those of the no less excited crowd.

Nothing can astonish an American. It has often been repeated that the word "impossible" is not French; the wrong dictionary must have been taken by mistake. In America everything is easy, everything is simple, and as to mechanical difficulties, they are dead before they are born. Between the Barbicane project and its realisation not one true Yankee would have allowed himself to see even the appearance of a difficulty. As soon said as done.

The triumphant march of the president was prolonged during the evening. A veritable torchlight procession--Irish, Germans, Frenchmen, Scotchmen--all the heterogeneous individuals that compose the population of Maryland--shouted in their maternal tongue, and the cheering was unanimous.

Precisely as if she knew it was all about her, the moon shone out then with serene magnificence, eclipsing other lights with her intense irradiation. All the Yankees directed their eyes towards the shining disc; some saluted her with their hands, others called her by the sweetest names; between eight o'clock and midnight an optician in Jones-Fall-street made a fortune by selling field-glasses. The Queen of Night was looked at through them like a lady of high life. The Americans acted in regard to her with the freedom of proprietors. It seemed as if the blonde Phoebe belonged to these enterprising conquerors and already formed part of the Union territory. And yet the only question was that of sending a projectile--a rather brutal way of entering into communication even with a satellite, but much in vogue amongst civilised nations.

Midnight had just struck, and the enthusiasm did not diminish; it was kept up in equal doses in all classes of the population; magistrates, _savants_, merchants,

tradesmen, street-porters, intelligent as well as "green" men were moved even in their most delicate fibres. It was a national enterprise; the high town, low town, the quays bathed by the waters of the Patapsco, the ships, imprisoned in their docks, overflowed with crowds intoxicated with joy, gin, and whisky; everybody talked, argued, perorated, disputed, approved, and applauded, from the gentleman comfortably stretched on the bar-room couch before his glass of "sherry-cobbler" to the waterman who got drunk upon "knock-me-down" in the dark taverns of Fell's Point.

However, about 2 a.m. the emotion became calmer. President Barbicane succeeded in getting home almost knocked to pieces. A Hercules could not have resisted such enthusiasm. The crowd gradually abandoned the squares and streets. The four railroads of Ohio, Susquehanna, Philadelphia, and Washington, which converge at Baltimore, took the heterogeneous population to the four corners of the United States, and the town reposed in a relative tranquillity.

It would be an error to believe that during this memorable evening Baltimore alone was agitated. The large towns of the Union, New York, Boston, Albany, Washington, Richmond, New Orleans, Charlestown, La Mobile of Texas, Massachusetts, Michigan, and Florida, all shared in the delirium. The thirty thousand correspondents of the Gun Club were acquainted with their president's letter, and awaited with equal impatience the famous communication of the 5th of October. The same evening as the orator uttered his speech it ran along the telegraph wires, across the states of the Union, with a speed of 348,447 miles a second. It may, therefore, be said with absolute certainty that at the same moment the United States of America, ten times as large as France, cheered with a single voice, and twenty-five millions of hearts, swollen with pride, beat with the same pulsation.

The next day five hundred daily, weekly, monthly, or bi-monthly newspapers took up the question; they examined it under its different aspects--physical, meteorological, economical, or moral, from a political or social point of view. They debated whether the moon was a finished world, or if she was not still undergoing transformation. Did she resemble the earth in the time when the atmosphere did not yet exist? What kind of spectacle would her hidden hemisphere present to our terrestrial spheroid? Granting that the question at present was simply about sending a projectile to the Queen of Night, every one saw in that the starting-point of a series of experiments; all hoped that one day America would penetrate the last secrets of the mysterious orb, and some even

seemed to fear that her conquest would disturb the balance of power in Europe.

The project once under discussion, not one of the papers suggested a doubt of its realisation; all the papers, treatises, bulletins, and magazines published by scientific, literary, or religious societies enlarged upon its advantages, and the "Natural History Society" of Boston, the "Science and Art Society" of Albany, the "Geographical and Statistical Society" of New York, the "American Philosophical Society" of Philadelphia, and the "Smithsonian Institution" of Washington sent in a thousand letters their congratulations to the Gun Club, with immediate offers of service and money.

It may be said that no proposition ever had so many adherents; there was no question of hesitations, doubts, or anxieties. As to the jokes, caricatures, and comic songs that would have welcomed in Europe, and, above all, in France, the idea of sending a projectile to the moon, they would have been turned against their author; all the "life-preservers" in the world would have been powerless to guarantee him against the general indignation. There are things that are not to be laughed at in the New World.

Impey Barbicane became from that day one of the greatest citizens of the United States, something like a Washington of science, and one fact amongst several will serve to show the sudden homage which was paid by a nation to one man.

Some days after the famous meeting of the Gun Club the manager of an English company announced at the Baltimore Theatre a representation of _Much Ado About Nothing_, but the population of the town, seeing in the title a damaging allusion to the projects of President Barbicane, invaded the theatre, broke the seats, and forced the unfortunate manager to change the play. Like a sensible man, the manager, bowing to public opinion, replaced the offending comedy by _As You Like It_, and for several weeks he had fabulous houses.

CHAPTER IV

.

ANSWER FROM THE CAMBRIDGE OBSERVATORY.

In the meantime Barbicane did not lose an instant amidst the enthusiasm of

which he was the object. His first care was to call together his colleagues in the board-room of the Gun Club. There, after a debate, they agreed to consult astronomers about the astronomical part of their enterprise. Their answer once known, they would then discuss the mechanical means, and nothing would be neglected to assure the success of their great experiment.

A note in precise terms, containing special questions, was drawn up and addressed to the observatory of Cambridge in Massachusetts. This town, where the first University of the United States was founded, is justly celebrated for its astronomical staff. There are assembled the greatest men of science; there is the powerful telescope which enabled Bond to resolve the nebula of Andromeda and Clarke to discover the satellite of Sirius. This celebrated institution was, therefore, worthy in every way of the confidence of the Gun Club.

After two days the answer, impatiently awaited, reached the hands of President Barbicane.

It ran as follows:--

"*The Director of the Cambridge Observatory to the President of the Gun Club at Baltimore*.

"On the receipt of your favour of the 6th inst., addressed to the Observatory of Cambridge in the name of the members of the Baltimore Gun Club, we immediately called a meeting of our staff, who have deemed it expedient to answer as follows:--

"The questions proposed to it were these:--

"'1. Is it possible to send a projectile to the moon?

"'2. What is the exact distance that separates the earth and her satellite?

"'3. What would be the duration of the projectile's transit to which a sufficient initial speed had been given, and consequently at what moment should it be hurled so as to reach the moon at a particular point?

"'4. At what moment would the moon present the most favourable position for being reached by the projectile?

"'5. What point in the heavens ought the cannon, destined to hurl the projectile, be aimed at?

"'6. What place in the heavens will the moon occupy at the moment when the projectile will start?'

"Regarding question No. 1, 'Is it possible to send a projectile to the moon?'

"Yes, it is possible to send a projectile to the moon if it is given an initial velocity of 1,200 yards a second. Calculations prove that this speed is sufficient. In proportion to the distance from the earth the force of gravitation diminishes in an inverse ratio to the square of the distance--that is to say, that for a distance three times greater that force is nine times less. In consequence, the weight of the projectile will decrease rapidly, and will end by being completely annulled at the moment when the attraction of the moon will be equal to that of the earth--that is to say, at the 47/52 of the distance. At that moment the projectile will have no weight at all, and if it clears that point it will fall on to the moon only by the effect of lunar gravitation. The theoretic possibility of the experiment is, therefore, quite demonstrated; as to its success, that depends solely in the power of the engine employed.

"Regarding question No. 2, 'What is the exact distance that separates the earth from her satellite?'

"The moon does not describe a circle round the earth, but an ellipse, of which our earth occupies one of the foci; the consequence is, therefore, that at certain times it approaches nearer to, and at others recedes farther from, the earth, or, in astronomical language, it has its apogee and its perigee. At its apogee the moon is at 247,552 miles from the earth, and at its perigee at 218,657 miles only, which makes a difference of 28,895, or more than a ninth of the distance. The perigee distance is, therefore, the one that should give us the basis of all calculations.

"Regarding question No. 3, 'What would be the duration of the projectile's transit to which a sufficient initial speed has been given, and consequently at what moment should it be hurled so as to reach the moon at a particular point?'

"If the projectile kept indefinitely the initial speed of 12,000 yards a second, it would only take about nine hours to reach its destination; but as that initial velocity will go on decreasing, it will happen, everything calculated upon, that

the projectile will take 300,000 seconds, or 83 hours and 20 minutes, to reach the point where the terrestrial and lunar gravitations are equal, and from that point it will fall upon the moon in 50,000 seconds, or 13 hours, 53 minutes, and 20 seconds. It must, therefore, be hurled 97 hours, 13 minutes, and 20 seconds before the arrival of the moon at the point aimed at.

"Regarding question No. 4, 'At what moment would the moon present the most favourable position for being reached by the projectile?'

"According to what has been said above the epoch of the moon's perigee must first be chosen, and at the moment when she will be crossing her zenith, which will still further diminish the entire distance by a length equal to the terrestrial radius--i.e., 3,919 miles; consequently, the passage to be accomplished will be 214,976 miles. But the moon is not always at her zenith when she reaches her perigee, which is once a month. She is only under the two conditions simultaneously at long intervals of time. This coincidence of perigee and zenith must be waited for. It happens fortunately that on December 4th of next year the moon will offer these two conditions; at midnight she will be at her perigee and her zenith--that is to say, at her shortest distance from the earth and at her zenith at the same time.

"Regarding question No. 5, 'At what point in the heavens ought the cannon destined to hurl the projectile be aimed?'

"The preceding observations being admitted, the cannon ought to be aimed at the zenith of the place (the zenith is the spot situated vertically above the head of a spectator), so that its range will be perpendicular to the plane of the horizon, and the projectile will pass the soonest beyond the range of terrestrial gravitation. But for the moon to reach the zenith of a place that place must not exceed in latitude the declination of the luminary--in other words, it must be comprised between 0° and 28° of north or south latitude. In any other place the range must necessarily be oblique, which would seriously affect the success of the experiment.

"Regarding question No. 6, 'What place will the moon occupy In the heavens at the moment of the projectile's departure?'

"At the moment when the projectile is hurled into space, the moon, which travels forward 13° 10' 35" each day, will be four times as distant from her zenith point-

-i.e., by 52° 42' 20", a space which corresponds to the distance she will travel during the transit of the projectile. But as the deviation which the rotatory movement of the earth will impart to the shock must also be taken into account, and as the projectile cannot reach the moon until after a deviation equal to sixteen radii of the earth, which, calculated upon the moon's orbit, is equal to about 11°, it is necessary to add these 11° to those caused by the already-mentioned delay of the moon, or, in round numbers, 64°. Thus, at the moment of firing, the visual radius applied to the moon will describe with the vertical line of the place an angle of 64°.

"Such are the answers to the questions proposed to the Observatory of Cambridge by the members of the Gun Club.

"To sum up--

"1st. The cannon must be placed in a country situated between 0° and 28° of north or south latitude.

"2nd. It must be aimed at the zenith of the place.

"3rd. The projectile must have an initial speed of 12,000 yards a second.

"4th. It must be hurled on December 1st of next year, at 10hrs. 46mins. 40secs. p.m.

"5th. It will meet the moon four days after its departure on December 4th, at midnight precisely, at the moment she arrives at her zenith.

"The members of the Gun Club ought, therefore, at once to commence the labour necessitated by such an enterprise, and be ready to put them into execution at the moment fixed upon, for they will not find the moon in the same conditions of perigee and zenith till eighteen years and eleven days later.

"The staff of the Observatory of Cambridge puts itself entirely at their disposition for questions of theoretic astronomy, and begs to join its congratulations to those of the whole of America.

"On behalf of the staff,

"J.M. BELFAST,

"*Director of the Observatory of Cambridge*."

CHAPTER V

.

THE ROMANCE OF THE MOON.

A spectator endowed with infinite power of sight, and placed at the unknown centre round which gravitates the universe, would have seen myriads of atoms filling all space during the chaotic epoch of creation. But by degrees, as centuries went on, a change took place; a law of gravitation manifested itself which the wandering atoms obeyed; these atoms, combined chemically according to their affinities, formed themselves into molecules, and made those nebulous masses with which the depths of the heavens are strewed.

These masses were immediately animated by a movement of rotation round their central point. This centre, made of vague molecules, began to turn on itself whilst progressively condensing; then, following the immutable laws of mechanics, in proportion as its volume became diminished by condensation its movement of rotation was accelerated, and these two effects persisting, there resulted a principal planet, the centre of the nebulous mass.

By watching attentively the spectator would then have seen other molecules in the mass behave like the central planet, and condense in the same manner by a movement of progressively-accelerated rotation, and gravitate round it under the form of innumerable stars. The nebulae, of which astronomers count nearly 5,000 at present, were formed.

Amongst these 5,000 nebulae there is one that men have called the Milky Way, and which contains eighteen millions of stars, each of which has become the centre of a solar world.

If the spectator had then specially examined amongst these eighteen millions of stars one of the most modest and least brilliant, a star of the fourth order, the one that proudly named itself the sun, all the phenomena to which the formation of the universe is due would have successively taken place under his eyes.

In fact, he would have perceived this sun still in its gaseous state, and composed of mobile molecules; he would have perceived it turning on its own axis to finish its work of concentration. This movement, faithful to the laws of mechanics, would have been accelerated by the diminution of volume, and a time would have come when the centrifugal force would have overpowered the centripetal, which causes the molecules all to tend towards the centre.

Then another phenomenon would have passed before the eyes of the spectator, and the molecules situated in the plane of the equator would have formed several concentric rings like that of Saturn round the sun. In their turn these rings of cosmic matter, seized with a movement of rotation round the central mass, would have been broken up into secondary nebulae--that is to say, into planets.

If the spectator had then concentrated all his attention on these planets he would have seen them behave exactly like the sun and give birth to one or more cosmic rings, origin of those secondary bodies which we call satellites.

Thus in going up from the atom to the molecule, from the molecule to the nebulae, and from the nebulae to the principal star, from the principal star to the sun, from the sun to the planet, and from the planet to the satellite, we have the whole series of transformations undergone by the celestial powers from the first days of the universe.

The sun seems lost amidst the immensities of the stellar universe, and yet it is related, by actual theories of science, to the nebula of the Milky Way. Centre of a world, and small as it appears amidst the ethereal regions, it is still enormous, for its size is 1,400,000 times that of the earth. Around it gravitate eight planets, struck off from its own mass in the first days of creation. These are, in proceeding from the nearest to the most distant, Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Between Mars and Jupiter circulate regularly other smaller bodies, the wandering _débris_, perhaps, of a star broken up into thousands of pieces, of which the telescope has discovered eighty-two at present. Some of these asteroids are so small that they could be walked round in a single day by going at a gymnastic pace.

Of these attendant bodies which the sun maintains in their elliptical orbit by the great law of gravitation, some possess satellites of their own. Uranus has eight, Saturn eight, Jupiter four, Neptune three perhaps, and the Earth one; this latter, one of the least important of the solar world, is called the Moon, and it is that

one that the enterprising genius of the Americans means to conquer.

The Queen of Night, from her relative proximity and the spectacle rapidly renewed of her different phases, at first divided the attention of the inhabitants of the earth with the sun; but the sun tires the eyesight, and the splendour of its light forces its admirers to lower their eyes.

The blonde Phoebe, more humane, graciously allows herself to be seen in her modest grace; she is gentle to the eye, not ambitious, and yet she sometimes eclipses her brother the radiant Apollo, without ever being eclipsed by him. The Mahommedans understood what gratitude they owed to this faithful friend of the earth, and they ruled their months at 29-1/2 days on her revolution.

The first people of the world dedicated particular worship to this chaste goddess. The Egyptians called her Isis, the Phoenicians Astarte, the Greeks Phoebe, daughter of Jupiter and Latona, and they explained her eclipses by the mysterious visits of Diana and the handsome Endymion. The mythological legend relates that the Nemean lion traversed the country of the moon before its apparition upon earth, and the poet Agesianax, quoted by Plutarch, celebrated in his sweet lines its soft eyes, charming nose, and admirable mouth, formed by the luminous parts of the adorable Selene.

But though the ancients understood the character, temperament, and, in a word, moral qualities of the moon from a mythological point of view, the most learned amongst them remained very ignorant of selenography.

Several astronomers, however, of ancient times discovered certain particulars now confirmed by science. Though the Arcadians pretended they had inhabited the earth at an epoch before the moon existed, though Simplicius believed her immovable and fastened to the crystal vault, though Tacitus looked upon her as a fragment broken off from the solar orbit, and Clearch, the disciple of Aristotle, made of her a polished mirror upon which were reflected the images of the ocean--though, in short, others only saw in her a mass of vapours exhaled by the earth, or a globe half fire and half ice that turned on itself, other _savants_, by means of wise observations and without optical instruments, suspected most of the laws that govern the Queen of Night.

Thus Thales of Miletus, B.C. 460, gave out the opinion that the moon was lighted up by the sun. Aristarchus of Samos gave the right explanation of her

phases. Cleomenus taught that she shone by reflected light. Berose the Chaldean discovered that the duration of her movement of rotation was equal to that of her movement of revolution, and he thus explained why the moon always presented the same side. Lastly, Hipparchus, 200 years before the Christian era, discovered some inequalities in the apparent movements of the earth's satellite.

These different observations were afterwards confirmed, and other astronomers profited by them. Ptolemy in the second century, and the Arabian Aboul Wefa in the tenth, completed the remarks of Hipparchus on the inequalities that the moon undergoes whilst following the undulating line of its orbit under the action of the sun. Then Copernicus, in the fifteenth century, and Tycho Brahe, in the sixteenth, completely exposed the system of the world and the part that the moon plays amongst the celestial bodies.

At that epoch her movements were pretty well known, but very little of her physical constitution was known. It was then that Galileo explained the phenomena of light produced in certain phases by the existence of mountains, to which he gave an average height of 27,000 feet.

After him, Hevelius, an astronomer of Dantzig, lowered the highest altitudes to 15,000 feet; but his contemporary, Riccioli, brought them up again to 21,000 feet.

Herschel, at the end of the eighteenth century, armed with a powerful telescope, considerably reduced the preceding measurements. He gave a height of 11,400 feet to the highest mountains, and brought down the average of different heights to little more than 2,400 feet. But Herschel was mistaken too, and the observations of Schroeter, Louville, Halley, Nasmyth, Bianchini, Pastorff, Lohrman, Gruithuysen, and especially the patient studies of MM. Boeer and Moedler, were necessary to definitely resolve the question. Thanks to these _savants_, the elevation of the mountains of the moon is now perfectly known. Boeer and Moedler measured 1,905 different elevations, of which six exceed 15,000 feet and twenty-two exceed 14,400 feet. Their highest summit towers to a height of 22,606 feet above the surface of the lunar disc.

At the same time the survey of the moon was being completed; she appeared riddled with craters, and her essentially volcanic nature was affirmed by each observation. From the absence of refraction in the rays of the planets occulted by her it is concluded that she can have no atmosphere. This absence of air entails

absence of water; it therefore became manifest that the Selenites, in order to live under such conditions, must have a special organisation, and differ singularly from the inhabitants of the earth.

Lastly, thanks to new methods, more perfected instruments searched the moon without intermission, leaving not a point of her surface unexplored, and yet her diameter measures 2,150 miles; her surface is one-thirteenth of the surface of the globe, and her volume one-forty-ninth of the volume of the terrestrial spheroid; but none of her secrets could escape the astronomers' eyes, and these clever *savants* carried their wonderful observations still further.

Thus they remarked that when the moon was at her full the disc appeared in certain places striped with white lines, and during her phases striped with black lines. By prosecuting the study of these with greater precision they succeeded in making out the exact nature of these lines. They are long and narrow furrows sunk between parallel ridges, bordering generally upon the edges of the craters; their length varied from ten to one hundred miles, and their width was about 1,600 yards. Astronomers called them furrows, and that was all they could do; they could not ascertain whether they were the dried-up beds of ancient rivers or not. The Americans hope, some day or other, to determine this geological question. They also undertake to reconnoitre the series of parallel ramparts discovered on the surface of the moon by Gruithuysen, a learned professor of Munich, who considered them to be a system of elevated fortifications raised by Selenite engineers. These two still obscure points, and doubtless many others, can only be definitely settled by direct communication with the moon.

As to the intensity of her light there is nothing more to be learnt; it is 300,000 times weaker than that of the sun, and its heat has no appreciable action upon thermometers; as to the phenomenon known as the "ashy light," it is naturally explained by the effect of the sun's rays transmitted from the earth to the moon, and which seem to complete the lunar disc when it presents a crescent form during its first and last phases.

Such was the state of knowledge acquired respecting the earth's satellite which the Gun Club undertook to perfect under all its aspects, cosmographical, geographical, geological, political, and moral.

CHAPTER VI

.

WHAT IT IS IMPOSSIBLE TO IGNORE AND WHAT IS NO LONGER ALLOWED TO BE BELIEVED IN THE UNITED STATES.

The immediate effect of Barbicane's proposition was that of bringing out all astronomical facts relative to the Queen of Night. Everybody began to study her assiduously. It seemed as if the moon had appeared on the horizon for the first time, and that no one had ever seen her in the sky before. She became the fashion; she was the lion of the day, without appearing less modest on that account, and took her place amongst the "stars" without being any the prouder. The newspapers revived old anecdotes in which this "Sun of the wolves" played a part; they recalled the influence which the ignorance of past ages had ascribed to her; they sang about her in every tone; a little more and they would have quoted her witty sayings; the whole of America was filled with selenomania.

The scientific journals treated the question which touched upon the enterprise of the Gun Club more specially; they published the letter from the Observatory of Cambridge, they commented upon it and approved of it without reserve.

In short, even the most ignorant Yankee was no longer allowed to be ignorant of a single fact relative to his satellite, nor, to the oldest women amongst them, to have any superstitions about her left. Science flooded them; it penetrated into their eyes and ears; it was impossible to be an ass--in astronomy.

Until then many people did not know how the distance between the earth and the moon had been calculated. This fact was taken advantage of to explain to them that it was done by measuring the parallax of the moon. If the word "parallax" seemed new to them, they were told it was the angle formed by two straight lines drawn from either extremity of the earth's radius to the moon. If they were in doubt about the perfection of this method, it was immediately proved to them that not only was the mean distance 234,347 miles, but that astronomers were right to within seventy miles.

To those who were not familiar with the movements of the moon, the newspapers demonstrated daily that she possesses two distinct movements, the first being that of rotation upon her axis, the second that of revolution round the earth, accomplishing both in the same time--that is to say, in 27-1/3 days.

The movement of rotation is the one that causes night and day on the surface of

the moon, only there is but one day and one night in a lunar month, and they each last 354-1/3 hours. But, happily, the face, turned towards the terrestrial globe, is lighted by it with an intensity equal to the light of fourteen moons. As to the other face, the one always invisible, it has naturally 354 hours of absolute night, tempered only by "the pale light that falls from the stars." This phenomenon is due solely to the peculiarity that the movements of rotation and revolution are accomplished in rigorously equal periods, a phenomenon which, according to Cassini and Herschel, is common to the satellites of Jupiter, and, very probably to the other satellites.

Some well-disposed but rather unyielding minds did not quite understand at first how, if the moon invariably shows the same face to the earth during her revolution, she describes one turn round herself in the same period of time. To such it was answered--"Go into your dining-room, and turn round the table so as always to keep your face towards the centre; when your circular walk is ended you will have described one circle round yourselves, since your eye will have successively traversed every point of the room. Well, then, the room is the heavens, the table is the earth, and you are the moon!"

And they go away delighted with the comparison.

Thus, then, the moon always presents the same face to the earth; still, to be quite exact, it should be added that in consequence of certain fluctuations from north to south and from west to east, called libration, she shows rather more than the half of her disc, about 0.57.

When the ignoramuses knew as much as the director of the Cambridge Observatory about the moon's movement of rotation they began to make themselves uneasy about her movement of revolution round the earth, and twenty scientific reviews quickly gave them the information they wanted. They then learnt that the firmament, with its infinite stars, may be looked upon as a vast dial upon which the moon moves, indicating the time to all the inhabitants of the earth; that it is in this movement that the Queen of Night shows herself in her different phases, that she is full when she is in opposition with the sun--that is to say, when the three bodies are on a line with each other, the earth being in the centre; that the moon is new when she is in conjunction with the sun--that is to say, when she is between the sun and the earth; lastly, that the moon is in her first or last quarter when she makes, with the sun and the earth, a right angle of which she occupies the apex.

Some perspicacious Yankees inferred in consequence that eclipses could only take place at the periods of conjunction or opposition, and their reasoning was just. In conjunction the moon can eclipse the sun, whilst in opposition it is the earth that can eclipse him in her turn; and the reason these eclipses do not happen twice in a lunar month is because the plane upon which the moon moves is elliptical like that of the earth.

As to the height which the Queen of Night can attain above the horizon, the letter from the Observatory of Cambridge contained all that can be said about it. Every one knew that this height varies according to the latitude of the place where the observation is taken. But the only zones of the globe where the moon reaches her zenith--that is to say, where she is directly above the heads of the spectators--are necessarily comprised between the 28th parallels and the equator. Hence the important recommendation given to attempt the experiment upon some point in this part of the globe, in order that the projectile may be hurled perpendicularly, and may thus more quickly escape the attraction of gravitation. This was a condition essential to the success of the enterprise, and public opinion was much exercised thereupon.

As to the line followed by the moon in her revolution round the earth, the Observatory of Cambridge had demonstrated to the most ignorant that it is an ellipse of which the earth occupies one of the foci. These elliptical orbits are common to all the planets as well as to all the satellites, and rational mechanism rigorously proves that it could not be otherwise. It was clearly understood that when at her apogee the moon was farthest from the earth, and when at her perigee she was nearest to our planet.

This, therefore, was what every American knew whether he wished to or no, and what no one could decently be ignorant of. But if these true principles rapidly made their way, certain illusive fears and many errors were with difficulty cleared away.

Some worthy people maintained, for instance, that the moon was an ancient comet, which, whilst travelling along its elongated orbit round the sun, passed near to the earth, and was retained in her circle of attraction. The drawing-room astronomers pretended to explain thus the burnt aspect of the moon, a misfortune of which they accused the sun. Only when they were told to notice that comets have an atmosphere, and that the moon has little or none, they did not know what to answer.

Others belonging to the class of "Shakers" manifested certain fears about the moon; they had heard that since the observations made in the times of the Caliphs her movement of revolution had accelerated in a certain proportion; they thence very logically concluded that an acceleration of movement must correspond to a diminution in the distance between the two bodies, and that this double effect going on infinitely the moon would one day end by falling into the earth. However, they were obliged to reassure themselves and cease to fear for future generations when they were told that according to the calculations of Laplace, an illustrious French mathematician, this acceleration of movement was restricted within very narrow limits, and that a proportional diminution will follow it. Thus the equilibrium of the solar world cannot be disturbed in future centuries.

Lastly there was the superstitious class of ignoramuses to be dealt with; these are not content with being ignorant; they know what does not exist, and about the moon they know a great deal. Some of them considered her disc to be a polished mirror by means of which people might see themselves from different points on the earth, and communicate their thoughts to one another. Others pretended that out of 1,000 new moons 950 had brought some notable change, such as cataclysms, revolutions, earthquakes, deluges, &c.; they therefore believed in the mysterious influence of the Queen of Night on human destinies; they think that every Selenite is connected by some sympathetic tie with each inhabitant of the earth; they pretend, with Dr. Mead, that she entirely governs the vital system--that boys are born during the new moon and girls during her last quarter, &c., &c. But at last it became necessary to give up these vulgar errors, to come back to truth; and if the moon, stripped of her influence, lost her prestige in the minds of courtesans of every power, if some turned their backs on her, the immense majority were in her favour. As to the Yankees, they had no other ambition than that of taking possession of this new continent of the sky, and to plant upon its highest summit the star-spangled banner of the United States of America.

CHAPTER VII

.

THE HYMN OF THE CANNON-BALL.

The Cambridge Observatory had, in its memorable letter of October 7th, treated

the question from an astronomical point of view--the mechanical point had still to be treated. It was then that the practical difficulties would have seemed insurmountable to any other country but America; but there they were looked upon as play.

President Barbicane had, without losing any time, nominated a working committee in the heart of the Gun Club. This committee was in three sittings to elucidate the three great questions of the cannon, the projectile, and the powder. It was composed of four members very learned upon these matters. Barbicane had the casting vote, and with him were associated General Morgan, Major Elphinstone, and, lastly, the inevitable J.T. Maston, to whom were confided the functions of secretary.

On the 8th of October the committee met at President Barbicane's house, No. 3, Republican-street; as it was important that the stomach should not trouble so important a debate, the four members of the Gun Club took their seats at a table covered with sandwiches and teapots. J.T. Maston immediately screwed his pen on to his steel hook and the business began.

Barbicane opened the meeting as follows:--

"Dear colleagues," said he, "we have to solve one of the more important problems in ballistics--that greatest of sciences which treats of the movement of projectiles--that is to say, of bodies hurled into space by some power of impulsion and then left to themselves."

"Oh, ballistics, ballistics!" cried J.T. Maston in a voice of emotion.

"Perhaps," continued Barbicane, "the most logical thing would be to consecrate this first meeting to discussing the engine."

"Certainly," answered General Morgan.

"Nevertheless," continued Barbicane, "after mature deliberation, it seems to me that the question of the projectile ought to precede that of the cannon, and that the dimensions of the latter ought to depend upon the dimensions of the former."

J.T. Maston here interrupted the president, and was heard with the attention which his magnificent past career deserved.

"My dear friends," said he in an inspired tone, "our president is right to give the question of the projectile the precedence of every other; the cannon-ball we mean to hurl at the moon will be our messenger, our ambassador, and I ask your permission to regard it from an entirely moral point of view."

This new way of looking at a projectile excited the curiosity of the members of the committee; they therefore listened attentively to the words of J.T. Maston.

"My dear colleagues," he continued, "I will be brief. I will lay aside the material projectile--the projectile that kills--in order to take up the mathematical projectile--the moral projectile. A cannon-ball is to me the most brilliant manifestation of human power, and by creating it man has approached nearest to the Creator!"

"Hear, hear!" said Major Elphinstone.

"In fact," cried the orator, "if God has made the stars and the planets, man has made the cannon-ball--that criterion of terrestrial speed--that reduction of bodies wandering in space which are really nothing but projectiles. Let Providence claim the speed of electricity, light, the stars, comets, planets, satellites, sound, and wind! But ours is the speed of the cannon-ball--a hundred times greater than that of trains and the fastest horses!"

J.T. Maston was inspired; his accents became quite lyrical as he chanted the hymn consecrated to the projectile.

"Would you like figures?" continued he; "here are eloquent ones. Take the simple 24 pounder; though it moves 80,000 times slower than electricity, 64,000 times slower than light, 76 times slower than the earth in her movement of translation round the sun, yet when it leaves the cannon it goes quicker than sound; it goes at the rate of 14 miles a minute, 840 miles an hour, 20,100 miles a day--that is to say, at the speed of the points of the equator in the globe's movement of rotation, 7,336,500 miles a year. It would therefore take 11 days to get to the moon, 12 years to get to the sun, 360 years to reach Neptune, at the limits of the solar world. That is what this modest cannon-ball, the work of our hands, can do! What will it be, therefore, when, with twenty times that speed, we shall hurl it with a rapidity of seven miles a second? Ah! splendid shot! superb projectile! I like to think you will be received up there with the honours due to a terrestrial ambassador!"

Cheers greeted this brilliant peroration, and J.T. Maston, overcome with emotion, sat down amidst the felicitations of his colleagues.

"And now," said Barbicane, "that we have given some time to poetry, let us proceed to facts."

"We are ready," answered the members of the committee as they each demolished half-a-dozen sandwiches.

"You know what problem it is we have to solve," continued the president; "it is that of endowing a projectile with a speed of 12,000 yards per second. I have every reason to believe that we shall succeed, but at present let us see what speeds we have already obtained; General Morgan can edify us upon that subject."

"So much the more easily," answered the general, "because during the war I was a member of the Experiment Commission. The 100-pound cannon of Dahlgren, with a range of 5,000 yards, gave their projectiles an initial speed of 500 yards a second."

"Yes; and the Rodman Columbiad?" (the Americans gave the name of "Columbiad" to their enormous engines of destruction) asked the president.

"The Rodman Columbiad, tried at Fort Hamilton, near New York, hurled a projectile, weighing half a ton, a distance of six miles, with a speed of 800 yards a second, a result which neither Armstrong nor Palliser has obtained in England."

"Englishmen are nowhere!" said J.T. Maston, pointing his formidable steel hook eastward.

"Then," resumed Barbicane, "a speed of 800 yards is the maximum obtained at present."

"Yes," answered Morgan.

"I might add, however," replied J.T. Maston, "that if my mortar had not been blown up--"

"Yes, but it was blown up," replied Barbicane with a benevolent gesture. "We

must take the speed of 800 yards for a starting point. We must keep till another meeting the discussion of the means used to produce this speed; allow me to call your attention to the dimensions which our projectile must have. Of course it must be something very different to one of half a ton weight."

"Why?" asked the major.

"Because," quickly answered J.T. Maston, "it must be large enough to attract the attention of the inhabitants of the moon, supposing there are any."

"Yes," answered Barbicane, "and for another reason still more important."

"What do you mean, Barbicane?" asked the major.

"I mean that it is not enough to send up a projectile and then to think no more about it; we must follow it in its transit."

"What?" said the general, slightly surprised at the proposition.

"Certainly," replied Barbicane, like a man who knew what he was saying, "or our experiment will be without result."

"But then," replied the major, "you will have to give the projectile enormous dimensions."

"No. Please grant me your attention. You know that optical instruments have acquired great perfection; certain telescopes increase objects six thousand, and bring the moon to within a distance of forty miles. Now at that distance objects sixty feet square are perfectly visible. The power of penetration of the telescope has not been increased, because that power is only exercised to the detriment of their clearness, and the moon, which is only a reflecting mirror, does not send a light intense enough for the telescopes to increase objects beyond that limit."

"Very well, then, what do you mean to do?" asked the general. "Do you intend giving a diameter of sixty feet to your projectile?"

"No."

"You are not going to take upon yourself the task of making the moon more luminous?"

"I am, though."

"That's rather strong!" exclaimed Maston.

"Yes, but simple," answered Barbicane. "If I succeed in lessening the density of the atmosphere which the moon's light traverses, shall I not render that light more intense?"

"Evidently."

"In order to obtain that result I shall only have to establish my telescope upon some high mountain. We can do that."

"I give in," answered the major; "you have such a way of simplifying things! What enlargement do you hope to obtain thus?"

"One of 48,000 times, which will bring the moon within five miles only, and objects will only need a diameter of nine feet."

"Perfect!" exclaimed J.T. Maston; "then our projectile will have a diameter of nine feet?"

"Precisely."

"Allow me to inform you, however," returned Major Elphinstone, "that its weight will still be--"

"Oh, major!" answered Barbicane, "before discussing its weight allow me to tell you that our forefathers did marvels in that way. Far be it from me to pretend that ballistics have not progressed, but it is well to know that in the Middle Ages surprising results were obtained, I dare affirm, even more surprising than ours."

"Justify your statement," exclaimed J.T. Maston.

"Nothing is easier," answered Barbicane; "I can give you some examples. At the siege of Constantinople by Mahomet II., in 1453, they hurled stone bullets that weighed 1,900 lbs.; at Malta, in the time of its knights, a certain cannon of Fort Saint Elme hurled projectiles weighing 2,500 lbs. According to a French historian, under Louis XI. a mortar hurled a bomb of 500 lbs. only; but that bomb, fired at the Bastille, a place where mad men imprisoned wise ones, fell at

Charenton, where wise men imprison mad ones."

"Very well," said J.T. Maston.

"Since, what have we seen, after all? The Armstrong cannons hurl projectiles of 500 lbs., and the Rodman Columbiads projectiles of half a ton! It seems, then, that if projectiles have increased in range they have lost in weight. Now, if we turn our efforts in that direction, we must succeed with the progress of the science in doubling the weight of the projectiles of Mahomet II. and the Knights of Malta."

"That is evident," answered the major; "but what metal do you intend to employ for your own projectile?"

"Simply cast-iron," said General Morgan.

"Cast-iron!" exclaimed J.T. Maston disdainfully, "that's very common for a bullet destined to go to the moon."

"Do not let us exaggerate, my honourable friend," answered Morgan; "cast-iron will be sufficient."

"Then," replied Major Elphinstone, "as the weight of the projectile is in proportion to its volume, a cast-iron bullet, measuring nine feet in diameter, will still be frightfully heavy."

"Yes, if it be solid, but not if it be hollow," said Barbicane.

"Hollow!--then it will be an obus?"

"In which we can put despatches," replied J.T. Maston, "and specimens of our terrestrial productions."

"Yes, an obus," answered Barbicane; "that is what it must be; a solid bullet of 108 inches would weigh more than 200,000 lbs., a weight evidently too great; however, as it is necessary to give the projectile a certain stability, I propose to give it a weight of 20,000 lbs."

"What will be the thickness of the metal?" asked the major.

"If we follow the usual proportions," replied Morgan, "a diameter of 800 inches demands sides two feet thick at least."

"That would be much too thick," answered Barbicane; "we do not want a projectile to pierce armour-plate; it only needs sides strong enough to resist the pressure of the powder-gas. This, therefore, is the problem:--What thickness ought an iron obus to have in order to weigh only 20,000 lbs.? Our clever calculator, Mr. Maston, will tell us at once."

"Nothing is easier," replied the honourable secretary.

So saying, he traced some algebraical signs on the paper, amongst which n^2 and x^2 frequently appeared. He even seemed to extract from them a certain cubic root, and said--

"The sides must be hardly two inches thick."

"Will that be sufficient?" asked the major doubtfully.

"No," answered the president, "certainly not."

"Then what must be done?" resumed Elphinstone, looking puzzled.

"We must use another metal instead of cast-iron."

"Brass?" suggested Morgan.

"No; that is too heavy too, and I have something better than that to propose."

"What?" asked the major.

"Aluminium," answered Barbicane.

"Aluminium!" cried all the three colleagues of the president.

"Certainly, my friends. You know that an illustrious French chemist, Henry St. Claire Deville, succeeded in 1854 in obtaining aluminium in a compact mass. This precious metal possesses the whiteness of silver, the indestructibility of gold, the tenacity of iron, the fusibility of copper, the lightness of glass; it is easily wrought, and is very widely distributed in nature, as aluminium forms the

basis of most rocks; it is three times lighter than iron, and seems to have been created expressly to furnish us with the material for our projectile!"

"Hurrah for aluminium!" cried the secretary, always very noisy in his moments of enthusiasm.

"But, my dear president," said the major, "is not aluminium quoted exceedingly high?"

"It was so," answered Barbicane; "when first discovered a pound of aluminium cost 260 to 280 dollars; then it fell to twenty-seven dollars, and now it is worth nine dollars."

"But nine dollars a pound," replied the major, who did not easily give in; "that is still an enormous price."

"Doubtless, my dear major; but not out of reach."

"What will the projectile weigh, then?" asked Morgan.

"Here is the result of my calculations," answered Barbicane. "A projectile of 108 inches in diameter and 12 inches thick would weigh, if it were made of cast-iron, 67,440 lbs.; cast in aluminium it would be reduced to 19,250 lbs."

"Perfect!" cried Maston; "that suits our programme capitally."

"Yes," replied the major; "but do you not know that at nine dollars a pound the projectile would cost--"

"One hundred seventy-three thousand and fifty dollars. Yes, I know that; but fear nothing, my friends; money for our enterprise will not be wanting, I answer for that."

"It will be showered upon us," replied J.T. Maston.

"Well, what do you say to aluminium?" asked the president.

"Adopted," answered the three members of the committee.

"As to the form of the projectile," resumed Barbicane, "it is of little

consequence, since, once the atmosphere cleared, it will find itself in empty space; I therefore propose a round ball, which will turn on itself, if it so pleases."

Thus ended the first committee meeting. The question of the projectile was definitely resolved upon, and J.T. Maston was delighted with the idea of sending an aluminium bullet to the Selenites, "as it will give them no end of an idea of the inhabitants of the earth!"

CHAPTER VIII

.

HISTORY OF THE CANNON.

The resolutions passed at this meeting produced a great effect outside. Some timid people grew alarmed at the idea of a projectile weighing 20,000 lbs. hurled into space. People asked what cannon could ever transmit an initial speed sufficient for such a mass. The report of the second meeting was destined to answer these questions victoriously.

The next evening the four members of the Gun Club sat down before fresh mountains of sandwiches and a veritable ocean of tea. The debate then began.

"My dear colleagues," said Barbicane, "we are going to occupy ourselves with the construction of the engine, its length, form, composition, and weight. It is probable that we shall have to give it gigantic dimensions, but, however great our difficulties might be, our industrial genius will easily overcome them. Will you please listen to me and spare objections for the present? I do not fear them."

An approving murmur greeted this declaration.

"We must not forget," resumed Barbicane, "to what point our yesterday's debate brought us; the problem is now the following: how to give an initial speed of 12,000 yards a second to a shot 108 inches in diameter weighing 20,000 lbs.

"That is the problem indeed," answered Major Elphinstone.

"When a projectile is hurled into space," resumed Barbicane, "what happens? It is acted upon by three independent forces, the resistance of the medium, the

attraction of the earth, and the force of impulsion with which it is animated. Let us examine these three forces. The resistance of the medium--that is to say, the resistance of the air--is of little importance. In fact, the terrestrial atmosphere is only forty miles deep. With a rapidity of 12,000 yards the projectile will cross that in five seconds, and this time will be short enough to make the resistance of the medium insignificant. Let us now pass to the attraction of the earth--that is to say, to the weight of the projectile. We know that that weight diminishes in an inverse ratio to the square of distances--in fact, this is what physics teach us: when a body left to itself falls on the surface of the earth, it falls 15 feet in the first second, and if the same body had to fall 257,542 miles--that is to say, the distance between the earth and the moon--its fall would be reduced to half a line in the first second. That is almost equivalent to immobility. The question is, therefore, how progressively to overcome this law of gravitation. How shall we do it? By the force of impulsion?"

"That is the difficulty," answered the major.

"That is it indeed," replied the president. "But we shall triumph over it, for this force of impulsion we want depends on the length of the engine and the quantity of powder employed, the one only being limited by the resistance of the other. Let us occupy ourselves, therefore, to-day with the dimensions to be given to the cannon. It is quite understood that we can make it, as large as we like, seeing it will not have to be moved."

"All that is evident," replied the general.

"Until now," said Barbicane, "the longest cannon, our enormous Columbiads, have not been more than twenty-five feet long; we shall therefore astonish many people by the dimensions we shall have to adopt."

"Certainly," exclaimed J.T. Maston. "For my part, I ask for a cannon half a mile long at least!"

"Half a mile!" cried the major and the general.

"Yes, half a mile, and that will be half too short."

"Come, Maston," answered Morgan, "you exaggerate."

"No, I do not," said the irate secretary; "and I really do not know why you tax

me with exaggeration."

"Because you go too far."

"You must know, sir," answered J.T. Maston, looking dignified, "that an artilleryman is like a cannon-ball, he can never go too far."

The debate was getting personal, but the president interfered.

"Be calm, my friends, and let us reason it out. We evidently want a gun of great range, as the length of the engine will increase the detention of gas accumulated behind the projectile, but it is useless to overstep certain limits."

"Perfectly," said the major.

"What are the usual rules in such a case? Ordinarily the length of a cannon is twenty or twenty-five times the diameter of the projectile, and it weighs 235 to 240 times its weight."

"It is not enough," cried J.T. Maston with impetuosity.

"I agree to that, my worthy friend, and in fact by keeping that proportion for a projectile nine feet wide, weighing 30,000 lbs., the engine would only have a length of 225 feet and a weight of 7,200,000 lbs."

"That is ridiculous," resumed J.T. Maston. "You might as well take a pistol."

"I think so too," answered Barbicane; "that is why I propose to quadruple that length, and to construct a cannon 900 feet long."

The general and the major made some objections, but, nevertheless, this proposition, strongly supported by the secretary, was definitely adopted.

"Now," said Elphinstone, "what thickness must we give its sides?"

"A thickness of six feet," answered Barbicane.

"You do not think of raising such a mass upon a gun-carriage?" asked the major.

"That would be superb, however! said J.T. Maston.

"But impracticable," answered Barbicane. "No, I think of casting this engine in the ground itself, binding it up with wrought-iron hoops, and then surrounding it with a thick mass of stone and cement masonry. When it is cast it must be bored with great precision so as to prevent windage, so there will be no loss of gas, and all the expansive force of the powder will be employed in the propulsion."

"Hurrah! hurrah!" said Maston, "we have our cannon."

"Not yet," answered Barbicane, calming his impatient friend with his hand.

"Why not?"

"Because we have not discussed its form. Shall it be a cannon, howitzer, or a mortar?"

"A cannon," replied Morgan.

"A howitzer," said the major.

"A mortar," exclaimed J.T. Maston.

A fresh discussion was pending, each taking the part of his favourite weapon, when the president stopped it short.

"My friends," said he, "I will soon make you agree. Our Columbiad will be a mixture of all three. It will be a cannon, because the powder-magazine will have the same diameter as the chamber. It will be a howitzer, because it will hurl an obus. Lastly, it will be a mortar, because it will be pointed at an angle of 90°, and that without any chance of recoil; unalterably fixed to the ground, it will communicate to the projectile all the power of impulsion accumulated in its body."

"Adopted, adopted," answered the members of the committee.

"One question," said Elphinstone, "and will this *canobusomortar* be rifled?"

"No," answered Barbicane. "No, we must have an enormous initial speed, and you know very well that a shot leaves a rifle less rapidly than a smooth-bore."

"True," answered the major.

"Well, we have it this time," repeated J.T. Maston.

"Not quite yet," replied the president.

"Why not?"

"Because we do not yet know of what metal it will be made."

"Let us decide that without delay."

"I was going to propose it to you."

The four members of the committee each swallowed a dozen sandwiches, followed by a cup of tea, and the debate recommenced.

"Our cannon," said Barbicane, "must be possessed of great tenacity, great hardness; it must be infusible by heat, indissoluble, and inoxydable by the corrosive action of acids."

"There is no doubt about that," answered the major, "and as we shall have to employ a considerable quantity of metal we shall not have much choice."

"Well, then," said Morgan, "I propose for the fabrication of the Columbiad the best alloy hitherto known--that is to say, 100 parts of copper, 12 of tin, and 6 of brass."

"My friends," answered the president, "I agree that this composition has given excellent results; but in bulk it would be too dear and very hard to work. I therefore think we must adopt an excellent material, but cheap, such as cast-iron. Is not that your opinion, major?"

"Quite," answered Elphinstone.

"In fact," resumed Barbicane, "cast-iron costs ten times less than bronze; it is easily melted, it is readily run into sand moulds, and is rapidly manipulated; it is, therefore, an economy of money and time. Besides, that material is excellent, and I remember that during the war at the siege of Atlanta cast-iron cannon fired a thousand shots each every twenty minutes without being damaged by it."

"Yet cast-iron is very brittle," answered Morgan.

"Yes, but it possesses resistance too. Besides, we shall not let it explode, I can answer for that."

"It is possible to explode and yet be honest," replied J.T. Maston sententiously.

"Evidently," answered Barbicane. "I am, therefore, going to beg our worthy secretary to calculate the weight of a cast-iron cannon 900 feet long, with an inner diameter of nine feet, and sides six feet thick."

"At once," answered J.T. Maston, and, as he had done the day before, he made his calculations with marvellous facility, and said at the end of a minute--

"This cannon will weigh 68,040 tons."

"And how much will that cost at two cents a pound?"

"Two million five hundred and ten thousand seven hundred and one dollars."

J.T. Maston, the major, and the general looked at Barbicane anxiously.

"Well, gentlemen," said the president, "I can only repeat what I said to you yesterday, don't be uneasy; we shall not want for money."

Upon this assurance of its president the committee broke up, after having fixed a third meeting for the next evening.

CHAPTER IX

.

THE QUESTION OF POWDERS.

The question of powder still remained to be settled. The public awaited this last decision with anxiety. The size of the projectile and length of the cannon being given, what would be the quantity of powder necessary to produce the impulsion? This terrible agent, of which, however, man has made himself master, was destined to play a part in unusual proportions.

It is generally known and often asserted that gunpowder was invented in the

fourteenth century by the monk Schwartz, who paid for his great discovery with his life. But it is nearly proved now that this story must be ranked among the legends of the Middle Ages. Gunpowder was invented by no one; it is a direct product of Greek fire, composed, like it, of sulphur and saltpetre; only since that epoch these mixtures; which were only dissolving, have been transformed into detonating mixtures.

But if learned men know perfectly the false history of gunpowder, few people are aware of its mechanical power. Now this is necessary to be known in order to understand the importance of the question submitted to the committee.

Thus a litre of gunpowder weighs about 2 lbs.; it produces, by burning, about 400 litres of gas; this gas, liberated, and under the action of a temperature of 2,400°, occupies the space of 4,000 litres. Therefore the volume of powder is to the volume of gas produced by its deflagration as 1 to 400. The frightful force of this gas, when it is compressed into a space 4,000 times too small, may be imagined.

This is what the members of the committee knew perfectly when, the next day, they began their sitting. Major Elphinstone opened the debate.

"My dear comrades," said the distinguished chemist, "I am going to begin with some unexceptionable figures, which will serve as a basis for our calculation. The 24-lb. cannon-ball, of which the Hon. J.T. Maston spoke the day before yesterday, is driven out of the cannon by 16 lbs. of powder only."

"You are certain of your figures?" asked Barbicane.

"Absolutely certain," answered the major. "The Armstrong cannon only uses 75 lbs. of powder for a projectile of 800 lbs., and the Rodman Columbiad only expends 160 lbs. of powder to send its half-ton bullet six miles. These facts cannot be doubted, for I found them myself in the reports of the Committee of Artillery."

"That is certain," answered the general.

"Well," resumed the major, "the conclusion to be drawn from these figures is that the quantity of powder does not augment with the weight of the shot; in fact, if a shot of 24 lbs. took 16 lbs. of powder, and, in other terms, if in ordinary cannons a quantity of powder weighing two-thirds of the weight of the projectile is used,

this proportion is not always necessary. Calculate, and you will see that for the shot of half a ton weight, instead of 333 lbs. of powder, this quantity has been reduced to 116 lbs. only.

"What are you driving at?" asked the president.

"The extreme of your theory, my dear major," said J.T. Maston, "would bring you to having no powder at all, provided your shot were sufficiently heavy."

"Friend Maston will have his joke even in the most serious things," replied the major; "but he need not be uneasy; I shall soon propose a quantity of powder that will satisfy him. Only I wish to have it understood that during the war, and for the largest guns, the weight of the powder was reduced, after experience, to a tenth of the weight of the shot."

"Nothing is more exact," said Morgan; "but, before deciding the quantity of powder necessary to give the impulsion, I think it would be well to agree upon its nature."

"We shall use a large-grained powder," answered the major; "its deflagration is the most rapid."

"No doubt," replied Morgan; "but it is very brittle, and ends by damaging the chamber of the gun."

"Certainly; but what would be bad for a gun destined for long service would not be so for our Columbiad. We run no danger of explosion, and the powder must immediately take fire to make its mechanical effect complete."

"We might make several touchholes," said J.T. Maston, "so as to set fire to it in several places at the same time."

"No doubt," answered Elphinstone, "but that would make the working of it more difficult. I therefore come back to my large-grained powder that removes these difficulties."

"So be it," answered the general.

"To load his Columbiad," resumed the major, "Rodman used a powder in grains as large as chestnuts, made of willow charcoal, simply rarefied in cast-iron pans.

This powder was hard and shining, left no stain on the hands, contained a great proportion of hydrogen and oxygen, deflagrated instantaneously, and, though very brittle, did not much damage the mouthpiece."

"Well, it seems to me," answered J.T. Maston, "that we have nothing to hesitate about, and that our choice is made."

"Unless you prefer gold-powder," replied the major, laughing, which provoked a threatening gesture from the steel hook of his susceptible friend.

Until then Barbicane had kept himself aloof from the discussion; he listened, and had evidently an idea. He contented himself with saying simply--

"Now, my friends, what quantity of powder do you propose?"

The three members of the Gun Club looked at one another for the space of a minute.

"Two hundred thousand pounds," said Morgan at last.

"Five hundred thousand," replied the major.

"Eight hundred thousand," exclaimed J.T. Maston.

This, time Elphinstone dared not tax his colleague with exaggeration. In fact, the question was that of sending to the moon a projectile weighing 20,000 lbs., and of giving it an initial force of 2000 yards a second. A moment of silence, therefore, followed the triple proposition made by the three colleagues.

It was at last broken by President Barbicane.

"My brave comrades," said he in a quiet tone, "I start from this principle, that the resistance of our cannon, in the given conditions, is unlimited. I shall, therefore, surprise the Honourable J.T. Maston when I tell him that he has been timid in his calculations, and I propose to double his 800,000 lbs. of powder."

"Sixteen hundred thousand pounds!" shouted J.T. Maston, jumping out of his chair.

"Quite as much as that."

"Then we shall have to come back to my cannon half a mile long."

"It is evident," said the major.

"Sixteen hundred thousand pounds of powder," resumed the Secretary of Committee, "will occupy about a space of 22,000 cubic feet; now, as your cannon will only hold about 54,000 cubic feet, it will be half full, and the chamber will not be long enough to allow the explosion of the gas to give sufficient impulsion to your projectile."

There was nothing to answer. J.T. Maston spoke the truth. They all looked at Barbicane.

"However," resumed the president, "I hold to that quantity of powder. Think! 1,600,000 pounds of powder will give 6,000,000,000 litres of gas."

"Then how is it to be done?" asked the general.

"It is very simple. We must reduce this enormous quantity of powder, keeping at the same time its mechanical power."

"Good! By what means?"

"I will tell you," answered Barbicane simply.

His interlocutors all looked at him.

"Nothing is easier, in fact," he resumed, "than to bring that mass of powder to a volume four times less. You all know that curious cellular matter which constitutes the elementary tissues of vegetables?"

"Ah!" said the major, "I understand you, Barbicane."

"This matter," said the president, "is obtained in perfect purity in different things, especially in cotton, which is nothing but the skin of the seeds of the cotton plant. Now cotton, combined with cold nitric acid, is transformed into a substance eminently insoluble, eminently combustible, eminently explosive. Some years ago, in 1832, a French chemist, Braconnot, discovered this substance, which he called xyloidine. In 1838, another Frenchman, Pelouze, studied its different properties; and lastly, in 1846, Schonbein, professor of

chemistry at Basle, proposed it as gunpowder. This powder is nitric cotton."

"Or pyroxyle," answered Elphinstone.

"Or fulminating cotton," replied Morgan.

"Is there not an American name to put at the bottom of this discovery?" exclaimed J.T. Maston, animated by a lively sentiment of patriotism.

"Not one, unfortunately," replied the major.

"Nevertheless, to satisfy Maston," resumed the president, "I may tell him that one of our fellow-citizens may be annexed to the study of the celluosity, for collodion, which is one of the principal agents in photography, is simply pyroxyle dissolved in ether to which alcohol has been added, and it was discovered by Maynard, then a medical student."

"Hurrah for Maynard and fulminating cotton!" cried the noisy secretary of the Gun Club.

"I return to pyroxyle," resumed Barbicane. "You are acquainted with its properties which make it so precious to us. It is prepared with the greatest facility; cotton plunged in smoking nitric acid for fifteen minutes, then washed in water, then dried, and that is all."

"Nothing is more simple, certainty," said Morgan.

"What is more, pyroxyle is not damaged by moisture, a precious quality in our eyes, as it will take several days to load the cannon. Its inflammability takes place at 170° instead of at 240° and its deflagration is so immediate that it may be fired on ordinary gunpowder before the latter has time to catch fire too."

"Perfect," answered the major.

"Only it will cost more."

"What does that matter?" said J.T. Maston.

"Lastly, it communicates to projectiles a speed four times greater than that of gunpowder. I may even add that if 8/10ths of its weight of nitrate of potash is

added its expansive force is still greatly augmented."

"Will that be necessary?" asked the major.

"I do not think so," answered Barbicane. "Thus instead of 1,600,000 lbs. of powder, we shall only have 400,000 lbs. of fulminating cotton, and as we can, without danger, compress 500 lbs. of cotton into 27 cubic feet, that quantity will not take up more than 180 feet in the chamber of the Columbiad. By these means the projectile will have more than 700 feet of chamber to traverse under a force of 6,000,000,000 of litres of gas before taking its flight over the Queen of Night."

Here J.T. Maston could not contain his emotion. He threw himself into the arms of his friend with the violence of a projectile, and he would have been stove in had he not have been bombproof.

This incident ended the first sitting of the committee. Barbicane and his enterprising colleagues, to whom nothing seemed impossible, had just solved the complex question of the projectile, cannon, and powder. Their plan being made, there was nothing left but to put it into execution.

CHAPTER X

.

ONE ENEMY AGAINST TWENTY-FIVE MILLIONS OF FRIENDS.

The American public took great interest in the least details of the Gun Club's enterprise. It followed the committee debates day by day. The most simple preparations for this great experiment, the questions of figures it provoked, the mechanical difficulties to be solved, all excited popular opinion to the highest pitch.

More than a year would elapse between the commencement of the work and its completion; but the interval would not be void of excitement. The place to be chosen for the boring, the casting the metal of the Columbiad, its perilous loading, all this was more than necessary to excite public curiosity. The projectile, once fired, would be out of sight in a few seconds; then what would

become of it, how it would behave in space, how it would reach the moon, none but a few privileged persons would see with their own eyes. Thus, then, the preparations for the experiment and the precise details of its execution constituted the real source of interest.

In the meantime the purely scientific attraction of the enterprise was all at once heightened by an incident.

It is known what numerous legions of admirers and friends the Barbicane project had called round its author. But, notwithstanding the number and importance of the majority, it was not destined to be unanimous. One man, one out of all the United States, protested against the Gun Club. He attacked it violently on every occasion, and--for human nature is thus constituted--Barbicane was more sensitive to this one man's opposition than to the applause of all the others.

Nevertheless he well knew the motive of this antipathy, from whence came this solitary enmity, why it was personal and of ancient date; lastly, in what rivalry it had taken root.

The president of the Gun Club had never seen this persevering enemy. Happily, for the meeting of the two men would certainly have had disastrous consequences. This rival was a *savant* like Barbicane, a proud, enterprising, determined, and violent character, a pure Yankee. His name was Captain Nicholl. He lived in Philadelphia.

No one is ignorant of the curious struggle which went on during the Federal war between the projectile and ironclad vessels, the former destined to pierce the latter, the latter determined not to be pierced. Thence came a radical transformation in the navies of the two continents. Cannon-balls and iron plates struggled for supremacy, the former getting larger as the latter got thicker. Ships armed with formidable guns went into the fire under shelter of their invulnerable armour. The Merrimac, Monitor, ram Tennessee, and Wechhausen shot enormous projectiles after having made themselves proof against the projectiles of other ships. They did to others what they would not have others do to them, an immoral principle upon which the whole art of war is based.

Now Barbicane was a great caster of projectiles, and Nicholl was an equally great forger of plate-armour. The one cast night and day at Baltimore, the other forged day and night at Philadelphia. Each followed an essentially different

current of ideas.

As soon as Barbicane had invented a new projectile, Nicholl invented a new plate armour. The president of the Gun Club passed his life in piercing holes, the captain in preventing him doing it. Hence a constant rivalry which even touched their persons. Nicholl appeared in Barbicane's dreams as an impenetrable ironclad against which he split, and Barbicane in Nicholl's dreams appeared like a projectile which ripped him up.

Still, although they ran along two diverging lines, these *savants* would have ended by meeting each other in spite of all the axioms in geometry; but then it would have been on a duel field. Happily for these worthy citizens, so useful to their country, a distance of from fifty to sixty miles separated them, and their friends put such obstacles in the way that they never met.

At present it was not clearly known which of the two inventors held the palm. The results obtained rendered a just decision difficult. It seemed, however, that in the end armour-plate would have to give way to projectiles. Nevertheless, competent men had their doubts. At the latest experiments the cylindro-conical shots of Barbicane had no more effect than pins upon Nicholl's armour-plate. That day the forger of Philadelphia believed himself victorious, and henceforth had nothing but disdain for his rival. But when, later on, Barbicane substituted simple howitzers of 600 lbs. for conical shots, the captain was obliged to go down in his own estimation. It fact, these projectiles, though of mediocre velocity, drilled with holes and broke to pieces armour-plate of the best metal.

Things had reached this point and victory seemed to rest with the projectile, when the war ended the very day that Nicholl terminated a new forged armour-plate. It was a masterpiece of its kind. It defied all the projectiles in the world. The captain had it taken to the Washington Polygon and challenged the president of the Gun Club to pierce it. Barbicane, peace having been made, would not attempt the experiment.

Then Nicholl, in a rage, offered to expose his armour-plate to the shock of any kind of projectile, solid, hollow, round, or conical.

The president, who was determined not to compromise his last success, refused.

Nicholl, excited by this unqualified obstinacy, tried to tempt Barbicane by leaving him every advantage. He proposed to put his plate 200 yards from the

gun. Barbicane still refused. At 100 yards? Not even at 75.

"At 50, then," cried the captain, through the newspapers, "at 25 yards from my plate, and I will be behind it."

Barbicane answered that even if Captain Nicholl would be in front of it he would not fire any more.

On this reply, Nicholl could no longer contain himself. He had recourse to personalities; he insinuated cowardice--that the man who refuses to fire a shot from a cannon is very nearly being afraid of it; that, in short, the artillerymen who fight now at six miles distance have prudently substituted mathematical formulae for individual courage, and that there is as much bravery required to quietly wait for a cannon-ball behind armour-plate as to send it according to all the rules of science.

To these insinuations Barbicane answered nothing. Perhaps he never knew about them, for the calculations of his great enterprise absorbed him entirely.

When he made his famous communication to the Gun Club, the anger of Captain Nicholl reached its maximum. Mixed with it was supreme jealousy and a sentiment of absolute powerlessness. How could he invent anything better than a Columbiad 900 feet long? What armour-plate could ever resist a projectile of 30,000 lbs.? Nicholl was at first crushed by this cannon-ball, then he recovered and resolved to crush the proposition by the weight of his best arguments.

He therefore violently attacked the labours of the Gun Club. He sent a number of letters to the newspapers, which they did not refuse to publish. He tried to demolish Barbicane's work scientifically. Once the war begun, he called reasons of every kind to his aid, reasons it must be acknowledged often specious and of bad metal.

Firstly, Barbicane was violently attacked about his figures. Nicholl tried to prove by A + B the falseness of his formulae, and he accused him of being ignorant of the rudimentary principles of ballistics. Amongst other errors, and according to Nicholl's own calculations, it was impossible to give any body a velocity of 12,000 yards a second. He sustained, algebra in hand, that even with that velocity a projectile thus heavy would never pass the limits of the terrestrial atmosphere. It would not even go eight leagues! Better still. Granted the velocity, and taking it as sufficient, the shot would not resist the pressure of the gas

developed by the combustion of 1,600,000 pounds of powder, and even if it did resist that pressure, it at least would not support such a temperature; it would melt as it issued from the Columbiad, and would fall in red-hot rain on the heads of the imprudent spectators.

Barbicane paid no attention to these attacks, and went on with his work.

Then Nicholl considered the question in its other aspects. Without speaking of its uselessness from all other points of view, he looked upon the experiment as exceedingly dangerous, both for the citizens who authorised so condemnable a spectacle by their presence, and for the towns near the deplorable cannon. He also remarked that if the projectile did not reach its destination, a result absolutely impossible, it was evident that it would fall on to the earth again, and that the fall of such a mass multiplied by the square of its velocity would singularly damage some point on the globe. Therefore, in such a circumstance, and without any restriction being put upon the rights of free citizens, it was one of those cases in which the intervention of government became necessary, and the safety of all must not be endangered for the good pleasure of a single individual.

It will be seen to what exaggeration Captain Nicholl allowed himself to be carried. He was alone in his opinion. Nobody took any notice of his Cassandra prophecies. They let him exclaim as much as he liked, till his throat was sore if he pleased. He had constituted himself the defender of a cause lost in advance. He was heard but not listened to, and he did not carry off a single admirer from the president of the Gun Club, who did not even take the trouble to refute his rival's arguments.

Nicholl, driven into his last intrenchments, and not being able to fight for his opinion, resolved to pay for it. He therefore proposed in the *Richmond Inquirer* a series of bets conceived in these terms and in an increasing proportion.

He bet that--

1. The funds necessary for the Gun Club's enterprise would not be forthcoming, 1,000 dols.

2. That the casting of a cannon of 900 feet was impracticable and would not succeed, 2,000 dols.

3. That it would be impossible to load the Columbiad, and that the pyroxyle would ignite spontaneously under the weight of the projectile, 3,000 dols.

4. That the Columbiad would burst at the first discharge, 4,000 dols.

5. That the projectile would not even go six miles, and would fall a few seconds after its discharge, 5,000 dols.

It will be seen that the captain was risking an important sum in his invincible obstinacy. No less than 15,000 dols. were at stake.

Notwithstanding the importance of the wager, he received on the 19th of October a sealed packet of superb laconism, couched in these terms:--

"Baltimore, October 18th.

"Done.

"BARBICANE."

CHAPTER XI

.

FLORIDA AND TEXAS.

There still remained one question to be decided--a place favourable to the experiment had to be chosen. According to the recommendation of the Cambridge Observatory the gun must be aimed perpendicularly to the plane of the horizon--that is to say, towards the zenith. Now the moon only appears in the zenith in the places situated between 0° and 28° of latitude, or, in other terms, when her declination is only 28°. The question was, therefore, to determine the exact point of the globe where the immense Columbiad should be cast.

On the 20th of October the Gun Club held a general meeting. Barbicane brought a magnificent map of the United States by Z. Belltropp. But before he had time to unfold it J.T. Maston rose with his habitual vehemence, and began to speak as follows:--

"Honourable colleagues, the question we are to settle to-day is really of national importance, and will furnish us with an occasion for doing a great act of patriotism."

The members of the Gun Club looked at each other without understanding what the orator was coming to.

"Not one of you," he continued, "would think of doing anything to lessen the glory of his country, and if there is one right that the Union may claim it is that of harbouring in its bosom the formidable cannon of the Gun Club. Now, under the present circumstances--"

"Will you allow me--" said Barbicane.

"I demand the free discussion of ideas," replied the impetuous J.T. Maston, "and I maintain that the territory from which our glorious projectile will rise ought to belong to the Union."

"Certainly," answered several members.

"Well, then, as our frontiers do not stretch far enough, as on the south the ocean is our limit, as we must seek beyond the United States and in a neighbouring country this 28th parallel, this is all a legitimate _casus belli_, and I demand that war should be declared against Mexico!"

"No, no!" was cried from all parts.

"No!" replied J.T. Maston. "I am much astonished at hearing such a word in these precincts!"

"But listen--"

"Never! never!" cried the fiery orator. "Sooner or later this war will be declared, and I demand that it should be this very day."

"Maston," said Barbicane, making his bell go off with a crash, "I agree with you that the experiment cannot and ought not to be made anywhere but on the soil of the Union, but if I had been allowed to speak before, and you had glanced at this map, you would know that it is perfectly useless to declare war against our neighbours, for certain frontiers of the United States extend beyond the 28th

parallel. Look, we have at our disposition all the southern part of Texas and Florida."

This incident had no consequences; still it was not without regret that J.T. Maston allowed himself to be convinced. It was, therefore, decided that the Columbiad should be cast either on the soil of Texas or on that of Florida. But this decision was destined to create an unexampled rivalry between the towns of these two states.

The 28th parallel, when it touches the American coast, crosses the peninsula of Florida, and divides it into two nearly equal portions. Then, plunging into the Gulf of Mexico, it subtends the arc formed by the coasts of Alabama, Mississippi, and Louisiana; then skirting Texas, off which it cuts an angle, it continues its direction over Mexico, crosses the Sonora and Old California, and loses itself in the Pacific Ocean; therefore only the portions of Texas and Florida situated below this parallel fulfilled the requisite conditions of latitude recommended by the Observatory of Cambridge.

The southern portion of Florida contains no important cities. It only bristles with forts raised against wandering Indians. One town only, Tampa Town, could put in a claim in favour of its position.

In Texas, on the contrary, towns are more numerous and more important. Corpus Christi in the county of Nuaces, and all the cities situated on the Rio Bravo, Laredo, Comalites, San Ignacio in Web, Rio Grande city in Starr, Edinburgh in Hidalgo, Santa-Rita, El Panda, and Brownsville in Cameron, formed a powerful league against the pretensions of Florida.

The decision, therefore, was hardly made public before the Floridan and Texican deputies flocked to Baltimore by the shortest way. From that moment President Barbicane and the influential members of the Gun Club were besieged day and night by formidable claims. If seven towns of Greece contended for the honour of being Homer's birthplace, two entire states threatened to fight over a cannon.

These rival parties were then seen marching with weapons about the streets of the town. Every time they met a fight was imminent, which would have had disastrous consequences. Happily the prudence and skill of President Barbicane warded off this danger. Personal demonstrations found an outlet in the newspapers of the different states. It was thus that the *New York Herald* and the

Tribune supported the claims of Texas, whilst the *Times* and the *American Review* took the part of the Floridan deputies. The members of the Gun Club did not know which to listen to.

Texas came up proudly with its twenty-six counties, which it seemed to put in array; but Florida answered that twelve counties proved more than twenty-six in a country six times smaller.

Texas bragged of its 33,000 inhabitants; but Florida, much smaller, boasted of being much more densely populated with 56,000. Besides, Florida accused Texas of being the home of paludian fevers, which carried off, one year with another, several thousands of inhabitants, and Florida was not far wrong.

In its turn Texas replied that Florida need not envy its fevers, and that it was, at least, imprudent to call other countries unhealthy when Florida itself had chronic "vomito negro," and Texas was not far wrong.

"Besides," added the Texicans through the _New York Herald_, "there are rights due to a state that grows the best cotton in all America, a state which produces holm oak for building ships, a state that contains superb coal and mines of iron that yield fifty per cent. of pure ore."

To that the *American Review* answered that the soil of Florida, though not so rich, offered better conditions for the casting of the Columbiad, as it was composed of sand and clay-ground.

"But," answered the Texicans, "before anything can be cast in a place, it must get to that place; now communication with Florida is difficult, whilst the coast of Texas offers Galveston Bay, which is fourteen leagues round, and could contain all the fleets in the world."

"Why," replied the newspapers devoted to Florida, "your Galveston Bay is situated above the 29th parallel, whilst our bay of Espiritu-Santo opens precisely at the 28th degree of latitude, and by it ships go direct to Tampa Town."

"A nice bay truly!" answered Texas; "it is half-choked up with sand."

"Any one would think, to hear you talk," cried Florida, "that I was a savage country."

"Well, the Seminoles do still wander over your prairies!"

"And what about your Apaches and your Comanches--are they civilised?"

The war had been thus kept up for some days when Florida tried to draw her adversary upon another ground, and one morning the *Times* insinuated that the enterprise being "essentially American," it ought only to be attempted upon an "essentially American" territory.

At these words Texas could not contain itself.

"American!" it cried, "are we not as American as you? Were not Texas and Florida both incorporated in the Union in 1845?"

"Certainly," answered the _Times_, "but we have belonged to America since 1820."

"Yes," replied the _Tribune_, "after having been Spanish or English for 200 years, you were sold to the United States for 5,000,000 of dollars!"

"What does that matter?" answered Florida. "Need we blush for that? Was not Louisiana bought in 1803 from Napoleon for 16,000,000 of dollars?"

"It is shameful!" then cried the Texican deputies. "A miserable slice of land like Florida to dare to compare itself with Texas, which, instead of being sold, made itself independent, which drove out the Mexicans on the 2nd of March, 1836, which declared itself Federative Republican after the victory gained by Samuel Houston on the banks of the San Jacinto over the troops of Santa-Anna--a country, in short, which voluntarily joined itself to the United States of America!"

"Because it was afraid of the Mexicans!" answered Florida.

"Afraid!" From the day this word, really too cutting, was pronounced, the situation became intolerable. An engagement was expected between the two parties in the streets of Baltimore. The deputies were obliged to be watched.

President Barbicane was half driven wild. Notes, documents, and letters full of threats inundated his house. Which course ought he to decide upon? In the point of view of fitness of soil, facility of communications, and rapidity of transport,

the rights of the two states were really equal. As to the political personalities, they had nothing to do with the question.

Now this hesitation and embarrassment had already lasted some time when Barbicane resolved to put an end to it; he called his colleagues together, and the solution he proposed to them was a profoundly wise one, as will be seen from the following:--

"After due consideration," said he, "of all that has just occurred between Florida and Texas, it is evident that the same difficulties will again crop up between the towns of the favoured state. The rivalry will be changed from state to city, and that is all. Now Texas contains eleven towns with the requisite conditions that will dispute the honour of the enterprise, and that will create fresh troubles for us, whilst Florida has but one; therefore I decide for Tampa Town!"

The Texican deputies were thunderstruck at this decision. It put them into a terrible rage, and they sent nominal provocations to different members of the Gun Club. There was only one course for the magistrates of Baltimore to take, and they took it. They had the steam of a special train got up, packed the Texicans into it, whether they would or no, and sent them away from the town at a speed of thirty miles an hour.

But they were not carried off too quickly to hurl a last and threatening sarcasm at their adversaries.

Making allusion to the width of Florida, a simple peninsula between two seas, they pretended it would not resist the shock, and would be blown up the first time the cannon was fired.

"Very well! let it be blown up!" answered the Floridans with a laconism worthy of ancient times.

CHAPTER XII

.

"URBI ET ORBI."

The astronomical, mechanical, and topographical difficulties once removed,

there remained the question of money. An enormous sum was necessary for the execution of the project. No private individual, no single state even, could have disposed of the necessary millions.

President Barbicane had resolved--although the enterprise was American--to make it a business of universal interest, and to ask every nation for its financial co-operation. It was the bounded right and duty of all the earth to interfere in the business of the satellite. The subscription opened at Baltimore, for this end extended thence to all the world--*urbi et orbi*.

This subscription was destined to succeed beyond all hope; yet the money was to be given, not lent. The operation was purely disinterested, in the literal meaning of the word, and offered no chance of gain.

But the effect of Barbicane's communication had not stopped at the frontiers of the United States; it had crossed the Atlantic and Pacific, had invaded both Asia and Europe, both Africa and Oceania. The observatories of the Union were immediately put into communication with the observatories of foreign countries; some--those of Paris, St. Petersburg, the Cape, Berlin, Altona, Stockholm, Warsaw, Hamburg, Buda, Bologna, Malta, Lisbon, Benares, Madras, and Pekin--sent their compliments to the Gun Club; the others prudently awaited the result.

As to the Greenwich Observatory, seconded by the twenty-two astronomical establishments of Great Britain, it made short work of it; it boldly denied the possibility of success, and took up Captain Nicholl's theories. Whilst the different scientific societies promised to send deputies to Tampa Town, the Greenwich staff met and contemptuously dismissed the Barbicane proposition. This was pure English jealousy and nothing else.

Generally speaking, the effect upon the world of science was excellent, and from thence it passed to the masses, who, in general, were greatly interested in the question, a fact of great importance, seeing those masses were to be called upon to subscribe a considerable capital.

On the 8th of October President Barbicane issued a manifesto, full of enthusiasm, in which he made appeal to "all persons on the face of the earth willing to help." This document, translated into every language, had great success.

Subscriptions were opened in the principal towns of the Union with a central

office at the Baltimore Bank, 9, Baltimore street; then subscriptions were opened in the different countries of the two continents:--At Vienna, by S.M. de Rothschild; St. Petersburg, Stieglitz and Co.; Paris, Crédit Mobilier; Stockholm, Tottie and Arfuredson; London, N.M. de Rothschild and Son; Turin, Ardouin and Co.; Berlin, Mendelssohn; Geneva, Lombard, Odier, and Co.; Constantinople, Ottoman Bank; Brussels, J. Lambert; Madrid, Daniel Weisweller; Amsterdam, Netherlands Credit Co.; Rome, Torlonia and Co.; Lisbon, Lecesne; Copenhagen, Private Bank; Buenos Ayres, Mana Bank; Rio Janeiro, Mana Bank; Monte Video, Mana Bank; Valparaiso, Thomas La Chambre and Co.; Lima, Thomas La Chambre and Co.; Mexico, Martin Daran and Co.

Three days after President Barbicane's manifesto 400,000 dollars were received in the different towns of the Union. With such a sum in hand the Gun Club could begin at once.

But a few days later telegrams informed America that foreign subscriptions were pouring in rapidly. Certain countries were distinguished by their generosity; others let go their money less easily. It was a matter of temperament.

However, figures are more eloquent than words, and the following is an official statement of the sums paid to the credit of the Gun Club when the subscription was closed:--

The contingent of Russia was the enormous sum of 368,733 roubles. This need astonish no one who remembers the scientific taste of the Russians and the impetus which they have given to astronomical studies, thanks to their numerous observatories, the principal of which cost 2,000,000 roubles.

France began by laughing at the pretensions of the Americans. The moon served as an excuse for a thousand stale puns and a score of vaudevilles in which bad taste contested the palm with ignorance. But, as the French formerly paid after singing, they now paid after laughing, and subscribed a sum of 1,258,930 francs. At that price they bought the right to joke a little.

Austria, in the midst of her financial difficulties, was sufficiently generous. Her part in the public subscription amounted to 216,000 florins, which were welcome.

Sweden and Norway contributed 52,000 rix-dollars. The figure was small

considering the country; but it would certainly have been higher if a subscription had been opened at Christiania as well as at Stockholm. For some reason or other the Norwegians do not like to send their money to Norway.

Prussia, by sending 250,000 thalers, testified her approbation of the enterprise. Her different observatories contributed an important sum, and were amongst the most ardent in encouraging President Barbicane.

Turkey behaved generously, but she was personally interested in the business; the moon, in fact, rules the course of her years and her Ramadan fast. She could do no less than give 1,372,640 piastres, and she gave them with an ardour that betrayed, however, a certain pressure from the Government of the Porte.

Belgium distinguished herself amongst all the second order of States by a gift of 513,000 francs, about one penny and a fraction for each inhabitant.

Holland and her colonies contributed 110,000 florins, only demanding a discount of five per cent., as she paid ready money.

Denmark, rather confined for room, gave, notwithstanding, 9,000 ducats, proving her love for scientific experiments.

The Germanic Confederation subscribed 34,285 florins; more could not be asked from her; besides, she would not have given more.

Although in embarrassed circumstances, Italy found 2,000,000 francs in her children's pockets, but by turning them well inside out. If she had then possessed Venetia she would have given more, but she did not yet possess Venetia.

The Pontifical States thought they could not send less than 7,040 Roman crowns, and Portugal pushed her devotion to the extent of 3,000 cruzades.

Mexico gent the widow's mite, 86 piastres; but empires in course of formation are always in rather embarrassed circumstances.

Switzerland sent the modest sum of 257 francs to the American scheme. It must be frankly stated that Switzerland only looked upon the practical side of the operation; the action of sending a bullet to the moon did not seem of a nature sufficient for the establishing of any communication with the Queen of Night, so Switzerland thought it imprudent to engage capital in an enterprise depending

upon such uncertain events. After all, Switzerland was, perhaps, right.

As to Spain, she found it impossible to get together more than 110 reals. She gave as an excuse that she had her railways to finish. The truth is that science is not looked upon very favourably in that country; it is still a little behindhand. And then certain Spaniards, and not the most ignorant either, had no clear conception of the size of the projectile compared with that of the moon; they feared it might disturb the satellite from her orbit, and make her fall on to the surface of the terrestrial globe. In that case it was better to have nothing to do with it, which they carried out, with that small exception.

England alone remained. The contemptuous antipathy with which she received Barbicane's proposition is known. The English have but a single mind in their 25,000,000 of bodies which Great Britain contains. They gave it to be understood that the enterprise of the Gun Club was contrary "to the principle of non-intervention," and they did not subscribe a single farthing.

At this news the Gun Club contented itself with shrugging its shoulders, and returned to its great work. When South America--that is to say, Peru, Chili, Brazil, the provinces of La Plata and Columbia--had poured into their hands their quota of 300,000 dollars, it found itself possessed of a considerable capital of which the following is a statement:--

United States subscription, 4,000,000 dollars; foreign subscriptions, 1,446,675 dollars; total, 5,446,675 dollars.

This was the large sum poured by the public into the coffers of the Gun Club.

No one need be surprised at its importance. The work of casting, boring, masonry, transport of workmen, and their installation in an almost uninhabited country, the construction of furnaces and workshops, the manufacturing tools, powder, projectile and incidental expenses would, according to the estimates, absorb nearly the whole. Some of the cannon-shots fired during the war cost 1,000 dollars each; that of President Barbicane, unique in the annals of artillery, might well cost 5,000 times more.

On the 20th of October a contract was made with the Goldspring Manufactory, New York, which during the war had furnished Parrott with his best cast-iron guns.

It was stipulated between the contracting parties that the Goldspring Manufactory should pledge itself to send to Tampa Town, in South Florida, the necessary materials for the casting of the Columbiad.

This operation was to be terminated, at the latest, on the 15th of the next October, and the cannon delivered in good condition, under penalty of 100 dollars a day forfeit until the moon should again present herself under the same conditions--that is to say, during eighteen years and eleven days.

The engagement of the workmen, their pay, and the necessary transports all to be made by the Goldspring Company.

This contract, made in duplicate, was signed by I. Barbicane, president of the Gun Club, and J. Murphison, Manager of the Goldspring Manufactory, who thus signed on the part of the contracting parties.

CHAPTER XIII

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STONY HILL.

Since the choice made by the members of the Gun Club to the detriment of Texas, every one in America--where every one knows how to read--made it his business to study the geography of Florida. Never before had the booksellers sold so many _Bertram's Travels in Florida_, _Roman's Natural History of East and West Florida_, _Williams' Territory of Florida_, and *Cleland on the Culture of the Sugar Cane in East Florida*. New editions of these works were required. There was quite a rage for them.

Barbicane had something better to do than to read; he wished to see with his own eyes and choose the site of the Columbiad. Therefore, without losing a moment, he put the funds necessary for the construction of a telescope at the disposition of the Cambridge Observatory, and made a contract with the firm of Breadwill and Co., of Albany, for the making of the aluminium projectile; then he left Baltimore accompanied by J.T. Maston, Major Elphinstone, and the manager of the Goldspring Manufactory.

The next day the four travelling companions reached New Orleans. There they embarked on board the _Tampico_, a despatch-boat belonging to the Federal Navy, which the Government had placed at their disposal, and, with all steam on, they quickly lost sight of the shores of Louisiana.

The passage was not a long one; two days after its departure the _Tampico_, having made four hundred and eighty miles, sighted the Floridian coast. As it approached, Barbicane saw a low, flat coast, looking rather unfertile. After coasting a series of creeks rich in oysters and lobsters, the *Tampico* entered the Bay of Espiritu-Santo.

This bay is divided into two long roadsteads, those of Tampa and Hillisboro, the narrow entrance to which the steamer soon cleared. A short time afterwards the batteries of Fort Brooke rose above the waves and the town of Tampa appeared, carelessly lying on a little natural harbour formed by the mouth of the river Hillisboro.

There the *Tampico* anchored on October 22nd, at seven p.m.; the four passengers landed immediately.

Barbicane felt his heart beat violently as he set foot on Floridian soil; he seemed to feel it with his feet like an architect trying the solidity of a house. J.T. Maston scratched the ground with his steel hook.

"Gentlemen," then said Barbicane, "we have no time to lose, and we will set off on horseback to-morrow to survey the country."

The minute Barbicane landed the three thousand inhabitants of Tampa Town went out to meet him, an honour quite due to the president of the Gun Club, who had decided in their favour. They received him with formidable exclamations, but Barbicane escaped an ovation by shutting himself up in his room at the Franklin Hotel and refusing to see any one.

The next day, October 23rd, small horses of Spanish race, full of fire and vigour, pawed the ground under his windows. But, instead of four, there were fifty, with their riders. Barbicane went down accompanied by his three companions, who were at first astonished to find themselves in the midst of such a cavalcade. He remarked besides that each horseman carried a carbine slung across his shoulders and pistols in his holsters. The reason for such a display of force was immediately given him by a young Floridian, who said to him--

"Sir, the Seminoles are there."

"What Seminoles?"

"Savages who frequent the prairies, and we deemed it prudent to give you an escort."

"Pooh!" exclaimed J.T. Maston as he mounted his steed.

"It is well to be on the safe side," answered the Floridian.

"Gentlemen," replied Barbicane, "I thank you for your attention, and now let us be off."

The little troop set out immediately, and disappeared in a cloud of dust. It was five a.m.; the sun shone brilliantly already, and the thermometer indicated 84°,

but fresh sea breezes moderated this excessive heat.

Barbicane, on leaving Tampa Town, went down south and followed the coast to Alifia Creek. This small river falls into Hillisboro Bay, twelve miles below Tampa Town. Barbicane and his escort followed its right bank going up towards the east. The waves of the bay disappeared behind an inequality in the ground, and the Floridian country was alone in sight.

Florida is divided into two parts; the one to the north, more populous and less abandoned, has Tallahassee for capital, and Pensacola, one of the principal marine arsenals of the United States; the other, lying between the Atlantic and the Gulf of Mexico, is only a narrow peninsula, eaten away by the current of the Gulf Stream--a little tongue of land lost amidst a small archipelago, which the numerous vessels of the Bahama Channel double continually. It is the advanced sentinel of the gulf of great tempests. The superficial area of this state measures 38,033,267 acres, amongst which one had to be chosen situated beyond the 28th parallel and suitable for the enterprise. As Barbicane rode along he attentively examined the configuration of the ground and its particular distribution.

Florida, discovered by Juan Ponce de Leon in 1512, on Palm Sunday, was first of all named *Pascha Florida*. It was well worthy of that designation with its dry and arid coasts. But a few miles from the shore the nature of the ground gradually changed, and the country showed itself worthy of its name; the soil was cut up by a network of creeks, rivers, watercourses, ponds, and small lakes; it might have been mistaken for Holland or Guiana; but the ground gradually rose and soon showed its cultivated plains, where all the vegetables of the North and South grow in perfection, its immense fields, where a tropical sun and the water conserved in its clayey texture do all the work of cultivating, and lastly its prairies of pineapples, yams, tobacco, rice, cotton, and sugarcanes, which extended as far as the eye could reach, spreading out their riches with careless prodigality.

Barbicane appeared greatly satisfied on finding the progressive elevation of the ground, and when J.T. Maston questioned him on the subject,

"My worthy friend," said he, "it is greatly to our interest to cast our Columbiad on elevated ground."

"In order to be nearer the moon?" exclaimed the secretary of the Gun Club.

"No," answered Barbicane, smiling. "What can a few yards more or less matter? No, but on elevated ground our work can be accomplished more easily; we shall not have to struggle against water, which will save us long and expensive tubings, and that has to be taken into consideration when a well 900 feet deep has to be sunk."

"You are right," said Murchison, the engineer; "we must, as much as possible, avoid watercourses during the casting; but if we meet with springs they will not matter much; we can exhaust them with our machines or divert them from their course. Here we have not to work at an artesian well, narrow and dark, where all the boring implements have to work in the dark. No; we can work under the open sky, with spade and pickaxe, and, by the help of blasting, our work will not take long."

"Still," resumed Barbicane, "if by the elevation of the ground or its nature we can avoid a struggle with subterranean waters, we can do our work more rapidly and perfectly; we must, therefore, make our cutting in ground situated some thousands of feet above the level of the sea."

"You are right, Mr. Barbicane, and, if I am not mistaken, we shall soon find a suitable spot."

"I should like to see the first spadeful turned up," said the president.

"And I the last!" exclaimed J.T. Maston.

"We shall manage it, gentlemen," answered the engineer; "and, believe me, the Goldspring Company will not have to pay you any forfeit for delay."

"Faith! it had better not," replied J.T. Maston; "a hundred dollars a day till the moon presents herself in the same conditions--that is to say, for eighteen years and eleven days--do you know that would make 658,000 dollars?"

"No, sir, we do not know, and we shall not need to learn."

About ten a.m. the little troop had journeyed about twelve miles; to the fertile country succeeded a forest region. There were the most varied perfumes in tropical profusion. The almost impenetrable forests were made up of pomegranates, orange, citron, fig, olive, and apricot trees, bananas, huge vines, the blossoms and fruit of which rivalled each other in colour and perfume. Under

the perfumed shade of these magnificent trees sang and fluttered a world of brilliantly-coloured birds, amongst which the crab-eater deserved a jewel casket, worthy of its feathered gems, for a nest.

J.T. Maston and the major could not pass through such opulent nature without admiring its splendid beauty.

But President Barbicane, who thought little of these marvels, was in a hurry to hasten onwards; this country, so fertile, displeased him by its very fertility; without being otherwise hydropical, he felt water under his feet, and sought in vain the signs of incontestable aridity.

In the meantime they journeyed on. They were obliged to ford several rivers, and not without danger, for they were infested with alligators from fifteen to eighteen feet long. J.T. Maston threatened them boldly with his formidable hook, but he only succeeded in frightening the pelicans, phaetons, and teals that frequented the banks, while the red flamingoes looked on with a stupid stare.

At last these inhabitants of humid countries disappeared in their turn. The trees became smaller and more thinly scattered in smaller woods; some isolated groups stood amidst immense plains where ranged herds of startled deer.

"At last!" exclaimed Barbicane, rising in his stirrups. "Here is the region of pines."

"And savages," answered the major.

In fact, a few Seminoles appeared on the horizon. They moved about backwards and forwards on their fleet horses, brandishing long lances or firing their guns with a dull report. However, they confined themselves to these hostile demonstrations, which had no effect on Barbicane and his companions.

They were then in the middle of a rocky plain, a vast open space of several acres in extent which the sun covered with burning rays. It was formed by a wide elevation of the soil, and seemed to offer to the members of the Gun Club all the required conditions for the construction of their Columbiad.

"Halt!" cried Barbicane, stopping. "Has this place any name?"

"It is called Stony Hill," answered the Floridians.

Barbicane, without saying a word, dismounted, took his instruments, and began to fix his position with extreme precision. The little troop drawn up around him watched him in profound silence.

At that moment the sun passed the meridian. Barbicane, after an interval, rapidly noted the result of his observation, and said--

"This place is situated 1,800 feet above the sea level in lat. 27° 7' and West long. 5° 7' by the Washington meridian. It appears to me by its barren and rocky nature to offer every condition favourable to our enterprise; we will therefore raise our magazines, workshops, furnaces, and workmen's huts here, and it is from this very spot," said he, stamping upon it with his foot, "the summit of Stony Hill, that our projectile will start for the regions of the solar world!"

CHAPTER XIV

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PICKAXE AND TROWEL.

That same evening Barbicane and his companions returned to Tampa Town, and Murchison, the engineer, re-embarked on board the *Tampico* for New Orleans. He was to engage an army of workmen to bring back the greater part of the working-stock. The members of the Gun Club remained at Tampa Town in order to set on foot the preliminary work with the assistance of the inhabitants of the country.

Eight days after its departure the *Tampico* returned to the Espiritu-Santo Bay with a fleet of steamboats. Murchison had succeeded in getting together 1,500 workmen. In the evil days of slavery he would have lost his time and trouble; but since America, the land of liberty, has only contained freemen, they flock wherever they can get good pay. Now money was not wanting to the Gun Club; it offered a high rate of wages with considerable and proportionate perquisites. The workman enlisted for Florida could, once the work finished, depend upon a capital placed in his name in the bank of Baltimore.

Murchison had therefore only to pick and choose, and could be severe about the intelligence and skill of his workmen. He enrolled in his working legion the pick

of mechanics, stokers, iron-founders, lime-burners, miners, brickmakers, and artisans of every sort, white or black without distinction of colour. Many of them brought their families with them. It was quite an emigration.

On the 31st of October, at 10 a.m., this troop landed on the quays of Tampa Town. The movement and activity which reigned in the little town that had thus doubled its population in a single day may be imagined. In fact, Tampa Town was enormously benefited by this enterprise of the Gun Club, not by the number of workmen who were immediately drafted to Stony Hill, but by the influx of curious idlers who converged by degrees from all points of the globe towards the Floridian peninsula.

During the first few days they were occupied in unloading the flotilla of the tools, machines, provisions, and a large number of plate iron houses made in pieces separately pieced and numbered. At the same time Barbicane laid the first sleepers of a railway fifteen miles long that was destined to unite Stony Hill and Tampa Town.

It is known how American railways are constructed, with capricious bends, bold slopes, steep hills, and deep valleys. They do not cost much and are not much in their way, only their trains run off or jump off as they please. The railway from Tampa Town to Stony Hill was but a trifle, and wanted neither much time nor much money for its construction.

Barbicane was the soul of this army of workmen who had come at his call. He animated them, communicated to them his ardour, enthusiasm, and conviction. He was everywhere at once, as if endowed with the gift of ubiquity, and always followed by J.T. Maston, his bluebottle fly. His practical mind invented a thousand things. With him there were no obstacles, difficulties, or embarrassment. He was as good a miner, mason, and mechanic as he was an artilleryman, having an answer to every question, and a solution to every problem. He corresponded actively with the Gun Club and the Goldspring Manufactory, and day and night the *Tampico* kept her steam up awaiting his orders in Hillisboro harbour.

Barbicane, on the 1st of November, left Tampa Town with a detachment of workmen, and the very next day a small town of workmen's houses rose round Stony Hill. They surrounded it with palisades, and from its movement and ardour it might soon have been taken for one of the great cities of the Union.

Life was regulated at once and work began in perfect order.

Careful boring had established the nature of the ground, and digging was begun on November 4th. That day Barbicane called his foremen together and said to them--

"You all know, my friends, why I have called you together in this part of Florida. We want to cast a cannon nine feet in diameter, six feet thick, and with a stone revetment nineteen and a half feet thick; we therefore want a well 60 feet wide and 900 feet deep. This large work must be terminated in nine months. You have, therefore, 2,543,400 cubic feet of soil to dig out in 255 days--that is to say, 10,000 cubic feet a day. That would offer no difficulty if you had plenty of elbow-room, but as you will only have a limited space it will be more trouble. Nevertheless as the work must be done it will be done, and I depend upon your courage as much as upon your skill."

At 8 a.m. the first spadeful was dug out of the Floridian soil, and from that moment this useful tool did not stop idle a moment in the hands of the miner. The gangs relieved each other every three hours.

Besides, although the work was colossal it did not exceed the limit of human capability. Far from that. How many works of much greater difficulty, and in which the elements had to be more directly contended against, had been brought to a successful termination! Suffice it to mention the well of Father Joseph, made near Cairo by the Sultan Saladin at an epoch when machines had not yet appeared to increase the strength of man a hundredfold, and which goes down to the level of the Nile itself at a depth of 300 feet! And that other well dug at Coblentz by the Margrave Jean of Baden, 600 feet deep! All that was needed was a triple depth and a double width, which made the boring easier. There was not one foreman or workman who doubted about the success of the operation.

An important decision taken by Murchison and approved of by Barbicane accelerated the work. An article in the contract decided that the Columbiad should be hooped with wrought-iron--a useless precaution, for the cannon could evidently do without hoops. This clause was therefore given up. Hence a great economy of time, for they could then employ the new system of boring now used for digging wells, by which the masonry is done at the same time as the boring. Thanks to this very simple operation they were not obliged to prop up the ground; the wall kept it up and went down by its own weight.

This manoeuvre was only to begin when the spade should have reached the solid part of the ground.

On the 4th of November fifty workmen began to dig in the very centre of the inclosure surrounded by palisades--that is to say, the top of Stony Hill--a circular hole sixty feet wide.

The spade first turned up a sort of black soil six inches deep, which it soon carried away. To this soil succeeded two feet of fine sand, which was carefully taken out, as it was to be used for the casting.

After this sand white clay appeared, similar to English chalk, and which was four feet thick.

Then the pickaxes rang upon the hard layer, a species of rock formed by very dry petrified shells. At that point the hole was six and a half feet deep, and the masonry was begun.

At the bottom of that excavation they made an oak wheel, a sort of circle strongly bolted and of enormous strength; in its centre a hole was pierced the size of the exterior diameter of the Columbiad. It was upon this wheel that the foundations of the masonry were placed, the hydraulic cement of which joined the stones solidly together. After the workmen had bricked up the space from the circumference to the centre, they found themselves inclosed in a well twenty-one feet wide.

When this work was ended the miners began again with spade and pickaxe, and set upon the rock under the wheel itself, taking care to support it on extremely strong tressels; every time the hole was two feet deeper they took away the tressels; the wheel gradually sank, taking with it its circle of masonry, at the upper layer of which the masons worked incessantly, taking care to make vent-holes for the escape of gas during the operation of casting.

This kind of work required great skill and constant attention on the part of the workmen; more than one digging under the wheel was dangerous, and some were even mortally wounded by the splinters of stone; but their energy did not slacken for a moment by day nor night; by day, when the sun's rays sent the thermometer up to 99° on the calcined planes; by night, under the white waves of electric light, the noise of the pickaxe on the rock, the blasting and the machines, together with the wreaths of smoke scattered through the air, traced a

circle of terror round Stony Hill, which the herds of buffaloes and the detachments of Seminoles never dared to pass.

In the meantime the work regularly advanced; steam-cranes speeded the carrying away of the rubbish; of unexpected obstacles there were none; all the difficulties had been foreseen and guarded against.

When the first month had gone by the well had attained the depth assigned for the time--i.e., 112 feet. In December this depth was doubled, and tripled in January. During February the workmen had to contend against a sheet of water which sprang from the ground. They were obliged to employ powerful pumps and apparatus of compressed air to drain it off, so as to close up the orifice from which it issued, just as leaks are caulked on board ship. At last they got the better of these unwelcome springs, only in consequence of the loosening of the soil the wheel partially gave way, and there was a landslip. The frightful force of this bricked circle, more than 400 feet high, may be imagined! This accident cost the life of several workmen. Three weeks had to be taken up in propping the stone revetment and making the wheel solid again. But, thanks to the skill of the engineer and the power of the machines, it was all set right, and the boring continued.

No fresh incident henceforth stopped the progress of the work, and on the 10th of June, twenty days before the expiration of the delay fixed by Barbicane, the well, quite bricked round, had reached the depth of 900 feet. At the bottom the masonry rested upon a massive block, thirty feet thick, whilst at the top it was on a level with the soil.

President Barbicane and the members of the Gun Club warmly congratulated the engineer Murchison; his cyclopean work had been accomplished with extraordinary rapidity.

During these eight months Barbicane did not leave Stony Hill for a minute; whilst he narrowly watched over the boring operations, he took every precaution to insure the health and well-being of his workmen, and he was fortunate enough to avoid the epidemics common to large agglomerations of men, and so disastrous in those regions of the globe exposed to tropical influence.

It is true that several workmen paid with their lives for the carelessness engendered by these dangerous occupations; but such deplorable misfortunes

cannot be avoided, and these are details that Americans pay very little attention to. They are more occupied with humanity in general than with individuals in particular. However, Barbicane professed the contrary principles, and applied them upon every occasion. Thanks to his care, to his intelligence and respectful intervention in difficult cases, to his prodigious and humane wisdom, the average of catastrophes did not exceed that of cities on the other side of the Atlantic, amongst others those of France, where they count about one accident upon every 200,000 francs of work.

CHAPTER XV

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THE CEREMONY OF THE CASTING.

During the eight months that were employed in the operation of boring the preparatory works of the casting had been conducted simultaneously with extreme rapidity; a stranger arriving at Stony Hill would have been much surprised at what he saw there.

Six hundred yards from the well, and standing in a circle round it as a central point, were 1,200 furnaces, each six feet wide and three yards apart. The line made by these 1,200 furnaces was two miles long. They were all built on the same model, with high quadrangular chimneys, and had a singular effect. J.T. Maston thought the architectural arrangement superb. It reminded him of the monuments at Washington. He thought there was nothing finer in the world, not even in Greece, where he acknowledged never to have been.

It will be remembered that at their third meeting the committee decided to use cast-iron for the Columbiad, and in particular the grey description. This metal is, in fact, the most tenacious, ductile, and malleable, suitable for all moulding operations, and when smelted with pit coal it is of superior quality for engine-cylinders, hydraulic presses, &c.

But cast-iron, if it has undergone a single fusion, is rarely homogeneous enough; and it is by means of a second fusion that it is purified, refined, and dispossessed of its last earthly deposits.

Before being forwarded to Tampa Town, the iron ore, smelted in the great furnaces of Goldspring, and put in contact with coal and silicium heated to a high temperature, was transformed into cast-iron. After this first operation the metal was taken to Stony Hill. But there were 136 millions of pounds of cast-iron, a bulk too expensive to be sent by railway; the price of transport would have doubled that of the raw material. It appeared preferable to freight vessels at New York and to load them with the iron in bars; no less than sixty-eight vessels of 1,000 tons were required, quite a fleet, which on May 3rd left New York, took the Ocean route, coasted the American shores, entered the Bahama Channel, doubled the point of Florida, and on the 10th of the same month entered the Bay of Espiritu-Santo and anchored safely in the port of Tampa Town. There the vessels were unloaded and their cargo carried by railway to Stony Hill, and about the middle of January the enormous mass of metal was delivered at its destination.

It will easily be understood that 1,200 furnaces were not too many to melt these 60,000 tons of iron simultaneously. Each of these furnaces contained about 1,400,000 lbs. of metal; they had been built on the model of those used for the casting of the Rodman gun; they were trapezoidal in form, with a high elliptical arch. The warming apparatus and the chimney were placed at the two extremities of the furnace, so that it was equally heated throughout. These furnaces, built of fireproof brick, were filled with coal-grates and a "sole" for the bars of iron; this sole, inclosed at an angle of 25°, allowed the metal to flow into the receiving-troughs; from thence 1,200 converging trenches carried it down to the central well.

The day following that upon which the works of masonry and casting were terminated, Barbicane set to work upon the interior mould; his object now was to raise in the centre of the well, with a coincident axis, a cylinder 900 feet high and nine in diameter, to exactly fill up the space reserved for the bore of the Columbiad. This cylinder was made of a mixture of clay and sand, with the addition of hay and straw. The space left between the mould and the masonry was to be filled with the molten metal, which would thus make the sides of the cannon six feet thick.

This cylinder, in order to have its equilibrium maintained, had to be consolidated with iron bands and fixed at intervals by means of cross-clamps fastened into the stone lining; after the casting these clamps would be lost in the block of metal, which would not be the worse for them.

This operation was completed on the 8th of July, and the casting was fixed for the 10th.

"The casting will be a fine ceremony," said J.T. Maston to his friend Barbicane.

"Undoubtedly," answered Barbicane, "but it will not be a public one!"

"What! you will not open the doors of the inclosure to all comers?"

"Certainly not; the casting of the Columbiad is a delicate, not to say a dangerous, operation, and I prefer that it should be done with closed doors. When the projectile is discharged you may have a public ceremony if you like, but till then, no!"

The president was right; the operation might be attended with unforeseen danger, which a large concourse of spectators would prevent being averted. It was necessary to preserve complete freedom of movement. No one was admitted into the inclosure except a delegation of members of the Gun Club who made the voyage to Tampa Town. Among them was the brisk Bilsby, Tom Hunter, Colonel Blomsberry, Major Elphinstone, General Morgan, and _tutti quanti_, to whom the casting of the Columbiad was a personal business. J.T. Maston constituted himself their cicerone; he did not excuse them any detail; he led them about everywhere, through the magazines, workshops, amongst the machines, and he forced them to visit the 1,200 furnaces one after the other. At the end of the 1,200th visit they were rather sick of it.

The casting was to take place precisely at twelve o'clock; the evening before each furnace had been charged with 114,000 lbs. of metal in bars disposed crossway to each other so that the warm air could circulate freely amongst them. Since early morning the 1,200 chimneys had been pouring forth volumes of flames into the atmosphere, and the soil was shaken convulsively. There were as many pounds of coal to be burnt as metal to be melted. There were, therefore, 68,000 tons of coal throwing up before the sun a thick curtain of black smoke.

The heat soon became unbearable in the circle of furnaces, the rambling of which resembled the rolling of thunder; powerful bellows added their continuous blasts, and saturated the incandescent furnaces with oxygen.

The operation of casting in order to succeed must be done rapidly. At a signal given by a cannon-shot each furnace was to pour out the liquid iron and to be

entirely emptied.

These arrangements made, foremen and workmen awaited the preconcerted moment with impatience mixed with emotion. There was no longer any one in the inclosure, and each superintendent took his place near the aperture of the run.

Barbicane and his colleagues, installed on a neighbouring eminence, assisted at the operation. Before them a cannon was planted ready to be fired as a sign from the engineer.

A few minutes before twelve the first drops of metal began to run; the reservoirs were gradually filled, and when the iron was all in a liquid state it was left quiet for some instants in order to facilitate the separation of foreign substances.

Twelve o'clock struck. The cannon was suddenly fired, and shot its flame into the air. Twelve hundred tapping-holes were opened simultaneously, and twelve hundred fiery serpents crept along twelve hundred troughs towards the central well, rolling in rings of fire. There they plunged with terrific noise down a depth of 900 feet. It was an exciting and magnificent spectacle. The ground trembled, whilst these waves of iron, throwing into the sky their clouds of smoke, evaporated at the same time the humidity of the mould, and hurled it upwards through the vent-holes of the masonry in the form of impenetrable vapour. These artificial clouds unrolled their thick spirals as they went up to a height of 3,000 feet into the air. Any Red Indian wandering upon the limits of the horizon might have believed in the formation of a new crater in the heart of Florida, and yet it was neither an irruption, nor a typhoon, nor a storm, nor a struggle of the elements, nor one of those terrible phenomena which Nature is capable of producing. No; man alone had produced those reddish vapours, those gigantic flames worthy of a volcano, those tremendous vibrations like the shock of an earthquake, those reverberations, rivals of hurricanes and storms, and it was his hand which hurled into an abyss, dug by himself, a whole Niagara of molten metal!

CHAPTER XVI

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THE COLUMBIAD.

Had the operation of casting succeeded? People were reduced to mere conjecture. However, there was every reason to believe in its success, as the mould had absorbed the entire mass of metal liquefied in the furnaces. Still it was necessarily a long time impossible to be certain.

In fact, when Major Rodman cast his cannon of 160,000 lbs., it took no less than a fortnight to cool. How long, therefore, would the monstrous Columbiad, crowned with its clouds of vapour, and guarded by its intense heat, be kept from the eyes of its admirers? It was difficult to estimate.

The impatience of the members of the Gun Club was put to a rude test during this lapse of time. But it could not be helped. J.T. Maston was nearly roasted through his anxiety. A fortnight after the casting an immense column of smoke was still soaring towards the sky, and the ground burnt the soles of the feet within a radius of 200 feet round the summit of Stony Hill.

The days went by; weeks followed them. There were no means of cooling the immense cylinder. It was impossible to approach it. The members of the Gun Club were obliged to wait with what patience they could muster.

"Here we are at the 10th of August," said J.T. Maston one morning. "It wants hardly four months to the 1st of December! There still remains the interior mould to be taken out, and the Columbiad to be loaded! We never shall be ready! One cannot even approach the cannon! Will it never get cool? That would be a cruel deception!"

They tried to calm the impatient secretary without succeeding. Barbicane said nothing, but his silence covered serious irritation. To see himself stopped by an obstacle that time alone could remove--time, an enemy to be feared under the circumstances--and to be in the power of an enemy was hard for men of war.

However, daily observations showed a certain change in the state of the ground. Towards the 15th of August the vapour thrown off had notably diminished in intensity and thickness. A few days after the earth only exhaled a slight puff of smoke, the last breath of the monster shut up in its stone tomb. By degrees the vibrations of the ground ceased, and the circle of heat contracted; the most impatient of the spectators approached; one day they gained ten feet, the next twenty, and on the 22nd of August Barbicane, his colleagues, and the engineer could take their place on the cast-iron surface which covered the summit of

Stony Hill, certainly a very healthy spot, where it was not yet allowed to have cold feet.

"At last!" cried the president of the Gun Club with an immense sigh of satisfaction.

The works were resumed the same day. The extraction of the interior mould was immediately proceeded with in order to clear out the bore; pickaxes, spades, and boring-tools were set to work without intermission; the clay and sand had become exceedingly hard under the action of the heat; but by the help of machines they cleared away the mixture still burning at its contact with the iron; the rubbish was rapidly carted away on the railway, and the work was done with such spirit, Barbicane's intervention was so urgent, and his arguments, presented under the form of dollars, carried so much conviction, that on the 3rd of September all trace of the mould had disappeared.

The operation of boring was immediately begun; the boring-machines were set up without delay, and a few weeks later the interior surface of the immense tube was perfectly cylindrical, and the bore had acquired a high polish.

At last, on the 22nd of September, less than a year after the Barbicane communication, the enormous weapon, raised by means of delicate instruments, and quite vertical, was ready for use. There was nothing but the moon to wait for, but they were sure she would not fail.

J.T. Maston's joy knew no bounds, and he nearly had a frightful fall whilst looking down the tube of 900 feet. Without Colonel Blomsberry's right arm, which he had happily preserved, the secretary of the Gun Club, like a modern Erostatus, would have found a grave in the depths of the Columbiad.

The cannon was then finished; there was no longer any possible doubt as to its perfect execution; so on the 6th of October Captain Nicholl cleared off his debt to President Barbicane, who inscribed in his receipt-column a sum of 2,000 dollars. It may be believed that the captain's anger reached its highest pitch, and cost him an illness. Still there were yet three bets of 3,000, 4,000, and 5,000 dollars, and if he only gained 2,000, his bargain would not be a bad one, though not excellent. But money did not enter into his calculations, and the success obtained by his rival in the casting of a cannon against which iron plates sixty feet thick would not have resisted was a terrible blow to him.

Since the 23rd of September the inclosure on Stony Hill had been quite open to the public, and the concourse of visitors will be readily imagined.

In fact, innumerable people from all points of the United States flocked to Florida. The town of Tampa was prodigiously increased during that year, consecrated entirely to the works of the Gun Club; it then comprised a population of 150,000 souls. After having surrounded Fort Brooke in a network of streets it was now being lengthened out on that tongue of land which separated the two harbours of Espiritu-Santo Bay; new quarters, new squares, and a whole forest of houses had grown up in these formerly-deserted regions under the heat of the American sun. Companies were formed for the erection of churches, schools, private dwellings, and in less than a year the size of the town was increased tenfold.

It is well known that Yankees are born business men; everywhere that destiny takes them, from the glacial to the torrid zone, their instinct for business is usefully exercised. That is why simple visitors to Florida for the sole purpose of following the operations of the Gun Club allowed themselves to be involved in commercial operations as soon as they were installed in Tampa Town. The vessels freighted for the transport of the metal and the workmen had given unparalleled activity to the port. Soon other vessels of every form and tonnage, freighted with provisions and merchandise, ploughed the bay and the two harbours; vast offices of shipbrokers and merchants were established in the town, and the *Shipping Gazette* each day published fresh arrivals in the port of Tampa.

Whilst roads were multiplied round the town, in consequence of the prodigious increase in its population and commerce, it was joined by railway to the Southern States of the Union. One line of rails connected La Mobile to Pensacola, the great southern maritime arsenal; thence from that important point it ran to Tallahassee. There already existed there a short line, twenty-one miles long, to Saint Marks on the seashore. It was this loop-line that was prolonged as far as Tampa Town, awakening in its passage the dead or sleeping portions of Central Florida. Thus Tampa, thanks to these marvels of industry due to the idea born one line day in the brain of one man, could take as its right the airs of a large town. They surnamed it "Moon-City," and the capital of Florida suffered an eclipse visible from all points of the globe.

Every one will now understand why the rivalry was so great between Texas and

Florida, and the irritation of the Texicans when they saw their pretensions set aside by the Gun Club. In their long-sighted sagacity they had foreseen what a country might gain from the experiment attempted by Barbicane, and the wealth that would accompany such a cannon-shot. Texas lost a vast centre of commerce, railways, and a considerable increase of population. All these advantages had been given to that miserable Floridian peninsula, thrown like a pier between the waves of the Gulf and those of the Atlantic Ocean. Barbicane, therefore, divided with General Santa-Anna the Texan antipathy.

However, though given up to its commercial and industrial fury, the new population of Tampa Town took care not to forget the interesting operations of the Gun Club. On the contrary, the least details of the enterprise, every blow of the pickaxe, interested them. There was an incessant flow of people to and from Tampa Town to Stony Hill--a perfect procession, or, better still, a pilgrimage.

It was already easy to foresee that the day of the experiment the concourse of spectators would be counted by millions, for they came already from all points of the earth to the narrow peninsula. Europe was emigrating to America.

But until then, it must be acknowledged, the curiosity of the numerous arrivals had only been moderately satisfied. Many counted upon seeing the casting who only saw the smoke from it. This was not much for hungry eyes, but Barbicane would allow no one to see that operation. Thereupon ensued grumbling, discontent, and murmurs; they blamed the president for what they considered dictatorial conduct. His act was stigmatised as "un-American." There was nearly a riot round Stony Hill, but Barbicane was not to be moved. When, however, the Columbiad was quite finished, this state of closed doors could no longer be kept up; besides, it would have been in bad taste, and even imprudent, to offend public opinion. Barbicane, therefore, opened the inclosure to all comers; but, in accordance with his practical character, he determined to coin money out of the public curiosity.

It was, indeed, something to even be allowed to see this immense Columbiad, but to descend into its depths seemed to the Americans the *ne plus ultra* of earthly felicity. In consequence there was not one visitor who was not willing to give himself the pleasure of visiting the interior of this metallic abyss. Baskets hung from steam-cranes allowed them to satisfy their curiosity. It became a perfect mania. Women, children, and old men all made it their business to penetrate the mysteries of the colossal gun. The price for the descent was fixed

at five dollars a head, and, notwithstanding this high charge, during the two months that preceded the experiment, the influx of visitors allowed the Gun Club to pocket nearly 500,000 dollars!

It need hardly be said that the first visitors to the Columbiad were the members of the Gun Club. This privilege was justly accorded to that illustrious body. The ceremony of reception took place on the 25th of September. A basket of honour took down the president, J.T. Maston, Major Elphinstone, General Morgan, Colonel Blomsberry, and other members of the Gun Club, ten in all. How hot they were at the bottom of that long metal tube! They were nearly stifled, but how delightful--how exquisite! A table had been laid for ten on the massive stone which formed the bottom of the Columbiad, and was lighted by a jet of electric light as bright as day itself. Numerous exquisite dishes, that seemed to descend from heaven, were successively placed before the guests, and the richest wines of France flowed profusely during this splendid repast, given 900 feet below the surface of the earth!

The festival was a gay, not to say a noisy one. Toasts were given and replied to. They drank to the earth and her satellite, to the Gun Club, the Union, the Moon, Diana, Phoebe, Selene, "the peaceful courier of the night." All the hurrahs, carried up by the sonorous waves of the immense acoustic tube, reached its mouth with a noise of thunder; then the multitude round Stony Hill heartily united their shouts to those of the ten revellers hidden from sight in the depths of the gigantic Columbiad.

J.T. Maston could contain himself no longer. Whether he shouted or ate, gesticulated or talked most would be difficult to determine. Any way he would not have given up his place for an empire, "not even if the cannon--loaded, primed, and fired at that very moment--were to blow him in pieces into the planetary universe."

CHAPTER XVII

.

A TELEGRAM.

The great work undertaken by the Gun Club was now virtually ended, and yet

two months would still elapse before the day the projectile would start for the moon. These two months would seem as long as two years to the universal impatience. Until then the smallest details of each operation had appeared in the newspapers every day, and were eagerly devoured by the public, but now it was to be feared that this "interest dividend" would be much diminished, and every one was afraid of no longer receiving his daily share of emotions.

They were all agreeably disappointed: the most unexpected, extraordinary, incredible, and improbable incident happened in time to keep up the general excitement to its highest pitch.

On September 30th, at 3.47 p.m., a telegram, transmitted through the Atlantic Cable, arrived at Tampa Town for President Barbicane.

He tore open the envelope and read the message, and, notwithstanding his great self-control, his lips grew pale and his eyes dim as he read the telegram.

The following is the text of the message stored in the archives of the Gun Club:--

"France, Paris,

"September 30th, 4 a.m.

"Barbicane, Tampa Town, Florida, United States.

"Substitute a cylindro-conical projectile for your spherical shell. Shall go inside. Shall arrive by steamer *Atlanta*.

"MICHEL ARDAN."

CHAPTER XVIII

.

THE PASSENGER OF THE ATLANTA.

If this wonderful news, instead of coming by telegraph, had simply arrived by post and in a sealed envelope--if the French, Irish, Newfoundland, and American telegraph clerks had not necessarily been acquainted with it--Barbicane would

not have hesitated for a moment. He would have been quite silent about it for prudence' sake, and in order not to throw discredit on his work. This telegram might be a practical joke, especially as it came from a Frenchman. What probability could there be that any man should conceive the idea of such a journey? And if the man did exist was he not a madman who would have to be inclosed in a strait-waistcoat instead of in a cannon-ball?

But the message was known, and Michel Ardan's proposition was already all over the States of the Union, so Barbicane had no reason for silence. He therefore called together his colleagues then in Tampa Town, and, without showing what he thought about it or saying a word about the degree of credibility the telegram deserved, he read coldly the laconic text.

"Not possible!"--"Unheard of!"--"They are laughing at us!"--"Ridiculous!"--"Absurd!" Every sort of expression for doubt, incredulity, and folly was heard for some minutes with accompaniment of appropriate gestures. J.T. Maston alone uttered the words:--

"That's an idea!" he exclaimed.

"Yes," answered the major, "but if people have such ideas as that they ought not to think of putting them into execution."

"Why not?" quickly answered the secretary of the Gun Club, ready for an argument. But the subject was let drop.

In the meantime Michel Ardan's name was already going about Tampa Town. Strangers and natives talked and joked together, not about the European--evidently a mythical personage--but about J.T. Maston, who had the folly to believe in his existence. When Barbicane proposed to send a projectile to the moon every one thought the enterprise natural and practicable--a simple affair of ballistics. But that a reasonable being should offer to go the journey inside the projectile was a farce, or, to use a familiar Americanism, it was all "humbug."

This laughter lasted till evening throughout the Union, an unusual thing in a country where any impossible enterprise finds adepts and partisans.

Still Michel Ardan's proposition did not fail to awaken a certain emotion in many minds. "They had not thought of such a thing." How many things denied one day had become realities the next! Why should not this journey be

accomplished one day or another? But, any way, the man who would run such a risk must be a madman, and certainly, as his project could not be taken seriously, he would have done better to be quiet about it, instead of troubling a whole population with such ridiculous trash.

But, first of all, did this personage really exist? That was the great question. The name of "Michel Ardan" was not altogether unknown in America. It belonged to a European much talked about for his audacious enterprises. Then the telegram sent all across the depths of the Atlantic, the designation of the ship upon which the Frenchman had declared he had taken his passage, the date assigned for his arrival--all these circumstances gave to the proposition a certain air of probability. They were obliged to disburden their minds about it. Soon these isolated individuals formed into groups, the groups became condensed under the action of curiosity like atoms by virtue of molecular attraction, and the result was a compact crowd going towards President Barbicane's dwelling.

The president, since the arrival of the message, had not said what he thought about it; he had let J.T. Maston express his opinions without manifesting either approbation or blame. He kept quiet, proposing to await events, but he had not taken public impatience into consideration, and was not very pleased at the sight of the population of Tampa Town assembled under his windows. Murmurs, cries, and vociferations soon forced him to appear. It will be seen that he had all the disagreeables as well as the duties of a public man.

He therefore appeared; silence was made, and a citizen asked him the following question:--"Is the person designated in the telegram as Michel Ardan on his way to America or not?"

"Gentlemen," answered Barbicane, "I know no more than you."

"We must get to know," exclaimed some impatient voices.

"Time will inform us," answered the president coldly.

"Time has no right to keep a whole country in suspense," answered the orator. "Have you altered your plans for the projectile as the telegram demanded?"

"Not yet, gentlemen; but you are right, we must have recourse to the telegraph that has caused all this emotion."

"To the telegraph-office!" cried the crowd.

Barbicane descended into the street, and, heading the immense assemblage, he went towards the telegraph-office.

A few minutes afterwards a telegram was on its way to the underwriters at Liverpool, asking for an answer to the following questions:--

"What sort of vessel is the _Atlanta_? When did she leave Europe? Had she a Frenchman named Michel Ardan on board?"

Two hours afterwards Barbicane received such precise information that doubt was no longer possible.

"The steamer _Atlanta_, from Liverpool, set sail on October 2nd for Tampa Town, having on board a Frenchman inscribed in the passengers' book as Michel Ardan."

At this confirmation of the first telegram the eyes of the president were lighted up with a sudden flame; he clenched his hands, and was heard to mutter--

"It is true, then! It is possible, then! the Frenchman does exist! and in a fortnight he will be here! But he is a madman! I never can consent."

And yet the very same evening he wrote to the firm of Breadwill and Co. begging them to suspend the casting of the projectile until fresh orders.

Now how can the emotion be described which took possession of the whole of America? The effect of the Barbicane proposition was surpassed tenfold; what the newspapers of the Union said, the way they accepted the news, and how they chanted the arrival of this hero from the old continent; how to depict the feverish agitation in which every one lived, counting the hours, minutes, and seconds; how to give even a feeble idea of the effect of one idea upon so many heads; how to show every occupation being given up for a single preoccupation, work stopped, commerce suspended, vessels, ready to start, waiting in the ports so as not to miss the arrival of the _Atlanta_, every species of conveyance arriving full and returning empty, the bay of Espiritu-Santo incessantly ploughed by steamers, packet-boats, pleasure-yachts, and fly-boats of all dimensions; how to denominate in numbers the thousands of curious people who in a fortnight increased the population of Tampa Town fourfold, and were obliged to encamp

under tents like an army in campaign--all this is a task above human force, and could not be undertaken without rashness.

At 9 a.m. on the 20th of October the semaphores of the Bahama Channel signalled thick smoke on the horizon. Two hours later a large steamer exchanged signals with them. The name *Atlanta* was immediately sent to Tampa Town. At 4 p.m. the English vessel entered the bay of Espiritu-Santo. At 5 p.m. she passed the entrance to Hillisboro Harbour, and at 6 p.m. weighed anchor in the port of Tampa Town.

The anchor had not reached its sandy bed before 500 vessels surrounded the *Atlanta* and the steamer was taken by assault. Barbicane was the first on deck, and in a voice the emotion of which he tried in vain to suppress--

"Michel Ardan!" he exclaimed.

"Present!" answered an individual mounted on the poop.

Barbicane, with his arms crossed, questioning eyes, and silent mouth, looked fixedly at the passenger of the *Atlanta*.

He was a man forty-two years of age, tall, but already rather stooping, like caryatides which support balconies on their shoulders. His large head shook every now and then a shock of red hair like a lion's mane; a short face, wide forehead, a moustache bristling like a cat's whiskers, and little bunches of yellow hair on the middle of his cheeks, round and rather wild-looking, short-sighted eyes completed this eminently feline physiognomy. But the nose was boldly cut, the mouth particularly humane, the forehead high, intelligent, and ploughed like a field that was never allowed to remain fallow. Lastly, a muscular body well poised on long limbs, muscular arms, powerful and well-set levers, and a decided gait made a solidly built fellow of this European, "rather wrought than cast," to borrow one of his expressions from metallurgic art.

The disciples of Lavater or Gratiolet would have easily deciphered in the cranium and physiognomy of this personage indisputable signs of combativity--that is to say, of courage in danger and tendency to overcome obstacles, those of benevolence, and a belief in the marvellous, an instinct that makes many natures dwell much on superhuman things; but, on the other hand, the bumps of acquisivity, the need of possessing and acquiring, were absolutely wanting.

To put the finishing touches to the physical type of the passenger of the _Atlanta_, his garments wide, loose, and flowing, open cravat, wide collar, and cuffs always unbuttoned, through which came nervous hands. People felt that even in the midst of winter and dangers that man was never cold.

On the deck of the steamer, amongst the crowd, he bustled about, never still for a moment, "dragging his anchors," in nautical speech, gesticulating, making friends with everybody, and biting his nails nervously. He was one of those original beings whom the Creator invents in a moment of fantasy, and of whom He immediately breaks the cast.

In fact, the character of Michel Ardan offered a large field for physiological analysis. This astonishing man lived in a perpetual disposition to hyperbole, and had not yet passed the age of superlatives; objects depicted themselves on the retina of his eye with exaggerated dimensions; from thence an association of gigantic ideas; he saw everything on a large scale except difficulties and men.

He was besides of a luxuriant nature, an artist by instinct, and witty fellow; he loved arguments _ad hominem_, and defended the weak side tooth and nail.

Amongst other peculiarities he gave himself out as "sublimely ignorant," like Shakspeare, and professed supreme contempt for all _savants_, "people," said he, "who only score our points." He was, in short, a Bohemian of the country of brains, adventurous but not an adventurer, a harebrained fellow, a Phaeton running away with the horses of the sun, a kind of Icarus with relays of wings. He had a wonderful facility for getting into scrapes, and an equally wonderful facility for getting out of them again, falling on his feet like a cat.

In short, his motto was, "Whatever it may cost!" and the love of the impossible his "ruling passion," according to Pope's fine expression.

But this enterprising fellow had the defects of his qualities. Who risks nothing wins nothing, it is said. Ardan often risked much and got nothing. He was perfectly disinterested and chivalric; he would not have signed the death-warrant of his worst enemy, and would have sold himself into slavery to redeem a negro.

In France and Europe everybody knew this brilliant, bustling person. Did he not get talked of ceaselessly by the hundred voices of Fame, hoarse in his service? Did he not live in a glass house, taking the entire universe as confidant of his most intimate secrets? But he also possessed an admirable collection of enemies

amongst those he had cuffed and wounded whilst using his elbows to make a passage in the crowd.

Still he was generally liked and treated like a spoiled child. Every one was interested in his bold enterprises, and followed them with uneasy mind. He was known to be so imprudent! When some friend wished to stop him by predicting an approaching catastrophe, "The forest is only burnt by its own trees," he answered with an amiable smile, not knowing that he was quoting the prettiest of Arabian proverbs.

Such was the passenger of the _Atlanta_, always in a bustle, always boiling under the action of inward fire, always moved, not by what he had come to do in America--he did not even think about it--but on account of his feverish organisation. If ever individuals offered a striking contrast they were the Frenchman Michel Ardan and the Yankee Barbicane, both, however, enterprising, bold, and audacious, each in his own way.

Barbicane's contemplation of his rival was quickly interrupted by the cheers of the crowd. These cries became even so frantic and the enthusiasm took such a personal form that Michel Ardan, after having shaken a thousand hands in which he nearly left his ten fingers, was obliged to take refuge in his cabin.

Barbicane followed him without having uttered a word.

"You are Barbicane?" Michel Ardan asked him as soon as they were alone, and in the same tone as he would have spoken to a friend of twenty years' standing.

"Yes," answered the president of the Gun Club.

"Well, good morning, Barbicane. How are you? Very well? That's right! that's right!"

"Then," said Barbicane, without further preliminary, "you have decided to go?"

"Quite decided."

"Nothing will stop you?"

"Nothing. Have you altered your projectile as I told you in my message?"

"I waited till you came. But," asked Barbicane, insisting once more, "you have quite reflected?"

"Reflected! have I any time to lose? I find the occasion to go for a trip to the moon, I profit by it, and that is all. It seems to me that does not want so much reflection."

Barbicane looked eagerly at the man who spoke of his project of journey with so much carelessness, and with such absence of anxiety.

"But at least," he said, "you have some plan, some means of execution?"

"Excellent means. But allow me to tell you one thing. I like to say my say once and for all, and to everybody, and to hear no more about it. Then, unless you can think of something better, call together your friends, your colleagues, all the town, all Florida, all America if you like, and to-morrow I shall be ready to state my means of execution, and answer any objections, whatever they may be. Will that do?"

"Yes, that will do," answered Barbicane.

Whereupon the president left the cabin, and told the crowd about Michel Ardan's proposition. His words were received with great demonstrations of joy. That cut short all difficulties. The next day every one could contemplate the European hero at their ease. Still some of the most obstinate spectators would not leave the deck of the _Atlanta_; they passed the night on board. Amongst others, J.T. Maston had screwed his steel hook into the combing of the poop, and it would have taken the capstan to get it out again.

"He is a hero! a hero!" cried he in every tone, "and we are only old women compared to that European!"

As to the president, after having requested the spectators to withdraw, he re-entered the passenger's cabin, and did not leave it till the bell of the steamer rang out the midnight quarter.

But then the two rivals in popularity shook each other warmly by the hand, and separated friends.

CHAPTER XIX

.

A MEETING.

The next day the sun did not rise early enough to satisfy public impatience. Barbicane, fearing that indiscreet questions would be put to Michel Ardan, would like to have reduced his auditors to a small number of adepts, to his colleagues for instance. But it was as easy as to dam up the Falls at Niagara. He was, therefore, obliged to renounce his project, and let his friend run all the risks of a public lecture. The new Town Hall of Tampa Town, notwithstanding its colossal dimensions, was considered insufficient for the occasion, which had assumed the proportions of a public meeting.

The place chosen was a vast plain, situated outside the town. In a few hours they succeeded in sheltering it from the rays of the sun. The ships of the port, rich in canvas, furnished the necessary accessories for a colossal tent. Soon an immense sky of cloth was spread over the calcined plain, and defended it against the heat of the day. There 300,000 persons stood and braved a stifling temperature for several hours whilst awaiting the Frenchman's arrival. Of that crowd of spectators one-third alone could see and hear; a second third saw badly, and did not hear. As to the remaining third, it neither heard nor saw, though it was not the least eager to applaud.

At three o'clock Michel Ardan made his appearance, accompanied by the principal members of the Gun Club. He gave his right arm to President Barbicane, and his left to J.T. Maston, more radiant than the midday sun, and nearly as ruddy.

Ardan mounted the platform, from which his eyes extended over a forest of black hats. He did not seem in the least embarrassed; he did not pose; he was at home there, gay, familiar, and amiable. To the cheers that greeted him he answered by a gracious bow; then with his hand asked for silence, began to speak in English, and expressed himself very correctly in these terms:--

"Gentlemen," said he, "although it is very warm, I intend to keep you a few minutes to give you some explanation of the projects which have appeared to interest you. I am neither an orator nor a _savant_, and I did not count upon

having to speak in public; but my friend Barbicane tells me it would give you pleasure, so I do it. Then listen to me with your 600,000 ears, and please to excuse the faults of the orator."

This unceremonious beginning was much admired by the audience, who expressed their satisfaction by an immense murmur of applause.

"Gentlemen," said he, "no mark of approbation or dissent is prohibited. That settled, I continue. And, first of all, do not forget that you have to do with an ignorant man, but his ignorance goes far enough to ignore difficulties. It has, therefore, appeared a simple, natural, and easy thing to him to take his passage in a projectile and to start for the moon. That journey would be made sooner or later, and as to the mode of locomotion adopted, it simply follows the law of progress. Man began by travelling on all fours, then one fine day he went on two feet, then in a cart, then in a coach, then on a railway. Well, the projectile is the carriage of the future, and, to speak the truth, planets are only projectiles, simple cannon-balls hurled by the hand of the Creator. But to return to our vehicle. Some of you, gentlemen, may think that the speed it will travel at is excessive--nothing of the kind. All the planets go faster, and the earth itself in its movement round the sun carries us along three times as fast. Here are some examples. Only I ask your permission to express myself in leagues, for American measures are not very familiar to me, and I fear getting muddled in my calculations."

The demand appeared quite simple, and offered no difficulty. The orator resumed his speech.

"The following, gentlemen, is the speed of the different planets. I am obliged to acknowledge that, notwithstanding my ignorance, I know this small astronomical detail exactly, but in two minutes you will be as learned as I. Learn, then, that Neptune goes at the rate of 5,000 leagues an hour; Uranus, 7,000; Saturn, 8,858; Jupiter, 11,675; Mars, 22,011; the earth, 27,500; Venus, 32,190; Mercury, 52,520; some comets, 14,000 leagues in their perihelion! As to us, veritable idlers, people in no hurry, our speed does not exceed 9,900 leagues, and it will go on decreasing! I ask you if there is anything to wonder at, and if it is not evident that it will be surpassed some day by still greater speeds, of which light or electricity will probably be the mechanical agents?"

No one seemed to doubt this affirmation.

"Dear hearers," he resumed, "according to certain narrow minds--that is the best qualification for them--humanity is inclosed in a Popilius circle which it cannot break open, and is condemned to vegetate upon this globe without ever flying towards the planetary shores! Nothing of the kind! We are going to the moon, we shall go to the planets, we shall go to the stars as we now go from Liverpool to New York, easily, rapidly, surely, and the atmospheric ocean will be as soon crossed as the oceans of the earth! Distance is only a relative term, and will end by being reduced to zero."

The assembly, though greatly in favour of the French hero, was rather staggered by this audacious theory. Michel Ardan appeared to see it.

"You do not seem convinced, my worthy hosts," he continued with an amiable smile. "Well, let us reason a little. Do you know how long it would take an express train to reach the moon? Three hundred days. Not more. A journey of 86,410 leagues, but what is that? Not even nine times round the earth, and there are very few sailors who have not done that during their existence. Think, I shall be only ninety-eight hours on the road! Ah, you imagine that the moon is a long way from the earth, and that one must think twice before attempting the adventure! But what would you say if I were going to Neptune, which gravitates at 1,147,000,000 leagues from the sun? That is a journey that very few people could go, even if it only cost a farthing a mile! Even Baron Rothschild would not have enough to take his ticket!"

This argument seemed greatly to please the assembly; besides, Michel Ardan, full of his subject, grew superbly eloquent; he felt he was listened to, and resumed with admirable assurance--

"Well, my friends, this distance from Neptune to the sun is nothing compared to that of the stars, some of which are billions of leagues from the sun! And yet people speak of the distance that separates the planets from the sun! Do you know what I think of this universe that begins with the sun and ends at Neptune? Should you like to know my theory? It is a very simple one. According to my opinion, the solar universe is one solid homogeneous mass; the planets that compose it are close together, crowd one another, and the space between them is only the space that separates the molecules of the most compact metal--silver, iron, or platinum! I have, therefore, the right to affirm, and I will repeat it with a conviction you will all share--distance is a vain word; distance does not exist!"

"Well said! Bravo! Hurrah!" cried the assembly with one voice, electrified by the gesture and accent of the orator, and the boldness of his conceptions.

"No!" cried J.T. Maston, more energetically than the others; "distance does not exist!"

And, carried away by the violence of his movements and emotions he could hardly contain, he nearly fell from the top of the platform to the ground. But he succeeded in recovering his equilibrium, and thus avoided a fall that would have brutally proved distance not to be a vain word. Then the speech of the distinguished orator resumed its course.

"My friends," said he, "I think that this question is now solved. If I have not convinced you all it is because I have been timid in my demonstrations, feeble in my arguments, and you must set it down to my theoretic ignorance. However that may be, I repeat, the distance from the earth to her satellite is really very unimportant and unworthy to occupy a serious mind. I do not think I am advancing too much in saying that soon a service of trains will be established by projectiles, in which the journey from the earth to the moon will be comfortably accomplished. There will be no shocks nor running off the lines to fear, and the goal will be reached rapidly, without fatigue, in a straight line, 'as the crow flies.' Before twenty years are over, half the earth will have visited the moon!"

"Three cheers for Michel Ardan!" cried the assistants, even those least convinced.

"Three cheers for Barbicane!" modestly answered the orator.

This act of gratitude towards the promoter of the enterprise was greeted with unanimous applause.

"Now, my friends," resumed Michel Ardan, "if you have any questions to ask me you will evidently embarrass me, but still I will endeavour to answer you."

Until now the president of the Gun Club had reason to be very satisfied with the discussion. It had rolled upon speculative theories, upon which Michel Ardan, carried away by his lively imagination, had shown himself very brilliant. He must, therefore, be prevented from deviating towards practical questions, which he would doubtless not come out of so well. Barbicane made haste to speak, and asked his new friend if he thought that the moon or the planets were inhabited.

"That is a great problem, my worthy president," answered the orator, smiling; "still, if I am not mistaken, men of great intelligence--Plutarch, Swedenborg, Bernardin de Saint-Pierre, and many others--answered in the affirmative. If I answered from a natural philosophy point of view I should do the same--I should say to myself that nothing useless exists in this world, and, answering your question by another, friend Barbicane, I should affirm that if the planets are inhabitable, either they are inhabited, they have been, or they will be."

"Very well," cried the first ranks of spectators, whose opinion had the force of law for the others.

"It is impossible to answer with more logic and justice," said the president of the Gun Club. "The question, therefore, comes to this: 'Are the planets inhabitable?' I think so, for my part."

"And I--I am certain of it," answered Michel Ardan.

"Still," replied one of the assistants, "there are arguments against the inhabitability of the worlds. In most of them it is evident that the principles of life must be modified. Thus, only to speak of the planets, the people must be burnt up in some and frozen in others according as they are a long or short distance from the sun."

"I regret," answered Michel Ardan, "not to know my honourable opponent personally. His objection has its value, but I think it may be combated with some success, like all those of which the habitability of worlds has been the object. If I were a physician I should say that if there were less caloric put in motion in the planets nearest to the sun, and more, on the contrary, in the distant planets, this simple phenomenon would suffice to equalise the heat and render the temperature of these worlds bearable to beings organised like we are. If I were a naturalist I should tell him, after many illustrious _savants_, that Nature furnishes us on earth with examples of animals living in very different conditions of habitability; that fish breathe in a medium mortal to the other animals; that amphibians have a double existence difficult to explain; that certain inhabitants of the sea live in the greatest depths, and support there, without being crushed, pressures of fifty or sixty atmospheres; that some aquatic insects, insensible to the temperature, are met with at the same time in springs of boiling water and in the frozen plains of the Polar Ocean--in short, there are in nature many means of action, often incomprehensible, but no less real. If I were a

chemist I should say that aërolites--bodies evidently formed away from our terrestrial globe--have when analysed, revealed indisputable traces of carbon, a substance that owes its origin solely to organised beings, and which, according to Reichenbach's experiments, must necessarily have been 'animalised.' Lastly, if I were a theologian I should say that Divine Redemption, according to St. Paul, seems applicable not only to the earth but to all the celestial bodies. But I am neither a theologian, chemist, naturalist, nor natural philosopher. So, in my perfect ignorance of the great laws that rule the universe, I can only answer, 'I do not know if the heavenly bodies are inhabited, and, as I do not know, I am going to see!'"

Did the adversary of Michel Ardan's theories hazard any further arguments? It is impossible to say, for the frantic cries of the crowd would have prevented any opinion from being promulgated. When silence was again restored, even in the most distant groups, the triumphant orator contented himself with adding the following considerations:--

"You will think, gentlemen, that I have hardly touched upon this grave question. I am not here to give you an instructive lecture upon this vast subject. There is another series of arguments in favour of the heavenly bodies being inhabited; I do not look upon that. Allow me only to insist upon one point. To the people who maintain that the planets are not inhabited you must answer, 'You may be right if it is demonstrated that the earth is the best of possible worlds; but it is not so, notwithstanding Voltaire.' It has only one satellite, whilst Jupiter, Uranus, Saturn, and Neptune have several at their service, an advantage that is not to be disdained. But that which now renders the earth an uncomfortable place of abode is the inclination of its axis upon its orbit. Hence the inequality of day and night; hence the unfortunate diversity of seasons. Upon our miserable spheroid it is always either too warm or too cold; we are frozen in winter and roasted in summer; it is the planet of colds, rheumatism, and consumption, whilst on the surface of Jupiter, for instance, where the axis has only a very slight inclination, the inhabitants can enjoy invariable temperature. There is the perpetual spring, summer, autumn, and winter zone; each 'Jovian' may choose the climate that suits him, and may shelter himself all his life from the variations of the temperature. You will doubtless agree to this superiority of Jupiter over our planet without speaking of its years, which each lasts twelve years! What is more, it is evident to me that, under these auspices, and under such marvellous conditions of existence, the inhabitants of that fortunate world are superior beings--that *savants* are more learned, artists more artistic, the wicked less

wicked, and the good are better. Alas! what is wanting to our spheroid to reach this perfection is very little!--an axis of rotation less inclined on the plane of its orbit."

"Well!" cried an impetuous voice, "let us unite our efforts, invent machines, and rectify the earth's axis!"

Thunders of applause greeted this proposition, the author of which could be no other than J.T. Maston. It is probable that the fiery secretary had been carried away by his instincts as engineer to venture such a proposition; but it must be said, for it is the truth, many encouraged him with their cries, and doubtless, if they had found the resting-point demanded by Archimedes, the Americans would have constructed a lever capable of raising the world and redressing its axis. But this point was wanting to these bold mechanicians.

Nevertheless, this eminently practical idea had enormous success: the discussion was suspended for a good quarter of an hour, and long, very long afterwards, they talked in the United States of America of the proposition so energetically enunciated by the perpetual secretary of the Gun Club.

CHAPTER XX

.

THRUST AND PARRY.

This incident seemed to have terminated the discussion, but when the agitation had subsided these words were heard uttered in a loud and severe voice:--

"Now that the orator has allowed his fancy to roam, perhaps he would kindly go back to his subject, pay less attention to theories, and discuss the practical part of his expedition."

All eyes were turned towards the person who spoke thus. He was a thin, dry-looking man, with an energetic face and an American beard. By taking advantage of the agitation in the assembly from time to time he had gained, by degrees, the front row of spectators. There, with his arms crossed, his eyes brilliant and bold, he stared imperturbably at the hero of the meeting. After

having asked his question he kept silence, and did not seem disturbed by the thousands of eyes directed towards him nor by the disapproving murmur excited by his words. The answer being delayed he again put the question with the same clear and precise accent; then he added--

"We are here to discuss the moon, not the earth."

"You are right, sir," answered Michel Ardan, "the discussion has wandered from the point; we will return to the moon."

"Sir," resumed the unknown man, "you pretend that our satellite is inhabited. So far so good; but if Selenites do exist they certainly live without breathing, for--I tell you the fact for your good--there is not the least particle of air on the surface of the moon."

At this affirmation Ardan shook his red mane; he understood that a struggle was coming with this man on the real question. He looked at him fixedly in his turn, and said--

"Ah! there is no air in the moon! And who says so, pray?"

"The *savants*."

"Indeed?"

"Indeed."

"Sir," resumed Michel, "joking apart, I have a profound respect for *savants* who know, but a profound contempt for *savants* who do not know."

"Do you know any who belong to the latter category?"

"Yes; in France there is one who maintains that, 'mathematically,' a bird cannot fly, and another who demonstrates that a fish is not made to live in water."

"There is no question of those two, sir, and I can quote in support of my proposition names that you will not object to."

"Then, sir, you would greatly embarrass a poor ignorant man like me!"

"Then why do you meddle with scientific questions which you have never studied?" asked the unknown brutally.

"Why?" answered Ardan; "because the man who does not suspect danger is always brave! I know nothing, it is true, but it is precisely my weakness that makes my strength."

"Your weakness goes as far as madness," exclaimed the unknown in a bad-tempered tone.

"So much the better," replied the Frenchman, "if my madness takes me to the moon!"

Barbicane and his colleagues stared at the intruder who had come so boldly to stand in the way of their enterprise. None of them knew him, and the president, not reassured upon the upshot of such a discussion, looked at his new friend with some apprehension. The assembly was attentive and slightly uneasy, for this struggle called attention to the dangers and impossibilities of the expedition.

"Sir," resumed Michel Ardan's adversary, "the reasons that prove the absence of all atmosphere round the moon are numerous and indisputable. I may say, even, that, _à priori_ if that atmosphere had ever existed, it must have been drawn away by the earth, but I would rather oppose you with incontestable facts."

"Oppose, sir," answered Michel Ardan, with perfect gallantry--oppose as much as you like."

"You know," said the unknown, "that when the sun's rays traverse a medium like air they are deviated from a straight line, or, in other words, they are refracted. Well, when stars are occulted by the moon their rays, on grazing the edge of her disc, do not show the least deviation nor offer the slightest indication of refraction. It follows, therefore, that the moon can have no atmosphere."

Every one looked at the Frenchman, for, this once admitted, the consequences were rigorous.

"In fact," answered Michel Ardan, "that is your best if not only argument, and a _savant_, perhaps, would be embarrassed to answer it. I can only tell you that this argument has no absolute value because it supposes the angular diameter of the moon to be perfectly determined, which it is not. But let us waive that, and

tell me, my dear sir, if you admit the existence of volcanoes on the surface of the moon."

"Extinct volcanoes, yes; volcanoes in eruption, no."

"For the sake of argument let us suppose that these volcanoes have been in eruption for a certain period."

"That is certain, but as they can themselves furnish the oxygen necessary for combustion the fact of their eruption does not in the least prove the presence of a lunar atmosphere."

"We will pass on, then," answered Michel Ardan, "and leave this series of argument and arrive at direct observation. But I warn you that I am going to quote names."

"Very well."

"In 1715 the astronomers Louville and Halley, observing the eclipse of the 3rd of May, remarked certain fulminations of a remarkable nature. These jets of light, rapid and frequent, were attributed by them to storms in the atmosphere of the moon."

"In 1715," replied the unknown, "the astronomers Louville and Halley took for lunar phenomena phenomena purely terrestrial, such as meteoric or other bodies which are generated in our own atmosphere. That was the scientific aspect of these facts, and I go with it."

"Let us pass on again," answered Ardan, without being confused by the reply. "Did not Herschel, in 1787, observe a great number of luminous points on the surface of the moon?"

"Certainly; but without explaining the origin of these luminous points. Herschel himself did not thereby conclude the necessity of a lunar atmosphere."

"Well answered," said Michel Ardan, complimenting his adversary; "I see that you are well up in selenography."

"Yes, sir; and I may add that the most skilful observers, MM. Boeer and Moedler, agree that air is absolutely wanting on the moon's surface."

A movement took place amongst the audience, who appeared struck by the arguments of this singular personage.

"We will pass on again," answered Michel Ardan, with the greatest calmness, "and arrive now at an important fact. A skilful French astronomer, M. Laussedat, whilst observing the eclipse of July 18th, 1860, proved that the horns of the solar crescent were rounded and truncated. Now this appearance could only have been produced by a deviation of the solar rays in traversing the atmosphere of the moon. There is no other possible explanation of the fact."

"But is this fact authenticated?"

"It is absolutely certain."

An inverse movement brought back the audience to the side of their favourite hero, whose adversary remained silent.

Ardan went on speaking without showing any vanity about his last advantage; he said simply--

"You see, therefore, my dear sir, that it cannot be positively affirmed that there is no atmosphere on the surface of the moon. This atmosphere is probably not dense, but science now generally admits that it exists."

"Not upon the mountains," replied the unknown, who would not give in.

"No, but in the depths of the valleys, and it is not more than some hundreds of feet deep."

"Any way you will do well to take your precautions, for the air will be terribly rarefied."

"Oh, there will always be enough for one man. Besides, once delivered up there, I shall do my best to economise it and only to breathe it on great occasions."

A formidable burst of laughter saluted the mysterious interlocutor, who looked round the assembly daring it proudly.

"Then," resumed Michel Ardan, carelessly, "as we are agreed upon the presence of some atmosphere, we are forced to admit the presence of some water--a

consequence I am delighted with, for my part. Besides, I have another observation to make. We only know one side of the moon's disc, and if there is little air on that side there may be much on the other."

"How so?"

"Because the moon under the action of terrestrial attraction has assumed the form of an egg, of which we see the small end. Hence the consequence due to the calculations of Hausen, that its centre of gravity is situated in the other hemisphere. Hence this conclusion that all the masses of air and water have been drawn to the other side of our satellite in the first days of the creation."

"Pure fancies," exclaimed the unknown.

"No, pure theories based upon mechanical laws, and it appears difficult to me to refute them. I make appeal to this assembly and put it to the vote to know if life such as it exists upon earth is possible on the surface of the moon?"

Three hundred thousand hearers applauded this proposition. Michel Ardan's adversary wished to speak again, but he could not make himself heard. Cries and threats were hailed upon him.

"Enough, enough!" said some.

"Turn him out!" repeated others.

But he, holding on to the platform, did not move, and let the storm pass by. It might have assumed formidable proportions if Michel Ardan had not appeased it by a gesture. He was too chivalrous to abandon his contradicter in such an extremity.

"You wish to add a few words?" he asked, in the most gracious tone.

"Yes, a hundred! a thousand!" answered the unknown, carried away, "or rather no, one only! To persevere in your enterprise you must be--"

"Imprudent! How can you call me that when I have asked for a cylindro-conical bullet from my friend Barbicane so as not to turn round on the road like a squirrel?"

"But, unfortunate man! the fearful shock will smash you to pieces when you start."

"You have there put your finger upon the real and only difficulty; but I have too good an opinion of the industrial genius of the Americans to believe that they will not overcome that difficulty."

"But the heat developed by the speed of the projectile whilst crossing the beds of air?"

"Oh, its sides are thick, and I shall so soon pass the atmosphere."

"But provisions? water?"

"I have calculated that I could carry enough for one year, and I shall only be four days going."

"But air to breathe on the road?"

"I shall make some by chemical processes."

"But your fall upon the moon, supposing you ever get there?"

"It will be six times less rapid than a fall upon the earth, as attraction is six times less on the surface of the moon."

"But it still will be sufficient to smash you like glass."

"What will prevent me delaying my fall by means of rockets conveniently placed and lighted at the proper time?"

"But lastly, supposing that all difficulties be solved, all obstacles cleared away by uniting every chance in your favour, admitting that you reach the moon safe and well, how shall you come back?"

"I shall not come back."

Upon this answer, which was almost sublime by reason of its simplicity, the assembly remained silent. But its silence was more eloquent than its cries of enthusiasm would have been. The unknown profited by it to protest one last

time.

"You will infallibly kill yourself," he cried, "and your death, which will be only a madman's death, will not even be useful to science."

"Go on, most generous of men, for you prophesy in the most agreeable manner."

"Ah, it is too much!" exclaimed Michel Ardan's adversary, "and I do not know why I go on with so childish a discussion. Go on with your mad enterprise as you like. It is not your fault."

"Fire away."

"No, another must bear the responsibility of your acts."

"Who is that, pray?" asked Michel Ardan in an imperious voice.

"The fool who has organised this attempt, as impossible as it is ridiculous."

The attack was direct. Barbicane since the intervention of the unknown had made violent efforts to contain himself and "consume his own smoke," but upon seeing himself so outrageously designated he rose directly and was going to walk towards his adversary, who dared him to his face, when he felt himself suddenly separated from him.

The platform was lifted up all at once by a hundred vigorous arms, and the president of the Gun Club was forced to share the honours of triumph with Michel Ardan. The platform was heavy, but the bearers came in continuous relays, disputing, struggling, even fighting for the privilege of lending the support of their shoulders to this manifestation.

However, the unknown did not take advantage of the tumult to leave the place. He kept in the front row, his arms folded, still staring at President Barbicane.

The president did not lose sight of him either, and the eyes of these two men met like flaming swords.

The cries of the immense crowds kept at their maximum of intensity during this triumphant march. Michel Ardan allowed himself to be carried with evident pleasure.

Sometimes the platform pitched and tossed like a ship beaten by the waves. But the two heroes of the meeting were good sailors, and their vessel safely arrived in the port of Tampa Town.

Michel Ardan happily succeeded in escaping from his vigorous admirers. He fled to the Franklin Hotel, quickly reached his room, and glided rapidly into bed whilst an army of 100,000 men watched under his windows.

In the meanwhile a short, grave, and decisive scene had taken place between the mysterious personage and the president of the Gun Club.

Barbicane, liberated at last, went straight to his adversary.

"Come!" said he in a curt voice.

The stranger followed him on to the quay, and they were soon both alone at the entrance to a wharf opening on to Jones' Fall.

There these enemies, still unknown to one another, looked at each other.

"Who are you?" asked Barbicane.

"Captain Nicholl."

"I thought so. Until now fate has never made you cross my path."

"I crossed it of my own accord."

"You have insulted me."

"Publicly."

"And you shall give me satisfaction for that insult."

"Now, this minute."

"No. I wish everything between us to be kept secret. There is a wood situated three miles from Tampa--Skersnaw Wood. Do you know it?"

"Yes."

"Will you enter it to-morrow morning at five o'clock by one side?"

"Yes, if you will enter it by the other at the same time."

"And you will not forget your rifle?" said Barbicane.

"Not more than you will forget yours," answered Captain Nicholl.

After these words had been coldly pronounced the president of the Gun Club and the captain separated. Barbicane returned to his dwelling; but, instead of taking some hours' rest, he passed the night in seeking means to avoid the shock of the projectile, and to solve the difficult problem given by Michel Ardan at the meeting.

CHAPTER XXI

.

HOW A FRENCHMAN SETTLES AN AFFAIR.

Whilst the duel was being discussed between the president and the captain--a terrible and savage duel in which each adversary became a man-hunter--Michel Ardan was resting after the fatigues of his triumph. Resting is evidently not the right expression, for American beds rival in hardness tables of marble or granite.

Ardan slept badly, turning over and over between the *serviettes* that served him for sheets, and he was thinking of installing a more comfortable bed in his projectile when a violent noise startled him from his slumbers. Thundering blows shook his door. They seemed to be administered with an iron instrument. Shouts were heard in this racket, rather too early to be agreeable.

"Open!" some one cried. "Open, for Heaven's sake!"

There was no reason why Ardan should acquiesce in so peremptory a demand. Still he rose and opened his door at the moment it was giving way under the efforts of the obstinate visitor.

The secretary of the Gun Club bounded into the room. A bomb would not have entered with less ceremony.

"Yesterday evening," exclaimed J.T. Maston _ex abrupto_, "our president was publicly insulted during the meeting! He has challenged his adversary, who is no other than Captain Nicholl! They are going to fight this morning in Skersnaw Wood! I learnt it all from Barbicane himself! If he is killed our project will be at an end! This duel must be prevented! Now one man only can have enough empire over Barbicane to stop it, and that man is Michel Ardan."

Whilst J.T. Maston was speaking thus, Michel Ardan, giving up interrupting him, jumped into his vast trousers, and in less than two minutes after the two friends were rushing as fast as they could go towards the suburbs of Tampa Town.

It was during this rapid course that Maston told Ardan the state of the case. He told him the real causes of the enmity between Barbicane and Nicholl, how that enmity was of old date, why until then, thanks to mutual friends, the president and the captain had never met; he added that it was solely a rivalry between iron-plate and bullet; and, lastly, that the scene of the meeting had only been an occasion long sought by Nicholl to satisfy an old grudge.

There is nothing more terrible than these private duels in America, during which the two adversaries seek each other across thickets, and hunt each other like wild animals. It is then that each must envy those marvellous qualities so natural to the Indians of the prairies, their rapid intelligence, their ingenious ruse, their scent of the enemy. An error, a hesitation, a wrong step, may cause death. In these meetings the Yankees are often accompanied by their dogs, and both sportsmen and game go on for hours.

"What demons you are!" exclaimed Michel Ardan, when his companion had depicted the scene with much energy.

"We are what we are," answered J.T. Maston modestly; "but let us make haste."

In vain did Michel Ardan and he rush across the plain still wet with dew, jump the creeks, take the shortest cuts; they could not reach Skersnaw Wood before half-past five. Barbicane must have entered it half-an-hour before.

There an old bushman was tying up faggots his axe had cut.

Maston ran to him crying--

"Have you seen a man enter the wood armed with a rifle? Barbicane, the president--my best friend?"

The worthy secretary of the Gun Club thought naïvely that all the world must know his president. But the bushman did not seem to understand.

"A sportsman," then said Ardan.

"A sportsman? Yes," answered the bushman.

"Is it long since?"

"About an hour ago."

"Too late!" exclaimed Maston.

"Have you heard any firing?" asked Michel Ardan.

"No."

"Not one shot?"

"Not one. That sportsman does not seem to bag much game!"

"What shall we do?" said Maston.

"Enter the wood at the risk of catching a bullet not meant for us."

"Ah!" exclaimed Maston, with an unmistakable accent, "I would rather have ten bullets in my head than one in Barbicane's head."

"Go ahead, then!" said Ardan, pressing his companion's hand.

A few seconds after the two companions disappeared in a copse. It was a dense thicket made of huge cypresses, sycamores, tulip-trees, olives, tamarinds, oaks, and magnolias. The different trees intermingled their branches in inextricable confusion, and quite hid the view. Michel Ardan and Maston walked on side by side phasing silently through the tall grass, making a road for themselves through the vigorous creepers, looking in all the bushes or branches lost in the sombre shade of the foliage, and expecting to hear a shot at every step. As to the traces that Barbicane must have left of his passage through the wood, it was

impossible for them to see them, and they marched blindly on in the hardly-formed paths in which an Indian would have followed his adversary step by step.

After a vain search of about an hour's length the two companions stopped. Their anxiety was redoubled.

"It must be all over," said Maston in despair. "A man like Barbicane would not lay traps or condescend to any manoeuvre! He is too frank, too courageous. He has gone straight into danger, and doubtless far enough from the bushman for the wind to carry off the noise of the shot!"

"But we should have heard it!" answered Michel Ardan.

"But what if we came too late?" exclaimed J.T. Maston in an accent of despair.

Michel Ardan did not find any answer to make. Maston and he resumed their interrupted walk. From time to time they shouted; they called either Barbicane or Nicholl; but neither of the two adversaries answered. Joyful flocks of birds, roused by the noise, disappeared amongst the branches, and some frightened deer fled through the copses.

They continued their search another hour. The greater part of the wood had been explored. Nothing revealed the presence of the combatants. They began to doubt the affirmation of the bushman, and Ardan was going to renounce the pursuit as useless, when all at once Maston stopped.

"Hush!" said he. "There is some one yonder!"

"Some one?" answered Michel Ardan.

"Yes! a man! He does not seem to move. His rifle is not in his hand. What can he be doing?"

"But do you recognise him?" asked Michel Ardan.

"Yes, yes! he is turning round," answered Maston.

"Who is it?"

"Captain Nicholl!"

"Nicholl!" cried Michel Ardan, whose heart almost stopped beating.

"Nicholl disarmed! Then he had nothing more to fear from his adversary?"

"Let us go to him," said Michel Ardan; "we shall know how it is."

But his companion and he had not gone fifty steps when they stopped to examine the captain more attentively. They imagined they should find a bloodthirsty and revengeful man. Upon seeing him they remained stupefied.

A net with fine meshes was hung between two gigantic tulip-trees, and in it a small bird, with its wings entangled, was struggling with plaintive cries. The bird-catcher who had hung the net was not a human being but a venomous spider, peculiar to the country, as large as a pigeon's egg, and furnished with enormous legs. The hideous insect, as he was rushing on his prey, was forced to turn back and take refuge in the high branches of a tulip-tree, for a formidable enemy threatened him in his turn.

In fact, Captain Nicholl, with his gun on the ground, forgetting the dangers of his situation, was occupied in delivering as delicately as possible the victim taken in the meshes of the monstrous spider. When he had finished he let the little bird fly away; it fluttered its wings joyfully and disappeared.

Nicholl, touched, was watching it fly through the copse when he heard these words uttered in a voice full of emotion:--

"You are a brave man, you are!"

He turned. Michel Ardan was in front of him, repeating in every tone--

"And a kind one!"

"Michel Ardan!" exclaimed the captain, "what have you come here for, sir?"

"To shake hands with you, Nicholl, and prevent you killing Barbicane or being killed by him."

"Barbicane!" cried the captain, "I have been looking for him these two hours without finding him! Where is he hiding himself?"

"Nicholl!" said Michel Ardan, "this is not polite! You must always respect your adversary; don't be uneasy; if Barbicane is alive we shall find him, and so much the more easily that if he has not amused himself with protecting birds he must be looking for you too. But when you have found him--and Michel Ardan tells you this--there will be no duel between you."

"Between President Barbicane and me," answered Nicholl gravely, "there is such rivalry that the death of one of us--"

"Come, come!" resumed Michel Ardan, "brave men like you may detest one another, but they respect one another too. You will not fight."

"I shall fight, sir."

"No you won't."

"Captain," then said J.T. Maston heartily, "I am the president's friend, his _alter ego_; if you must absolutely kill some one kill me; that will be exactly the same thing."

"Sir," said Nicholl, convulsively seizing his rifle, "this joking--"

"Friend Maston is not joking," answered Michel Ardan, "and I understand his wanting to be killed for the man he loves; but neither he nor Barbicane will fall under Captain Nicholl's bullets, for I have so tempting a proposition to make to the two rivals that they will hasten to accept it."

"But what is it, pray?" asked Nicholl, with visible incredulity.

"Patience," answered Ardan; "I can only communicate it in Barbicane's presence."

"Let us look for him, then," cried the captain.

The three men immediately set out; the captain, having discharged his rifle, threw it on his shoulder and walked on in silence.

During another half-hour the search was in vain. Maston was seized with a sinister presentiment. He observed Captain Nicholl closely, asking himself if, once the captain's vengeance satisfied, the unfortunate Barbicane had not been

left lying in some bloody thicket. Michel Ardan seemed to have the same thought, and they were both looking questioningly at Captain Nicholl when Maston suddenly stopped.

The motionless bust of a man leaning against a gigantic catalpa appeared twenty feet off half hidden in the grass.

"It is he!" said Maston.

Barbicane did not move. Ardan stared at the captain, but he did not wince. Ardan rushed forward, crying--

"Barbicane! Barbicane!"

No answer. Ardan was about to seize his arm; he stopped short, uttering a cry of surprise.

Barbicane, with a pencil in his hand, was tracing geometrical figures upon a memorandum-book, whilst his unloaded gun lay on the ground.

Absorbed in his work, the _savant_, forgetting in his turn his duel and his vengeance, had neither seen nor heard anything.

But when Michel Ardan placed his hand on that of the president, he got up and looked at him with astonishment.

"Ah!" cried he at last; "you here! I have found it, my friend, I have found it!"

"What?"

"The way to do it."

"The way to do what?"

"To counteract the effect of the shock at the departure of the projectile."

"Really?" said Michel, looking at the captain out of the corner of his eye.

"Yes, water! simply water, which will act as a spring. Ah, Maston!" cried Barbicane, "you too!"

"Himself," answered Michel Ardan; "and allow me to introduce at the same time the worthy Captain Nicholl."

"Nicholl!" cried Barbicane, up in a moment. "Excuse me, captain," said he; "I had forgotten. I am ready."

Michel Ardan interfered before the two enemies had time to recriminate.

"Faith," said he, "it is fortunate that brave fellows like you did not meet sooner. We should now have to mourn for one or other of you; but, thanks to God, who has prevented it, there is nothing more to fear. When one forgets his hatred to plunge into mechanical problems and the other to play tricks on spiders, their hatred cannot be dangerous to anybody."

And Michel Ardan related the captain's story to the president.

"I ask you now," said he as he concluded, "if two good beings like you were made to break each other's heads with gunshots?"

There was in this rather ridiculous situation something so unexpected, that Barbicane and Nicholl did not know how to look at one another. Michel Ardan felt this, and resolved to try for a reconciliation.

"My brave friends," said he, smiling in his most fascinating manner, "it has all been a mistake between you, nothing more. Well, to prove that all is ended between you, and as you are men who risk your lives, frankly accept the proposition that I am going to make to you."

"Speak," said Nicholl.

"Friend Barbicane believes that his projectile will go straight to the moon."

"Yes, certainly," replied the president.

"And friend Nicholl is persuaded that it will fall back on the earth."

"I am certain of it," cried the captain.

"Good," resumed Michel Ardan. "I do not pretend to make you agree; all I say to you is, 'Come with me, and see if we shall stop on the road.'"

"What?" said J.T. Maston, stupefied.

The two rivals at this sudden proposition had raised their eyes and looked at each other attentively. Barbicane waited for Captain Nicholl's answer; Nicholl awaited the president's reply.

"Well," said Michel in his most engaging tone, "as there is now no shock to fear----"

"Accepted!" cried Barbicane.

But although this word was uttered very quickly, Nicholl had finished it at the same time.

"Hurrah! bravo!" cried Michel Ardan, holding out his hands to the two adversaries. "And now that the affair is arranged, my friends, allow me to treat you French fashion. _Allons déjeuner_."

CHAPTER XXII

.

THE NEW CITIZEN OF THE UNITED STATES.

That day all America heard about the duel and its singular termination. The part played by the chivalrous European, his unexpected proposition which solved the difficulty, the simultaneous acceptation of the two rivals, that conquest of the lunar continent to which France and the United States were going to march in concert--everything tended to increase Michel Ardan's popularity. It is well known how enthusiastic the Yankees will get about an individual. In a country where grave magistrates harness themselves to a dancer's carriage and draw it in triumph, it may be judged how the bold Frenchman was treated. If they did not take out his horses it was probably because he had none, but all other marks of enthusiasm were showered upon him. There was no citizen who did not join him heart and mind:--_Ex pluribus unam_, according to the motto of the United States.

From that day Michel Ardan had not a minute's rest. Deputations from all parts of the Union worried him incessantly. He was forced to receive them whether he

would or no. The hands he shook could not be counted; he was soon completely worn out, his voice became hoarse in consequence of his innumerable speeches, and only escaped from his lips in unintelligible sounds, and he nearly caught a gastro-enterite after the toasts he proposed to the Union. This success would have intoxicated another man from the first, but he managed to stay in a *spirituelle* and charming demi-inebriety.

Amongst the deputations of every sort that assailed him, that of the "Lunatics" did not forget what they owed to the future conqueror of the moon. One day some of these poor creatures, numerous enough in America, went to him and asked to return with him to their native country. Some of them pretended to speak "Selenite," and wished to teach it to Michel Ardan, who willingly lent himself to their innocent mania, and promised to take their messages to their friends in the moon.

"Singular folly!" said he to Barbicane, after having dismissed them; "and a folly that often takes possession of men of great intelligence. One of our most illustrious _savants_, Arago, told me that many very wise and reserved people in their conceptions became much excited and gave way to incredible singularities every time the moon occupied them. Do you believe in the influence of the moon upon maladies?"

"Very little," answered the president of the Gun Club.

"I do not either, and yet history has preserved some facts that, to say the least, are astonishing. Thus in 1693, during an epidemic, people perished in the greatest numbers on the 21st of January, during an eclipse. The celebrated Bacon fainted during the moon eclipses, and only came to himself after its entire emersion. King Charles VI. relapsed six times into madness during the year 1399, either at the new or full moon. Physicians have ranked epilepsy amongst the maladies that follow the phases of the moon. Nervous maladies have often appeared to be influenced by it. Mead speaks of a child who had convulsions when the moon was in opposition. Gall remarked that insane persons underwent an accession of their disorder twice in every month, at the epochs of the new and full moon. Lastly, a thousand observations of this sort made upon malignant fevers and somnambulism tend to prove that the Queen of Night has a mysterious influence upon terrestrial maladies."

"But how? why?" asked Barbicane.

"Why?" answered Ardan. "Why, the only thing I can tell you is what Arago repeated nineteen centuries after Plutarch. Perhaps it is because it is not true."

In the height of his triumph Michel Ardan could not escape any of the annoyances incidental to a celebrated man. Managers of entertainments wished to exhibit him. Barnum offered him a million dollars to show him as a curious animal in the different towns of the United States.

Still, though he refused to satisfy public curiosity in that way, his portraits went all over the world, and occupied the place of honour in albums; proofs were made of all sizes from life size to medallions. Every one could possess the hero in all positions--head, bust, standing, full-face, profile, three-quarters, back. Fifteen hundred thousand copies were taken, and it would have been a fine occasion to get money by relics, but he did not profit by it. If he had sold his hairs for a dollar apiece there would have remained enough to make his fortune!

To tell the truth, this popularity did not displease him. On the contrary, he put himself at the disposition of the public, and corresponded with the entire universe. They repeated his witticisms, especially those he did not perpetrate.

Not only had he all the men for him, but the women too. What an infinite number of good marriages he might have made if he had taken a fancy to "settle!" Old maids especially dreamt before his portraits day and night.

It is certain that he would have found female companions by hundreds, even if he had imposed the condition of following him up into the air. Women are intrepid when they are not afraid of everything. But he had no intention of transplanting a race of Franco-Americans upon the lunar continent, so he refused.

"I do not mean," said he, "to play the part of Adam with a daughter of Eve up there. I might meet with serpents!"

As soon as he could withdraw from the joys of triumph, too often repeated, he went with his friends to pay a visit to the Columbiad. He owed it that. Besides, he was getting very learned in ballistics since he had lived with Barbicane, J.T. Maston, and *tutti quanti*. His greatest pleasure consisted in repeating to these brave artillerymen that they were only amiable and learned murderers. He was always joking about it. The day he visited the Columbiad he greatly admired it, and went down to the bore of the gigantic mortar that was soon to hurl him

towards the Queen of Night.

"At least," said he, "that cannon will not hurt anybody, which is already very astonishing on the part of a cannon. But as to your engines that destroy, burn, smash, and kill, don't talk to me about them!"

It is necessary to report here a proposition made by J.T. Maston. When the secretary of the Gun Club heard Barbicane and Nicholl accept Michel Ardan's proposition he resolved to join them, and make a party of four. One day he asked to go. Barbicane, grieved at having to refuse, made him understand that the projectile could not carry so many passengers. J.T. Maston, in despair, went to Michel Ardan, who advised him to be resigned, adding one or two arguments *ad hominem*.

"You see, old fellow," he said to him, "you must not be offended, but really, between ourselves, you are too incomplete to present yourself in the moon."

"Incomplete!" cried the valiant cripple.

"Yes, my brave friend. Suppose we should meet with inhabitants up there. Do you want to give them a sorry idea of what goes on here, teach them what war is, show them that we employ the best part of our time in devouring each other and breaking arms and limbs, and that upon a globe that could feed a hundred thousand millions of inhabitants, and where there are hardly twelve hundred millions? Why, my worthy friend, you would have us shown to the door!"

"But if you arrive smashed to pieces," replied J.T. Maston, "you will be as incomplete as I."

"Certainly," answered Michel Ardan, "but we shall not arrive in pieces."

In fact, a preparatory experiment, tried on the 18th of October, had been attended with the best results, and given rise to the most legitimate hopes. Barbicane, wishing to know the effect of the shock at the moment of the projectile's departure, sent for a 32-inch mortar from Pensacola Arsenal. It was installed upon the quay of Hillisboro Harbour, in order that the bomb might fall into the sea, and the shock of its fall be deadened. He only wished to experiment upon the shock of its departure, not that of its arrival.

A hollow projectile was prepared with the greatest care for this curious

experiment. A thick wadding put upon a network of springs made of the best steel lined it inside. It was quite a wadded nest.

"What a pity one can't go in it!" said J.T. Maston, regretting that his size did not allow him to make the venture.

Into this charming bomb, which was closed by means of a lid, screwed down, they put first a large cat, then a squirrel belonging to the perpetual secretary of the Gun Club, which J.T. Maston was very fond of. But they wished to know how this little animal, not likely to be giddy, would support this experimental journey.

The mortar was loaded with 160 lbs. of powder and the bomb. It was then fired.

The projectile immediately rose with rapidity, described a majestic parabola, attained a height of about a thousand feet, and then with a graceful curve fell into the waves.

Without losing an instant, a vessel was sent to the spot where it fell; skilful divers sank under water and fastened cable-chains to the handles of the bomb, which was rapidly hoisted on board. Five minutes had not elapsed between the time the animals were shut up and the unscrewing of their prison lid.

Ardan, Barbicane, Maston, and Nicholl were upon the vessel, and they assisted at the operation with a sentiment of interest easy to understand. The bomb was hardly opened before the cat sprang out, rather bruised but quite lively, and not looking as if it had just returned from an aërial expedition. But nothing, was seen of the squirrel. The truth was then discovered. The cat had eaten its travelling companion.

J.T. Maston was very grieved at the loss of his poor squirrel, and proposed to inscribe it in the martyrology of science.

However that may be, after this experiment all hesitation and fear were at an end; besides, Barbicane's plans were destined further to perfect the projectile, and destroy almost entirely the effect of the shock. There was nothing more to do but to start.

Two days later Michel Ardan received a message from the President of the Union, an honour which he much appreciated.

After the example of his chivalrous countryman, La Fayette, the government had bestowed upon him the title of "Citizen of the United States of America."

CHAPTER XXIII

.

THE PROJECTILE COMPARTMENT.

After the celebrated Columbiad was completed public interest immediately centred upon the projectile, the new vehicle destined to transport the three bold adventurers across space. No one had forgotten that in his despatch of September 30th Michel Ardan asked for a modification of the plans laid out by the members of the committee.

President Barbicane then thought with reason that the form of the projectile was of slight importance, for, after crossing the atmosphere in a few seconds, it would meet with vacuum. The committee had therefore chosen the round form, so that the ball might turn over and over and do as it liked. But as soon as it had to be made into a vehicle, that was another thing. Michel Ardan did not want to travel squirrel-fashion; he wished to go up head up and feet down with as much dignity as in the car of a balloon, quicker of course, but without unseemly gambols.

New plans were, therefore, sent to the firm of Breadwill and Co., of Albany, with the recommendation to execute them without delay. The projectile, thus modified, was cast on the 2nd of November, and sent immediately to Stony Hill by the Eastern Railway.

On the 10th it arrived without accident at its place of destination. Michel Ardan, Barbicane, and Nicholl awaited with the most lively impatience this "projectile compartment" in which they were to take their passage for the discovery of a new world.

It must be acknowledged that it was a magnificent piece of metal, a metallurgic production that did the greatest honour to the industrial genius of the Americans. It was the first time that aluminium had been obtained in so large a mass, which result might be justly regarded as prodigious. This precious projectile sparkled in

the rays of the sun. Seeing it in its imposing shape with its conical top, it might easily have been taken for one of those extinguisher-shaped towers that architects of the Middle Ages put at the angles of their castles. It only wanted loopholes and a weathercock.

"I expect," exclaimed Michel Ardan, "to see a man armed _cap-à-pie_ come out of it. We shall be like feudal lords in there; with a little artillery we could hold our own against a whole army of Selenites--that is, if there are any in the moon!"

"Then the vehicle pleases you?" asked Barbicane.

"Yes, yes! certainly," answered Michel Ardan, who was examining it as an artist. "I only regret that its form is not a little more slender, its cone more graceful; it ought to be terminated by a metal group, some Gothic ornament, a salamander escaping from it with outspread wings and open beak."

"What would be the use?" said Barbicane, whose positive mind was little sensitive to the beauties of art.

"Ah, friend Barbicane, I am afraid you will never understand the use, or you would not ask!"

"Well, tell me, at all events, my brave companion."

"Well, my friend, I think we ought always to put a little art in all we do. Do you know an Indian play called _The Child's Chariot_?"

"Not even by name," answered Barbicane.

"I am not surprised at that," continued Michel Ardan. "Learn, then, that in that play there is a robber who, when in the act of piercing the wall of a house, stops to consider whether he shall make his hole in the shape of a lyre, a flower, or a bird. Well, tell me, friend Barbicane, if at that epoch you had been his judge would you have condemned that robber?"

"Without hesitation," answered the president of the Gun Club, "and as a burglar too."

"Well, I should have acquitted him, friend Barbicane. That is why you could never understand me."

"I will not even try, my valiant artist."

"But, at least," continued Michel Ardan, "as the exterior of our projectile compartment leaves much to be desired, I shall be allowed to furnish the inside as I choose, and with all luxury suitable to ambassadors from the earth."

"About that, my brave Michel," answered Barbicane, "you can do entirely as you please."

But before passing to the agreeable the president of the Gun Club had thought of the useful, and the means he had invented for lessening the effects of the shock were applied with perfect intelligence.

Barbicane had said to himself, not unreasonably, that no spring would be sufficiently powerful to deaden the shock, and during his famous promenade in Skersnaw Wood he had ended by solving this great difficulty in an ingenious fashion. He depended upon water to render him this signal service. This is how:--

The projectile was to be filled to the depth of three feet with water destined to support a water-tight wooden disc, which easily worked within the walls of the projectile. It was upon this raft that the travellers were to take their place. As to the liquid mass, it was divided by horizontal partitions which the departing shock would successively break; then each sheet of water, from the lowest to the highest, escaping by valves in the upper part of the projectile, thus making a spring, and the disc, itself furnished with extremely powerful buffers, could not strike the bottom until it had successively broken the different partitions. The travellers would doubtless feel a violent recoil after the complete escape of the liquid mass, but the first shock would be almost entirely deadened by so powerful a spring.

It is true that three feet on a surface of 541 square feet would weigh nearly 11,500 lbs; but the escape of gas accumulated in the Columbiad would suffice, Barbicane thought to conquer that increase of weight; besides, the shock would send out all that water in less than a second, and the projectile would soon regain its normal weight.

This is what the president of the Gun Club had imagined, and how he thought he had solved the great question of the recoil. This work, intelligently comprehended by the engineers of the Breadwill firm, was marvellously

executed; the effect once produced and the water gone, the travellers could easily get rid of the broken partitions and take away the mobile disc that bore them at the moment of departure.

As to the upper sides of the projectile, they were lined with a thick wadding of leather, put upon the best steel springs as supple as watch-springs. The escape-pipes hidden under this wadding were not even seen.

All imaginable precautions for deadening the first shock having been taken, Michel Ardan said they must be made of "very bad stuff" to be crushed.

The projectile outside was nine feet wide and twelve feet high. In order not to pass the weight assigned the sides had been made a little less thick and the bottom thicker, as it would have to support all the violence of the gases developed by the deflagration of the pyroxyle. Bombs and cylindro-conical howitzers are always made with thicker bottoms.

The entrance to this tower of metal was a narrow opening in the wall of the cone, like the "man-hole" of steam boilers. It closed hermetically by means of an aluminium plate fastened inside by powerful screw pressure. The travellers could therefore leave their mobile prison at will as soon as they had reached the Queen of Night.

But going was not everything; it was necessary to see on the road. Nothing was easier. In fact, under the wadding were four thick lenticular footlights, two let into the circular wall of the projectile, the third in its lower part, and the fourth in its cone. The travellers could, therefore, observe during their journey the earth they were leaving, the moon they were approaching, and the constellated spaces of the sky. These skylights were protected against the shocks of departure by plates let into solid grooves, which it was easy to move by unscrewing them. By that means the air contained in the projectile could not escape, and it was possible to make observations.

All these mechanical appliances, admirably set, worked with the greatest ease, and the engineers had not shown themselves less intelligent in the arrangement of the projectile compartment.

Lockers solidly fastened were destined to contain the water and provisions necessary for the three travellers; they could even procure themselves fire and light by means of gas stored up in a special case under a pressure of several

atmospheres. All they had to do was to turn a tap, and the gas would light and warm this comfortable vehicle for six days. It will be seen that none of the things essential to life, or even to comfort, were wanting. More, thanks to the instincts of Michel Ardan, the agreeable was joined to the useful under the form of objects of art; he would have made a veritable artist's studio of his projectile if room had not been wanting. It would be mistaken to suppose that three persons would be restricted for space in that metal tower. It had a surface of 54 square feet, and was nearly 10 feet high, and allowed its occupiers a certain liberty of movement. They would not have been so much at their ease in the most comfortable railway compartment of the United States.

The question of provisions and lighting having been solved, there remained the question of air. It was evident that the air confined in the projectile would not be sufficient for the travellers' respiration for four days; each man, in fact, consumes in one hour all the oxygen contained in 100 litres of air. Barbicane, his two companions, and two dogs that he meant to take, would consume every twenty-four hours 2,400 litres of oxygen, or a weight equal to 7 lbs. The air in the projectile must, therefore, be renewed. How? By a very simple method, that of Messrs. Reiset and Regnault, indicated by Michel Ardan during the discussion of the meeting.

It is known that the air is composed principally of twenty-one parts of oxygen and seventy-nine parts of azote. Now what happens in the act of respiration? A very simple phenomenon, Man absorbs the oxygen of the air, eminently adapted for sustaining life, and throws out the azote intact. The air breathed out has lost nearly five per cent, of its oxygen, and then contains a nearly equal volume of carbonic acid, the definitive product of the combustion of the elements of the blood by the oxygen breathed in it. It happens, therefore, that in a confined space and after a certain time all the oxygen of the air is replaced by carbonic acid, an essentially deleterious gas.

The question was then reduced to this, the azote being conserved intact--1. To remake the oxygen absorbed; 2. To destroy the carbonic acid breathed out. Nothing easier to do by means of chlorate of potash and caustic potash. The former is a salt which appears under the form of white crystals; when heated to a temperature of 400° it is transformed into chlorine of potassium, and the oxygen which it contains is given off freely. Now 18 lbs. of chlorate of potash give 7 lbs of oxygen--that is to say, the quantity necessary to the travellers for twenty-four hours.

As to caustic potash, it has a great affinity for carbonic acid mixed in air, and it is sufficient to shake it in order for it to seize upon the acid and form bicarbonate of potash. So much for the absorption of carbonic acid.

By combining these two methods they were certain of giving back to vitiated air all its life-giving qualities. The two chemists, Messrs. Reiset and Regnault, had made the experiment with success.

But it must be said the experiment had only been made *in anima vili*. Whatever its scientific accuracy might be, no one knew how man could bear it.

Such was the observation made at the meeting where this grave question was discussed. Michel Ardan meant to leave no doubt about the possibility of living by means of this artificial air, and he offered to make the trial before the departure.

But the honour of putting it to the proof was energetically claimed by J.T. Maston.

"As I am not going with you," said the brave artilleryman, "the least I can do will be to live in the projectile for a week."

It would have been ungracious to refuse him. His wish was complied with. A sufficient quantity of chlorate of potash and caustic potash was placed at his disposition, with provisions for a week; then having shaken hands with his friends, on the 12th of November at 6 a.m., after having expressly recommended them not to open his prison before the 20th at 6 p.m., he crept into the projectile, the iron plate of which was hermetically shut.

What happened during that week? It was impossible to ascertain. The thickness of the projectile's walls prevented any interior noise from reaching the outside.

On the 20th of November, at six o'clock precisely, the plate was removed; the friends of J.T. Maston were rather uneasy. But they were promptly reassured by hearing a joyful voice shouting a formidable hurrah!

The secretary of the Gun Club appeared on the summit of the cone in a triumphant attitude.

He had grown fat!

CHAPTER XXIV

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THE TELESCOPE OF THE ROCKY MOUNTAINS.

On the 20th of October of the preceding year, after the subscription list was closed, the president of the Gun Club had credited the Cambridge Observatory with the sums necessary for the construction of a vast optical instrument. This telescope was to be powerful enough to render visible on the surface of the moon an object being at least nine feet wide.

There is an important difference between a field-glass and a telescope, which it is well to recall here. A field-glass is composed of a tube which carries at its upper extremity a convex glass called an object-glass, and at its lower extremity a second glass called ocular, to which the eye of the observer is applied. The rays from the luminous object traverse the first glass, and by refraction form an image upside down at its focus. This image is looked at with the ocular, which magnifies it. The tube of the field-glass is, therefore, closed at each extremity by the object and the ocular glasses.

The telescope, on the contrary, is open at its upper extremity. The rays from the object observed penetrate freely into it, and strike a concave metallic mirror--that is to say, they are focussed. From thence their reflected rays meet with a little mirror, which sends them back to the ocular in such a way as to magnify the image produced.

Thus in field-glasses refraction plays the principal part, and reflection does in the telescope. Hence the name of refractors given to the former, and reflectors given to the latter. All the difficulty in the execution of these optical instruments lies in the making of the object-glass, whether they be made of glass or metallic mirrors.

Still at the epoch when the Gun Club made its great experiment these instruments were singularly perfected and gave magnificent results. The time was far distant when Galileo observed the stars with his poor glass, which magnified seven times at the most. Since the 16th century optical instruments had widened and lengthened in considerable proportions, and they allowed the

stellar spaces to be gauged to a depth unknown before. Amongst the refracting instruments at work at that period were the glass of the Poulkowa Observatory in Russia, the object-glass of which measured 15 inches in width, that of the French optician Lerebours, furnished with an object-glass equally large, and lastly that of the Cambridge Observatory, furnished with an object-glass 19 inches in diameter.

Amongst telescopes, two were known of remarkable power and gigantic dimensions. The first, constructed by Herschel, was 36 feet in length, and had an object-glass of 4 feet 6 inches; it magnified 6,000 times; the second, raised in Ireland, at Birrcastle, in Parsonstown Park, belonged to Lord Rosse; the length of its tube was 48 feet and the width of its mirror 6 feet; it magnified 6,400 times, and it had required an immense erection of masonry on which to place the apparatus necessary for working the instrument, which weighed 12-1/2 tons.

But it will be seen that notwithstanding these colossal dimensions the magnifying power obtained did not exceed 6,000 times in round numbers; now that power would only bring the moon within 39 miles, and would only allow objects 60 feet in diameter to be perceived unless these objects were very elongated.

Now in space they had to deal with a projectile 9 feet wide and 15 long, so the moon had to be brought within five miles at least, and for that a magnifying power of 48,000 times was necessary.

Such was the problem propounded to the Cambridge Observatory. They were not to be stopped by financial difficulties, so there only remained material difficulties.

First of all they had to choose between telescopes and field-glasses. The latter had some advantages. With equal object-glasses they have a greater magnifying power, because the luminous rays that traverse the glasses lose less by absorption than the reflection on the metallic mirror of telescopes; but the thickness that can be given to glass is limited, for too thick it does not allow the luminous rays to pass. Besides, the construction of these vast glasses is excessively difficult, and demands a considerable time, measured by years.

Therefore, although images are better given by glasses, an inappreciable advantage when the question is to observe the moon, the light of which is simply

reflected they decided to employ the telescope, which is prompter in execution and is capable of a greater magnifying power; only as the luminous rays lose much of their intensity by traversing the atmosphere, the Gun Club resolved to set up the instrument on one of the highest mountains of the Union, which would diminish the depth of the aërial strata.

In telescopes it has been seen that the glass placed at the observer's eye produces the magnifying power, and the object-glass which bears this power the best is the one that has the largest diameter and the greatest focal distance. In order to magnify 48,000 times it must be much larger than those of Herschel and Lord Rosse. There lay the difficulty, for the casting of these mirrors is a very delicate operation.

Happily, some years before a *savant* of the _Institut de France_, Léon Foucault, had just invented means by which the polishing of object-glasses became very prompt and easy by replacing the metallic mirror by taking a piece of glass the size required and plating it.

It was to be fixed according to the method invented by Herschel for telescopes. In the great instrument of the astronomer at Slough, the image of objects reflected by the mirror inclined at the bottom of the tube was formed at the other extremity where the eyeglass was placed. Thus the observer, instead of being placed at the lower end of the tube, was hoisted to the upper end, and there with his eyeglass he looked down into the enormous cylinder. This combination had the advantage of doing away with the little mirror destined to send back the image to the ocular glass, which thus only reflected once instead of twice; therefore there were fewer luminous rays extinguished, the image was less feeble, and more light was obtained, a precious advantage in the observation that was to be made.

This being resolved upon, the work was begun. According to the calculations of the Cambridge Observatory staff, the tube of the new reflector was to be 280 feet long and its mirror 16 feet in diameter. Although it was so colossal it was not comparable to the telescope 10,000 feet long which the astronomer Hooke proposed to construct some years ago. Nevertheless the setting up of such an apparatus presented great difficulties.

The question of its site was promptly settled. It must be upon a high mountain, and high mountains are not numerous in the States.

In fact, the orographical system of this great country only contains two chains of average height, amongst which flows the magnificent Mississippi, which the Americans would call the "king of rivers" if they admitted any royalty whatever.

On the east rise the Apalachians, the very highest point of which, in New Hampshire, does not exceed the very moderate altitude of 5,600 feet.

On the west are, however, the Rocky Mountains, that immense chain which begins at the Straits of Magellan, follows the west coast of South America under the name of the Andes or Cordilleras, crosses the Isthmus of Panama, and runs up the whole of North America to the very shores of the Polar Sea.

These mountains are not very high, and the Alps or Himalayas would look down upon them with disdain. In fact, their highest summit is only 10,701 feet high, whilst Mont Blanc is 14,439, and the highest summit of the Himalayas is 26,776 feet above the level of the sea.

But as the Gun Club wished that its telescope, as well as the Columbiad, should be set up in the States of the Union, they were obliged to be content with the Rocky Mountains, and all the necessary material was sent to the summit of Long's Peak in the territory of Missouri.

Neither pen nor language could relate the difficulties of every kind that the American engineers had to overcome, and the prodigies of audacity and skill that they accomplished. Enormous stones, massive pieces of wrought-iron, heavy corner-clamps, and huge portions of cylinder had to be raised with an object-glass, weighing nearly 30,000 lbs., above the line of perpetual snow for more than 10,000 feet in height, after crossing desert prairies, impenetrable forests, fearful rapids far from all centres of population, and in the midst of savage regions in which every detail of life becomes an insoluble problem, and, nevertheless, American genius triumphed over all these obstacles. Less than a year after beginning the works in the last days of the month of September, the gigantic reflector rose in the air to a height of 280 feet. It was hung from an enormous iron scaffolding; an ingenious arrangement allowed it to be easily moved towards every point of the sky, and to follow the stars from one horizon to the other during their journey across space.

It had cost more than 400,000 dollars. The first time it was pointed at the moon the observers felt both curious and uneasy. What would they discover in the field

of this telescope which magnified objects 48,000 times? Populations, flocks of lunar animals, towns, lakes, and oceans? No, nothing that science was not already acquainted with, and upon all points of her disc the volcanic nature of the moon could be determined with absolute precision.

But the telescope of the Rocky Mountains, before being used by the Gun Club, rendered immense services to astronomy. Thanks to its power of penetration, the depths of the sky were explored to their utmost limits, the apparent diameter of a great number of stars could be rigorously measured, and Mr. Clarke, of the Cambridge staff, resolved the Crab nebula in Taurus, which Lord Rosse's reflector had never been able to do.

CHAPTER XXV

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FINAL DETAILS.

It was the 22nd of November. The supreme departure was to take place ten days later. One operation still remained to bring it to a happy termination, a delicate and perilous operation exacting infinite precautions, and against the success of which Captain Nicholl had laid his third bet. It was, in fact, nothing less than the loading of the gun and the introduction into it of 400,000 lbs. of gun-cotton. Nicholl had thought, not without reason, perhaps, that the handling of so large a quantity of pyroxyle would cause grave catastrophes, and that in any case this eminently explosive mass would ignite of itself under the pressure of the projectile.

There were also grave dangers increased by the carelessness of the Americans, who, during the Federal war, used to load their cannon cigar in mouth. But Barbicane had set his heart on succeeding, and did not mean to founder in port; he therefore chose his best workmen, made them work under his superintendence, and by dint of prudence and precautions he managed to put all the chances of success on his side.

First he took care not to bring all his charge at once to the inclosure of Stony Hill. He had it brought little by little carefully packed in sealed cases. The 400,000 lbs. of pyroxyle had been divided into packets of 500 lbs., which made

800 large cartridges made carefully by the cleverest artisans of Pensacola. Each case contained ten, and they arrived one after the other by the railroad of Tampa Town; by that means there were never more than 500 lbs. of pyroxyle at once in the inclosure. As soon as it arrived each case was unloaded by workmen walking barefoot, and each cartridge transported to the orifice of the Columbiad, into which they lowered them by means of cranes worked by the men. Every steam-engine had been excluded, and the least fires extinguished for two miles round. Even in November it was necessary to preserve this gun-cotton from the ardour of the sun. So they worked at night by light produced in a vacuum by means of Rühmkorff's apparatus, which threw an artificial brightness into the depths of the Columbiad. There the cartridges were arranged with the utmost regularity, fastened together by a wire destined to communicate the electric spark to them all simultaneously.

In fact, it was by means of electricity that fire was to be set to this mass of gun-cotton. All these single wires, surrounded by isolating material, were rolled into a single one at a narrow hole pierced at the height the projectile was to be placed; there they crossed the thick metal wall and came up to the surface by one of the vent-holes in the masonry made on purpose. Once arrived at the summit of Stony Hill, the wire supported on poles for a distance of two miles met a powerful pile of Bunsen passing through a non-conducting apparatus. It would, therefore, be enough to press with the finger the knob of the apparatus for the electric current to be at once established, and to set fire to the 400,000 lbs. of gun-cotton. It is hardly necessary to say that this was only to be done at the last moment.

On the 28th of November the 800 cartridges were placed at the bottom of the Columbiad. That part of the operation had succeeded. But what worry, anxiety, and struggles President Barbicane had to undergo! In vain had he forbidden entrance to Stony Hill; every day curious sightseers climbed over the palisading, and some, pushing imprudence to folly, came and smoked amongst the bales of gun-cotton. Barbicane put himself into daily rages. J.T. Maston seconded him to the best of his ability, chasing the intruders away and picking up the still-lighted cigar-ends which the Yankees threw about--a rude task, for more than 300,000 people pressed round the palisades. Michel Ardan had offered himself to escort the cases to the mouth of the gun, but having caught him with a cigar in his mouth whilst he drove out the intruders to whom he was giving this unfortunate example, the president of the Gun Club saw that he could not depend upon this intrepid smoker, and was obliged to have him specially watched.

At last, there being a Providence even for artillerymen, nothing blew up, and the loading was happily terminated. The third bet of Captain Nicholl was therefore much imperilled. There still remained the work of introducing the projectile into the Columbiad and placing it on the thick bed of gun-cotton.

But before beginning this operation the objects necessary for the journey were placed with order in the waggon-compartment. There were a good many of them, and if they had allowed Michel Ardan to do as he pleased he would soon have filled up all the space reserved for the travellers. No one can imagine all that the amiable Frenchman wished to carry to the moon--a heap of useless trifles. But Barbicane interfered, and refused all but the strictly necessary.

Several thermometers, barometers, and telescopes were placed in the instrument-case.

The travellers were desirous of examining the moon during their transit, and in order to facilitate the survey of this new world they took an excellent map by Boeer and Moedler, the _Mappa Selenographica_, published in four plates, which is justly looked upon as a masterpiece of patience and observation. It represented with scrupulous exactitude the slightest details of that portion of the moon turned towards the earth. Mountains, valleys, craters, peaks, watersheds, were depicted on it in their exact dimensions, faithful positions, and names, from Mounts Doerfel and Leibnitz, whose highest summits rise on the eastern side of the disc, to the _Mare Frigoris_, which extends into the North Polar regions.

It was, therefore, a precious document for the travellers, for they could study the country before setting foot upon it.

They took also three rifles and three fowling-pieces with powder and shot in great quantity.

"We do not know with whom we may have to deal," said Michel Ardan. "Both men and beasts may be displeased at our visit; we must, therefore, take our precautions."

The instruments of personal defence were accompanied by pickaxes, spades, saws, and other indispensable tools, without mentioning garments suitable to every temperature, from the cold of the polar regions to the heat of the torrid zone.

Michel Ardan would have liked to take a certain number of animals of different sorts, not male and female of every species, as he did not see the necessity of acclimatising serpents, tigers, alligators, or any other noxious beasts in the moon.

"No," said he to Barbicane, "but some useful animals, ox or cow, ass or horse, would look well in the landscape and be of great use."

"I agree with you, my dear Ardan," answered the president of the Gun Club; "but our projectile is not Noah's Ark. It differs both in dimensions and object, so let us remain in the bounds of possibility."

At last after long discussions it was agreed that the travellers should be content to take with them an excellent sporting dog belonging to Nicholl and a vigorous Newfoundland of prodigious strength. Several cases of the most useful seeds were included amongst the indispensable objects. If they had allowed him, Michel Ardan would have taken several sacks of earth to sow them in. Any way he took a dozen little trees, which were carefully enveloped in straw and placed in a corner of the projectile.

Then remained the important question of provisions, for they were obliged to provide against finding the moon absolutely barren. Barbicane managed so well that he took enough for a year. But it must be added, to prevent astonishment, that these provisions consisted of meat and vegetable compressed to their smallest volume by hydraulic pressure, and included a great quantity of nutritive elements; there was not much variety, but it would not do to be too particular in such an expedition. There was also about fifty gallons of brandy and water for two months only, for, according to the latest observations of astronomers, no one doubted the presence of a large quantity of water in the moon. As to provisions, it would have been insane to believe that the inhabitants of the earth would not find food up there. Michel Ardan had no doubt about it. If he had he would not have gone.

"Besides," said he one day to his friends, "we shall not be completely abandoned by our friends on earth, and they will take care not to forget us."

"No, certainly," answered J.T. Maston.

"What do you mean?" asked Nicholl.

"Nothing more simple," answered Ardan. "Will not our Columbiad be still there? Well, then, every time that the moon is in favourable conditions of zenith, if not of perigee--that is to say, about once a year--could they not send us a projectile loaded with provisions which we should expect by a fixed date?"

"Hurrah!" cried J.T. Maston. "That is not at all a bad idea. Certainly we will not forget you."

"I depend upon you. Thus you see we shall have news regularly from the globe, and for our part we shall be very awkward if we do not find means to communicate with our good friends on earth."

These words inspired such confidence that Michel Ardan with his superb assurance would have carried the whole Gun Club with him. What he said seemed simple, elementary, and sure of success, and it would have been sordid attachment to this earth to hesitate to follow the three travellers upon their lunar expedition.

When the different objects were placed in the projectile the water was introduced between the partitions and the gas for lighting purposes laid in. Barbicane took enough chlorate of potash and caustic potash for two months, as he feared unforeseen delay. An extremely ingenious machine working automatically put the elements for good air in motion. The projectile, therefore, was ready, and the only thing left to do was to lower it into the gun, an operation full of perils and difficulty.

The enormous projectile was taken to the summit of Stony Hill. There enormous cranes seized it and held it suspended over the metal well.

This was an anxious moment. If the chains were to break under the enormous weight the fall of such a mass would inevitably ignite the gun-cotton.

Happily nothing of the sort happened, and a few hours afterwards the projectile-compartment rested on its pyroxyle bed, a veritable fulminating pillow. The only effect of its pressure was to ram the charge of the gun more strongly.

"I have lost," said the captain, handing the sum of 3,000 dollars to President Barbicane.

Barbicane did not wish to receive this money from his travelling companion, but

he was obliged to give way to Nicholl, who wished to fulfil all his engagements before leaving the earth.

"Then," said Michel Ardan, "there is but one thing I wish for you now, captain."

"What is that?" asked Nicholl.

"It is that you may lose your other two wagers. By that means we shall be sure not to be stopped on the road."

CHAPTER XXVI

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FIRE!

The 1st of December came, the fatal day, for if the projectile did not start that very evening at 10h. 46m. and 40s. p.m., more than eighteen years would elapse before the moon would present the same simultaneous conditions of zenith and perigee.

The weather was magnificent; notwithstanding the approach of winter the sun shone brightly and bathed in its radiance that earth which three of its inhabitants were about to leave for a new world.

How many people slept badly during the night that preceded the ardently-longed-for day! How many breasts were oppressed with the heavy burden of waiting! All hearts beat with anxiety except only the heart of Michel Ardan. This impassible person went and came in his usual business-like way, but nothing in him denoted any unusual preoccupation. His sleep had been peaceful--it was the sleep of Turenne upon a gun-carriage the night before the battle.

From early dawn an innumerable crowd covered the prairie, which extended as far as the eye could reach round Stony Hill. Every quarter of an hour the railroad of Tampa brought fresh sightseers. According to the _Tampa Town Observer_, five millions of spectators were that day upon Floridian soil.

The greater part of this crowd had been living in tents round the inclosure, and laid the foundations of a town which has since been called "Ardan's Town." The ground bristled with huts, cabins, and tents, and these ephemeral habitations sheltered a population numerous enough to rival the largest cities of Europe.

Every nation upon earth was represented; every language was spoken at the same time. It was like the confusion of tongues at the Tower of Babel. There the different classes of American society mixed in absolute equality. Bankers, cultivators, sailors, agents, merchants, cotton-planters, and magistrates elbowed each other with primitive ease. The creoles of Louisiana fraternised with the farmers of Indiana; the gentlemen of Kentucky and Tennessee, the elegant and

haughty Virginians, joked with the half-savage trappers of the Lakes and the butchers of Cincinnati. They appeared in broad-brimmed white beavers and Panamas, blue cotton trousers, from the Opelousa manufactories, draped in elegant blouses of écru cloth, in boots of brilliant colours, and extravagant shirt-frills; upon shirt-fronts, cuffs, cravats, on their ten fingers, even in their ears, an assortment of rings, pins, diamonds, chains, buckles, and trinkets, the cost of which equalled the bad taste. Wife, children, servants, in no less rich dress, accompanied, followed, preceded, and surrounded their husbands, fathers, and masters, who resembled the patriarchs amidst their innumerable families.

At meal-times it was a sight to see all these people devour the dishes peculiar to the Southern States, and eat, with an appetite menacing to the provisioning of Florida, the food that would be repugnant to a European stomach, such as fricasseed frogs, monkey-flesh, fish-chowder, underdone opossum, and raccoon steaks.

The liquors that accompanied this indigestible food were numerous. Shouts and vociferations to buy resounded through the bar-rooms or taverns, decorated with glasses, tankards, decanters, and bottles of marvellous shapes, mortars for pounding sugar, and bundles of straws.

"Mint-julep!" roars out one of the salesmen.

"Claret sangaree!" shouts another through his nose.

"Gin-sling!" shouts one.

"Cocktail! Brandy-smash!" cries another.

"Who'll buy real mint-julep in the latest style?" shouted these skilful salesmen, rapidly passing from one glass to another the sugar, lemon, green mint, crushed ice, water, cognac, and fresh pine-apple which compose this refreshing drink.

Generally these sounds, addressed to throats made thirsty by the spices they consumed, mingled into one deafening roar. But on this 1st of December these cries were rare. No one thought of eating and drinking, and at 4 p.m. there were many spectators in the crowd who had not taken their customary lunch! A much more significant fact, even the national passion for gaming was allayed by the general emotion. Thimbles, skittles, and cards were left in their wrappings, and testified that the great event of the day absorbed all attention.

Until nightfall a dull, noiseless agitation like that which precedes great catastrophes ran through the anxious crowd. An indescribable uneasiness oppressed all minds, and stopped the beating of all hearts. Every one wished it over.

However, about seven o'clock this heavy silence was suddenly broken. The moon rose above the horizon. Several millions of hurrahs saluted her apparition. She was punctual to the appointment. Shouts of welcome broke from all parts, whilst the blonde Phoebe shone peacefully in a clear sky, and caressed the enraptured crowd with her most affectionate rays.

At that moment the three intrepid travellers appeared. When they appeared the cries redoubled in intensity. Unanimously, instantaneously, the national song of the United States escaped from all the spectators, and "Yankee Doodle," sung by 5,000,000 of hearty throats, rose like a roaring tempest to the farthest limits of the atmosphere.

Then, after this irresistible outburst, the hymn was ended, the last harmonies died away by degrees, and a silent murmur floated over the profoundly-excited crowd.

In the meantime the Frenchman and the two Americans had stepped into the inclosure round which the crowd was pressing. They were accompanied by the members of the Gun Club, and deputations sent by the European observatories. Barbicane was coolly and calmly giving his last orders. Nicholl, with compressed lips and hands crossed behind his back, walked with a firm and measured step. Michel Ardan, always at his ease, clothed in a perfect travelling suit, with leather gaiters on his legs, pouch at his side, in vast garment of maroon velvet, a cigar in his mouth, distributed shakes of the hand with princely prodigality. He was full of inexhaustible gaiety, laughing, joking, playing pranks upon the worthy J.T. Maston, and was, in a word, "French," and, what is worse, "Parisian," till the last second.

Ten o'clock struck. The moment had come to take their places in the projectile; the necessary mechanism for the descent the door-plate to screw down, the removal of the cranes and scaffolding hung over the mouth of the Columbiad, took some time.

Barbicane had set his chronometer to the tenth of a second by that of the

engineer Murchison, who was entrusted with setting fire to the powder by means of the electric spark; the travellers shut up in the projectile could thus watch the impassive needle which was going to mark the precise instant of their departure.

The moment for saying farewell had come. The scene was touching; in spite of his gaiety Michel Ardan felt touched. J.T. Maston had found under his dry eyelids an ancient tear that he had, doubtless, kept for the occasion. He shed it upon the forehead of his dear president.

"Suppose I go too?" said he. "There is still time!"

"Impossible, old fellow," answered Barbicane.

A few moments later the three travelling companions were installed in the projectile, and had screwed down the door-plate, and the mouth of the Columbiad, entirely liberated, rose freely towards the sky.

Nicholl, Barbicane, and Michel Ardan were definitively walled up in their metal vehicle.

Who could predict the universal emotion then at its paroxysm?

The moon was rising in a firmament of limpid purity, outshining on her passage the twinkling fire of the stars; she passed over the constellation of the Twins, and was now nearly halfway between the horizon and the zenith.

A frightful silence hung over all that scene. There was not a breath of wind on the earth! Not a sound of breathing from the crowd! Hearts dared not beat. Every eye was fixed on the gaping mouth of the Columbiad.

Murchison watched the needle of his chronometer. Hardly forty seconds had to elapse before the moment of departure struck, and each one lasted a century!

At the twentieth there was a universal shudder, and the thought occurred to all the crowd that the audacious travellers shut up in the vehicle were likewise counting these terrible seconds! Some isolated cries were heard.

"Thirty-five!--thirty-six!--thirty-seven!--thirty--eight!--thirty-nine! --forty! Fire!!!"

Murchison immediately pressed his finger upon the electric knob and hurled the electric spark into the depths of the Columbiad.

A fearful, unheard-of, superhuman report, of which nothing could give an idea, not even thunder or the eruption of volcanoes, was immediately produced. An immense spout of fire sprang up from the bowels of the earth as if from a crater. The soil heaved and very few persons caught a glimpse of the projectile victoriously cleaving the air amidst the flaming smoke.

CHAPTER XXVII

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CLOUDY WEATHER.

At the moment when the pyramid of flame rose to a prodigious height in the air it lighted up the whole of Florida, and for an incalculable moment day was substituted for night over a considerable extent of country. This immense column of fire was perceived for a hundred miles out at sea, from the Gulf and from the Atlantic, and more than one ship's captain noted the apparition of this gigantic meteor in his log-book.

The discharge of the Columbiad was accompanied by a veritable earthquake. Florida was shaken to its very depths. The gases of the powder, expanded by heat, forced back the atmospheric strata with tremendous violence, passing like a waterspout through the air.

Not one spectator remained on his legs; men, women, and children were thrown down like ears of wheat in a storm; there was a terrible tumult, and a large number of people were seriously injured. J.T. Maston, who had very imprudently kept to the fore, was thrown twenty yards backwards like a bullet over the heads of his fellow-citizens. Three hundred thousand people were temporarily deafened and as though thunderstruck.

The atmospheric current, after throwing over huts and cabins, uprooting trees within a radius of twenty miles, throwing the trains off the railway as far as Tampa, burst upon the town like an avalanche and destroyed a hundred houses, amongst others the church of St. Mary and the new edifice of the Exchange.

Some of the vessels in the port were run against each other and sunk, and ten of them were stranded high and dry after breaking their chains like threads of cotton.

But the circle of these devastations extended farther still, and beyond the limits of the United States. The recoil, aided by the westerly winds, was felt on the Atlantic at more than 300 miles from the American shores. An unexpected tempest, which even Admiral Fitzroy could not have foreseen, broke upon the ships with unheard-of violence. Several vessels, seized by a sort of whirlwind before they had time to furl their sails, were sunk, amongst others the _Childe Harold_, of Liverpool, a regrettable catastrophe which was the object of lively recriminations.

Lastly--although the fact is not warranted except by the affirmation of a few natives--half-an-hour after the departure of the projectile the inhabitants of Sierra-Leone pretended that they heard a dull noise, the last displacement of the sonorous waves, which, after crossing the Atlantic, died away on the African coast.

But to return to Florida. The tumult once lessened, the wounded and deaf--in short, all the crowd--rose and shouted in a sort of frenzy, "Hurrah for Ardan! Hurrah for Barbicane! Hurrah for Nicholl!" Several millions of men, nose in air, armed with telescopes and every species of field-glass, looked into space, forgetting contusions and feelings, in order to look at the projectile. But they sought in vain; it was not to be seen, and they resolved to await the telegrams from Long's Peak. The director of the Cambridge Observatory, M. Belfast, was at his post in the Rocky Mountains, and it was to this skilful and persevering astronomer that the observations had been entrusted.

But an unforeseen phenomenon, against which nothing could be done, soon came to put public impatience to a rude test.

The weather, so fine before, suddenly changed; the sky became covered with clouds. It could not be otherwise after so great a displacement of the atmospheric strata and the dispersion of the enormous quantity of gases from the combustion of 200,000 lbs. of pyroxyle. All natural order had been disturbed. There is nothing astonishing in that, for in sea-fights it has been noticed that the state of the atmosphere has been suddenly changed by the artillery discharge.

The next day the sun rose upon an horizon covered with thick clouds, a heavy and an impenetrable curtain hung between earth and sky, and which unfortunately extended as far as the regions of the Rocky Mountains. It was a fatality. A concert of complaints rose from all parts of the globe. But Nature took no notice, and as men had chosen to disturb the atmosphere with their gun, they must submit to the consequences.

During this first day every one tried to pierce the thick veil of clouds, but no one was rewarded for the trouble; besides, they were all mistaken in supposing they could see it by looking up at the sky, for on account of the diurnal movement of the globe the projectile was then, of course, shooting past the line of the antipodes.

However that might be, when night again enveloped the earth--a dark, impenetrable night--it was impossible to see the moon above the horizon; it might have been thought that she was hiding on purpose from the bold beings who had shot at her. No observation was, therefore, possible, and the despatches from Long's Peak confirmed the disastrous intelligence.

However, if the experiment had succeeded, the travellers, who had started on the 1st of December, at 10h. 46m. 40s. p.m., were due at their destination on the 4th at midnight; so that as up to that time it would, after all, have been difficult to observe a body so small, people waited with all the patience they could muster.

On the 4th of December, from 8 p.m. till midnight, it would have been possible to follow the trace of the projectile, which would have appeared like a black speck on the shining disc of the moon. But the weather remained imperturbably cloudy, and exasperated the public, who swore at the moon for not showing herself. _Sic transit gloria mundi_!

J.T. Maston, in despair, set out for Long's Peak. He wished to make an observation himself. He did not doubt that his friends had arrived at the goal of their journey. No one had heard that the projectile had fallen upon any continent or island upon earth, and J.T. Maston did not admit for a moment that it could have fallen into any of the oceans with which the earth is three parts covered.

On the 5th the same weather. The large telescopes of the old world--those of Herschel, Rosse, and Foucault--were invariably fixed upon the Queen of Night, for the weather was magnificent in Europe, but the relative weakness of these

instruments prevented any useful observation.

On the 6th the same weather reigned. Impatience devoured three parts of the globe. The most insane means were proposed for dissipating the clouds accumulated in the air.

On the 7th the sky seemed to clear a little. Hopes revived but did not last long, and in the evening thick clouds defended the starry vault against all eyes.

Things now became grave. In fact, on the 11th, at 9.11 a.m., the moon would enter her last quarter. After this delay she would decline every day, and even if the sky should clear the chances of observation would be considerably lessened--in fact, the moon would then show only a constantly-decreasing portion of her disc, and would end by becoming new--that is to say, she would rise and set with the sun, whose rays would make her quite invisible. They would, therefore, be obliged to wait till the 3rd of January, at 12.43 p.m., till she would be full again and ready for observation.

The newspapers published these reflections with a thousand commentaries, and did not fail to tell the public that it must arm itself with angelic patience.

On the 8th no change. On the 9th the sun appeared for a moment, as if to jeer at the Americans. It was received with hisses, and wounded, doubtless, by such a reception, it was very miserly of its rays.

On the 10th no change. J.T. Maston nearly went mad, and fears were entertained for his brain until then so well preserved in its gutta-percha cranium.

But on the 11th one of those frightful tempests peculiar to tropical regions was let loose in the atmosphere. Terrific east winds swept away the clouds which had been so long there, and in the evening the half-disc of the moon rode majestically amidst the limpid constellations of the sky.

CHAPTER XXVIII

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A NEW STAR.

That same night the news so impatiently expected burst like a thunderbolt over the United States of the Union, and thence darting across the Atlantic it ran along all the telegraphic wires of the globe. The projectile had been perceived, thanks to the gigantic reflector of Long's Peak.

The following is the notice drawn up by the director of the Cambridge Observatory. It resumes the scientific conclusion of the great experiment made by the Gun Club:--

"Long's Peak, December 12th.

"To the Staff of the Cambridge Observatory.

"The projectile hurled by the Columbiad of Stony Hill was perceived by Messrs. Belfast and J.T. Maston on the 12th of December at 8.47 p.m., the moon having entered her last quarter.

"The projectile has not reached its goal. It has deviated to the side, but near enough to be detained by lunar attraction.

"There its rectilinear movement changed to a circular one of extreme velocity, and it has been drawn round the moon in an elliptical orbit, and has become her satellite.

"We have not yet been able to determine the elements of this new star. Neither its speed of translation or rotation is known. The distance which separates it from the surface of the moon may be estimated at about 2,833 miles.

"Now two hypotheses may be taken into consideration as to a modification in this state of things:--

"Either the attraction of the moon will end by drawing it towards her, and the travellers will reach the goal of their journey,

"Or the projectile, maintained in an immutable orbit, will gravitate round the lunar disc till the end of time.

"Observation will settle this point some day, but until now the experiment of the Gun Club has had no other result than that of providing our solar system with a new star.

"J BELFAST."

What discussions this unexpected _dénouement_ gave rise to! What a situation full of mystery the future reserved for the investigations of science! Thanks to the courage and devotion of three men, this enterprise of sending a bullet to the moon, futile enough in appearance, had just had an immense result, the consequences of which are incalculable. The travellers imprisoned in a new satellite, if they have not attained their end, form at least part of the lunar world; they gravitate around the Queen of Night, and for the first time human eyes can penetrate all her mysteries. The names of Nicholl, Barbicane, and Michel Ardan would be for ever celebrated in astronomical annals, for these bold explorers, desirous of widening the circle of human knowledge, had audaciously rushed into space, and had risked their lives in the strangest experiment of modern times.

The notice from Long's Peak once made known, there spread throughout the universe a feeling of surprise and horror. Was it possible to go to the aid of these bold inhabitants of the earth? Certainly not, for they had put themselves outside of the pale of humanity by crossing the limits imposed by the Creator on His terrestrial creatures. They could procure themselves air for two months; they had provisions for one year; but after? The hardest hearts palpitated at this terrible question.

One man alone would not admit that the situation was desperate. One alone had confidence, and it was their friend--devoted, audacious, and resolute as they--the brave J.T. Maston.

He resolved not to lose sight of them. His domicile was henceforth the post of Long's Peak--his horizon the immense reflector. As soon as the moon rose above the horizon he immediately framed her in the field of his telescope; he did not lose sight of her for an instant, and assiduously followed her across the stellar spaces; he watched with eternal patience the passage of the projectile over her disc of silver, and in reality the worthy man remained in perpetual communication with his three friends, whom he did not despair of seeing again one day.

"We will correspond with them," said he to any one who would listen, "as soon as circumstances will allow. We shall have news from them, and they will have news from us. Besides, I know them--they are ingenious men. Those three carry

with them into space all the resources of art, science, and industry. With those everything can be accomplished, and you will see that they will get out of the difficulty."

(FOR SEQUEL, SEE "AROUND THE MOON.")

[Illustration: "They watched thus through the lateral windows."]

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ROUND THE MOON.

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INTRODUCTION.

PRELIMINARY CHAPTER.

CONTAINING A SHORT ACCOUNT OF THE FIRST PART OF THIS WORK TO SERVE AS PREFACE TO THE SECOND.

During the course of the year 186---- the entire world was singularly excited by a scientific experiment without precedent in the annals of science. The members of the Gun Club, a circle of artillerymen established at Baltimore after the American war, had the idea of putting themselves in communication with the moon--yes, with the moon--by sending a bullet to her. Their president, Barbicane, the promoter of the enterprise, having consulted the astronomers of the Cambridge Observatory on this subject, took all the precautions necessary for the success of the extraordinary enterprise, declared practicable by the majority of competent people. After having solicited a public subscription which produced nearly 30,000,000 of francs, it began its gigantic labours.

According to the plan drawn up by the members of the observatory, the cannon destined to hurl the projectile was to be set up in some country situated between the 0° and 28° of north or south latitude in order to aim at the moon at the zenith. The bullet was to be endowed with an initial velocity of 12,000 yards a second. Hurled on the 1st of December at thirteen minutes and twenty seconds to eleven in the evening, it was to get to the moon four days after its departure on the 5th of December at midnight precisely, at the very instant she would be at her

perigee--that is to say, nearest to the earth, or at exactly 86,410 leagues' distance.

The principal members of the Gun Club, the president, Barbicane, Major Elphinstone, the secretary, J.T. Maston, and other _savants_, held several meetings, in which the form and composition of the bullet were discussed, as well as the disposition and nature of the cannon, and the quality and quantity of the powder to be employed. It was decided--1, that the projectile should be an obus of aluminium, with a diameter of 800 inches; its sides were to be 12 inches thick, and it was to weigh 19,250 lbs.; 2, that the cannon should be a cast-iron Columbiad 900 feet long, and should be cast at once in the ground; 3, that the charge should consist of 400,000 lbs. of gun-cotton, which, by developing 6,000,000,000 litres of gas under the projectile, would carry it easily towards the Queen of Night.

These questions settled, President Barbicane, aided by the engineer, Murchison, chose a site in Florida in 27° 7' north lat. and 5° 7' west long. It was there that after marvels of labour the Columbiad was cast quite successfully.

Things were at that pass when an incident occurred which Increased the interest attached to this great enterprise.

A Frenchman, a regular Parisian, an artist as witty as audacious, asked leave to shut himself up in the bullet in order to reach the moon and make a survey of the terrestrial satellite. This intrepid adventurer's name was Michel Ardan. He arrived in America, was received with enthusiasm, held meetings, was carried in triumph, reconciled President Barbicane to his mortal enemy, Captain Nicholl, and in pledge of the reconciliation he persuaded them to embark with him in the projectile.

The proposition was accepted. The form of the bullet was changed. It became cylindro-conical. They furnished this species of aërial compartment with powerful springs and breakable partitions to break the departing shock. It was filled with provisions for one year, water for some months, and gas for some days. An automatic apparatus made and gave out the air necessary for the respiration of the three travellers. At the same time the Gun Club had a gigantic telescope set up on one of the highest summits of the Rocky Mountains, through which the projectile could be followed during its journey through space. Everything was then ready.

On the 30th of November, at the time fixed, amidst an extraordinary concourse of spectators, the departure took place, and for the first time three human beings left the terrestrial globe for the interplanetary regions with almost the certainty of reaching their goal.

These audacious travellers, Michel Ardan, President Barbicane, and Captain Nicholl were to accomplish their journey in ninety-seven hours thirteen minutes and twenty seconds; consequently they could not reach the lunar disc until the 5th of December, at midnight, at the precise moment that the moon would be full, and not on the 4th, as some wrongly-informed newspapers had given out.

But an unexpected circumstance occurred; the detonation produced by the Columbiad had the immediate effect of disturbing the terrestrial atmosphere, where an enormous quantity of vapour accumulated. This phenomenon excited general indignation, for the moon was hidden during several nights from the eyes of her contemplators.

The worthy J.T. Maston, the greatest friend of the three travellers, set out for the Rocky Mountains in the company of the Honourable J. Belfast, director of the Cambridge Observatory, and reached the station of Long's Peak, where the telescope was set up which brought the moon, apparently, to within two leagues. The honourable secretary of the Gun Club wished to observe for himself the vehicle that contained his audacious friends.

The accumulation of clouds in the atmosphere prevented all observation during the 5th, 6th, 7th, 8th, 9th, and 10th of December. It was even thought that no observation could take place before the 3rd of January in the following year, for the moon, entering her last quarter on the 11th, would after that not show enough of her surface to allow the trace of the projectile to be followed.

But at last, to the general satisfaction, a strong tempest during the night between the 11th and 12th of December cleared the atmosphere, and the half-moon was distinctly visible on the dark background of the sky.

That same night a telegram was sent from Long's Peak Station by J.T. Maston and Belfast to the staff of the Cambridge Observatory.

This telegram announced that on the 11th of December, at 8.47 p.m., the projectile hurled by the Columbiad of Stony Hill had been perceived by Messrs. Belfast and J.T. Maston, that the bullet had deviated from its course through

some unknown cause, and had not reached its goal, but had gone near enough to be retained by lunar attraction; that its rectilinear movement had been changed to a circular one, and that it was describing an elliptical orbit round the moon, and had become her satellite.

The telegram added that the elements of this new star had not yet been calculated--in fact, three observations, taking a star in three different positions, are necessary to determine them. Then it stated that the distance separating the projectile from the lunar surface "might be" estimated at about 2,833 leagues, or 4,500 miles.

It ended with the following double hypothesis:--Either the attraction of the moon would end by carrying the day, and the travellers would reach their goal; or the projectile, fixed in an immutable orbit, would gravitate around the lunar disc to the end of time.

In either of these alternatives what would be the travellers' fate? It is true they had provisions enough for some time. But even supposing that their bold enterprise were crowned with success, how would they return? Could they ever return? Would news of them ever reach the earth? These questions, debated upon by the most learned writers of the time, intensely interested the public.

A remark may here be made which ought to be meditated upon by too impatient observers. When a *savant* announces a purely speculative discovery to the public he cannot act with too much prudence. No one is obliged to discover either a comet or a satellite, and those who make a mistake in such a case expose themselves justly to public ridicule. Therefore it is better to wait; and that is what impatient J.T. Maston ought to have done before sending to the world the telegram which, according to him, contained the last communication about this enterprise.

In fact, the telegram contained errors of two sorts, verified later:--1. Errors of observation concerning the distance of the projectile from the surface of the moon, for upon the date of the 11th of December it was impossible to perceive it, and that which J.T. Maston had seen, or thought he saw, could not be the bullet from the Columbiad. 2. A theoretic error as to the fate of the said projectile, for making it a satellite of the moon was an absolute contradiction of the laws of rational mechanics.

One hypothesis only made by the astronomers of Long's Peak might be realised, the one that foresaw the case when the travellers--if any yet existed--should unite their efforts with the lunar attraction so as to reach the surface of the disc.

Now these men, as intelligent as they were bold, had survived the terrible shock at departure, and their journey in their bullet-carriage will be related in its most dramatic as well as in its most singular details. This account will put an end to many illusions and previsions, but it will give a just idea of the various circumstances incidental to such an enterprise, and will set in relief Barbicane's scientific instincts, Nicholl's industrial resources, and the humorous audacity of Michel Ardan.

Besides, it will prove that their worthy friend J.T. Maston was losing his time when, bending over the gigantic telescope, he watched the course of the moon across the planetary regions.

CHAPTER I

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FROM 10.20 P.M. TO 10.47 P.M.

When ten o'clock struck, Michel Ardan, Barbicane, and Nicholl said good-bye to the numerous friends they left upon the earth. The two dogs, destined to acclimatise the canine race upon the lunar continents, were already imprisoned in the projectile. The three travellers approached the orifice of the enormous iron tube, and a crane lowered them to the conical covering of the bullet.

There an opening made on purpose let them down into the aluminium vehicle. The crane's tackling was drawn up outside, and the mouth of the Columbiad instantly cleared of its last scaffolding.

As soon as Nicholl and his companions were in the projectile he closed the opening by means of a strong plate screwed down inside. Other closely-fitting plates covered the lenticular glasses of the skylights. The travellers, hermetically inclosed in their metal prison, were in profound darkness.

"And now, my dear companions," said Michel Ardan, "let us make ourselves at

home. I am a domestic man myself, and know how to make the best of any lodgings. First let us have a light; gas was not invented for moles!"

Saying which the light-hearted fellow struck a match on the sole of his boot and then applied it to the burner of the receptacle, in which there was enough carbonised hydrogen, stored under strong pressure, for lighting and heating the bullet for 144 hours, or six days and six nights.

Once the gas lighted, the projectile presented the aspect of a comfortable room with padded walls, furnished with circular divans, the roof of which was in the shape of a dome.

The objects in it, weapons, instruments, and utensils, were solidly fastened to the sides in order to bear the parting shock with impunity. Every possible precaution had been taken to insure the success of so bold an experiment.

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

"It is a prison," said he, "but a travelling prison, and if I had the right to put my nose to the window I would take it on a hundred years' lease! You are smiling, Barbicane. You are thinking of something you do not communicate. Do you say to yourself that this prison may be our coffin? Our coffin let it be; I would not change it for Mahomet's, which only hangs in space, and does not move!"

Whilst Michel Ardan was talking thus, Barbicane and Nicholl were making their last preparations.

It was 10.20 p.m. by Nicholl's chronometer when the three travellers were definitely walled up in their bullet. This chronometer was regulated to the tenth of a second by that of the engineer, Murchison. Barbicane looked at it.

"My friends," said he, "it is twenty minutes past ten; at thirteen minutes to eleven Murchison will set fire to the Columbiad; at that minute precisely we shall leave our spheroid. We have, therefore, still seven-and-twenty minutes to remain upon earth."

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

"Very well!" cried Michel Ardan good-humouredly; "in twenty-six minutes lots

of things can be done. We can discuss grave moral or political questions, and even solve them. Twenty-six minutes well employed are worth more than twenty-six years of doing nothing. A few seconds of a Pascal or a Newton are more precious than the whole existence of a crowd of imbeciles."

"And what do you conclude from that, talker eternal?" asked President Barbicane.

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

"Twenty-four only," said Nicholl.

"Twenty-four, then, if you like, brave captain," answered Ardan; "twenty-four minutes, during which we might investigate--"

"Michel," said Barbicane, "during our journey we shall have plenty of time to investigate the deepest questions. Now we must think of starting."

"Are we not ready?"

"Certainly. But there are still some precautions to be taken to deaden the first shock as much as possible!"

"Have we not water-cushions placed between movable partitions elastic enough to protect us sufficiently?"

"I hope so, Michel," answered Barbicane gently; "but I am not quite sure!"

"Ah, the joker!" exclaimed Michel Ardan. "He hopes! He is not quite sure! And he waits till we are encased to make this deplorable acknowledgment! I ask to get out."

"By what means?" asked Barbicane.

"Well!" said Michel Ardan, "it would be difficult. We are in the train, and the guard's whistle will be heard in twenty-four minutes."

"Twenty!" ejaculated Nicholl.

The three travellers looked at one another for a few seconds. Then they

examined all the objects imprisoned with them.

"Everything is in its place," said Barbicane. "The question now is where we can place ourselves so as best to support the departing shock. The position we assume must be important too--we must prevent the blood rushing too violently to our heads."

"That is true," said Nicholl.

"Then," answered Michel Ardan, always ready to suit the action to the word, "we will stand on our heads like the clowns at the circus."

"No," said Barbicane; "but let us lie on our sides; we shall thus resist the shock better. When the bullet starts it will not much matter whether we are inside or in front."

"If it comes to 'not much matter' I am more reassured," answered Michel Ardan.

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

"Entirely," answered the captain. "Still thirteen minutes and a-half."

"Nicholl is not a man," exclaimed Michel; "he is a chronometer marking the seconds, and with eight holes in--"

But his companions were no longer listening to him, and they were making their last preparations with all the coolness imaginable. They looked like two methodical travellers taking their places in the train and making themselves as comfortable as possible. One wonders, indeed, of what materials these American hearts are made, to which the approach of the most frightful danger does not add a single pulsation.

Three beds, thick and solidly made, had been placed in the projectile. Nicholl and Barbicane placed them in the centre of the disc that formed the movable flooring. There the three travellers were to lie down a few minutes before their departure.

In the meanwhile Ardan, who could not remain quiet, turned round his narrow prison like a wild animal in a cage, talking to his friends and his dogs, Diana and Satellite, to whom it will be noticed he had some time before given these

significant names.

"Up, Diana! up, Satellite!" cried he, exciting them. "You are going to show to the Selenite dogs how well-behaved the dogs of the earth can be! That will do honour to the canine race. If we ever come back here I will bring back a cross-breed of 'moon-dogs' that will become all the rage."

"If there are any dogs in the moon," said Barbicane.

"There are some," affirmed Michel Ardan, "the same as there are horses, cows, asses, and hens. I wager anything we shall find some hens."

"I bet a hundred dollars we find none," said Nicholl.

"Done, captain," answered Ardan, shaking hands with Nicholl. "But, by-the-bye, you have lost three bets with the president, for the funds necessary for the enterprise were provided, the casting succeeded, and lastly, the Columbiad was loaded without accident--that makes six thousand dollars."

"Yes," answered Nicholl. "Twenty-three minutes and six seconds to eleven."

"I hear, captain. Well, before another quarter of an hour is over you will have to make over another nine thousand dollars to the president, four thousand because the Columbiad will not burst, and five thousand because the bullet will rise higher than six miles into the air."

"I have the dollars," answered Nicholl, striking his coat pocket, "and I only want to pay."

"Come, Nicholl, I see you are a man of order, what I never could be; but allow me to tell you that your series of bets cannot be very advantageous to you."

"Why?" asked Barbicane.

"Because if you win the first the Columbiad will have burst, and the bullet with it, and Barbicane will not be there to pay you your dollars."

"My wager is deposited in the Baltimore Bank," answered Barbicane simply; "and in default of Nicholl it will go to his heirs."

"What practical men you are!" cried Michel Ardan. "I admire you as much as I do not understand you."

"Eighteen minutes to eleven," said Nicholl.

"Only five minutes more," answered Barbicane.

"Yes, five short minutes!" replied Michel Ardan. "And we are shut up in a bullet at the bottom of a cannon 900 feet long! and under this bullet there are 400,000 lbs. of gun-cotton, worth more than 1,600,000 lbs. of ordinary powder! And friend Murchison, with his chronometer in hand and his eye fixed on the hand and his finger on the electric knob, is counting the seconds to hurl us into the planetary regions."

"Enough, Michel, enough!" said Barbicane in a grave tone. "Let us prepare ourselves. A few seconds only separate us from a supreme moment. Your hands, my friends."

"Yes," cried Michel Ardan, more moved than he wished to appear.

The three bold companions shook hands.

"God help us!" said the religious president.

Michel Ardan and Nicholl lay down on their beds in the centre of the floor.

"Thirteen minutes to eleven," murmured the captain.

Twenty seconds more! Barbicane rapidly put out the gas, and lay down beside his companions.

The profound silence was only broken by the chronometer beating the seconds.

Suddenly a frightful shock was felt, and the projectile, under the impulsion of 6,000,000,000 litres of gas developed by the deflagration of the pyroxyle, rose into space.

CHAPTER II

.

THE FIRST HALF-HOUR.

What had happened? What was the effect of the frightful shock? Had the ingenuity of the constructors of the projectile been attended by a happy result? Was the effect of the shock deadened, thanks to the springs, the four buffers, the water-cushions, and the movable partitions? Had they triumphed over the frightful impulsion of the initial velocity of 11,000 metres a second? This was evidently the question the thousands of witnesses of the exciting scene asked themselves. They forgot the object of the journey, and only thought of the travellers! Suppose one of them--J.T. Maston, for instance--had been able to get a glimpse of the interior of the projectile, what would he have seen?

Nothing then. The obscurity was profound in the bullet. Its cylindro-conical sides had resisted perfectly. There was not a break, a crack, or a dint in them. The admirable projectile was not hurt by the intense deflagration of the powders, instead of being liquefied, as it was feared, into a shower of aluminium.

In the interior there was very little disorder on the whole. A few objects had been violently hurled up to the roof, but the most important did not seem to have suffered from the shock. Their fastenings were intact.

On the movable disc, crushed down to the bottom by the smashing of the partitions and the escape of the water, three bodies lay motionless. Did Barbicane, Nicholl, and Michel Ardan still breathe? Was the projectile nothing but a metal coffin carrying three corpses into space?

A few minutes after the departure of the bullet one of these bodies moved, stretched out its arms, lifted up its head, and succeeded in getting upon its knees. It was Michel Ardan. He felt himself, uttered a sonorous "Hum," then said--

"Michel Ardan, complete. Now for the others!"

The courageous Frenchman wanted to get up, but he could not stand. His head vacillated; his blood, violently sent up to his head, blinded him. He felt like a drunken man.

"Brrr!" said he. "I feel as though I had been drinking two bottles of Corton, only that was not so agreeable to swallow!"

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

"Nicholl! Barbicane!"

He waited anxiously. No answer. Not even a sigh to indicate that the hearts of his companions still beat. He reiterated his call. Same silence.

"The devil!" said he. "They seem as though they had fallen from the fifth story upon their heads! Bah!" he added with the imperturbable confidence that nothing could shake, "if a Frenchman can get upon his knees, two Americans will have no difficulty in getting upon their feet. But, first of all, let us have a light on the subject."

Ardan felt life come back to him in streams. His blood became calm, and resumed its ordinary circulation. Fresh efforts restored his equilibrium. He succeeded in getting up, took a match out of his pocket, and struck it; then putting it to the burner he lighted the gas. The meter was not in the least damaged. The gas had not escaped. Besides, the smell would have betrayed it, and had this been the case, Michel Ardan could not with impunity have lighted a match in a medium filled with hydrogen. The gas, mixed in the air, would have produced a detonating mixture, and an explosion would have finished what a shock had perhaps begun.

As soon as the gas was lighted Ardan bent down over his two companions. Their bodies were thrown one upon the other, Nicholl on the top, Barbicane underneath.

Ardan raised the captain, propped him up against a divan, and rubbed him vigorously. This friction, administered skilfully, reanimated Nicholl, who opened his eyes, instantly recovered his presence of mind, seized Ardan's hand, and then looking round him--

"And Barbicane?" he asked.

"Each in turn," answered Michel Ardan tranquilly. "I began with you, Nicholl, because you were on the top. Now I'll go to Barbicane."

That said, Ardan and Nicholl raised the president of the Gun Club and put him on a divan. Barbicane seemed to have suffered more than his companions. He

was bleeding, but Nicholl was glad to find that the hemorrhage only came from a slight wound in his shoulder. It was a simple scratch, which he carefully closed.

Nevertheless, Barbicane was some time before he came to himself, which frightened his two friends, who did not spare their friction.

"He is breathing, however," said Nicholl, putting his ear to the breast of the wounded man.

"Yes," answered Ardan, "he is breathing like a man who is in the habit of doing it daily. Rub, Nicholl, rub with all your might."

And the two improvised practitioners set to work with such a will and managed so well that Barbicane at last came to his senses. He opened his eyes, sat up, took the hands of his two friends, and his first words were--

"Nicholl, are we going on?"

Nicholl and Ardan looked at one another. They had not yet thought about the projectile. Their first anxiety had been for the travellers, not for the vehicle.

"Well, really, are we going on?" repeated Michel Ardan.

"Or are we tranquilly resting on the soil of Florida?" asked Nicholl.

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

"Impossible!" cried President Barbicane.

This double hypothesis suggested by his two friends immediately recalled him to life and energy.

They could not yet decide the question. The apparent immovability of the bullet and the want of communication with the exterior prevented them finding it out. Perhaps the projectile was falling through space. Perhaps after rising a short distance it had fallen upon the earth, or even into the Gulf of Mexico, a fall which the narrowness of the Floridian peninsula rendered possible.

The case was grave, the problem interesting. It was necessary to solve it as soon as possible. Barbicane, excited, and by his moral energy triumphing over his

physical weakness, stood up and listened. A profound silence reigned outside. But the thick padding was sufficient to shut out all the noises on earth; However, one circumstance struck Barbicane. The temperature in the interior of the projectile was singularly high. The president drew out a thermometer from the envelope that protected it and consulted it. The instrument showed 81° Fahr.

"Yes!" he then exclaimed--"yes, we are moving! This stifling heat oozes through the sides of our projectile. It is produced by friction against the atmosphere. It will soon diminish; because we are already moving in space, and after being almost suffocated we shall endure intense cold."

"What!" asked Michel Ardan, "do you mean to say that we are already beyond the terrestrial atmosphere?"

"Without the slightest doubt, Michel. Listen to me. It now wants but five minutes to eleven. It is already eight minutes since we started. Now, if our initial velocity has not been diminished by friction, six seconds would be enough for us to pass the sixteen leagues of atmosphere which surround our spheroid."

"Just so," answered Nicholl; "but in what proportion do you reckon the diminution of speed by friction?"

"In the proportion of one-third," answered Barbicane. "This diminution is considerable, but it is so much according to my calculations. If, therefore, we have had an initial velocity of 11,000 metres, when we get past the atmosphere it will be reduced to 7,332 metres. However that may be, we have already cleared that space, and--"

"And then," said Michel Ardan, "friend Nicholl has lost his two bets--four thousand dollars because the Columbiad has not burst, five thousand dollars because the projectile has risen to a greater height than six miles; therefore, Nicholl, shell out."

"We must prove it first," answered the captain, "and pay afterwards. It is quite possible that Barbicane's calculations are exact, and that I have lost my nine thousand dollars. But another hypothesis has come into my mind, and it may cancel the wager."

"What is that?" asked Barbicane quickly.

"The supposition that for some reason or other the powder did not catch fire, and we have not started."

"Good heavens! captain," cried Michel Ardan, "that is a supposition worthy of me! It is not serious! Have we not been half stunned by the shock? Did I not bring you back to life? Does not the president's shoulder still bleed from the blow?"

"Agreed, Michel," replied Nicholl, "but allow me to ask one question."

"Ask it, captain."

"Did you hear the detonation, which must certainly have been formidable?"

"No," answered Ardan, much surprised, "I certainly did not hear it."

"And you, Barbicane?"

"I did not either."

"What do you make of that?" asked Nicholl.

"What indeed!" murmured the president; "why did we not hear the detonation?"

The three friends looked at one another rather disconcertedly. Here was an inexplicable phenomenon. The projectile had been fired, however, and there must have been a detonation.

"We must know first where we are," said Barbicane, "so let us open the panel."

This simple operation was immediately accomplished. The screws that fastened the bolts on the outer plates of the right-hand skylight yielded to the coach-wrench. These bolts were driven outside, and obturators wadded with indiarubber corked up the hole that let them through. The exterior plate immediately fell back upon its hinges like a port-hole, and the lenticular glass that covered the hole appeared. An identical light-port had been made in the other side of the projectile, another in the dome, and a fourth in the bottom. The firmament could therefore be observed in four opposite directions--the firmament through the lateral windows, and the earth or the moon more directly through the upper or lower opening of the bullet.

Barbicane and his companions immediately rushed to the uncovered port-hole. No ray of light illuminated it. Profound darkness surrounded the projectile. This darkness did not prevent Barbicane exclaiming--

"No, my friends, we have not fallen on the earth again! No, we are not immersed at the bottom of the Gulf of Mexico! Yes, we are going up through space! Look at those stars that are shining in the darkness, and the impenetrable darkness that lies between the earth and us!"

"Hurrah! hurrah!" cried Michel Ardan and Nicholl with one voice.

In fact, the thick darkness proved that the projectile had left the earth, for the ground, then brilliantly lighted by the moon, would have appeared before the eyes of the travellers if they had been resting upon it. This darkness proved also that the projectile had passed beyond the atmosphere, for the diffused light in the air would have been reflected on the metallic sides of the projectile, which reflection was also wanting. This light would have shone upon the glass of the light-port, and that glass was in darkness. Doubt was no longer possible. The travellers had quitted the earth.

"I have lost." said Nicholl.

"I congratulate you upon it," answered Ardan.

"Here are nine thousand dollars," said the captain, taking a bundle of notes out of his pocket.

"Will you have a receipt?" asked Barbicane as he took the money.

"If you do not mind," answered Nicholl; "it is more regular."

And as seriously and phlegmatically as if he had been in his counting-house, President Barbicane drew out his memorandum-book and tore out a clear page, wrote a receipt in pencil, dated it, signed it, and gave it to the captain, who put it carefully into his pocket-book.

Michel Ardan took off his hat and bowed to his two companions without speaking a word. Such formality under such circumstances took away his power of speech. He had never seen anything so American.

Once their business over, Barbicane and Nicholl went back to the light-port and looked at the constellations. The stars stood out clearly upon the dark background of the sky. But from this side the moon could not be seen, as she moves from east to west, rising gradually to the zenith. Her absence made Ardan say--

"And the moon? Is she going to fail us?"

"Do not frighten yourself," answered Barbicane, "Our spheroid is at her post, but we cannot see her from this side. We must open the opposite light-port."

At the very moment when Barbicane was going to abandon one window to set clear the opposite one, his attention was attracted by the approach of a shining object. It was an enormous disc the colossal dimensions of which could not be estimated. Its face turned towards the earth was brilliantly lighted. It looked like a small moon reflecting the light of the large one. It advanced at prodigious speed, and seemed to describe round the earth an orbit right across the passage of the projectile. To the movement of translation of this object was added a movement of rotation upon itself. It was therefore behaving like all celestial bodies abandoned in space.

"Eh!" cried Michel Ardan. "Whatever is that? Another projectile?"

Barbicane did not answer. The apparition of this enormous body surprised him and made him uneasy. A collision was possible which would have had deplorable results, either by making the projectile deviate from its route and fall back upon the earth, or be caught up by the attractive power of the asteroid.

President Barbicane had rapidly seized the consequences of these three hypotheses, which in one way or other would fatally prevent the success of his attempt. His companions were silently watching the object, which grew prodigiously larger as it approached, and through a certain optical illusion it seemed as if the projectile were rushing upon it.

"Ye gods!" cried Michel Ardan; "there will be a collision on the line!"

The three travellers instinctively drew back. Their terror was extreme, but it did not last long, hardly a few seconds. The asteroid passed at a distance of a few hundred yards from the projectile and disappeared, not so much on account of the rapidity of its course, but because its side opposite to the moon was suddenly

confounded with the absolute darkness of space.

"A good journey to you!" cried Michel Ardan, uttering a sigh of satisfaction. "Is not infinitude large enough to allow a poor little bullet to go about without fear? What was that pretentious globe which nearly knocked against us?"

"I know!" answered Barbicane.

"Of course! you know everything."

"It is a simple asteroid," said Barbicane; "but so large that the attraction of the earth has kept it in the state of a satellite."

"Is it possible!" exclaimed Michel Ardan. "Then the earth has two moons like Neptune?"

"Yes, my friend, two moons, though she is generally supposed to have but one. But this second moon is so small and her speed so great that the inhabitants of the earth cannot perceive her. It was by taking into account certain perturbations 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 asteroid accomplishes its revolution round the earth in three hours and twenty minutes only. That implies prodigious speed."

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

"No," answered Barbicane; "but if they had met it like we have they could not doubt any longer. By-the-bye, this asteroid, which would have much embarrassed us had it knocked against us, allows us to determine our position in space."

"How?" said Ardan.

"Because its distance is known, and where we met it we were exactly at 8,140 kilometres from the surface of the terrestrial globe."

"More than 2,000 leagues!" cried Michel Ardan. "That beats the express trains of the pitiable globe called the earth!"

"I should think it did," answered Nicholl, consulting his chronometer; "it is

eleven o'clock, only thirteen minutes since we left the American continent."

"Only thirteen minutes?" said Barbicane.

"That is all," answered Nicholl; "and if our initial velocity were constant we should make nearly 10,000 leagues an hour."

"That is all very well, my friends," said the president; "but one insoluble question still remains--why did we not hear the detonation of the Columbiad?"

For want of an answer the conversation stopped, and Barbicane, still reflecting, occupied himself with lowering the covering of the second lateral light-port. His operation succeeded, and through the glass the moon filled the interior of the projectile with brilliant light. Nicholl, like an economical man, put out the gas that was thus rendered useless, and the brilliance of which obstructed the observation of planetary space.

The lunar disc then shone with incomparable purity. Her rays, no longer filtered by the vapoury atmosphere of the terrestrial globe, shone clearly through the glass and saturated the interior air of the projectile with silvery reflections. The black curtain of the firmament really doubled the brilliancy of the moon, which in this void of ether unfavourable to diffusion did not eclipse the neighbouring stars. The sky, thus seen, presented quite a different aspect--one that no human eye could imagine.

It will be readily understood with what interest these audacious men contemplated the moon, the supreme goal of their journey. The earth's satellite, in her movement of translation, insensibly neared the zenith, a mathematical point which she was to reach about ninety-six hours later. Her mountains and plains, or any object in relief, were not seen more plainly than from the earth; but her light across the void was developed with incomparable intensity. The disc shone like a platinum mirror. The travellers had already forgotten all about the earth which was flying beneath their feet.

It was Captain Nicholl who first drew attention to the vanished globe.

"Yes!" answered Michel Ardan. "We must not be ungrateful to it. As we are leaving our country let our last looks reach it. I want to see the earth before it disappears completely from our eyes!"

Barbicane, to satisfy the desires of his companion, occupied himself with clearing the window at the bottom of the projectile, the one through which they could observe the earth directly. The movable floor which the force of projection had sent to the bottom was taken to pieces, not without difficulty; its pieces, carefully placed against the sides, might still be of use. Then appeared a circular bay window, half a yard wide, cut in the lower part of the bullet. It was filled with glass five inches thick, strengthened with brass settings. Under it was an aluminium plate, held down by bolts. The screws taken out and the bolts withdrawn, the plate fell back, and visual communication was established between interior and exterior.

Michel Ardan knelt upon the glass. It was dark, and seemed opaque.

"Well," cried he, "but where's the earth?"

"There it is," said Barbicane.

"What!" cried Ardan, "that thin streak, that silvery crescent?"

"Certainly, Michel. In four days' time, when the moon is full, at the very minute we shall reach her, the earth will be new. She will only appear to us under the form of a slender crescent, which will soon disappear, and then she will be buried for some days in impenetrable darkness."

"That the earth!" repeated Michel Ardan, staring at the thin slice of his natal planet.

The explanation given by President Barbicane was correct. The earth, looked at from the projectile, was entering her last quarter. She was in her octant, and her crescent was clearly outlined on the dark background of the sky. Her light, made bluish by the thickness of her atmosphere, was less intense than that of the lunar crescent. This crescent then showed itself under considerable dimensions. It looked like an enormous arch stretched across the firmament. Some points, more vividly lighted, especially in its concave part, announced the presence of high mountains; but they disappeared sometimes under black spots, which are never seen on the surface of the lunar disc. They were rings of clouds placed concentrically round the terrestrial spheroid.

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 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 stars. 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.

Whilst the travellers were trying to pierce the profound darkness of space, a brilliant shower of falling stars shone before their eyes. Hundreds of meteors, inflamed by contact with the atmosphere, streaked the darkness with luminous trails, and lined the cloudy part of the disc with their fire. At that epoch the earth was in her perihelion, and the month of December is so propitious to these shooting stars that astronomers have counted as many as 24,000 an hour. But Michel Ardan, disdaining scientific reasoning, preferred to believe that the earth was saluting with her finest fireworks the departure of her three children.

This was all they saw of the globe lost in the darkness, an inferior star of the solar world, which for the grand planets rises or sets as a simple morning or evening star! Imperceptible point in space, it was now only a fugitive crescent, this globe where they had left all their affections.

For a long time the three friends, not speaking, yet united in heart, watched while the projectile went on with uniformly decreasing velocity. Then irresistible sleep took possession of them. Was it fatigue of body and mind? Doubtless, for after the excitement of the last hours passed upon earth, reaction must inevitably set in.

"Well," said Michel, "as we must sleep, let us go to sleep."

Stretched upon their beds, all three were soon buried in profound slumber.

But they had not been unconscious for more than a quarter of an hour when Barbicane suddenly rose, and, waking his companions, in a loud voice cried--

"I've found it!"

"What have you found?" asked Michel Ardan, jumping out of bed.

"The reason we did not hear the detonation of the Columbiad!"

"Well?" said Nicholl.

"It was because our projectile went quicker than sound."

CHAPTER III

.

TAKING POSSESSION.

This curious but certainly correct explanation once given, the three friends fell again into a profound sleep. Where would they have found a calmer or more peaceful place to sleep in? Upon earth, houses in the town or cottages in the country feel every shock upon the surface of the globe. At sea, ships, rocked by the waves, are in perpetual movement. In the air, balloons incessantly oscillate upon the fluid strata of different densities. This projectile alone, travelling in absolute void amidst absolute silence, offered absolute repose to its inhabitants.

The sleep of the three adventurers would have, perhaps, been indefinitely prolonged if an unexpected noise had not awakened them about 7 a.m. on the 2nd of December, eight hours after their departure.

This noise was a very distinct bark.

"The dogs! It is the dogs!" cried Michel Ardan, getting up immediately.

"They are hungry," said Nicholl.

"I should think so," answered Michel; "we have forgotten them."

"Where are they?" asked Barbicane.

One of the animals was found cowering under the divan. Terrified and stunned

by the first shock, it had remained in a corner until the moment it had recovered its voice along with the feeling of hunger.

It was Diana, still rather sheepish, that came from the retreat, not without urging. Michel Ardan encouraged her with his most gracious words.

"Come, Diana," he said--"come, my child; your destiny will be noted in cynegetic annals! Pagans would have made you companion to the god Anubis, and Christians friend to St. Roch! You are worthy of being carved in bronze for the king of hell, like the puppy that Jupiter gave beautiful Europa as the price of a kiss! Your celebrity will efface that of the Montargis and St. Bernard heroes. You are rushing through interplanetary space, and will, perhaps, be the Eve of Selenite dogs! You will justify up there Toussenel's saying, 'In the beginning God created man, and seeing how weak he was, gave him the dog!' Come, Diana, come here!"

Diana, whether flattered or not, came out slowly, uttering plaintive moans.

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

"Adam," answered Michel Ardan, "can't be far off. He is here somewhere. He must be called! Satellite! here, Satellite!"

But Satellite did not appear. Diana continued moaning. It was decided, however, that she was not wounded, and an appetising dish was set before her to stop her complaining.

As to Satellite, he seemed lost. They were obliged to search a long time before discovering him in one of the upper compartments of the projectile, where a rather inexplicable rebound had hurled him violently. The poor animal was in a pitiable condition.

"The devil!" said Michel. "Our acclimatisation is in danger!"

The unfortunate dog was carefully lowered. His head had been fractured against the roof, and it seemed difficult for him to survive such a shock. Nevertheless, he was comfortably stretched on a cushion, where he sighed once.

"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."

So saying he offered some water to the wounded animal, who drank it greedily.

These attentions bestowed, the travellers attentively watched the earth and the moon. The earth only appeared like a pale disc terminated by a crescent smaller than that of the previous evening, but its volume compared with that of the moon, which was gradually forming a perfect circle, remained enormous.

"_Parbleu_!" then said Michel Ardan; "I am really sorry we did not start when the earth was at her full--that is to say, when our globe was in opposition to the sun!"

"Why?" asked Nicholl.

"Because we should have seen our continents and seas under a new aspect--the continents shining under the solar rays, the seas darker, like they figure upon certain maps of the world! I should like to have seen those poles of the earth upon which the eye of man has never yet rested!"

"I daresay," answered Barbicane, "but if the earth had been full the moon would have been new--that is to say, invisible amidst the irradiation of the sun. It is better for us to see the goal we want to reach than the place we started from."

"You are right, Barbicane," answered Captain Nicholl; "and besides, when we have reached the moon we shall have plenty of time during the long lunar nights to consider at leisure the globe that harbours men like us."

"Men like us!" cried Michel Ardan. "But now they are not more like us than the Selenites. We are inhabitants of a new world peopled by us alone--the projectile! I am a man like Barbicane, and Barbicane is a man like Nicholl. Beyond us and outside of us humanity ends, and we are the only population of this microcosm until the moment we become simple Selenites."

"In about eighty-eight hours," replied the captain.

"Which means?" asked Michel Ardan.

"That it is half-past eight," answered Nicholl.

"Very well," answered Michel, "I fail to find the shadow of a reason why we should not breakfast *illico*."

In fact, the inhabitants of the new star could not live in it without eating, and their stomachs then submitted to the imperious laws of hunger. Michel Ardan, in his quality of Frenchman, declared himself chief cook, an important function that no one disputed with him. The gas gave the necessary degrees of heat for cooking purposes, and the provision-locker furnished the elements of this first banquet.

The breakfast began with three cups of excellent broth, due to the liquefaction in hot water of three precious Liebig tablets, prepared from the choicest morsels of the Pampas ruminants. Some slices of beefsteak succeeded them, compressed by the hydraulic press, as tender and succulent as if they had just come from the butchers of the Paris Café Anglais. Michel, an imaginative man, would have it they were even rosy.

Preserved vegetables, "fresher than the natural ones," as the amiable Michel observed, succeeded the meat, and were followed by some cups of tea and slices of bread and butter, American fashion. This beverage, pronounced excellent, was made from tea of the first quality, of which the Emperor of Russia had put some cases at the disposition of the travellers.

Lastly, as a worthy ending to the meal, Ardan ferreted out a fine bottle of "Nuits" burgundy that "happened" to be in the provision compartment. The three friends drank it to the union of the earth and her satellite.

And as if the generous wine it had distilled upon the hill-sides of Burgundy were not enough, the sun was determined to help in the feast. The projectile at that moment emerged from the cone of shadow cast by the terrestrial globe, and the sun's rays fell directly upon the lower disc of the bullet, on account of the angle which the orbit of the moon makes with that of the earth.

"The sun!" exclaimed Michel Ardan.

"Of course," answered Barbicane; "I expected it."

"But," said Michel, "the cone of shadow thrown by the earth into space extends beyond the moon."

"Much beyond if you do not take the atmospheric refraction into account," said Barbicane. "But when the moon is enveloped in that shadow the centres of the three heavenly bodies--the sun, the earth, and the moon--are in a straight line.

Then the nodes coincide with the full moon and there is an eclipse. If, therefore, we had started during an eclipse of the moon all our journey would have been accomplished in the dark, which would have been a pity."

"Why?"

"Because, although we are journeying in the void, our projectile, bathed in the solar rays, will gather their light and heat; therefore there will be economy of gas, a precious economy in every way."

In fact, under these rays, the temperature and brilliancy of which there was no atmosphere to soften, the projectile was lighted and warmed as if it had suddenly passed from winter to summer. The moon above and the sun below inundated it with their rays.

"It is pleasant here now," said Nicholl.

"I believe you!" cried Michel Ardan. "With a little vegetable soil spread over our aluminium planet we could grow green peas in twenty-four hours. I have only one fear, that is that the walls of our bullet will melt."

"You need not alarm yourself, my worthy friend," answered Barbicane. "The projectile supported a much higher temperature while it was travelling through the atmosphere. I should not even wonder if it looked to the eyes of the spectators like a fiery meteor."

"Then J.T. Maston must think we are roasted!"

"What I am astonished at," answered Barbicane, "is that we are not. It was a danger we did not foresee."

"I feared it," answered Nicholl simply.

"And you did not say anything about it, sublime captain!" cried Michel Ardan, shaking his companion's hand.

In the meantime Barbicane was making his arrangements in the projectile as though he was never going to leave it. It will be remembered that the base of the aërial vehicle was fifty-four feet square. It was twelve feet high, and admirably fitted up in the interior. It was not much encumbered by the instruments and

travelling utensils, which were all in special places, and it left some liberty of movement to its three inhabitants. The thick glass let into a part of the floor could bear considerable weight with impunity. Barbicane and his companions walked upon it as well as upon a solid floor; but the sun, which struck it directly with its rays, lighting the interior of the projectile from below, produced singular effects of light.

They began by examining the state of the water and provision receptacles. They were not in the least damaged, thanks to the precautions taken to deaden the shock. The provisions were abundant, and sufficient for one year's food. Barbicane took this precaution in case the projectile should arrive upon an absolutely barren part of the moon. There was only enough water and brandy for two months. But according to the latest observations of astronomers, the moon had a dense low and thick atmosphere, at least in its deepest valleys, and there streams and watercourses could not fail. Therefore the adventurous explorers would not suffer from hunger or thirst during the journey, and the first year of their installation upon the lunar continent.

The question of air in the interior of the projectile also offered all security. The Reiset and Regnault apparatus, destined to produce oxygen, was furnished with enough chlorate of potash for two months. It necessarily consumed a large quantity of gas, for it was obliged to keep the productive matter up to 100°. But there was abundance of that also. The apparatus wanted little looking after. It worked automatically. At that high temperature the chlorate of potash changed into chlorine of potassium, and gave out all the oxygen it contained. The eighteen pounds of chlorate of potash 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 consumed; the carbonic acid gas produced by expiration must also be absorbed. Now for the last twelve hours the atmosphere of the bullet had become loaded with this deleterious gas, the product of the combustion of the elements of blood by the oxygen taken into the lungs. Nicholl perceived this state of the air by seeing Diana palpitate painfully. In fact, carbonic acid gas--through a phenomenon identical with the one to be noticed in the famous Dog's Grotto--accumulated at the bottom of the projectile by reason of its weight. Poor Diana, whose head was low down, therefore necessarily suffered from it before her masters. But Captain Nicholl made haste to remedy this state of things. He placed on the floor of the projectile several receptacles containing caustic potash which he shook about for some time, and

this matter, which is very greedy of carbonic acid, completely absorbed it, and thus purified the interior air.

An inventory of the instruments was then begun. The thermometers and barometers were undamaged, with the exception of a minimum thermometer the glass of which was broken. An excellent aneroid was taken out of its padded box and hung upon the wall. Of course it was only acted upon by and indicated the pressure of the air inside the projectile; but it also indicated the quantity of moisture it contained. At that moment its needle oscillated between 25.24 and 25.08. It was at "set fair."

Barbicane had brought several compasses, which were found intact. It will be easily understood that under those circumstances their needles were acting at random, without any constant direction. In fact, at the distance the projectile was from the earth the magnetic pole could not exercise any sensible action upon the apparatus. But these compasses, taken upon the lunar disc, might show particular phenomena. In any case it would be interesting to verify whether the earth's satellite, like the earth herself, submitted to magnetical influence.

A hypsometer to measure the altitude of the lunar mountains, a sextant to take the height of the sun, a theodolite, an instrument for surveying, telescopes to be used as the moon approached--all these instruments were carefully inspected and found in good condition, notwithstanding the violence of the initial shock.

As to the utensils--pickaxes, spades, and different tools--of which Nicholl had made a special collection, the sacks of various kinds of grain, and the shrubs which Michel Ardan counted upon transplanting into Selenite soil, they were in their places in the upper corners of the projectile. There was made a sort of granary, which the prodigal Frenchman had filled. What was in it was very little known, and the merry fellow did not enlighten anybody. From time to time he climbed up the cramp-irons riveted in the walls to this store-room, the inspection of which he had reserved to himself. He arranged and re-arranged, plunged his hand rapidly into certain mysterious boxes, singing all the time in a voice very out of tune some old French song to enliven the situation.

Barbicane noticed with interest that his rockets and other fireworks were not damaged. These were important, for, powerfully loaded, they were meant to slacken the speed with which the projectile would, when attracted by the moon after passing the point of neutral attraction, fall upon her surface. This fall

besides would be six times less rapid than it would have been upon the surface of the earth, thanks to the difference of volume in the two bodies.

The inspection ended, therefore, in general satisfaction. Then they all returned to their posts of observation at the lateral and lower port-lights.

The same spectacle was spread before them. All the extent of the celestial sphere swarmed with stars and constellations of marvellous brilliancy, enough to make an astronomer wild! On one side the sun, like the mouth of a fiery furnace, shone upon the dark background of the heavens. On the other side the moon, reflecting back his fires, seemed motionless amidst the starry world. Then a large spot, like a hole in the firmament, bordered still by a slight thread of silver--it was the earth. Here and there nebulous masses like large snow-flakes, and from zenith to nadir an immense ring, formed of an impalpable dust of stars--that milky way amidst which the sun only counts as a star of the fourth magnitude!

The spectators could not take their eyes off a spectacle so new, of which no description could give any idea. What reflections it suggested! What unknown emotions it aroused in the soul! Barbicane wished to begin the recital of his journey under the empire of these impressions, and he noted down hourly all the events that signalised the beginning of his enterprise. He wrote tranquilly in his large and rather commercial-looking handwriting.

During that time the calculating Nicholl looked over the formulae of trajectories, and worked away at figures with unparalleled dexterity. Michel Ardan talked sometimes to Barbicane, who did not answer much, to Nicholl, who did not hear, and to Diana, who did not understand his theories, and lastly to himself, making questions and answers, going and coming, occupying himself with a thousand details, sometimes leaning over the lower port-light, sometimes roosting in the heights of the projectile, singing all the time. In this microcosm he represented the French agitation and loquacity, and it was worthily represented.

The day, or rather--for the expression is not correct--the lapse of twelve hours which makes a day upon earth--was ended by a copious supper carefully prepared. No incident of a nature to shake the confidence of the travellers had happened, so, full of hope and already sure of success, they went to sleep peacefully, whilst the projectile, at a uniformly increasing speed, made its way in the heavens.

CHAPTER IV

.

A LITTLE ALGEBRA.

The night passed without incident. Correctly speaking, the word "night" is an improper one. The position of the projectile in regard to the sun did not change. Astronomically it was day on the bottom of the bullet, and night on the top. When, therefore, in this recital these two words are used they express the lapse of time between the rising and setting of the sun upon earth.

The travellers' sleep was so much the more peaceful because, notwithstanding its excessive speed, the projectile seemed absolutely motionless. No movement indicated its journey through space. However rapidly change of place may be effected, it cannot produce any sensible effect upon the organism when it takes place in the void, or when the mass of air circulates along with the travelling body. What inhabitant of the earth perceives the speed which carries him along at the rate of 68,000 miles an hour? Movement under such circumstances is not felt more than repose. Every object is indifferent to it. When a body is in repose it remains so until some foreign force puts it in movement. When in movement it would never stop if some obstacle were not in its road. This indifference to movement or repose is inertia.

Barbicane and his companions could, therefore, imagine themselves absolutely motionless, shut up in the interior of the projectile. The effect would have been the same if they had placed themselves on the outside. Without the moon, which grew larger above them, and the earth that grew smaller below, they would have sworn they were suspended in a complete stagnation.

That morning, the 3rd of December, they were awakened by a joyful but unexpected noise. It was the crowing of a cock in the interior of their vehicle.

Michel Ardan was the first to get up; he climbed to the top of the projectile and closed a partly-open case.

"Be quiet," said he in a whisper. "That animal will spoil my plan!"

In the meantime Nicholl and Barbicane awoke.

"Was that a cock?" said Nicholl.

"No, my friends," answered Michel quickly. "I wished to awake you with that rural sound."

So saying he gave vent to a cock-a-doodle-do which would have done honour to the proudest of gallinaceans.

The two Americans could not help laughing.

"A fine accomplishment that," said Nicholl, looking suspiciously at his companion.

"Yes," answered Michel, "a joke common in my country. It is very Gallic. We perpetrate it in the best society."

Then turning the conversation--

"Barbicane, do you know what I have been thinking about all night?"

"No," answered the president.

"About our friends at Cambridge. You have already remarked how admirably ignorant I am of mathematics. I find it, therefore, impossible to guess how our *savants* of the observatory could calculate what initial velocity the projectile ought to be endowed with on leaving the Columbiad in order to reach the moon."

"You mean," replied Barbicane, "in order to reach that neutral point where the terrestrial and lunar attractions are equal; for beyond this point, situated at about 0.9 of the distance, the projectile will fall upon the moon by virtue of its own weight merely."

"Very well," answered Michel; "but once more; how did they calculate the initial velocity?"

"Nothing is easier," said Barbicane.

"And could you have made the calculation yourself?" asked Michel Ardan.

"Certainly; Nicholl and I could have determined it if the notice from the

observatory had not saved us the trouble."

"Well, old fellow," answered Michel, "they might sooner cut off my head, beginning with my feet, than have made me solve that problem!"

"Because you do not know algebra," replied Barbicane tranquilly.

"Ah, that's just like you dealers in _x_! You think you have explained everything when you have said 'algebra.'"

"Michel," replied Barbicane, "do you think it possible to forge without a hammer, or to plough without a ploughshare?"

"It would be difficult."

"Well, then, algebra is a tool like a plough or a hammer, and a good tool for any one who knows how to use it."

"Seriously?"

"Quite."

"Could you use that tool before me?"

"If it would interest you."

"And could you show me how they calculated the initial speed of our vehicle?"

"Yes, my worthy friend. By taking into account all the elements of the problem, the distance from the centre of the earth to the centre of the moon, of the radius of the earth, the volume of the earth and the volume of the moon, I can determine exactly what the initial speed of the projectile ought to be, and that by a very simple formula."

"Show me the formula."

"You shall see it. Only I will not give you the curve really traced by the bullet between the earth and the moon, by taking into account their movement of translation round the sun. No. I will consider both bodies to be motionless, and that will be sufficient for us."

"Why?"

"Because that would be seeking to solve the problem called 'the problem of the three bodies,' for which the integral calculus is not yet far enough advanced."

"Indeed," said Michel Ardan in a bantering tone; "then mathematics have not said their last word."

"Certainly not," answered Barbicane.

"Good! Perhaps the Selenites have pushed the integral calculus further than you! By-the-bye, what is the integral calculus?"

"It is the inverse of the differential calculus," answered Barbicane seriously.

"Much obliged."

"To speak otherwise, it is a calculus by which you seek finished quantities of what you know the differential quantities."

"That is clear at least," answered Barbicane with a quite satisfied air.

"And now," continued Barbicane, "for a piece of paper and a pencil, and in half-an-hour I will have found the required formula."

That said, Barbicane became absorbed in his work, whilst 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, amidst which the following general formula was discernible:--

$$\frac{1}{2}\left(v_2^2 - v_0^2\right) = gr\left\{\frac{m'}{x}\left(\frac{r}{d-r} - \frac{r}{d-x}\right) - 1 + \frac{1}{r}\right\}$$

"And what does that mean?" asked Michel.

"That means," answered Nicholl, "that the half of *v* 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* upon *d* minus *x* minus _r_--"

"*X* upon *y* galloping upon *z* and rearing upon _p_" cried Michel Ardan, bursting

out laughing. "Do you mean to say you understand that, captain?"

"Nothing is clearer."

"Then," said Michel Ardan, "it is as plain as a pikestaff, and I want nothing more."

"Everlasting laugher," said Barbicane, "you wanted algebra, and now you shall have it over head and ears."

"I would rather be hung!"

"That appears a good solution, Barbicane," said Nicholl, who was examining the formula like a *connaisseur*. "It is the integral of the equation of 'vis viva,' and I do not doubt that it will give us the desired result."

"But I should like to understand!" exclaimed Michel. "I would give ten years of Nicholl's life to understand!"

"Then listen," resumed Barbicane. "The half of *v* minus *v* zero square is the formula that gives us the demi-variation of the 'vis viva.'"

"Good; and does Nicholl understand what that means?"

"Certainly, Michel," answered the captain. "All those signs that look so cabalistic to you form the clearest and most logical language for those who know how to read it."

"And do you pretend, Nicholl," asked Michel, "that by means of these hieroglyphics, more incomprehensible than the Egyptian ibis, you can find the initial speed necessary to give to the projectile?"

"Incontestably," answered Nicholl; "and even by that formula I could always tell you what speed it is going at on any point of the journey."

"Upon your word of honour?"

"Yes."

"Then you are as clever as our president."

"No, Michel, all the difficulty consists in what Barbicane has done. It is to establish an equation which takes into account all the conditions of the problem. The rest is only a question of arithmetic, and requires nothing but a knowledge of the four rules."

"That's something," answered Michel Ardan, who had never been able to make a correct addition in his life, and who thus defined the rule: "A Chinese puzzle, by which you can obtain infinitely various results."

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

"I do not know if I should," said Nicholl, "for the more I study it the more marvellously correct 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, looking resigned.

"_d_," said Barbicane, "is the distance from the centre of the earth to the centre 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 volume of the earth; *m prime* that of the moon. We are obliged to take into account the volume of the two attracting bodies, as the attraction is in proportion to the volume."

"I understand that."

"*g* represents gravity, the speed acquired at the end of a second by a body falling on the surface of the earth. Is that clear?"

"A mountain stream!" answered Michel.

"Now I represent by *x* the variable distance that separates the projectile from the centre of the earth, and by *v* the velocity the projectile has at that distance."

"Good."

"Lastly, the expression *v* zero which figures in the equation is the speed the bullet possesses when it emerges from the atmosphere."

"Yes," said Nicholl, "you were obliged to calculate the velocity from that point, because we knew before that the velocity at departure is exactly equal to 3/2 of the velocity upon emerging from the atmosphere."

"Don't understand any more!" said Michel.

"Yet it is very simple," said Barbicane.

"I do not find it very simple," replied Michel.

"It means that when our projectile reached the limit of the terrestrial atmosphere it had already lost one-third of its initial velocity."

"As much as that?"

"Yes, my friend, simply by friction against the atmosphere. You will easily understand that the greater its speed the more resistance it would meet with from the air."

"That I admit," answered Michel, "and I understand it, although your *v* zero two and your *v* zero square shake about in my head like nails in a sack."

"First effect of algebra," continued Barbicane. "And now to finish we are going to find the numerical known quantity of these different expressions--that is to say, find out their value."

"You will finish me first!" answered Michel.

"Some of these expressions," said Barbicane, "are known; the others have to be calculated."

"I will calculate those," said Nicholl.

"And _r_," resumed Barbicane, "*r* is the radius of the earth under the latitude of Florida, our point of departure, _d_--that is to say, the distance from the centre of the earth to the centre of the moon equals fifty-six terrestrial radii--"

Nicholl rapidly calculated.

"That makes 356,720,000 metres when the moon is at her perigee--that is to say, when she is nearest to the earth."

"Very well," said Barbicane, "now *m* prime upon _m_--that is to say, the proportion of the moon's volume to that of the earth equals 1/81."

"Perfect," said Michel.

"And _g_, the gravity, is to Florida 9-1/81 metres. From whence it results that *gr* equals--"

"Sixty-two million four hundred and twenty-six thousand square metres," answered Nicholl.

"What next?" asked Michel Ardan.

"Now that the expressions are reduced to figures, I am going to find the velocity _v zero_--that is to say, the velocity that the projectile ought to have on leaving the atmosphere to reach the point of equal attraction with no velocity. The velocity at that point I make equal _zero_, and _x_, the distance where the neutral point is, will be represented by the nine-tenths of _d_--that is to say, the distance that separates the two centres."

"I have some 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--

2 10r 1 10r r v = 2 gr { 1 - --- --- (--- - ---) } 0 9d 81 d d-r

Nicholl read it quickly.

"That's it! that is it!" he cried.

"Is it clear?" asked Barbicane.

"It is written in letters of fire!" answered Nicholl.

"Clever fellows!" murmured Michel.

"Do you understand now?" asked Barbicane.

"If I understand!" cried Michel Ardan. "My head is bursting with it."

"Thus," resumed Barbicane, "*v zero* square equals 2 *gr* multiplied by 1 minus 10 *r* upon 9 *d* minus 1/81 multiplied by 10 *r* upon *d* minus *r* upon *d* minus *r*."

"And now," said Nicholl, "in order to obtain the velocity of the bullet as it emerges from the atmosphere I have only to calculate."

The captain, like a man used to overcome all difficulties, began to calculate with frightful rapidity. Divisions and multiplications grew under his fingers. Figures dotted the page. Barbicane followed him with his eyes, whilst Michel Ardan compressed a coming headache with his two hands.

"Well, what do you make it?" asked Barbicane after several minutes' silence.

"I make it 11,051 metres in the first second."

"What do you say?" said Barbicane, starting.

"Eleven thousand and fifty-one metres."

"Malediction!" cried the president with a gesture of despair.

"What's the matter with you?" asked Michel Ardan, much surprised.

"The matter! why if at this moment the velocity was already diminished one-third by friction, the initial speed ought to have been--"

"Sixteen thousand five hundred and seventy-six metres!" answered Nicholl.

"But the Cambridge Observatory declared that 11,000 metres were enough at

departure, and our bullet started with that velocity only!"

"Well?" asked Nicholl.

"Why it was not enough!"

"No."

"We shall not reach the neutral point."

"The devil!"

"We shall not even go half way!"

"_Nom d'un boulet_!" exclaimed Michel Ardan, jumping up as if the projectile were on the point of striking against the terrestrial globe.

"And we shall fall back upon the earth!"

CHAPTER V

.

THE TEMPERATURE OF SPACE.

This revelation acted like a thunderbolt. Who could have expected such an error in calculation? Barbicane would not believe it. Nicholl went over the figures again. They were correct. The formula which had established them could not be mistrusted, and, when verified, the initial velocity of 16,576 metres, necessary for attaining the neutral point, was found quite right.

The three friends looked at one another in silence. No one thought about breakfast after that. Barbicane, with set teeth, contracted brow, and fists convulsively closed, looked through the port-light. Nicholl folded his arms and examined his calculations. Michel Ardan murmured--

"That's just like _savants_! That's the way they always do! I would give twenty pistoles to fall upon the Cambridge Observatory and crush it, with all its stupid staff inside!"

All at once the captain made a reflection which struck Barbicane at once.

"Why," said he, "it is seven o'clock in the morning, so we have been thirty-two hours on the road. We have come more than half way, and we are not falling yet that I know of!"

Barbicane did not answer, but after a rapid glance at the captain he took a compass, which he used to measure the angular distance of the terrestrial globe. Then through the lower port-light he made a very exact observation from the apparent immobility of the projectile. Then rising and wiping the perspiration from his brow, he put down some figures upon paper. Nicholl saw that the president wished to find out from the length of the terrestrial diameter the distance of the bullet from the earth. He looked at him anxiously.

"No!" cried Barbicane in a few minutes' time, "we are not falling! We are already more than 50,000 leagues from the earth! We have passed the point the projectile ought to have stopped at if its speed had been only 11,000 metres at our departure! We are still ascending!"

"That is evident," answered Nicholl; "so we must conclude that our initial velocity, under the propulsion of the 400,000 lbs. of gun-cotton, was greater than the 11,000 metres. I can now explain to myself why we met with the second satellite, that gravitates at more than 2,000 leagues from the earth, in less than thirteen minutes."

"That explanation is so much the more probable," added Barbicane, "because by throwing out the water in our movable partitions the projectile was made considerably lighter all at once."

"That is true," said Nicholl.

"Ah, my brave Nicholl," cried Barbicane, "we are saved!"

"Very well then," answered Michel Ardan tranquilly, "as we are saved, let us have breakfast."

Nicholl was not mistaken. The initial speed had happily been greater than that indicated by the Cambridge Observatory, but the Cambridge Observatory had no less been mistaken.

The travellers, recovered from their false alarm, sat down to table and breakfasted merrily. Though they ate much they talked more. Their confidence was greater after the "algebra incident."

"Why should we not succeed?" repeated Michel Ardan. "Why should we not arrive? We are on the road; there are no obstacles before us, and no stones on our route. It is free--freer than that of a ship that has to struggle with the sea, or a balloon with the wind against it! Now if a ship can go where it pleases, or a balloon ascend where it pleases, why should not our projectile reach the goal it was aimed at?"

"It will reach it," said Barbicane.

"If only to honour the American nation," added Michel Ardan, "the only nation capable of making such an enterprise succeed--the only one that could have produced a President Barbicane! Ah! now I think of it, now that all our anxieties are over, what will become of us? We shall be as dull as stagnant water."

Barbicane and Nicholl made gestures of repudiation.

"But I foresaw this, my friends," resumed Michel Ardan. "You have only to say the word. I have chess, backgammon, cards, and dominoes at your disposition. We only want a billiard-table!"

"What?" asked Barbicane, "did you bring such trifles as those?"

"Certainly," answered Michel; "not only for our amusement, but also in the praiseworthy intention of bestowing them upon Selenite inns."

"My friend," said Barbicane, "if the moon is inhabited its inhabitants appeared some thousands of years before those of the earth, for it cannot be doubted that the moon is older than the earth. If, therefore, the Selenites have existed for thousands of centuries--if their brains are organised like that of human beings--they have invented all that we have invented, already, and even what we shall only invent in the lapse of centuries. They will have nothing to learn from us, and we shall have everything to learn from them."

"What!" answered Michel, "do you think they have had 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, and Kant?"

"I have no doubt of it."

"*Savants* like Archimedes, Euclid, Pascal, and Newton?"

"I could swear it."

"Clowns like Arnal, and photographers like--Nadar?"

"I am certain of it."

"Then, friend Barbicane, if these Selenites are as learned as we, and even more so, why have they not hurled a lunar projectile as far as the terrestrial regions?"

"Who says they have not done it?" answered Barbicane seriously.

"In fact," added Nicholl, "it would have been easier to them than to us, and that for two reasons--the first because the attraction is six times less on the surface of the moon than on the surface of the earth, which would allow a projectile to go up more easily; secondly the projectile would only have 8,000 leagues to travel instead of 80,000, which would require a force of propulsion ten times less."

"Then," resumed Michel, "I repeat--why have they not done it?"

"And I," replied Barbicane, "I repeat--who says they have not done it?"

"When?"

"Hundreds of centuries ago, before man's appearance upon earth."

"And the bullet? Where is the bullet? I ask to see the bullet!"

"My friend," answered Barbicane, "the sea covers five-sixths of our globe, hence there are five good reasons for supposing that the lunar projectile, if it has been

fired, is now submerged at the bottom of the Atlantic or Pacific, unless it was buried down some abyss at the epoch when the earth's crust was not sufficiently formed."

"Old fellow," answered Michel, "you have an answer to everything, and I bow before your wisdom. There is one hypothesis I would rather believe than the others, and that is that the Selenites being older than we are wiser, and have not invented gunpowder at all."

At that moment Diana claimed her share in the conversation by a sonorous bark. She asked for her breakfast.

"Ah!" said Michel Ardan, "our arguments make us forget Diana and Satellite!"

A good dish of food was immediately offered to the dog, who devoured it with great appetite.

"Do you know, Barbicane," said Michel, "we ought to have made this projectile a sort of Noah's Ark, and have taken a couple of all the domestic animals with us to the moon."

"No doubt," answered Barbicane, "but we should not have had room enough."

"Oh, we might have been packed a little tighter!"

"The fact is," answered Nicholl, "that oxen, cows, bulls, and horses, all those ruminants would be useful on the lunar continent. Unfortunately we cannot make our projectile either a stable or a cowshed."

"But at least," said Michel Ardan, "we might have brought an ass, nothing but a little ass, the courageous and patient animal old Silenus loved to exhibit. I am fond of those poor asses! They are the least favoured animals in creation. They are not only beaten during their lifetime, but are still beaten after their death!"

"What do you mean by that?" asked Barbicane.

"Why, don't they use his skin to make drums of?"

Barbicane and Nicholl could not help laughing at this absurd reflection. But a cry from their merry companion stopped them; he was bending over Satellite's

niche, and rose up saying--

"Good! Satellite is no longer ill."

"Ah!" said Nicholl.

"No!" resumed Michel, "he is dead. Now," he added in a pitiful tone, "this will be embarrassing! I very much fear, poor Diana, that you will not leave any of your race in the lunar regions!"

The unfortunate Satellite had not been able to survive his wounds. He was dead, stone dead. Michel Ardan, much put out of countenance, looked at his friends.

"This makes another difficulty," said Barbicane. "We can't keep the dead body of this dog with us for another eight-and-forty hours."

"No, certainly not," answered Nicholl, "but our port-lights are hung upon hinges. They can be let down. We will open one of them, and throw the body into space."

The president reflected for a few minutes, and then said--

"Yes, that is what we must do, but we must take the most minute precautions."

"Why?" asked Michel.

"For two reasons that I will explain to you," answered Barbicane. "The first has reference to the air in the projectile, of which we must lose as little as possible."

"But we can renew the air!"

"Not entirely. We can only renew the oxygen, Michel; and, by-the-bye, we must be careful that the apparatus do not furnish us with this oxygen in an immoderate quantity, for an excess of it would cause grave physiological consequences. But although we can renew the oxygen we cannot renew the azote, that medium which the lungs do not absorb, and which ought to remain intact. Now the azote would rapidly escape if the port-lights were opened."

"Not just the time necessary to throw poor Satellite out."

"Agreed; but we must do it quickly."

"And what is the second reason?" asked Michel.

"The second reason is that we must not allow the exterior cold, which is excessive, to penetrate into our projectile lest we should be frozen alive."

"Still the sun--"

"The sun warms our projectile because it absorbs its rays, but it does not warm the void we are in now. When there is no air there is no more heat than there is diffused light, and where the sun's rays do not reach directly it is both dark and cold. The temperature outside is only that produced by the radiation of the stars--that is to say, the same as the temperature of the terrestrial globe would be if one day the sun were to be extinguished."

"No fear of that," answered Nicholl.

"Who knows?" said Michel Ardan. "And even supposing that the sun be not extinguished, it might happen that the earth will move farther away from it."

"Good!" said Nicholl; "that's one of Michel's ideas!"

"Well," resumed Michel, "it is well known that in 1861 the earth went through the tail of a comet. Now suppose there was a comet with a power of attraction greater than that of the sun, the terrestrial globe might make a curve towards the wandering star, and the earth would become its satellite, and would be dragged away to such a distance that the rays of the sun would have no action on its surface."

"That might happen certainly," answered Barbicane, "but the consequences would not be so redoubtable as you would suppose."

"How so?"

"Because heat and cold would still be pretty well balanced upon our globe. It has been calculated that if the earth had been carried away by the comet of 1861, it would only have felt, when at its greatest distance from the sun, a heat sixteen times greater than that sent to us by the moon--a heat which, when focussed by the strongest lens, produces no appreciable effect."

"Well?" said Michel.

"Wait a little," answered Barbicane. "It has been calculated that at its perihelion, when nearest to the sun, the earth would have borne a heat equal to 28,000 times that of summer. But this heat, capable of vitrifying terrestrial matters, and of evaporating water, would have formed a thick circle of clouds which would have lessened the excessive heat, hence there would be compensation between the cold of the aphelion and the heat of the perihelion, and an average probably supportable."

"At what number of degrees do they estimate the temperature of the planetary space?"

"Formerly," answered Barbicane, "it was believed that this temperature was exceedingly low. By calculating its thermometric diminution it was fixed at millions of degrees below zero. It was Fourier, one of Michel's countrymen, an illustrious *savant* of the _Académie des Sciences_, who reduced these numbers to a juster estimation. According to him, the temperature of space does not get lower than 60° Centigrade."

Michel whistled.

"It is about the temperature of the polar regions," answered Barbicane, "at Melville Island or Fort Reliance--about 56° Centigrade below zero."

"It remains to be proved," said Nicholl, "that Fourier was not mistaken in his calculations. If I am not mistaken, another Frenchman, M. Pouillet, estimates the temperature of space at 160° below zero. We shall be able to verify that."

"Not now," answered Barbicane, "for the solar rays striking directly upon our thermometer would give us, on the contrary, a very elevated temperature. But when we get upon the moon, during the nights, a fortnight long, which each of its faces endures alternately, we shall have leisure to make the experiment, for our satellite moves in the void."

"What do you mean by the void?" asked Michel; "is it absolute void?"

"It is absolutely void of air."

"Is there nothing in its place?"

"Yes, ether," answered Barbicane.

"Ah! and what is ether?"

"Ether, my friend, is an agglomeration of imponderable particles, which, relatively to their dimensions, are as far removed from each other as the celestial bodies are in space, so say works on molecular physics. It is these atoms that by their vibrating movement produce light and heat by making four hundred and thirty billions of oscillations a second."

"Millions of millions!" exclaimed Michel Ardan; "then *savants* have measured and counted these oscillations! All these figures, friend Barbicane, are _savants'_ figures, which reach the ear but say nothing to the mind."

"But they are obliged to have recourse to figures."

"No. It would be much better to compare. A billion signifies nothing. An object of comparison explains everything. Example--When you tell me that Uranus is 76 times larger than the earth, Saturn 900 times larger, Jupiter 1,300 times larger, the sun 1,300,000 times larger, I am not much wiser. So I much prefer the old comparisons of the _Double Liégoise_ that simply tells you, 'The sun is a pumpkin two feet in diameter, Jupiter an orange, Saturn a Blenheim apple, Neptune a large cherry, Uranus a smaller 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 fine grains of sand!' Then I know what it means!"

After this tirade of Michel Ardan's against *savants* and their billions, which he delivered without stopping to take breath, they set about burying Satellite. He was to be thrown into space like sailors throw a corpse into the sea.

As President Barbicane had recommended, they had to act quickly so as to lose as little air as possible. The bolts upon the right-hand port-hole were carefully unscrewed, and an opening of about half a yard made, whilst Michel prepared to hurl his dog into space. The window, worked by a powerful lever, which conquered the pressure of air in the interior upon the sides of the projectile, moved upon its hinges, and Satellite was thrown out. Scarcely a particle of air escaped, and the operation succeeded so well that later on Barbicane did not fear to get rid of all the useless rubbish that encumbered the vehicle in the same way.

CHAPTER VI

.

QUESTIONS AND ANSWERS.

On the 4th of December, at 5 a.m. by terrestrial reckoning, the travellers awoke, having been fifty-four hours on their journey. They had only been five hours and forty minutes more than half the time assigned for the accomplishment of their journey, but they had come more than seven-tenths of the distance. This peculiarity was due to their regularly-decreasing speed.

When they looked at the earth through the port-light at the bottom, it only looked like a black spot drowned in the sun's rays. No crescent or pale light was now to be seen. The next day at midnight the earth would be new at the precise moment when the moon would be full. Above, the Queen of Night was nearing the line followed by the projectile, so as to meet it at the hour indicated. All around the dark vault was studded with brilliant specks which seemed to move slowly; but through the great distance they were at their relative size did not seem to alter much. The sun and the stars appeared exactly as they do from the earth. The moon was considerably enlarged; but the travellers' not very powerful telescopes did not as yet allow them to make very useful observations on her surface, or to reconnoitre the topographical or geological details.

The time went by in interminable conversations. The talk was especially about the moon. Each brought his contingent of particular knowledge. Barbicane's and Nicholl's were always serious, Michel Ardan's always fanciful. The projectile, its situation and direction, the incidents that might arise, the precautions necessitated by its fall upon the moon, all this afforded inexhaustible material for conjecture.

Whilst breakfasting a question of Michel's relative to the projectile provoked a rather curious answer from Barbicane, and one worthy of being recorded.

Michel, supposing the bullet to be suddenly stopped whilst still endowed with its formidable initial velocity, wished to know what the consequences would have been.

"But," answered Barbicane, "I don't see how the projectile could have been

stopped."

"But let us suppose it," answered Nicholl.

"It is an impossible supposition," replied the practical president, "unless the force of impulsion had failed. But in that case its speed would have gradually decreased, and would not have stopped abruptly."

"Admit that it had struck against some body in space."

"What body?"

"The enormous meteor we met."

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

"More than that," answered Barbicane, "we should have been burnt alive."

"Burnt!" exclaimed Michel. "I regret it did not happen for us just to see."

"And you would have seen with a vengeance," answered Barbicane. "It is now known that heat is only a modification of movement when water is heated--that is to say, when heat is added to it--that means the giving of movement to its particles."

"That is an ingenious theory!" said Michel.

"And a correct one, my worthy friend, for it explains all the phenomena of caloric. Heat is only molecular movement, a single oscillation of the particles of a body. When the break is put on a train it stops. But what becomes of the movement which animated it? Why do they grease the axles of the wheels? In order to prevent them catching fire from the movement lost by transformation. Do you understand?"

"Admirably," answered Michel. "For example, when I have been running some time, and am covered with sweat, why am I forced to stop? Simply because my movement has been transformed into heat."

Barbicane could not help laughing at this _répartie_ of Michel's. Then resuming

his theory--

"Thus," said he, "in case of a collision, it would have happened to our projectile as it does to the metal cannon-ball after striking armour-plate; it would fall burning, because its movement had been transformed into heat. In consequence, I affirm that if our bullet had struck against the asteroid, its speed, suddenly annihilated, would have produced heat enough to turn it immediately into vapour."

"Then," asked Nicholl, "what would happen if the earth were to be suddenly stopped in her movement of translation?"

"Her temperature would be carried to such a point," answered Barbicane, "that she would be immediately reduced to vapour."

"Good," said Michel; "that means of ending the world would simplify many things."

"And suppose the earth were to fall upon the sun?" said Nicholl.

"According to calculations," answered Barbicane, "that would develop a heat equal to that produced by 1,600 globes of coal, equal in volume to the terrestrial globe."

"A good increase of temperature for the sun," replied Michel Ardan, "of which the inhabitants of Uranus or Neptune will probably not complain, for they must be dying of cold on their planet."

"Thus, then, my friends, any movement suddenly stopped produces heat. This theory makes it supposed that the sun is constantly fed by an incessant fall of bodies upon its surface. It has been calculated--"

"Now I shall be crushed," murmured Michel, "for figures are coming."

"It has been calculated," continued Barbicane imperturbably, "that the shock of each asteroid upon the sun must produce heat equal to that of 4,000 masses of coal of equal volume."

"And what is the heat of the sun?" asked Michel.

"It is equal to that which would be produced by a stratum of coal surrounding the sun to a depth of twenty-seven kilometres."

"And that heat--"

"Could boil 2,900,000,000 of cubic myriametres of water an hour." (A myriametre is equal to rather more than 6.2138 miles, or 6 miles 1 furlong 28 poles.)

"And we are not roasted by it?" cried Michel.

"No," answered Barbicane, "because the terrestrial atmosphere absorbs four-tenths of the solar heat. Besides, the quantity of heat intercepted by the earth is only two thousand millionth of the total."

"I see that all is for the best," replied Michel, "and that our atmosphere is a useful invention, for it not only allows us to breathe, but actually prevents us roasting."

"Yes," said Nicholl, "but, unfortunately, it will not be the same on the moon."

"Bah!" said Michel, always confident. "If there are any inhabitants they breathe. If there are no longer any they will surely have left enough oxygen for three people, if only at the bottom of those ravines where it will have accumulated by reason of its weight! Well, we shall not climb the mountains! That is all."

And Michel, getting up, went to look at the lunar disc, which was shining with intolerable brilliancy.

"Faith!" said he, "it must be hot up there."

"Without reckoning," answered Nicholl, "that daylight lasts 360 hours."

"And by way of compensation night has the same duration," said Barbicane, "and as heat is restored by radiation, their temperature must be that of planetary space."

"A fine country truly!" said Nicholl.

"Never mind! I should like to be there already! It will be comical to have the

earth for a moon, to see it rise on the horizon, to recognise the configuration of its continents, to say to oneself, 'There's America and there's Europe;' then to follow it till it is lost in the rays of the sun! By-the-bye, Barbicane, have the Selenites any eclipses?"

"Yes, eclipses of the sun," answered Barbicane, "when the centres of the three stars are on the same line with the earth in the middle. But they are merely annular eclipses, during which the earth, thrown like a screen across the solar disc, allows the greater part to be seen."

"Why is there no total eclipse?" asked Nicholl. "Is it because the cone of shade thrown by the earth does not extend beyond the moon?"

"Yes, if you do not take into account the refraction produced by the terrestrial atmosphere, not if you do take that refraction into account. Thus, let *delta* be the horizontal parallax and *p* the apparent semidiameter--"

"Ouf!" said Michel, "half of *v* zero square! Do speak the vulgar tongue, man of algebra!"

"Well, then, in popular language," answered Barbicane, "the mean distance between the moon and the earth being sixty terrestrial radii, the length of the cone of shadow, by dint of refraction, is reduced to less than forty-two radii. It follows, therefore, that during the eclipses the moon is beyond the cone of pure shade, and the sun sends it not only rays from its edges, but also rays from its centre."

"Then," said Michel in a grumbling tone, "why is there any eclipse when there ought to be none?"

"Solely because the solar rays are weakened by the refraction, and the atmosphere which they traverse extinguishes the greater part of them."

"That reason satisfies me," answered Michel; "besides, we shall see for ourselves when we get there. Now, Barbicane, do you believe that the moon is an ancient comet?"

"What an idea!"

"Yes," replied Michel, with amiable conceit, "I have a few ideas of that kind."

"But that idea does not originate with Michel," answered Nicholl.

"Then I am only a plagiarist."

"Without doubt," answered Nicholl. "According to the testimony of the ancients, the Arcadians pretended that their ancestors inhabited the earth before the moon became her satellite. Starting from this fact, certain *savants* think the moon was a comet which its orbit one day brought near enough to the earth to be retained by terrestrial attraction."

"And what truth is there in that hypothesis?" asked Michel.

"None," answered Barbicane, "and the proof is that the moon has not kept a trace of the gaseous envelope that always accompanies comets."

"But," said Nicholl, "might not the moon, before becoming the earth's satellite, have passed near enough to the sun to leave all her gaseous substances by evaporation?"

"It might, friend Nicholl, but it is not probable."

"Why?"

"Because--because, I really don't know."

"Ah, what hundreds of volumes we might fill with what we don't know!" exclaimed Michel. "But I say," he continued, "what time is it?"

"Three o'clock," answered Nicholl.

"How the time goes," said Michel, "in the conversation of *savants* like us! Decidedly I feel myself getting too learned! I feel that I am becoming a well of knowledge!"

So saying, Michel climbed to the roof of the projectile, "in order better to observe the moon," he pretended. In the meanwhile his companions watched the vault of space through the lower port-light. There was nothing fresh to signalise.

When Michel Ardan came down again he approached the lateral port-light, and suddenly uttered an exclamation of surprise.

"What is the matter now?" asked Barbicane.

The president approached the glass and saw a sort of flattened sack floating outside at some yards' distance from the projectile. This object seemed motionless like the bullet, and was consequently animated with the same ascensional movement.

"Whatever can that machine be?" said Michel Ardan. "Is it one of the corpuscles of space which our projectile holds in its radius of attraction, and which will accompany it as far as the moon?"

"What I am astonished at," answered Nicholl, "is that the specific weight of this body, which is certainly superior to that of the bullet, allows it to maintain itself so rigorously on its level."

"Nicholl," said Barbicane, after a moment's reflection, "I do not know what that object is, but I know perfectly why it keeps on a level with the projectile."

"Why, pray?"

"Because we are floating in the void where bodies fall or move--which is the same thing--with equal speed whatever their weight or form may be. It is the air which, by its resistance, creates differences in weight. When you pneumatically create void in a tube, the objects you throw down it, either lead or feathers, fall with the same rapidity. Here in space you have the same cause and the same effect."

"True," said Nicholl, "and all we throw out of the projectile will accompany us to the moon."

"Ah! what fools we are!" cried Michel.

"Why this qualification?" asked Barbicane.

"Because we ought to have filled the projectile with useful objects, books, instruments, tools, &c. We could have thrown them all out, and they would all have followed in our wake! But, now I think of it, why can't we take a walk outside this? Why can't we go into space through the port-light? What delight it would be to be thus suspended in ether, more favoured even than birds that are forced to flap their wings to sustain them!"

"Agreed," said Barbicane, "but how are we to breathe?"

"Confounded air to fail so inopportunely!"

"But if it did not fail, Michel, your density being inferior to that of the projectile, you would soon remain behind."

"Then it is a vicious circle."

"All that is most vicious."

"And we must remain imprisoned in our vehicle."

"Yes, we must."

"Ah!" cried Michel in a formidable voice.

"What is the matter with you?" asked Nicholl.

"I know, I guess what this pretended asteroid is! It is not a broken piece of planet!"

"What is it, then?" asked Nicholl.

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

In fact, this deformed object, reduced to nothing, and quite unrecognisable, was the body of Satellite flattened like a bagpipe without wind, and mounting, for ever mounting!

CHAPTER VII

.

A MOMENT OF INTOXICATION.

Thus a curious but logical, strange yet logical phenomenon took place under these singular conditions. Every object thrown out of the projectile would follow the same trajectory and only stop when it did. That furnished a text for

conversation which the whole evening could not exhaust. The emotion of the three travellers increased as they approached the end of their journey. They expected unforeseen incidents, fresh phenomena, and nothing would have astonished them under present circumstances. Their excited imagination outdistanced the projectile, the speed of which diminished notably without their feeling it. But the moon grew larger before their eyes, and they thought they had only to stretch out their hands to touch it.

The next day, the 5th of December, they were all wide awake at 5 a.m. That day was to be the last of their journey if the calculations were exact. That same evening, at midnight, within eighteen hours, at the precise moment of full moon, they would reach her brilliant disc. The next midnight would bring them to the goal of their journey, the most extraordinary one of ancient or modern times. At early dawn, through the windows made silvery with her rays, they saluted the Queen of Night with a confident and joyful hurrah.

The moon was sailing majestically across the starry firmament. A few more degrees and she would reach that precise point in space where the projectile was to meet her. According to his own observations, Barbicane thought that he should accost her in her northern hemisphere, where vast plains extend and mountains are rare--a favourable circumstance if the lunar atmosphere was, according to received opinion, stored up in deep places only.

"Besides," observed Michel Ardan, "a plain is more suitable for landing upon than a mountain. A Selenite landed in Europe on the summit of Mont Blanc, or in Asia on a peak of the Himalayas, would not be precisely at his destination!"

"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. Therefore all is for the best."

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 of the projectile towards the northern hemisphere proved that its trajectory had been slightly modified. The aim, mathematically calculated, ought to have sent the bullet into the very centre of the lunar disc. If it did not arrive

there it would be because it had deviated. What had caused it? Barbicane could not imagine nor determine the importance of this deviation, for there was no datum to go upon. He hoped, however, that the only result would be to take them towards the upper edge of the moon, a more suitable region for landing.

Barbicane, therefore, without saying anything to his friends, contented himself with frequently observing the moon, trying to see if the direction of the projectile would not change. For the situation would have been so terrible had the bullet, missing its aim, been dragged beyond the lunar disc and fallen into interplanetary space.

At that moment the moon, instead of appearing flat like a disc, already showed her convexity. If the sun's rays had reached her obliquely the shadow then thrown would have made the high mountains stand out. They could have seen the gaping craters and the capricious furrows that cut up the immense plains. But all relief was levelled in the intense brilliancy. Those large spots that give the appearance of a human face to the moon were scarcely distinguishable.

"It may be a face," said Michel Ardan, "but I am sorry for the amiable sister of Apollo, her face is so freckled!"

In the meantime the travellers so near their goal ceaselessly watched this new world. Their imagination made them take walks over these unknown countries. They climbed the elevated peaks. They descended to the bottom of the large amphitheatres. Here and there they thought they saw vast seas scarcely kept together under an atmosphere so rarefied, and streams of water that poured them their tribute from the mountains. Leaning over the abyss they hoped to catch the noise of this orb for ever mute in the solitudes of the void.

This last day left them the liveliest remembrances. They noted down the least details. A vague uneasiness took possession of them as they approached their goal. This uneasiness would have been doubled if they had felt how slight their speed was. It appeared quite insufficient to take them to the end of their journey. This was because the projectile scarcely "weighed" anything. Its weight constantly decreased, and would be entirely annihilated on that line where the lunar and terrestrial attractions neutralise each other, causing surprising effects.

Nevertheless, in spite of his preoccupations, Michel Ardan did not forget to prepare the morning meal with his habitual punctuality. They ate heartily.

Nothing was more excellent than their broth liquefied by the heat of the gas. Nothing better than these preserved meats. A few glasses of good French wine crowned the repast, and caused Michel Ardan to remark that the lunar vines, warmed by this ardent sun, ought to distil the most generous wines--that is, if they existed. Any way, 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.

The Reiset and Regnault apparatus always worked with extreme precision. The air was kept in a state of perfect purity. Not a particle of carbonic acid resisted the potash, and as to the oxygen, that, as Captain Nicholl said, was of "first quality." The small amount of humidity in the projectile mixed with this air and tempered its dryness, and many Paris, London, or New York apartments and many theatres do not certainly fulfil hygienic conditions so well.

But in order to work regularly this apparatus had to be kept going regularly. Each morning Michel inspected the escape regulators, tried the taps, and fixed by the pyrometer the heat of the gas. All had gone well so far, and the travellers, imitating the worthy J.T. Maston, began to get so stout that they would not be recognisable if their imprisonment lasted several months. They behaved like chickens in a cage--they fattened.

Looking through the port lights Barbicane saw the spectre of the dog, and the different objects thrown out of the projectile, which obstinately accompanied it. Diana howled lamentably when she perceived the remains of Satellite. All the things seemed as motionless as if they had rested upon solid ground.

"Do you know, my friends," said Michel Ardan, "that if one of us had succumbed to the recoil shock at departure we should have been much embarrassed as to how to get rid of him? You see the accusing corpse would have followed us in space like remorse!"

"That would have been sad," said Nicholl.

"Ah!" continued Michel, "what I regret is our not being able to take a walk outside. What delight it would be to float in this radiant ether, to bathe in these pure rays of the sun! If Barbicane had only thought of furnishing us with diving-dresses and air-pumps I should have ventured outside, and have assumed the attitude of a flying-horse on the summit of the projectile."

"Ah, old fellow!" answered Barbicane, "you would not have stayed there long in spite of your diving-dress; you would have burst like an obus by the expansion of air inside you, or rather like a balloon that goes up too high. So regret nothing, and do not forget this: while we are moving in the void you must do without any sentimental promenade out of the projectile."

Michel Ardan allowed himself to be convinced in a certain measure. He agreed that the thing was difficult, but not "impossible;" that was a word he never uttered.

The conversation passed from this subject to another, and never languished an instant. It seemed to the three friends that under these conditions ideas came into their heads like leaves in the first warm days of spring.

Amidst the questions and answers that crossed each other during this morning, Nicholl asked one that did not get an immediate solution.

"I say," said he, "it is all very well to go to the moon, but how shall we get back again?"

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

"It seems to me very inopportune to ask about getting away from a country before you get to it," added Michel.

"I don't ask that question because I want to draw back, but I repeat my question, and ask, 'How shall we get back?'"

"I have not the least idea," answered Barbicane.

"And as for me," said Michel, "if I had known how to come back I should not have gone."

"That is what you call answering," cried Nicholl.

"I approve of Michel's words, and add that the question has no actual interest. We will think about that later on, when we want to return. Though the Columbiad will not be there, the projectile will."

"Much good that will be, a bullet without a gun!"

"A gun can be made, and so can powder! Neither metal, saltpetre, nor coal can be wanting in the bowels of the moon. Besides, in order to return you have only the lunar attraction to conquer, and you will only have 8,000 leagues to go so as to fall on the terrestrial globe by the simple laws of weight."

"That is enough," said Michel, getting animated. "Let us hear no more about returning. As to communicating with our ancient colleagues upon earth, that will not be difficult."

"How are we to do that, pray?"

"By means of meteors hurled by the lunar volcanoes."

"A good idea, Michel," answered Barbicane. "Laplace has calculated that a force five times superior to that of our cannons would suffice to send a meteor from the moon to the earth. Now there is no volcano that has not a superior force of propulsion."

"Hurrah!" cried Michel. "Meteors will be convenient postmen and will not cost anything! And how we shall laugh at the postal service! But now I think--"

"What do you think?"

"A superb idea! Why did we not fasten a telegraph wire to our bullet? We could have exchanged telegrams with the earth!"

"And the weight of a wire 86,000 leagues long," answered Nicholl, "does that go for nothing?"

"Yes, for nothing! We should have trebled the charge of the Columbiad! We could have made it four times--five times--greater!" cried Michel, whose voice became more and more violent.

"There is a slight objection to make to your project," answered Barbicane. "It is that during the movement of rotation of the globe our wire would have been rolled round it like a chain round a windlass, and it would inevitably have dragged us down to the earth again."

"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 now I think of it, if

we do not return to earth J.T. Maston will certainly come to us!"

"Yes! he will come," replied Barbicane; "he is a worthy and courageous comrade. Besides, what could be easier? Is not the Columbiad still lying in Floridian soil? Is cotton and nitric acid wanting wherewith to manufacture the projectile? Will not the moon again pass the zenith of Florida? In another eighteen years will she not occupy exactly the same place that she occupies to-day?"

"Yes," repeated Michel--"yes, Maston will come, and with him our friends Elphinstone, Blomsberry, and all the members of the Gun Club, and they will be welcome! Later on trains of projectiles will be established between the earth and the moon! Hurrah for J.T. Maston!"

It is probable that if the Honourable J.T. Maston did not hear the hurrahs uttered in his honour his ears tingled at least. What was he doing then? He was no doubt stationed in the Rocky Mountains at Long's Peak, trying to discover the invisible bullet gravitating in space. If he was thinking of his dear companions it must be acknowledged that they were not behindhand with him, and that, under the influence of singular exaltation, they consecrated their best thoughts to him.

But whence came the animation that grew visibly greater in the inhabitants of the projectile? Their sobriety could not be questioned. Must this strange erethismus of the brain be attributed to the exceptional circumstances of the time, to that proximity of the Queen of Night from which a few hours only separated them, or to some secret influence of the moon acting on their nervous system? Their faces became as red as if exposed to the reverberation of a furnace; their respiration became more active, and their lungs played like forge-bellows; their eyes shone with extraordinary flame, and their voices became formidably loud, their words escaped like a champagne-cork driven forth by carbonic acid gas; their gestures became disquieting, they wanted so much room to perform them in. And, strange to say, they in no wise perceived this excessive tension of the mind.

"Now," said Nicholl in a sharp tone--"now that I do not know whether we shall come back from the moon, I will know what we are going there for!"

"What we are going there for!" answered Barbicane, stamping as if he were in a fencing-room; "I don't know."

"You don't know!" cried Michel with a shout that provoked a sonorous echo in the projectile.

"No, I have not the least idea!" answered Barbicane, shouting in unison with his interlocutor.

"Well, then, I know," answered Michel.

"Speak, then," said Nicholl, who could no longer restrain the angry tones of his voice.

"I shall speak if it suits me!" cried Michel, violently seizing his companion's arm. "It must suit you!" said Barbicane, with eyes on fire and threatening hands. "It was you who drew us into this terrible journey, and we wish to know why!"

"Yes," said the captain, "now I don't know where I am going, I will know why I am going."

"Why?" cried Michel, jumping a yard high--"why? To take possession of the moon in the name of the United States! To add a fortieth State to the Union! To colonise the lunar regions, to cultivate them, people them, to take them all the wonders of art, science, and industry! To civilise the Selenites, unless they are more civilised than we are, and to make them into a republic if they have not already done it for themselves!"

"If there are any Selenites!" answered Nicholl, who under the empire of this inexplicable intoxication became very contradictory.

"Who says there are no Selenites?" cried Michel in a threatening tone.

"I do!" shouted Nicholl.

"Captain," said Michel, "do not repeat that insult or I will knock your teeth down your throat!"

The two adversaries were about to rush upon one another, and this incoherent discussion was threatening to degenerate into a battle, when Barbicane interfered.

"Stop, unhappy men," said he, putting his two companions back to back, "if

there are no Selenites, we will do without them!"

"Yes!" exclaimed Michel, who did not care more about them than that. "We have nothing to do with the Selenites! Bother the Selenites!"

"The empire of the moon shall be ours," said Nicholl. "Let us found a Republic of three!"

"I shall be the Congress," cried Michel.

"And I the Senate," answered Nicholl.

"And Barbicane the President," shouted Michel.

"No President elected by the nation!" answered Barbicane.

"Well, then, a President elected by the Congress," exclaimed Michel; "and as I am the Congress I elect you unanimously."

"Hurrah! hurrah! hurrah for President Barbicane!" exclaimed Nicholl.

"Hip--hip--hip! hurrah!" vociferated Michel Ardan.

Then the President and Senate struck up "Yankee Doodle" as loudly as they could, whilst the Congress shouted the virile "Marseillaise."

Then began a frantic dance with maniacal gestures, mad stamping, and somersaults of boneless clowns. Diana took part in the dance, howling too, and jumped to the very roof of the projectile. An inexplicable flapping of wings and cock-crows of singular sonority were heard. Five or six fowls flew about striking the walls like mad bats.

Then the three travelling companions, whose lungs were disorganised under some incomprehensible influence, more than intoxicated, burnt by the air that had set their breathing apparatus on fire, fell motionless upon the bottom of the projectile.

CHAPTER VIII

.

AT SEVENTY-EIGHT THOUSAND ONE HUNDRED AND FOURTEEN LEAGUES.

What had happened? What was the cause of that singular intoxication, the consequences of which might prove so disastrous? Simply carelessness on Michel's part, which Nicholl was able to remedy in time.

After a veritable swoon, which lasted a few minutes, the captain, who was the first to regain consciousness, soon collected his intellectual faculties.

Although he had breakfasted two hours before, he began to feel as hungry as if he had not tasted food for several days. His whole being, his brain and stomach, were excited to the highest point.

He rose, therefore, and demanded a supplementary collation from Michel, who was still unconscious, and did not answer. Nicholl, therefore, proceeded to prepare some cups of tea, in order to facilitate the absorption of a dozen sandwiches. He busied himself first with lighting a fire, and so struck a match.

What was his surprise to see the sulphur burn with extraordinary and almost unbearable brilliancy! From the jet of gas he lighted rose a flame equal to floods of electric light.

A revelation took place in Nicholl's mind. This intensity of light, the physiological disturbance in himself, the extra excitement of all his moral and sensitive faculties--he understood it all.

"The oxygen!" he exclaimed.

And leaning over the air-apparatus, he saw that the tap was giving out a flood of colourless, savourless, and odourless gas, eminently vital, but which in a pure state produces the gravest disorders in the constitution. Through carelessness Michel had left the tap full on. Nicholl made haste to turn off this flow of oxygen with which the atmosphere was saturated, and which would have caused the death of the travellers, not by suffocation, but by combustion.

An hour afterwards the air was relieved, and gave their normal play to the lungs. By degrees the three friends recovered from their intoxication; but they were

obliged to recover from their oxygen like a drunkard from his wine.

When Michel knew his share of responsibility in this incident he did not appear in the least disconcerted. This unexpected intoxication broke the monotony of the journey. Many foolish things had been said under its influence, but they had been forgotten as soon as said.

"Then," added the merry Frenchman, "I am not sorry for having experienced the effect of this captious gas. Do you know, my friends, that there might be a curious establishment set up with oxygen-rooms, where people whose constitutions are weak might live a more active life during a few hours at least? Suppose we had meetings where the air could be saturated with this heroic fluid, theatres where the managers would send it out in strong doses, what passion there would be in the souls of actors and spectators, what fire and what enthusiasm! And if, instead of a simple assembly, a whole nation could be saturated with it, what activity, what a supplement of life it would receive! Of an exhausted nation it perhaps would make a great and strong nation, and I know more than one state in old Europe that ought to put itself under the oxygen _régime_ in the interest of its health."

Michel spoke with as much animation as if the tap were still full on. But with one sentence Barbicane damped his enthusiasm.

"All that is very well, friend Michel," he said, "but now perhaps you will tell us where those fowls that joined in our concert came from."

"Those fowls?"

"Yes."

In fact, half-a-dozen hens and a superb cock were flying hither and thither.

"Ah, the stupids!" cried Michel. "It was the oxygen that put them in revolt."

"But what are you going to do with those fowls?" asked Barbicane.

"Acclimatise them in the moon of course! For the sake of a joke, my worthy president; simply a joke that has unhappily come to nothing! I wanted to let them out on the lunar continent without telling you! How astounded you would have been to see these terrestrial poultry pecking the fields of the moon!"

"Ah, _gamin_, you eternal boy!" answered Barbicane, "you don't want oxygen to make you out of your senses! You are always what we were under the influence of this gas! You are always insane!"

"Ah! how do we know we were not wiser then?" replied Michel Ardan.

After this philosophical reflection the three friends repaired the disorder in the projectile. Cock and hens were put back in their cage. But as they were doing this Barbicane and his two companions distinctly perceived a fresh phenomenon.

Since the moment they had left the earth their own weight, that of the bullet and the objects it contained, had suffered progressive diminution. Though they could not have any experience of this in the projectile, a moment must come when the effect upon themselves and the tools and instruments they used would be felt.

Of course scales would not have indicated this loss of weight, for the weights used would have lost precisely as much as the object itself; but a spring weighing-machine, the tension of which is independent of attraction, would have given the exact valuation of this diminution.

It is well known that attraction, or weight, is in proportion to the bulk, and in inverse proportion to the square of distances. Hence this consequence. If the earth had been alone in space, if the other heavenly bodies were to be suddenly annihilated, the projectile, according to Newton's law, would have weighed less according to its distance from the earth, but without ever losing its weight entirely, for the terrestrial attraction would always have made itself felt, no matter at what distance.

But in the case with which we are dealing, a moment must come when the projectile would not be at all under the law of gravitation, after allowing for the other celestial bodies, whose effect could not be set down as zero.

In fact, the trajectory of the projectile was between the earth and the moon. As it went farther away from the earth terrestrial attraction would be diminished in inverse proportion to the square of distances, but the lunar attraction would be augmented in the same proportion. A point must, therefore, be reached where these two attractions would neutralise each other, and the bullet would have no weight at all. If the volumes of the moon and earth were equal, this point would have been reached at an equal distance between the two bodies. But by taking their difference of bulk into account it was easy to calculate that this point would

be situated at 47/52 of the journey, or at 78,114 leagues from the earth.

At this point a body that had no principle of velocity or movement in itself would remain eternally motionless, being equally attracted by the two heavenly bodies, and nothing drawing it more towards one than the other.

Now if the force of impulsion had been exactly calculated the projectile ought to reach that point with no velocity, having lost all weight like the objects it contained.

What would happen then? Three hypotheses presented themselves.

Either the projectile would have kept some velocity, and passing the point of equal attraction, would fall on the moon by virtue of the excess of lunar attraction over terrestrial attraction.

Or velocity sufficient to reach the neutral point being wanting, it would fall back on the earth by virtue of the excess of terrestrial attraction over lunar attraction.

Or lastly, endowed with sufficient velocity to reach the neutral point, but insufficient to pass it, it would remain eternally suspended in the same place, like the pretended coffin of Mahomet, between the zenith and nadir.

Such was the situation, and Barbicane clearly explained the consequences to his travelling companions. They were interested to the highest degree. How were they to know when they had reached this neutral point, situated at 78,114 leagues from the earth, at the precise moment when neither they nor the objects contained in the projectile should be in any way subject to the laws of weight?

Until now the travellers, though they had remarked that this action diminished little by little, had not yet perceived its total absence. But that day, about 11 a.m., Nicholl having let a tumbler escape from his hand, instead of falling, it remained suspended in the air.

"Ah!" cried Michel Ardan, "this is a little amusing chemistry!"

And immediately different objects, weapons, bottles, &c, left to themselves, hung suspended as if by miracle. Diana, too, lifted up by Michel into space, reproduced, but without trickery, the marvellous suspensions effected by Robert-Houdin and Maskelyne and Cook.

The three adventurous companions, surprised and stupefied in spite of their scientific reasoning, carried into the domain of the marvellous, felt weight go out of their bodies. When they stretched out their arms they felt no inclination to drop them. Their heads vacillated on their shoulders. Their feet no longer kept at the bottom of the projectile. They were like staggering drunkards. Imagination has created men deprived of their reflection, others deprived of their shadows! But here reality, by the neutrality of active forces, made men in whom nothing had any weight, and who weighed nothing themselves.

Suddenly Michel, making a slight spring, left the floor and remained suspended in the air like the good monk in Murillo's *Cuisine des Anges*. His two friends joined him in an instant, and all three, in the centre of the projectile, figured a miraculous ascension.

"Is it believable? Is it likely? Is it possible?" cried Michel. "No. And yet it exists! Ah! if Raphael could have seen us like this what an Assumption he could have put upon canvas!"

"The Assumption cannot last," answered Barbicane. "If the projectile passes the neutral point, the lunar attraction will draw us to the moon."

"Then our feet will rest upon the roof of the projectile,' answered Michel.

"No," said Barbicane, "because the centre of gravity in the projectile is very low, and it will turn over gradually."

"Then all our things will be turned upside down for certain!"

"Do not alarm yourself, Michel," answered Nicholl. "There is nothing of the kind to be feared. Not an object will move; the projectile will turn insensibly."

"In fact," resumed Barbicane, "when it has cleared the point of equal attraction, its bottom, relatively heavier, will drag it perpendicularly down to the moon. But in order that such a phenomenon should take place we must pass the neutral line."

"Passing the neutral line!" cried Michel. "Then let us do like the sailors who pass the equator--let us water our passage!"

A slight side movement took Michel to the padded wall. Thence he took a bottle

and glasses, placed them "in space" before his companions, and merrily touching glasses, they saluted the line with a triple hurrah.

This influence of the attractions lasted scarcely an hour. The travellers saw themselves insensibly lowered towards the bottom, and Barbicane thought he remarked that the conical end of the projectile deviated slightly from the normal direction towards the moon. By an inverse movement the bottom side approached it. Lunar attraction was therefore gaining over terrestrial attraction. The fall towards the moon began, insensibly as yet; it could only be that of a millimetre (0.03937 inch), and a third in the first second. But the attractive force would gradually increase, the fall would be more accentuated, the projectile, dragged down by its bottom side, would present its cone to the earth, and would fall with increasing velocity until it reached the Selenite surface. Now nothing could prevent the success of the enterprise, and Nicholl and Michel Ardan shared Barbicane's joy.

Then they chatted about all the phenomena that had astounded them one after another, especially about the neutralisation of the laws of weight. Michel Ardan, always full of enthusiasm, wished to deduce consequences which were only pure imagination.

"Ah! my worthy friends," he cried, "what progress we should make could we but get rid upon earth of this weight, this chain that rivets us to her! It would be the prisoner restored to liberty! There would be no more weariness either in arms or legs. And if it is true that, in order to fly upon the surface of the earth, to sustain yourself in the air by a simple action of the muscles, it would take a force 150 times superior to that we possess, a simple act of will, a caprice, would transport us into space, and attraction would not exist."

"In fact," said Nicholl, laughing, "if they succeeded in suppressing gravitation, like pain is suppressed by anaesthesia, it would change the face of modern society!"

"Yes," cried Michel, full of his subject, "let us destroy weight and have no more burdens! No more cranes, screw-jacks, windlasses, cranks, or other machines will be wanted."

"Well said," replied Barbicane; "but if nothing had any weight nothing would keep in its place, not even the hat on your head, worthy Michel; nor your house,

the stones of which only adhere by their weight! Not even ships, whose stability upon the water is only a consequence of weight. Not even the ocean, whose waves would no longer be held in equilibrium by terrestrial attraction. Lastly, not even the atmosphere, the molecules of which, being no longer held together, would disperse into space!"

"That is a pity," replied Michel. "There is nothing like positive people for recalling you brutally to reality!"

"Nevertheless, console yourself, Michel," resumed Barbicane, "for if no star could exist from which the laws of weight were banished, you are at least going to pay a visit where gravity is much less than upon earth."

"The moon?"

"Yes, the moon, on the surface of which objects weigh six times less than upon the surface of the earth, a phenomenon very easy to demonstrate."

"And shall we perceive it?" asked Michel. "Evidently, for 400 lbs. only weigh 60 lbs. on the surface of the moon."

"Will not our muscular strength be diminished?"

"Not at all. Instead of jumping one yard you will be able to rise six."

"Then we shall be Hercules in the moon," cried Michel.

"Yes," replied Nicholl, "and the more so because if the height of the Selenites is in proportion to the bulk of their globe they will be hardly a foot high."

"Liliputians!" replied Michel. "Then I am going to play the _rôle_ of Gulliver! We shall realise the fable of the giants! That is the advantage of leaving one's own planet to visit the solar world!"

"But if you want to play Gulliver," answered Barbicane, "only visit the inferior planets, such as Mercury, Venus, or Mars, whose bulk is rather less than that of the earth. But do not venture into the big planets, Jupiter, Saturn, Uranus, Neptune, for there the _rôles_ would be inverted, and you would become Liliputian."

"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 times greater, and gravitation there is twenty-seven times greater than upon the surface of our globe. Every proportion kept, the inhabitants ought on an average to be two hundred feet high."

"The devil!" exclaimed Michel. "I should only be a pigmy!"

"Gulliver amongst the giants," said Nicholl.

"Just so," answered Barbicane.

"It would not have been a bad thing to carry some pieces of artillery to defend oneself with."

"Good," replied Barbicane; "your bullets would have no effect on the sun, and they would fall to the ground in a few minutes."

"That's saying a great deal!"

"It is a fact," answered Barbicane. "Gravitation is so great on that enormous planet that an object weighing 70 lbs. on the earth would weigh 1,930 lbs. on the surface of the sun. Your hat would weigh 20 lbs.! your cigar 1/2 lb.! Lastly, if you fell on the solar continent your weight would be so great--about 5,000 lbs.--that you could not get up again."

"The devil!" said Michel, "I should have to carry about a portable crane! Well, my friends, let us be content with the moon for to-day. There, at least, we shall cut a great figure! Later on we shall see if we will go to the sun, where you can't drink without a crane to lift the glass to your mouth."

CHAPTER IX

.

THE CONSEQUENCES OF DEVIATION.

Barbicane had now no fear, if not about the issue of the journey, at least about the projectile's force of impulsion. Its own speed would carry it beyond the neutral line. Therefore it would not return to the earth nor remain motionless upon the point of attraction. One hypothesis only remained to be realised, the arrival of the bullet at its goal under the action of lunar attraction.

In reality it was a fall of 8,296 leagues upon a planet, it is true, where the gravity is six times less than upon the earth. Nevertheless it would be a terrible fall, and one against which all precautions ought to be taken without delay.

These precautions were of two sorts; some were for the purpose of deadening the shock at the moment the projectile would touch lunar ground; others were to retard the shock, and so make it less violent.

In order to deaden the shock, it was a pity that Barbicane was no longer able to employ the means that had so usefully weakened the shock at departure--that is to say, the water used as a spring and the movable partitions. The partitions still existed, but water was wanting, for they could not use the reserve for this purpose--that would be precious in case the liquid element should fail on the lunar soil.

Besides, this reserve would not have been sufficient for a spring. The layer of water stored in the projectile at their departure, and on which lay the waterproof disc, occupied no less than three feet in depth, and spread over a surface of not less than fifty-four feet square. Now the receptacles did not contain the fifth part of that. They were therefore obliged to give up this effectual means of deadening the shock.

Fortunately Barbicane, not content with employing water, had furnished the movable disc with strong spring buffers, destined to lessen the shock against the bottom, after breaking the horizontal partitions. These buffers were still in existence; they had only to be fitted on and the movable disc put in its place. All these pieces, easy to handle, as they weighed scarcely anything, could be rapidly mounted.

This was done. The different pieces were adjusted without difficulty. It was only a matter of bolts and screws. There were plenty of tools. The disc was soon fixed on its steel buffers like a table on its legs. One inconvenience resulted from this arrangement. The lower port-hole was covered, and it would be impossible for

the travellers to observe the moon through that opening whilst they were being precipitated perpendicularly upon her. But they were obliged to give it up. Besides, through the lateral openings they could still perceive the vast lunar regions, like the earth is seen from the car of a balloon.

This placing of the disc took an hour's work. It was more than noon when the preparations were completed. Barbicane made fresh observations on the inclination of the projectile, but to his great vexation it had not turned sufficiently for a fall; it appeared to be describing a curve parallel with the lunar disc. The Queen of Night was shining splendidly in space, whilst opposite the orb of day was setting her on fire with his rays.

This situation soon became an anxious one.

"Shall we get there?" said Nicholl.

"We must act as though we should," answered Barbicane.

"You are faint-hearted fellows," replied Michel Ardan. "We shall get there, and quicker than we want."

This answer recalled Barbicane to his preparations, and he occupied himself with placing the contrivances destined to retard the fall.

It will be remembered that, at the meeting held in Tampa Town, Florida, Captain Nicholl appeared as Barbicane's enemy, and Michel Ardan's adversary. When Captain Nicholl said that the projectile would be broken like glass, Michel answered that he would retard the fall by means of fusees properly arranged.

In fact, powerful fusees, resting upon the bottom, and being fired outside, might, by producing a recoil action, lessen the speed of the bullet. These fusees were to burn in the void it is true, but oxygen would not fail them, for they would furnish that themselves like the lunar volcanoes, the deflagration of which has never been prevented by the want of atmosphere around the moon.

Barbicane had therefore provided himself with fireworks shut up in little cannons of bored steel, which could be screwed on to the bottom of the projectile. Inside these cannons were level with the bottom; outside they went half a foot beyond it. There were twenty of them. An opening in the disc allowed them to light the match with which each was provided. All the effect took place

outside. The exploding mixture had been already rammed into each gun. All they had to do, therefore, was to take up the metallic buffers fixed in the base, and to put these cannons in their place, where they fitted exactly.

This fresh work was ended about 3 p.m., and all precaution taken they had now nothing to do but to wait.

In the meantime the projectile visibly drew nearer the moon. It was, therefore, submitted in some proportion to its influence; but its own velocity also inclined it in an oblique line. Perhaps the result of these two influences would be a line that would become a tangent. But it was certain that the projectile was not falling normally upon the surface of the moon, for its base, by reason of its weight, ought to have been turned towards her.

Barbicane's anxiety was increased on seeing that his bullet resisted the influence of gravitation. It was the unknown that was before him--the unknown of the interstellar regions. He, the _savant_, believed that he had foreseen the only three hypotheses that were possible--the return to the earth, the fall upon the moon, or stagnation upon the neutral line! And here a fourth hypothesis, full of all the terrors of the infinite, cropped up inopportunely. To face it without flinching took a resolute *savant* like Barbicane, a phlegmatic being like Nicholl, or an audacious adventurer like Michel Ardan.

Conversation was started on this subject. Other men would have considered the question from a practical point of view. They would have wondered where the projectile would take them to. Not they, however. They sought the cause that had produced this effect.

"So we are off the line," said Michel. "But how is that?"

"I am very much afraid," answered Nicholl, "that notwithstanding all the precautions that were taken, the Columbiad was not aimed correctly. The slightest error would suffice to throw us outside the pale of lunar attraction."

"Then the cannon was pointed badly?" said Michel.

"I do not think so," answered Barbicane. "The cannon was rigorously perpendicular, and its direction towards the zenith of the place was incontestable. The moon passing the zenith, we ought to have reached her at the full. There is another reason, but it escapes me."

"Perhaps we have arrived too late," suggested Nicholl.

"Too late?" said Barbicane.

"Yes," resumed Nicholl. "The notice from the Cambridge Observatory said that the transit ought to be accomplished in ninety-seven hours thirteen minutes and twenty seconds. That means that before that time the moon would not have reached the point indicated, and after she would have passed it."

"Agreed," answered Barbicane. "But we started on the 1st of December at 11h. 13m. 25s. p.m., and we ought to arrive at midnight on the 5th, precisely as the moon is full. Now this is the 5th of December. It is half-past three, and eight hours and a half ought to be sufficient to take us to our goal. Why are we not going towards it?"

"Perhaps the velocity was greater than it ought to have been," answered Nicholl, "for we know now that the initial velocity was greater than it was supposed to be."

"No! a hundred times no!" replied Barbicane. "An excess of velocity, supposing the direction of the projectile to have been correct, would not have prevented us reaching the moon. No! There has been a deviation. We have deviated!"

"Through whom? through what?" asked Nicholl.

"I cannot tell," answered Barbicane.

"Well, Barbicane," then said Michel, "should you like to know what I think about why we have deviated?"

"Say what you think."

"I would not give half a dollar to know! We have deviated, that is a fact. It does not matter much where we are going. We shall soon find out. As we are being carried along into space we shall end by falling into some centre of attraction or another."

Barbicane could not be contented with this indifference of Michel Ardan's. Not that he was anxious about the future. But what he wanted to know, at any price, was why his projectile had deviated.

In the meantime the projectile kept on its course sideways to the moon, and the objects thrown out along with it. Barbicane could even prove by the landmarks upon the moon, which was only at 2,000 leagues' distance, that its speed was becoming uniform--a fresh proof that they were not falling. Its force of impulsion was prevailing over the lunar attraction, but the trajectory of the projectile was certainly taking them nearer the lunar disc, and it might be hoped that at a nearer point the weight would predominate and provoke a fall.

The three friends, having nothing better to do, went on with their observations. They could not, however, yet determine the topography of the satellite. Every relief was levelled under the action of the solar rays.

They watched thus through the lateral windows until 8 p.m. The moon then looked so large that she hid half the firmament from them. The sun on one side, and the Queen of Night on the other, inundated the projectile with light.

At that moment Barbicane thought he could estimate at 700 leagues only the distance that separated them from their goal. The velocity of the projectile appeared to him to be 200 yards a second, or about 170 leagues an hour. The base of the bullet had a tendency to turn towards the moon under the influence of the centripetal force; but the centrifugal force still predominated, and it became probable that the rectilinear trajectory would change to some curve the nature of which could not be determined.

Barbicane still sought the solution of his insoluble problem. The hours went by without result. The projectile visibly drew nearer to the moon, but it was plain that it would not reach her. The short distance at which it would pass her would be the result of two forces, attractive and repulsive, which acted upon the projectile.

"I only pray for one thing," repeated Michel, "and that is to pass near enough to the moon to penetrate her secrets."

"Confound the cause that made our projectile deviate!" cried Nicholl.

"Then," said Barbicane, as if he had been suddenly struck with an idea, "confound that asteroid that crossed our path!"

"Eh?" said Michel Ardan.

"What do you mean?" exclaimed Nicholl.

"I mean," resumed Barbicane, who appeared convinced, "I mean that our deviation is solely due to the influence of that wandering body."

"But it did not even graze us," continued Michel.

"What does that matter? Its bulk, compared with that of our projectile, was enormous, and its attraction was sufficient to have an influence upon our direction."

"That influence must have been very slight," said Nicholl.

"Yes, Nicholl, but slight as it was," answered Barbicane, "upon a distance of 84,000 leagues it was enough to make us miss the moon!"

CHAPTER X

.

THE OBSERVERS OF THE MOON.

Barbicane had evidently found the only plausible reason for the deviation. However slight it had been, it had been sufficient to modify the trajectory of the projectile. It was a fatality. The audacious attempt had miscarried by a fortuitous circumstance, and unless anything unexpected happened, the lunar disc could no longer be reached. Would they pass it near enough to resolve certain problems in physics and geology until then unsolved? This was the only question that occupied the minds of these bold travellers. As to the fate the future held in store for them, they would not even think about it. Yet what was to become of them amidst these infinite solitudes when air failed them? A few more days and they would fall suffocated in this bullet wandering at hazard. But a few days were centuries to these intrepid men, and they consecrated every moment to observing the moon they no longer hoped to reach.

The distance which then separated the projectile from the satellite was estimated at about 200 leagues. Under these conditions, as far as regards the visibility of the details of the disc, the travellers were farther from the moon than are the inhabitants of the earth with their powerful telescopes.

It is, in fact, known that the instrument set up by Lord Rosse at Parsonstown, which magnifies 6,500 times, brings the moon to within sixteen leagues; and the powerful telescope set up at Long's Peak magnifies 48,000 times, and brings the moon to within less than two leagues, so that objects twelve yards in diameter were sufficiently distinct.

Thus, then, at that distance the topographical details of the moon, seen without a telescope, were not distinctly determined. The eye caught the outline of those vast depressions inappropriately called "seas," but they could not determine 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 leaning over a furnace of molten silver, turned from it involuntarily.

However, the oblong form of the orb was already clearly seen.

It appeared like a gigantic egg, with the small end turned towards the earth. The moon, liquid and pliable in the first days of her formation, was originally a perfect sphere. But soon, drawn within the pale of the earth's gravitation, she became elongated under its influence. By becoming a satellite she lost her native purity of form; her centre of gravity was in advance of the centre of her figure, and from this fact some *savants* draw the conclusion that air and water might have taken refuge on the opposite side of the moon, which is never seen from the earth.

This alteration in the primitive forms of the satellite was only visible for a few moments. The distance between the projectile and the moon diminished visibly; its velocity was considerably less than its initial velocity, but eight or nine times greater than that of our express trains. The oblique direction of the bullet, from its very obliquity, left Michel Ardan some hope of touching the lunar disc at some point or other. He could not believe that he should not get to it. No, he could not believe it, and this he often repeated. But Barbicane, who was a better judge, always answered him with pitiless 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 sends us irresistibly away from it."

This was said in a tone that deprived Michel Ardan of his last hopes.

The portion of the moon the projectile was approaching was the northern hemisphere. The selenographic maps make it the lower one, because they are generally drawn up according to the image given by the telescopes, and we know that they reverse the objects. Such was the *Mappa Selenographica* of Boeer and Moedler which Barbicane consulted. This northern hemisphere presented vast plains, relieved by isolated mountains.

At midnight the moon was full. At that precise moment the travellers ought to have set foot upon her if the unlucky asteroid had not made them deviate from their direction. The orb was exactly in the condition rigorously determined by the Cambridge Observatory. She was mathematically at her perigee, and at the zenith of the twenty-eighth parallel. An observer placed at the bottom of the enormous Columbiad while it is pointed perpendicularly at the horizon would have framed the moon in the mouth of the cannon. A straight line drawn through the axis of the piece would have passed through the centre of the moon.

It need hardly be stated that during the night between the 5th and 6th of December the travellers did not take a minute's rest. Could they have closed their eyes so near to a new world? No. All their feelings were concentrated in one thought--to see! Representatives of the earth, of humanity past and present, all concentrated in themselves, it was through their eyes that the human race looked at these lunar regions and penetrated the secrets of its satellite! A strange emotion filled their hearts, and they went silently from one window to another.

Their observations were noted down by Barbicane, and were made rigorously exact. To make them they had telescopes. To control them they had maps.

The first observer of the moon was Galileo. His poor telescope only magnified thirty times. Nevertheless, in the spots that pitted the lunar disc "like eyes in a peacock's tail," he was the first to recognise mountains, and measure some heights to which he attributed, exaggerating, an elevation equal to the 20th of the diameter of the disc, or 8,000 metres. Galileo drew up no map of his observations.

A few years later an astronomer of Dantzig, Hevelius--by operations which were only exact twice a month, at the first and second quadrature--reduced Galileo's heights to one-twenty-sixth only of the lunar diameter. This was an exaggeration the other way. 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 middle of an Arabia, Etna in the centre of Sicily, the Alps, Apennines, Carpathians, the Mediterranean, the Black Sea, the Caspian, &c.--names badly applied, for neither mountains nor 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 chartographer, knowing human nature better, proposed a fresh nomenclature, which human vanity made haste to adopt.

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

A third map of the moon was executed in the seventeenth century by Dominique Cassini; superior to that of Riccioli in the execution, it is inexact in the measurements. Several smaller copies were published, but the 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 and a half yards high, which was never engraved.

After him, a German astronomer, Tobie Marger, about the middle of the eighteenth 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.

It was in 1830 that Messrs. Boeer and Moedler composed their celebrated _Mappa Selenographica_, according to an orthographical projection. This map reproduces the exact lunar disc, such as it appears, only the configurations of the mountains and plains are only correct in the central part; everywhere else--in the northern or southern portions, eastern or western--the configurations foreshortened cannot be compared with those of the centre. This topographical map, one yard high and divided into four parts, is a masterpiece of lunar chartography.

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, Waren de la Rue, and lastly a map on orthographical projection of Messrs. Lecouturier and Chapuis, a fine model set up in 1860, of very correct design and clear outlines.

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

They had excellent marine glasses specially constructed for this journey. They magnified objects a hundred times; they would therefore have reduced the distance between the earth and the moon to less than 1,000 leagues. But then at a distance which towards 3 a.m. did not exceed a hundred miles, and in a medium which no atmosphere obstructed, these instruments brought the lunar level to less than fifteen hundred metres.

CHAPTER XI

.

IMAGINATION AND REALITY.

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

"No, sir," answered the pupil more ironically still, "but I have heard it spoken of."

In one sense the jocose answer of the pupil might have been made by the immense majority of sublunary beings. How many people there are who have heard the moon spoken of and have never seen it--at least through a telescope! How many even have never examined the map of their satellite!

Looking at a comprehensive selenographic map, one peculiarity strikes us at once. In contrast to the geographical arrangements of the earth and Mars, the continents occupy the more southern hemisphere of the lunar globe. These continents have not such clear and regular boundary-lines as those of South America, Africa, and the Indian Peninsula. Their angular, capricious, and deeply-indented coasts are rich in gulfs and peninsulas. They recall the confusion in the islands of the Sound, where the earth is excessively cut up. If navigation has ever existed upon the surface of the moon it must have been exceedingly difficult and dangerous, and the Selenite mariners and hydrographers were greatly to be pitied, the former when they came upon these perilous coasts, the latter when they were marine surveying on the stormy banks.

It may also be noticed that upon the lunar spheroid the South Pole is much more continental than the North Pole. On the latter there is only a slight strip of land capping it, separated from the other continents by vast seas. (When the word "seas" is used the vast plains probably covered by the sea formerly must be understood.) On the south the land covers nearly the whole hemisphere. It is, therefore, possible that the Selenites have already planted their flag on one of their poles, whilst Franklin, Ross, Kane, Dumont d'Urville, and Lambert have been unable to reach this unknown point on the terrestrial globe.

Islands are numerous on the surface of the moon. They are almost all oblong or

circular, as though traced with a compass, and seem to form a vast archipelago, like that charming group lying between Greece and Asia Minor which mythology formerly animated with its most graceful legends. Involuntarily the names of Naxos, Tenedos, Milo, and Carpathos come into the mind, and you seek the ship of Ulysses or the "clipper" of the Argonauts. That was what it appeared to Michel Ardan; it was a Grecian Archipelago that he saw on the map. In the eyes of his less imaginative companions the aspect of these shores recalled rather the cut-up lands of New Brunswick and Nova Scotia; and where the Frenchman looked for traces of the heroes of fable, these Americans were noting favourable points for the establishment of mercantile houses in the interest of lunar commerce and industry.

Some remarks on the orographical disposition of the moon must conclude the description of its continents, chains of mountains, isolated mountains, amphitheatres, and watercourses. 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 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 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 layers of soil.

After having wandered over these vast continents the eye is attracted by still vaster seas. Not only does their formation, situation, and aspect recall the terrestrial oceans, but, as upon earth, these seas occupy the largest part of the globe. And yet these are not liquid tracts, but plains, the nature of which the travellers hoped soon to determine.

Astronomers, it must be owned, have decorated these pretended seas with at least odd names which science has respected at present. Michel Ardan was right when he compared this map to a "map of tenderness," drawn up by Scudery or Cyrano de Bergerac.

"Only," added he, "it is no longer the map of sentiment like that of the 18th century; it is the map of life, clearly divided into two parts, the one feminine, the

other masculine. To the women, the right hemisphere; to the men, the left!"

When he spoke thus Michel made his prosaic companions shrug their shoulders. Barbicane and Nicholl looked at the lunar map from another point of view to that of their imaginative friend. However, their imaginative friend had some reason on his side. Judge if he had not.

In the left hemisphere stretches the "Sea of Clouds," where human reason is so often drowned. Not far off appears the "Sea of Rains," fed by all the worries of existence. Near lies the "Sea of Tempests," where man struggles incessantly against his too-often victorious passions. Then, exhausted by deceptions, treasons, infidelities, and all the procession of terrestrial miseries, what does he find at the end of his career? The vast "Sea of Humours," scarcely softened by some drops from the waters of the "Gulf of Dew!" Clouds, rain, tempests, humours, does the life of man contain aught but these? and is it not summed up in these four words?

The right-hand hemisphere dedicated to "the women" contains smaller seas, the significant names of which agree with every incident of feminine existence. There is the "Sea of Serenity," over which bends the young maiden, and the "Lake of Dreams," which reflects her back a happy future. The "Sea of Nectar," with its waves of tenderness and breezes of love! The "Sea of Fecundity," the "Sea of Crises," and the "Sea of Vapours," the dimensions of which are, perhaps, too restricted, and lastly, that vast "Sea of Tranquillity" where all false passions, all useless dreams, all unassuaged desires are absorbed, and the waves of which flow peacefully into the "Lake of Death!"

What a strange succession of names! What a singular division of these two hemispheres of the moon, united to one another like man and woman, and forming a sphere of life, carried through space. And was not the imaginative Michel right in thus interpreting the fancies of the old astronomers?

But whilst his imagination thus ran riot on the "seas," his grave companions were looking at things more geographically. They were learning this new world by heart. They were measuring its 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 _Mare Frigoris_, in north latitude 55° and longitude 0°, with 76,000 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 square 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, amphitheatres, islands--in a word, all that seems to form the solid portion of the globe--and 1,410,400 leagues for the seas, lake, 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 selenographers have already counted 50,000 craters. It is a rugged surface 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 19th century treat the beautiful Diana, the blonde Phoebe, the amiable Isis, the charming Astarte, the Queen of Night, the daughter of Latona and Jupiter, the younger sister of the radiant Apollo!"

CHAPTER XII

.

OROGRAPHICAL DETAILS.

It has already been pointed out that the direction followed by the projectile was taking us towards the northern hemisphere of the moon. The travellers were far from that central point which they ought to have touched if their trajectory had not suffered an irremediable deviation.

It was half-past twelve at night. Barbicane then estimated his distance at 1,400 kilometres, a distance rather greater than the length of the lunar radius, and which must diminish as he drew nearer the North Pole. The projectile was then not at the altitude of the equator, but on the tenth parallel, and from that latitude carefully observed on the map as far as the Pole, Barbicane and his two companions were able to watch the moon under the most favourable circumstances.

In fact, by using telescopes, this distance of 1,400 kilometres was reduced to fourteen miles, or four and a-half leagues. The telescope of the Rocky Mountains

brought the moon still nearer, but the terrestrial atmosphere singularly lessened its optical power. Thus Barbicane, in his projectile, by looking through his glass, could already perceive certain details almost imperceptible to observers on the earth.

"My friends," then said the president in a grave voice, "I do not know where we are going, nor whether we shall ever see the terrestrial globe again. Nevertheless, let us do our work as if one day it would be of use to our fellow-creatures. Let us keep our minds free from all preoccupation. We are astronomers. This bullet is the Cambridge Observatory transported into space. Let us make our observations."

That said, the work was begun with extreme precision, and it faithfully reproduced the different aspects of the moon at the variable distances which the projectile reached in relation to that orb.

Whilst the bullet was at the altitude of the 10th north parallel it seemed to follow the 20th degree of east longitude.

Here may be placed an important remark on the subject of the map which they used for their observations. In the selenographic maps, where, on account of the reversal of objects by the telescope, the south is at the top and the north at the bottom, it seems natural that the east should be on the left and the west on the right. However, it is not so. If the map were turned upside down, and showed the moon as she appears, the east would be left and the west right, the inverse of the terrestrial maps. The reason of this anomaly is the following:--Observers situated in the northern hemisphere--in Europe, for example--perceive the moon in the south from them. When they look at her they turn their backs to the north, the opposite position they take when looking at a terrestrial map. Their backs being turned to the north, they have the east to the left and the west to the right. For observers in the southern hemisphere--in Patagonia, for example--the west of the moon would be on their left and the east on their right, for the south would be behind them.

Such is the reason for the apparent reversal of these two cardinal points, and this must be remembered whilst following the observations of President Barbicane.

Helped by the *Mappa Selenographica* of Boeer and Moedler, the travellers could, without hesitating, survey that portion of the disc in the field of their

telescopes.

"What are we looking at now?" asked Michel.

"At the northern portion of the Sea of Clouds," answered Barbicane. "We are too far off to make out its nature. Are those plains composed of dry sand, as the first astronomers believed? Or are they only immense forests, according to the opinion of Mr. Waren de la Rue, who grants a very low but very dense atmosphere to the moon? We shall find that out later on. We will affirm nothing till we are quite certain."

"This Sea of Clouds is rather doubtfully traced upon the maps. It is supposed that this vast plain is strewn with blocks of lava vomited by the neighbouring volcanoes on its right side, Ptolemy, Purbach, and Arzachel. The projectile was drawing sensibly nearer, and the summits which close in this sea on the north were distinctly visible. In front rose a mountain shining gloriously, the top of which seemed drowned in the solar rays."

"That mountain is--?" asked Michel.

"Copernicus," answered Barbicane.

"Let us have a look at Copernicus," said Michel.

This mountain, situated in north latitude 9°, and east longitude 20°, rises to a height of nearly 11,000 feet above the surface of the moon. It is quite visible from the earth, and astronomers can study it with ease, especially during the phase between the last quarter and the new moon, because then shadows are thrown lengthways from east to west, and allow the altitudes to be taken.

Copernicus forms the most important radiating system in the southern hemisphere, according to Tycho Brahe. It rises isolated like a gigantic lighthouse over that of the Sea of Clouds bordering on the Sea of Tempests, and it lights two oceans at once with its splendid rays. Those long luminous trails, so dazzling at full moon, made a spectacle without an equal; they pass the boundary chains on the north, and stretch as far as the Sea of Rains. At 1 a.m., terrestrial time, the projectile, like a balloon carried into space, hung over this superb mountain.

Barbicane could perfectly distinguish its chief features. Copernicus is

comprehended in the series of annular mountains of the first order in the division of the large amphitheatres. Like the mountains of Kepler and Aristarchus, which overlook the Ocean of Tempests, it appears sometimes like a brilliant point through the pale light, and used to be taken for a volcano in activity. But it is only an extinct volcano, like those on that side of the moon. Its circumference presented a diameter of about twenty-two leagues. The glasses showed traces of stratifications in it produced by successive eruptions, and its neighbourhood appeared strewn with volcanic remains, which were still seen in the crater.

"There exist," said Barbicane, "several sorts of amphitheatres an the surface of the moon, and it is easy to see that Copernicus belongs to the radiating class. If we were nearer it we should perceive the cones which bristle in the interior, and which were formerly so many fiery mouths. A curious arrangement, and one without exception on the lunar disc, is presented on the interior surface of these amphitheatres, being notably downward from the exterior plane, a contrary form to that which terrestrial craters present. It follows, therefore, that the general curvature at the bottom of these amphitheatres gives us fear of an inferior diameter to that of the moon."

"What is the reason of this special arrangement?" asked Nicholl.

"It is not known," answered Barbicane.

"How splendidly it shines!" said Michel. "I think it would be difficult to see a more beautiful spectacle!"

"What should you say, then," answered Barbicane, "if the chances of our journey should take us towards the southern hemisphere?"

"Well, I should say it is finer still," replied Michel Ardan.

At that moment the projectile hung right over the amphitheatre. The circumference of Copernicus formed an almost perfect circle, and its steep ramparts were clearly defined. A second circular inclosure could even be distinguished. A grey plain of wild aspect spread around on which every relief appeared yellow. At the bottom of the amphitheatre, as if in a jewel-case, sparkled for one instant two or three eruptive cones like enormous dazzling gems. Towards the north the sides of the crater were lowered into a depression which would probably have given access to the interior of the crater.

As they passed above the surrounding plain Barbicane was able to note a large number of mountains of slight importance, amongst others a little circular mountain called "Gay-Lussac," more than twenty-three kilometres wide. Towards the south the plain was very flat, without one elevation or projection of the soil. Towards the north, on the contrary, as far as the place where it borders on the Ocean of Tempests, it was like a liquid surface agitated by a storm, of which the hills and hollows formed a succession of waves suddenly coagulated. Over the whole of this, and in all directions, ran the luminous trails which converged to the summit of Copernicus. Some had a width of thirty kilometres over a length that could not be estimated.

The travellers discussed the origin of these strange rays, but they could not determine their nature any better than terrestrial observers.

"Why," said Nicholl, "may not these rays be simply the spurs of the mountains reflecting the light of the sun more vividly?"

"No," answered Barbicane, "if it were so in certain conditions of the moon they would throw shadows, which they do not."

In fact, these rays only appear when the sun is in opposition with the moon, and they disappear as soon as its rays become oblique.

"But what explanation of these trails of light have been imagined?" asked Michel, "for I cannot believe that *savants* would ever stop short for want of explanation."

"Yes," answered Barbicane, "Herschel has uttered an opinion, but he does not affirm it."

"Never mind; what is his opinion?"

"He thought that these rays must be streams of cold lava which shone when the sun struck them normally."

"That may be true, but nothing is less certain. However, if we pass nearer to Tycho we shall be in a better position to find out the cause of this radiation."

"What do you think that plain is like, seen from the height we are at?" asked Michel.

"I don't know," answered Nicholl.

"Well, with all these pieces of lava, sharpened like spindles, it looks like 'an immense game of spilikins,' thrown down pell-mell. We only want a hook to draw them up."

"Be serious for once in your life," said Barbicane.

"I will be serious," replied Michel tranquilly, "and instead of spilikins let us say they are bones. This plain would then be only an immense cemetery upon which would repose the immortal remains of a thousand distinct generations. Do you like that comparison better?"

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

"The devil! You are difficult to please," replied Michel.

"My worthy friend," resumed the prosaic Barbicane, "it does not matter what it looks like when we don't know what it is."

"A good answer," exclaimed Michel; "that will teach me to argue with *savants*."

In the meantime the projectile went with almost uniform speed round the lunar disc. It may be easily imagined that the travellers did not dream of taking a minute's rest. A fresh landscape lay before their eyes every instant. About half-past one in the morning they caught a glimpse of the summit of another mountain. Barbicane consulted his map, and recognised Eratosthenes.

It was a circular mountain 4,500 metres high, one of those amphitheatres so numerous upon the satellite. Barbicane informed his friends of Kepler's singular opinion upon the formation of these circles. According to the celebrated mathematician, these crateriform cavities had been dug out by the hand of man.

"What for?" asked Nicholl.

"In order to preserve themselves from the ardour of the solar rays, which strike the moon during fifteen consecutive days."

"The Selenites were not fools!" said Michel.

"It was a singular idea!" answered Nicholl. "But it is probable that Kepler did not know the real dimensions of these circles, for digging them would have been giants' labour, impracticable for Selenites."

"Why so, if the weight on the surface of the moon is six times less than upon the surface of the earth?" said Michel.

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

"And if there are no Selenites?" added Barbicane, which terminated the discussion.

Eratosthenes soon disappeared from the horizon without the projectile having been sufficiently near it to allow a rigorous observation. This mountain separated the Apennines from the Carpathians.

In lunar orography, several chains of mountains have been distinguished which are principally distributed over the northern hemisphere. Some, however, occupy certain portions of the southern hemisphere.

The following is a list of these different chains, with their latitudes and the height of their highest summits:--

deg. deg. metres. Mounts Doerfel 84 to 0 S. lat. 7,603 " Leibnitz 65 " 0 " 7,600 " Rook 20 " 30 " 1,600 " Altai 17 " 28 " 4,047 " Cordilleras 10 " 20 " 3,898 " Pyrenees 8 " 18 " 3,631 " Oural 5 " 13 " 838 " Alembert 4 " 10 " 5,847 " Hoemus 8 " 21 N. lat. 2,021 " Carpathians 15 " 19 " 1,939 " Apennines 14 " 27 " 5,501 " Taurus 21 " 28 " 2,746 " Riphees 25 " 33 " 4,171 " Hercynians 17 " 29 " 1,170 " Caucasia 32 " 41 " 5,567 " Alps 42 " 49 " 3,617

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 long., 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 amphitheatres. These mountainous circles must have been broken up by the vast cataclysm to which the Sea of Rains was due. These Carpathians looked then what the amphitheatres 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. Their southern slopes fall straight into the immense Sea of Rains.

About 2 a.m. Barbicane was at the altitude of the 20th lunar parallel, not far from that little mountain, 1,559 metres high, which bears the name of Pythias. The distance from the projectile to the moon was only 1,200 kilometres, brought by means of telescopes to two and a half leagues.

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 long. 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 he 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 these hypotheses were allowable to terrestrial observers whose instruments were incomplete; but Barbicane was no longer contented to accept them, and seeing that his projectile drew regularly nearer the lunar disc he did not despair of ultimately reaching it, or at least of finding out the secrets of its formation.

CHAPTER XIII

.

LUNAR LANDSCAPES.

At half-past two in the morning the bullet was over the 30th lunar parallel at an effective distance of 1,000 kilometres, reduced by the optical instruments to ten. It still seemed impossible that it could reach any point on the disc. Its movement of translation, relatively slow, was inexplicable to President Barbicane. At that distance from the moon it ought to have been fast in order to maintain it against the power of attraction. The reason of that phenomenon was also inexplicable; besides, time was wanting to seek for the cause. The reliefs on the lunar surface flew beneath their eyes, and they did not want to lose a single detail.

The disc appeared through the telescopes at a distance of two and a half leagues. If an aëronaut were taken up that distance from the earth, what would he distinguish upon its surface? No one can tell, as the highest ascensions have not exceeded 8,000 metres.

The following, however, is an exact description of what Barbicane and his companions saw from that height:--

Large patches of different colours appeared on the disc. Selenographers do not agree about their nature. They are quite distinct from each other. Julius Schmidt is of opinion that if the terrestrial oceans were dried up, a Selenite observer could only tell the difference between the terrestrial oceans and continental plains by patches of colour as distinctly varied as those which a terrestrial observer sees upon the moon. According to him, the colour common to the vast plains, known under the name of "seas," is dark grey, intermingled with green and brown. Some of the large craters are coloured in the same way.

Barbicane knew this opinion of the German selenographer; it is shared by Messrs. Boeer and Moedler. He noticed that they were right, whilst certain astronomers, who only allow grey colouring on the surface of the moon, are wrong. In certain places the green colour was very vivid; according to Julius Schmidt, it is so in the Seas of Serenity and Humours. Barbicane likewise remarked the wide craters with no interior cones, which are of a bluish colour, analogous to that of fresh-polished sheets of steel. These colours really belonged to the lunar disc, and did not result, as certain astronomers think, either from some imperfection in the object-glasses of the telescopes or the interposition of the terrestrial atmosphere. Barbicane had no longer any doubt about it. He was looking at it through the void, and could not commit any optical error. He

considered that the existence of this different colouring was proved to science. Now were the green shades owing to tropical vegetation, kept up by a low and dense atmosphere? He could not yet be certain.

Farther on he noticed a reddish tinge, quite sufficiently distinct. A similar colour had already been observed upon the bottom of an isolated inclosure, known under the name of the Lichtenberg Amphitheatre, which is situated near the Hercynian Mountains, on the border of the moon. But he could not make out its nature.

He was not more fortunate about another peculiarity of the disc, for he could not find out its cause. The peculiarity was the following one:--

Michel Ardan was watching near the president when he remarked some long white lines brilliantly lighted up by the direct rays of the sun. It was a succession of luminous furrows, very different from the radiation that Copernicus had presented. They ran in parallel lines.

Michel, with his usual readiness, exclaimed--

"Why, there are cultivated fields!"

"Cultivated fields!" repeated Nicholl, shrugging his shoulders.

"Ploughed fields, at all events," replied Michel Ardan. "But what ploughmen these Selenites must be, and what gigantic oxen they must harness to their ploughs, to make such furrows!"

"They are not furrows, they are crevices!"

"Crevices let them be," answered Michel with docility. "Only what do you mean by crevices in the world of science?" Barbicane soon told his companions all he knew about lunar crevices. He knew that they were furrows observed upon all the non-mountainous parts of the lunar disc; that these furrows, generally isolated, were from four to five leagues only; that their width varies from 1,000 to 1,500 metres, and their edges are rigorously parallel. But he knew nothing more about their formation or their nature.

Barbicane watched these furrows through his telescope very attentively. He noticed that their banks were exceedingly steep. They were long parallel

ramparts; with a little imagination they might be taken for long lines of fortifications raised by Selenite engineers.

Some of these furrows were as straight as if they had been cut by line, others were slightly curved through with edges still parallel. Some crossed each other. Some crossed craters. Some furrowed the circular cavities, such as Posidonius or Petavius. Some crossed the seas, notably the Sea of Serenity.

These accidents of Nature had naturally exercised the imagination of terrestrial astronomers. The earliest observations did not discover these furrows. Neither Hevelius, Cassini, La Hire, nor Herschel seems to have known them. It was Schroeter who in 1789 first attracted the attention of *savants* to them. Others followed who studied them, such as Pastorff, Gruithuysen, Boeer, and Moedler. At present there are seventy-six; but though they have been counted, their nature has not yet been determined. They are not fortifications certainly, anymore than they are beds of dried-up rivers, for water so light on the surface of the moon could not have dug such ditches, and there furrows often cross craters at a great elevation.

It must, however, be acknowledged that Michel Ardan had an idea, and that, without knowing it, he shared it with Julius Schmidt.

"Why," said he, "may not these inexplicable appearances be simply phenomena of vegetation?"

"In what way do you mean?" asked Barbicane.

"Now do not be angry, worthy president," answered Michel, "but may not these black lines be regular rows of trees?"

"Do you want to find some vegetation?" said Barbicane.

"I want to explain what you scientific men do not explain! My hypothesis will at least explain why these furrows disappear, or seem to disappear, at regular epochs."

"Why should they?"

"Because trees might become invisible when they lose their leaves, and visible when they grow again."

"Your explanation is ingenious, old fellow," answered Barbicane, "but it cannot be admitted."

"Why?"

"Because it cannot be said to be any season on the surface of the moon, and, consequently, the phenomena of vegetation on the surface of the moon cannot be produced."

In fact, the slight obliquity of the lunar axis keeps the sun there at an almost equal altitude under every latitude. Above the equatorial regions the radiant orb almost invariably occupies the zenith, and hardly passes the limit of the horizon in the polar regions. Therefore, in each region, according to its position, there reigns perpetual spring, summer, autumn, or winter, as in the planet Jupiter, whose axis is also slightly inclined upon its orbit.

The origin of these furrows is a difficult question to solve. They are certainly posterior to the formation of the craters and amphitheatres, for several have crossed them, and broken their circular ramparts. It may be that they are contemporary with the latest geographical epochs, and are only owing to the expansion of natural forces.

In the meantime the projectile had reached the altitude of the 40th degree of lunar latitude at a distance that could not be greater than 800 kilometres. Objects appeared through the telescopes at two leagues only. At this point rose under their feet the Helicon, 505 metres high, and on the left were the mediocre heights, which inclose a small portion of the Sea of Rains under the name of the Gulf of Iris.

The terrestrial atmosphere ought to be 170 times more transparent than it is in order to allow astronomers to make complete observations on the surface of the moon. But in the void the projectile was moving in no fluid lay between the eye of the observer and the object observed. What is more, Barbicane was at a less distance than the most powerful telescopes, even that of Lord Rosse or the one on the Rocky Mountains, could give. It was, therefore, in circumstances highly favourable for solving the great question of the habitability of the moon. Yet the solution of this question escaped him still. He could only distinguish the deserted beds of the immense plains, and, towards the north, arid mountains. No labour betrayed the hand of man. No ruin indicated his passage. No agglomeration of

animals indicated that life was developed there, even in an inferior degree. There was no movement anywhere, no appearance of vegetation anywhere. Of the three kingdoms represented on the terrestrial globe, one only was represented on that of the moon--viz., the mineral kingdom.

"So," said Michel Ardan, looking rather put out, "there is nobody after all."

"No," answered Nicholl; "we have seen neither man, animal, nor tree as yet. After all, if the atmosphere has taken refuge at the bottom of cavities, in the interior of the amphitheatres, or even on the opposite face of the moon, we cannot decide the question."

"Besides," added Barbicane, "even for the most piercing sight a man is not visible at a distance of more than four miles. Therefore if there are any Selenites they can see our projectile, but we cannot see them."

About 11 a.m., at the altitude of the 50th parallel, the distance was reduced to 300 miles. On the left rose the capricious outlines of a chain of mountains, outlined in full light. Towards the right, on the contrary, was a large black hole like a vast dark and bottomless well bored in the lunar soil.

That hole was the Black Lake, or Pluto, a deep circle from which the earth could be conveniently studied between the last quarter and the new moon, when the shadows are thrown from west to east.

This black colour is rarely met with on the surface of the satellite. It has, as yet, only been seen in the depths of the circle of Endymion, to the east of the Cold Sea, in the northern hemisphere, and at the bottom of the circle of Grimaldi upon the equator towards the eastern border of the orb.

Pluto is a circular mountain, situated in north lat. 51° and east long. 9°. Its circle is fifty miles long and thirty wide. Barbicane regretted not passing perpendicularly over this vast opening. There was an abyss to see, perhaps some mysterious phenomenon to become acquainted with. But the course of the projectile could not be guided. There was nothing to do but submit. A balloon could not be guided, much less a projectile when you are inside.

About 5 a.m. the northern limit of the Sea of Rains was at last passed. Mounts La Condamine and Fontenelle remained, the one on the left, the other on the right. That part of the disc, starting from the 60th degree, became absolutely

mountainous. The telescopes brought it to within one league, an inferior distance to that between the summit of Mont Blanc and the sea level. All this region was bristling with peaks and amphitheatres. Mount Philolaus rose about the 70th degree to a height of 3,700 metres, opening an elliptical crater sixteen leagues long and four wide.

Then the disc, seen from that distance, presented an exceedingly strange aspect. The landscapes were very different to earthly ones, and also very inferior.

The moon having no atmosphere, this absence of vaporous covering had consequences already pointed out. There is no twilight on its surface, night following day and day following night, with the suddenness of a lamp extinguished or lighted in profound darkness. There is no transition from cold to heat: the temperature falls in one instant from boiling water heat to the cold of space.

Another consequence of this absence of air is the following:--Absolute darkness reigns where the sun's rays do not penetrate. What is called diffused light upon the earth, the luminous matter that the air holds in suspension, which creates twilights and dawns, which produces shadows, penumbrae, and all the magic of the chiaro-oscuro, does not exist upon the moon. Hence the harshness of contrasts that only admit two colours, black and white. If a Selenite shades his eyes from the solar rays the sky appears absolutely dark, and the stars shine as in the darkest nights.

The impression produced on Barbicane and his two friends by this strange state of things may well be imagined. They did not know how to use their eyes. They could no longer seize the respective distances in perspective. A lunar landscape, which does not soften the phenomenon of the chiaro-oscuro, could not be painted by a landscape-painter of the earth. It would be nothing but blots of ink upon white paper.

This aspect of things did not alter even when the projectile, then at the altitude of the 80th degree, was only separated from the moon by a distance of fifty miles, not even when, at 5 a.m., it passed at less than twenty-five miles from the mountain of Gioja, a distance which the telescopes reduced to half-a-mile. It seemed as if they could have touched the moon. It appeared impossible that before long the projectile should not knock against it, if only at the North Pole, where the brilliant mountains were clearly outlined against the dark background

of the sky. Michel Ardan wanted to open one of the port-lights and jump upon the lunar surface. What was a fall of twelve leagues? He thought nothing of that. It would, however, have been a useless attempt, for if the projectile was not going to reach any point on the satellite, Michel would have been hurled along by its movement, and not have reached it either.

At that moment, 6 a.m., the lunar pole appeared. Only half the disc, brilliantly lighted, appeared to the travellers, whilst the other half disappeared in the darkness. The projectile suddenly passed the line of demarcation between intense light and absolute darkness, and was suddenly plunged into the profoundest night.

CHAPTER XIV

.

A NIGHT OF THREE HUNDRED AND FIFTY-FOUR HOURS AND A HALF.

At the moment this phenomenon took place the projectile was grazing the moon's North Pole, at less that twenty-five miles' distance. A few seconds had, therefore, sufficed to plunge it into the absolute darkness of space. The transition had taken place so rapidly, without gradations of light or attenuation of the luminous undulations, that the orb seemed to have been blown out by a powerful gust.

"The moon has melted, disappeared!" cried Michel Ardan, wonder-stricken.

In fact, no ray of light or shade had appeared on the disc, formerly so brilliant. The obscurity was complete, and rendered deeper still by the shining of the stars. It was the darkness of lunar night, which lasts 354 hours and a half on each point of the disc--a long night, the result of the equality of the movements of translation and rotation of the moon, the one upon herself, the other round the earth. The projectile in the satellite's cone of shadow was no longer under the action of the solar rays.

In the interior darkness was, therefore, complete. The travellers could no longer see one another. Hence came the necessity to lighten this darkness. However desirous Barbicane might be to economise the gas, of which he had so small a

reserve, he was obliged to have recourse to it for artificial light--an expensive brilliancy which the sun then refused.

"The devil take the radiant orb!" cried Michel Ardan; "he is going to force us to spend our gas instead of giving us his rays for nothing."

"We must not accuse the sun," said Nicholl. "It is not his fault, it is the moon's fault for coming and putting herself like a screen between us and him."

"It's the sun!" said Michel again.

"It's the moon!" retorted Nicholl.

An idle dispute began, which Barbicane put an end to by saying--

"My friends, it is neither the fault of the sun nor the moon. It is the projectile's fault for deviating from its course instead of rigorously following it. Or, to be juster still, it is the fault of that unfortunate asteroid which so deplorably altered our first direction."

"Good!" answered Michel Ardan; "as that business is settled let us have our breakfast. After a night entirely passed in making observations, we want something to set us to rights a little."

This proposition met with no contradiction. Michel prepared the repast in a few minutes. But they ate for the sake of eating. They drank without toasts or hurrahs. The bold travellers, borne away into the darkness of space without their accustomed escort of rays, felt a vague uneasiness invade their hearts. The "farouche" darkness, so dear to the pen of Victor Hugo, surrounded them on all sides.

In the meantime they talked about this interminable night, 354 hours, or nearly 15 days, long, which physical laws have imposed upon the inhabitants of the moon. Barbicane gave his friends some explanation of the causes and consequences of this curious phenomenon.

"Curious it certainly is," said he, "for if each hemisphere of the moon is deprived of solar light for fifteen days, the one over which we are moving at this moment does not even enjoy, during its long night, a sight of the brilliantly-lighted earth. In a word, there is no moon, applying that qualification to our spheroid, except

for one side of the disc. Now, if it was the same upon earth--if, for example, Europe never saw the moon, and she was only visible at the antipodes--you can figure to yourselves the astonishment of a European on arriving in Australia."

"They would make the voyage for nothing but to go and see the moon," answered Michel.

"Well," resumed Barbicane, "that astonishment is reserved to the Selenite who inhabits the opposite side of the moon to the earth, a side for ever invisible to our fellow-beings of the terrestrial globe."

"And which we should have seen," added Nicholl, "if we had arrived here at the epoch when the moon is new--that is to say, a fortnight later."

"To make amends," resumed Barbicane, "an inhabitant of the visible face is singularly favoured by Nature to the detriment on the invisible face. The latter, as you see, has dark nights of 354 hours long, without a ray of light to penetrate the obscurity. The other, on the contrary, when the sun, which has lighted him for a fortnight, sets under the horizon, sees on the opposite horizon a splendid orb rise. It is the earth, thirteen times larger than that moon which we know--the earth, which is developed to a diameter of two degrees, and which sheds a light thirteen times greater, which no atmosphere qualifies; the earth, which only disappears when the sun reappears."

"A fine sentence," said Michel Ardan; "rather academical perhaps."

"It follows," resumed Barbicane, nowise put out, "that the visible face of the disc must be very agreeable to inhabit, as it is always lighted by the sun or the moon."

"But," said Nicholl, "this advantage must be quite compensated by the unbearable heat which this light must cause."

"This inconvenience is the same under two faces, for the light reflected by the earth is evidently deprived of heat. However, this invisible face is still more deprived of heat than the visible face. I say that for you, Nicholl; Michel would probably not understand."

"Thank you," said Michel.

"In fact," resumed Barbicane, "when the invisible face receives the solar light and heat the moon is new--that is to say, that she is in conjunction, that she is situated between the sun and the earth. She is then, on account of the situation which she occupies in opposition when she is full, nearer the sun by the double of her distance from the earth. Now this distance may be estimated at the two-hundredth part of that which separates the sun and the earth; or, in round numbers, at two hundred thousand leagues. Therefore this visible face is nearer the sun by two hundred thousand leagues when it receives his rays."

"Quite right," replied Nicholl.

"Whilst--" resumed Barbicane.

"Allow me," said Michel, interrupting his grave companion.

"What do you want?"

"I want to go on with the explanation."

"Why?"

"To prove that I have understood."

"Go on, then," said Barbicane, smiling.

"Whilst," said Michel, imitating the tone and gestures of President Barbicane, "when the visible face of the moon is lighted by the sun the moon is full--that is to say, situated with regard to the earth the opposite to the sun. The distance which separates it from the radiant orb is then increased in round numbers by 200,000 leagues, and the heat which it receives must be rather less."

"Well done!" exclaimed Barbicane. "Do you know, Michel, for an artist you are intelligent."

"Yes," answered Michel carelessly, "we are all intelligent on the Boulevard des Italiens."

Barbicane shook hands gravely with his amiable companion, and went on enumerating the few advantages reserved to the inhabitants of the visible face.

Amongst others he quoted the observations of the sun's eclipses, which can only be seen from one side of the lunar disc, because the moon must be in opposition before they can take place. These eclipses, caused by the interposition of the earth between the sun and the moon, may last two hours, during which, on account of the rays refracted by its atmosphere, the terrestrial globe can only appear like a black spot upon the sun.

"Then," said Nicholl, "the invisible hemisphere is very ill-treated by Nature."

"Yes," answered Barbicane, "but not the whole of it. By a certain movement of liberation, a sort of balancing on its centre, the moon presents more than the half of her disc to the earth. She is like a pendulum, the centre of gravity of which is towards the terrestrial globe, and which oscillates regularly. Whence comes that oscillation? Because her movement of rotation on her axis is animated with uniform velocity, whilst her movement of translation, following an elliptical orb round the earth, is not. At the perigee the velocity of translation is greater, and the moon shows a certain portion of her western border. At her apogee the velocity of rotation is greater, and a morsel of her eastern border appears. It is a strip of about eight degrees, which appears sometimes on the west, sometimes on the east. The result is, therefore, that of a thousand parts the moon shows five hundred and sixty-nine."

"No matter," answered Michel; "if we ever become Selenites, we will inhabit the visible face. I like light."

"Unless," replied Nicholl, "the atmosphere should be condensed on the other side, as certain astronomers pretend."

"That is a consideration," answered Michel simply.

In the meantime breakfast was concluded, and the observers resumed their posts. They tried to see through the dark port-light by putting out all light in the projectile. But not one luminous atom penetrated the obscurity.

One inexplicable fact preoccupied Barbicane. How was it that though the projectile had been so near the moon, within a distance of twenty-five miles, it had not fallen upon her? If its speed had been enormous, he would have understood why it had not fallen. But with a relatively slight speed the resistance to lunar attraction could not be explained. Was the projectile under the influence of some strange force? Did some body maintain it in the ether? It was henceforth

evident that it would not touch any point upon the moon. Where was it going? Was it going farther away from or nearer to the disc? Was it carried along in the gloom across infinitude? How were they to know, how calculate in the dark? All these questions made Barbicane anxious, but he could not solve them.

In fact, the invisible orb was there, perhaps, at a distance of some leagues only, but neither his companions nor he could any longer see it. If any noise was made on its surface they could not hear it. The air, that vehicle of transmission, was wanting to convey to them the groans of that moon which the Arabian legends make "a man already half-granite, but still palpitating."

It will be agreed that it was enough to exasperate the most patient observers. It was precisely the unknown hemisphere that was hidden from their eyes. That face which a fortnight sooner or a fortnight later had been, or would be, splendidly lighted up by the solar rays, was then lost in absolute darkness. Where would the projectile be in another fortnight? Where would the hazards of attraction have taken it? Who could say?

It is generally admitted that the invisible hemisphere of the moon is, by its constitution, absolutely similar to the visible hemisphere. One-seventh of it is seen in those movements of libration Barbicane spoke of. Now upon the surface seen there were only plains and mountains, amphitheatres and craters, like those on the maps. They could there imagine the same arid and dead nature. And yet, supposing the atmosphere to have taken refuge upon that face? Suppose that with the air water had given life to these regenerated continents? Suppose that vegetation still persists there? Suppose that animals people these continents and seas? Suppose that man still lives under those conditions of habitability? How many questions there were it would have been interesting to solve! What solutions might have been drawn from the contemplation of that hemisphere! What delight it would have been to glance at that world which no human eye has seen!

The disappointment of the travellers in the midst of this darkness may be imagined. All observation of the lunar disc was prevented. The constellations alone were visible, and it must be acknowledged that no astronomers, neither Faye, Chacornac, nor the Secchi, had ever been in such favourable conditions to observe them.

In fact, nothing could equal the splendour of this starry world, bathed in limpid

ether. Diamonds set in the celestial vault threw out superb flames. One look could take in the firmament from the Southern Cross to the North Star, those two constellations which will in 12,000 years, on account of the succession of equinoxes, resign their _rôles_ of polar stars, the one to Canopus in the southern hemisphere, the other to Wega in the northern. Imagination lost itself in this sublime infinitude, amidst which the projectile was moving like a new star created by the hand of man. From natural causes these constellations shone with a soft lustre; they did not twinkle because there was no atmosphere to intervene with its strata unequally dense, and of different degrees of humidity, which causes this scintillation.

The travellers long watched the constellated firmament, upon which the vast screen of the moon made an enormous black hole. But a painful sensation at length drew them from their contemplation. This was an intense cold, which soon covered the glasses of the port-lights with a thick coating of ice. The sun no longer warmed the projectile with his rays, and it gradually lost the heat stored up in its walls. This heat was by radiation rapidly evaporated into space, and a considerable lowering of the temperature was the result. The interior humidity was changed into ice by contact with the window-panes, and prevented all observation.

Nicholl, consulting the thermometer, said that it had fallen to 17° (centigrade) below zero (1° Fahr). Therefore, notwithstanding every reason for being economical, Barbicane was obliged to seek heat as well as light from gas. The low temperature of the bullet was no longer bearable. Its occupants would have been frozen to death.

"We will not complain about the monotony of the journey," said Michel Ardan. "What variety we have had, in temperature at all events! At times we have been blinded with light, and saturated with heat like the Indians of the Pampas! Now we are plunged into profound darkness amidst boreal cold, like the Esquimaux of the pole! No, indeed! We have no right to complain, and Nature has done many things in our honour!"

"But," asked Nicholl, "what is the exterior temperature?"

"Precisely that of planetary space," answered Barbicane.

"Then," resumed Michel Ardan, "would not this be an opportunity for making

that experiment we could not attempt when we were bathed in the solar rays?"

"Now or never," answered Barbicane, "for we are usefully situated in order to verify the temperature of space, and see whether the calculations of Fourier or Pouillet are correct."

"Any way it is cold enough," said Michel. "Look at the interior humidity condensing on the port-lights. If this fall continues the vapour of our respiration will fall around us in snow."

"Let us get a thermometer," said Barbicane.

It will be readily seen that an ordinary thermometer would have given no result under the circumstances in which it was going to be exposed. The mercury would have frozen in its cup, for it does not keep liquid below 44° below zero. But Barbicane had provided himself with a spirit thermometer, on the Walferdin system, which gives the minima of excessively low temperature.

Before beginning the experiment this instrument was compared with an ordinary thermometer, and Barbicane prepared to employ it.

"How shall we manage it?" asked Nicholl.

"Nothing is easier," answered Michel Ardan, who was never at a loss. "Open the port-light rapidly, throw out the instrument; it will follow the projectile with exemplary docility; a quarter of an hour after take it in."

"With your hand?" asked Barbicane.

"With my hand," answered Michel.

"Well, then, my friend, do not try it," said Barbicane, "for the hand you draw back will be only a stump, frozen and deformed by the frightful cold."

"Really?"

"You would feel the sensation of a terrible burn, like one made with a red-hot iron, for the same thing happens when heat is brutally abstracted from our body as when it is inserted. Besides, I am not sure that objects thrown out still follow us."

"Why?" said Nicholl.

"Because if we are passing through any atmosphere, however slightly dense, these objects will be delayed. Now the darkness prevents us verifying whether they still float around us. Therefore, in order not to risk our thermometer, we will tie something to it, and so easily pull it back into the interior."

Barbicane's advice was followed. Nicholl threw the instrument out of the rapidly-opened port-light, holding it by a very short cord, so that it could be rapidly drawn in. The window was only open one second, and yet that one second was enough to allow the interior of the projectile to become frightfully cold.

"_Mille diables!_" cried Michel Ardan, "it is cold enough here to freeze white bears!"

Barbicane let half-an-hour go by, more than sufficient time to allow the instrument to descend to the level of the temperature of space. The thermometer was then rapidly drawn in.

Barbicane calculated the quantity of mercury spilt into the little phial soldered to the lower part of the instrument, and said--

"One hundred and forty degrees centigrade below zero!" (218° Fahr.)

M. Pouillet was right, not Fourier. Such was the frightful temperature of sidereal space! Such perhaps that of the lunar continents when the orb of night loses by radiation all the heat which she absorbs during the fifteen days of sunshine.

CHAPTER XV

.

HYPERBOLA OR PARABOLA.

Our readers will probably be astonished that Barbicane and his companions were so little occupied with the future in store for them in their metal prison, carried along in the infinitude of ether. Instead of asking themselves where they were going, they lost their time in making experiments, just as if they had been

comfortably installed in their own studies.

It might be answered that men so strong-minded were above such considerations, that such little things did not make them uneasy, and that they had something else to do than to think about their future.

The truth is that they were not masters of their projectile--that they could neither stop it nor alter its direction. A seaman can direct the head of his ship as he pleases; an aëronaut can give his balloon vertical movement. They, on the contrary, had no authority over their vehicle. No manoeuvre was possible to them. Hence their not troubling themselves, or "let things go" state of mind.

Where were they at that moment, 8 a.m. during that day called upon earth the sixth of December? Certainly in the neighbourhood of the moon, and even near enough for her to appear like a vast black screen upon the firmament. As to the distance which separated them, it was impossible to estimate it. The projectile, kept up by inexplicable forces, has grazed the north pole of the satellite at less than twenty-five miles' distance. But had that distance increased or diminished since they had been in the cone of shadow? There was no landmark by which to estimate either the direction or the velocity of the projectile. Perhaps it was going rapidly away from the disc and would soon leave the pure shadow. Perhaps, on the contrary, it was approaching it, and would before long strike against some elevated peak in the invisible atmosphere, which would have terminated the journey, doubtless to the detriment of the travellers.

A discussion began upon this subject, and Michel Ardan, always rich in explanations, gave out the opinion that the bullet, restrained by lunar attraction, would end by falling on the moon like an aërolite on to the surface of the terrestrial globe.

"In the first place," answered Barbicane, "all aërolites do not fall upon the surface of the earth; only a small proportion do so. Therefore, if we are aërolites it does not necessarily follow that we shall fall upon the moon."

"Still," answered Michel, "if we get near enough--"

"Error," replied Barbicane. "Have you not seen shooting stars by thousands in the sky at certain epochs?"

"Yes."

"Well, those stars, or rather corpuscles, only shine by rubbing against the atmospheric strata. Now, if they pass through the atmosphere, they pass at less than 16 miles from our globe, and yet they rarely fall. It is the same with our projectile. It may approach very near the moon, and yet not fall upon it."

"But then," asked Michel, "I am curious to know how our vehicle would behave in space."

"I only see two hypotheses," answered Barbicane, after some minutes' reflection.

"What are they?"

"The projectile has the choice between two mathematical curves, and it will follow the one or the other according to the velocity with which it is animated, and which I cannot now estimate."

"Yes, it will either describe a parabola or an hyperbola."

"Yes," answered Barbicane, "with some speed it will describe a parabola, and with greater speed an hyperbola."

"I like those grand words!" exclaimed Michel Ardan. "I know at once what you mean. And what is your parabola, if you please?"

"My friend," answered the captain, "a parabola is a conic section arising from cutting a cone by a plane parallel to one of its sides."

"Oh!" said Michel in a satisfied tone.

"It is about the same trajectory that the bomb of a howitzer describes."

"Just so. And an hyperbola?" asked Michel.

"It is a curve formed by a section of a cone when the cutting plane makes a greater angle with the base than the side of the cone makes."

"Is it possible?" exclaimed Michel Ardan in the most serious tone, as if he had been informed of a grave event. "Then remember this, Captain Nicholl, what I like in your definition of the hyperbola--I was going to say of the hyperhumbug--is that it is still less easy to understand than the word you pretend to define."

Nicholl and Barbicane paid no attention to Michel Ardan's jokes. They had launched into a scientific discussion. They were eager about what curve the projectile would take. One was for the hyperbola, the other for the parabola. They gave each other reasons bristling with _x_'s. Their arguments were presented in a language which made Michel Ardan jump. The discussion was lively, and neither of the adversaries would sacrifice his curve of predilection.

This scientific dispute was prolonged until Michel Ardan became impatient, and said--

"I say, Messrs. Cosine, do leave off throwing your hyperbolas and parabolas at one's head. I want to know the only interesting thing about the business. We shall follow one or other of your curves. Very well. But where will they take us to?"

"Nowhere," answered Nicholl.

"How nowhere?"

"Evidently they are unfinished curves, prolonged indefinitely!"

"Ah, _savants_! What does it matter about hyperbola or parabola if they both carry us indefinitely into space?"

Barbicane and Nicholl could not help laughing. They cared for art for its own sake. Never had more useless question been discussed at a more inopportune moment. The fatal truth was that the projectile, whether hyperbolically or parabolically carried along, would never strike against either the earth or the moon.

What would become of these bold travellers in the most immediate future? If they did not die of hunger or thirst, they would in a few days, when gas failed them, die for want of air, if the cold had not killed them first!

Still, although it was so important to economise gas, the excessive lowness of the surrounding temperature forced them to consume a certain quantity. They could not do without either its light or heat. Happily the caloric developed by the Reiset and Regnault apparatus slightly elevated the temperature of the projectile, and without spending much they could raise it to a bearable degree.

In the meantime observation through the port-lights had become very difficult.

The steam inside the bullet condensed upon the panes and froze immediately. They were obliged to destroy the opacity of the glass by constant rubbing. However, they could record several phenomena of the highest interest.

In fact, if the invisible disc had any atmosphere, the shooting stars would be seen passing through it. If the projectile itself passed through the fluid strata, might it not hear some noise echoed--a storm, for instance, an avalanche, or a volcano in activity? Should they not see the intense fulgurations of a burning mountain? Such facts, carefully recorded, would have singularly elucidated the obscure question of the lunar constitution. Thus Barbicane and Nicholl, standing like astronomers at their port-lights, watched with scrupulous patience.

But until then the disc remained mute and dark. It did not answer the multifarious interrogations of these ardent minds.

This provoked from Michel a reflection that seemed correct enough.

"If ever we recommence our journey, we shall do well to choose the epoch when the moon is new."

"True," answered Nicholl, "that circumstance would have been more favourable. I agree that the moon, bathed in sunlight, would not be visible during the passage, but on the other hand the earth would be full. And if we are dragged round the moon like we are now, we should at least have the advantage of seeing the invisible disc magnificently lighted up."

"Well said, Nicholl," replied Michel Ardan. "What do you think about it, Barbicane?"

"I think this," answered the grave president: "if ever we recommence this journey, we shall start at the same epoch, and under the same circumstances. Suppose we had reached our goal, would it not have been better to find the continents in full daylight instead of dark night? Would not our first installation have been made under better circumstances? Yes, evidently. As to the invisible side, we could have visited that in our exploring expeditions on the lunar globe. So, therefore, the time of the full moon was well chosen. But we ought to have reached our goal, and in order to have reached it we ought not to have deviated from our road."

"There is no answer to make to that," said Michel Ardan. "Yet we have passed a

fine opportunity for seeing the moon! Who knows whether the inhabitants of the other planets are not more advanced than the *savants* of the earth on the subject of their satellites?"

The following answer might easily have been given to Michel Ardan's remark:--Yes, other satellites, on account of their greater proximity, have made the study of them easier. The inhabitants of Saturn, Jupiter, and Uranus, if they exist, have been able to establish communication with their moons 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 centre of the earth. Of the eight moons of Saturn, four are near. Diana is 84,600 leagues off; Thetys, 62,966 leagues; Enceladus, 48,191 leagues; and lastly, Mimas is at an average distance of 34,500 leagues only. Of the eighteen satellites of Uranus, the first, Ariel, is only 51,520 leagues from the planet.

Therefore, upon the surface of those three stars, an experiment analogous to that of President Barbicane would have presented less difficulties. If, therefore, their inhabitants have attempted the enterprise, they have, perhaps, acquainted themselves with the constitution of the half of the disc which their satellite hides eternally from their eyes. But if they have never left their planet, they do not know more about them than the astronomers of the earth.

In the meantime the bullet was describing in the darkness that incalculable trajectory which no landmark allowed them to find out. Was its direction altered either under the influence of lunar attraction or under the action of some unknown orb? Barbicane could not tell. But a change had taken place in the relative position of the vehicle, and Barbicane became aware of it about 4 a.m.

The change consisted in this, that the bottom of the projectile was turned towards the surface of the moon, and kept itself perpendicular with its axis. The attraction or gravitation had caused this modification. The heaviest part of the bullet inclined towards the invisible disc exactly as if it had fallen towards it.

Was it falling then? Were the travellers at last about to reach their desired goal? No. And the observation of one landmark, inexplicable in itself, demonstrated to Barbicane that his projectile was not nearing the moon, and that it was following

an almost concentric curve.

This was a flash of light which Nicholl signalised all at once on the limit of the horizon formed by the black disc. This point could not be mistaken for a star. It was a reddish flame, which grew gradually larger--an incontestable proof that the projectile was getting nearer it, and not falling normally upon the surface of the satellite.

"A volcano! It is a volcano in activity!" exclaimed Nicholl--"an eruption of the interior fires of the moon. That world, then, is not quite extinguished."

"Yes, an eruption!" answered Barbicane, who studied the phenomenon carefully through his night-glass. "What should it be if not a volcano?"

"But then," said Michel Ardan, "air is necessary to feed that combustion, therefore there is some atmosphere on that part of the moon."

"Perhaps so," answered Barbicane, "but not necessarily. A volcano, by the decomposition of certain matters, can furnish itself with oxygen, and so throw up flames into the void. It seems to me, too, that that deflagration has the intensity and brilliancy of objects the combustion of which is produced in pure oxygen. We must not be in a hurry to affirm the existence of a lunar atmosphere."

The burning mountain was situated at the 45th degree of south latitude on the invisible part of the disc. But to the great disappointment of Barbicane the curve that the projectile described dragged it away from the point signalised by the eruption, therefore he could not exactly determine its nature. Half-an-hour after it had first been seen this luminous point disappeared on the horizon. Still the authentication of this phenomenon was a considerable fact in selenographic studies. It proved that all heat had not yet disappeared from the interior of this globe, and where heat exists, who may affirm that the vegetable kingdom, or even the animal kingdom itself, has not until now resisted the destructive influences? The existence of this volcano in eruption, indisputably established by earthly _savants_, was favourable to the theory of the habitability of the moon.

Barbicane became absorbed in reflection. He forgot himself in a mute reverie, filled with the mysterious destinies of the lunar world. He was trying to connect the facts observed up till then, when a fresh incident recalled him suddenly to the reality.

This incident was more than a cosmic phenomenon; it was a threatening danger, the consequences 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 a burning moon of almost unbearable brilliancy, outlined as it was on the total obscurity of space. This mass, of a circular form, threw such light that it filled the projectile. The faces of Barbicane, Nicholl, and Michel Ardan, bathed in its white waves, looked spectral, livid, _blafard_, like the appearance produced by the artificial light of alcohol impregnated with salt.

"The devil!" cried Michel Ardan. "How hideous we are! Whatever is that wretched moon?"

"It is a bolis," answered Barbicane.

"A bolis, on fire, in the void?"

"Yes."

This globe of fire was indeed a bolis. Barbicane was not mistaken. But if these cosmic meteors, seen from the earth, present an inferior light 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. The surrounding air is not necessary to the deflagration. And, indeed, if certain of these bodies 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 are from one to two miles wide, and move at a speed of forty miles a second, following an inverse direction from the movement of the earth.

This shooting star suddenly appeared in the darkness at a distance of at least 100 leagues, and measured, according to Barbicane's estimate, a diameter of 2,000 metres. It moved with the speed of about thirty leagues a minute. It cut across the route of the projectile, and would reach it in a few minutes. As it approached it grew larger in an enormous proportion.

If possible, let the situation of the travellers be imagined! 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 fearful terror. Their projectile, the course of which they could not alter, was running straight on

to this burning mass, more intense than the open mouth of a furnace. They seemed to be rushing towards an abyss of fire.

Barbicane seized the hands of his two companions, and all three looked through their half-closed eyelids at the red-hot asteroid. If they still thought at all, they must have given themselves up as lost!

Two minutes after the sudden appearance of the bolis, two centuries of agony, the projectile seemed about to strike against it, when the ball of fire burst like a bomb, but without making any noise in the void, where sound, which is only the agitation of the strata of air, could not be made.

Nicholl uttered a cry. His companions and he rushed to the port-lights.

What a spectacle! What pen could describe it, what palette would be rich enough in colours to reproduce its magnificence?

It was like the opening of a crater, or the spreading of an immense fire. Thousands of luminous fragments lit up space with their fires. Every size, colour, and shade were there. There were yellow, red, green, grey, a crown of multi-coloured fireworks. There only remained of the enormous and terrible globe pieces carried in all directions, each an asteroid in its turn, some shining like swords, some surrounded by white vapour, others leaving behind them a trail of cosmic dust.

These incandescent blocks crossed each other, knocked against each other, and were scattered into smaller fragments, of which some struck the projectile. Its left window was even cracked by the violent shock. It seemed to be floating in a shower of bullets, of which the least could annihilate it in an instant.

The light which saturated the ether was of incomparable intensity, for these asteroids dispersed it in every direction. At a certain moment it was so bright that Michel dragged Barbicane and Nicholl to the window, exclaiming--

"The invisible moon is at last visible!"

And all three, across the illumination, saw for a few seconds that mysterious disc which the eye of man perceived for the first time.

What did they distinguish across that distance which they could not estimate?

Long bands across the disc, veritable clouds formed in a very restricted atmospheric medium, from which emerged not only all the mountains, but every relief of middling importance, amphitheatres, yawning craters, such as exist on the visible face. Then immense tracts, no longer arid plains, but veritable seas, oceans which reflected in their liquid mirror all the dazzling magic of the fires of space. Lastly, on the surface of the continents, vast dark masses, such as immense forests would resemble under the rapid illumination of a flash of lightning.

Was it an illusion, an error of the eyes, an optical deception? Could they give a scientific affirmation to that observation so superficially obtained? Dared they pronounce upon the question of its habitability after so slight a glimpse of the invisible disc?

By degrees the fulgurations of space gradually died out, its accidental brilliancy lessened, the asteroids fled away by their different trajectories, and went out in the distance. The ether resumed its habitual darkness; the stars, for one moment eclipsed, shone in the firmament, and the disc, of which scarcely a glimpse had been caught, was lost in the impenetrable night.

CHAPTER XVI

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THE SOUTHERN HEMISPHERE.

The projectile had just escaped a terrible danger, a danger quite unforeseen. Who would have imagined such a meeting of asteroids? These wandering bodies might prove serious perils to the travellers. They were to them like so many rocks in the sea of ether, which, less fortunate than navigators, they could not avoid. But did these adventurers of space complain? No, as Nature had given them the splendid spectacle of a cosmic meteor shining by formidable expansion, as this incomparable display of fireworks, which no Ruggieri could imitate, had lighted for a few seconds the invisible nimbus of the moon. During that rapid peep, continents, seas, and forests had appeared to them. Then the atmosphere did give there its life-giving particles? Questions still not solved, eternally asked by American curiosity.

It was then 3.30 p.m. The bullet was still describing its curve round the moon. Had its route again been modified by the meteor? It was to be feared. The projectile ought, however to describe a curve imperturbably determined by the laws of mechanics. Barbicane inclined to the opinion that this curve would be a parabola and not an hyperbola. However, if the parabola was admitted, the bullet ought soon to come out of the cone of shadow thrown into the space on the opposite side to the sun. This cone, in fact, is very narrow, the angular diameter of the moon is so small compared to the diameter of the orb of day. Until now the projectile had moved in profound darkness. Whatever its speed had been--and it could not have been slight--its period of occultation continued. That fact was evident, but perhaps that would not have been the case in a rigidly parabolical course. This was a fresh problem which tormented Barbicane's brain, veritably imprisoned as it was in a web of the unknown which he could not disentangle.

Neither of the travellers thought of taking a minute's rest. Each watched for some unexpected incident which should throw a new light on their uranographic studies. About five o'clock Michel distributed to them, by way of dinner, some morsels of bread and cold meat, which were rapidly absorbed, whilst no one thought of leaving the port-light, the panes of which were becoming incrusted under the condensation of vapour.

About 5.45 p.m., Nicholl, armed with his telescope, signalised upon the southern border of the moon, and in the direction followed by the projectile, a few brilliant points outlined against the dark screen of the sky. They looked like a succession of sharp peaks with profiles in a tremulous line. They were rather brilliant. The terminal line of the moon looks the same when she is in one of her octants.

They could not be mistaken. There was no longer any question of a simple meteor, of which that luminous line had neither the colour nor the mobility, nor of a volcano in eruption. Barbicane did not hesitate to declare what it was.

"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 border of the moon. We are evidently

approaching the South Pole!"

"After having passed the North Pole," answered Michel. "Then we have been all round our satellite."

"Yes, friend Michel."

"Then we have no more hyperbolas, no more parabolas, no more open curves to fear!"

"No, but a closed curve."

"Which is called--"

"An ellipsis. Instead of being lost in the interplanetary spaces it is possible that the projectile will describe an elliptical orbit round the moon."

"Really!"

"And that it will become its satellite."

"Moon of the moon," exclaimed Michel Ardan.

"Only I must tell you, my worthy friend, that we are none the less lost men on that account!"

"No, but in another and much pleasanter way!" answered the careless Frenchman, with his most amiable smile.

President Barbicane was right. By describing this elliptical orbit the projectile was 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 bullet by the double influence of the centripetal and centrifugal forces. His companions and he were again going to see the visible face of the 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 throw 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 seeing the 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 Doerfel 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 may be 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 method also allows the calculating of the depth of craters and cavities on the moon. Galileo used it, and since Messrs. Boeer and Moedler have employed it with the greatest success.

Another method, called the tangent radii, 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 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 9,000 yards. 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. Boeer and Moedler, 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 1,000 yards higher. But one remark must be made. If the respective volumes of the two orbs are compared the lunar mountains are relatively higher than the terrestrial. The lunar ones form 1/70 of the diameter of the moon, and the terrestrial only form 1/140 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 four miles.

Thus, then, to proceed by comparison, the chain of the Himalayas counts three peaks higher than the lunar ones, Mount Everest, Kunchinjuga, and Dwalagiri. Mounts Doerfel and Leibnitz, on the moon, are as high as Jewahir in the same chain. Newton, Casatus, Curtius, Short, Tycho, Clavius, Blancanus, Endymion, the principal summits of Caucasus and the Apennines, are higher than Mont Blanc. The mountains equal to Mont Blanc are Moret, Theophylus, and Catharnia; to Mount Rosa, Piccolomini, Werner, and Harpalus; to Mount Cervin, Macrobus, Eratosthenes, Albateque, and Delambre; to the Peak of Teneriffe, Bacon, Cysatus, Philolaus, and the Alps; to Mount Perdu, in the Pyrenees, Roemer and Boguslawski; to Etna, 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.

CHAPTER XVII

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TYCHO.

At 6 p.m. the projectile passed the South Pole at less than thirty miles, a distance equal to that already reached at the North Pole. The elliptical curve was, therefore, being rigorously described.

At that moment the travellers re-entered the beneficent sunshine. They saw once more the stars moving slowly from east to west. The radiant orb was saluted with a triple hurrah. With its light came also its heat, which soon pierced the middle walls. The windows resumed their accustomed transparency. Their "layer of ice" melted as if by enchantment. The gas was immediately extinguished by way of economy. The air apparatus alone was to consume its habitual quantity.

"Ah!" said Nicholl, "sunshine is good! How impatiently after their long nights the Selenites must await the reappearance of the orb of day!"

"Yes," answered Michel Ardan, "imbibing, as it were, the brilliant ether, light and heat, all life is in them."

At that moment the bottom of the projectile moved slightly from the lunar surface in order to describe a rather long elliptical orbit. From that point, if the earth had been full, Barbicane and his friends could have seen it again. But, drowned in the sun's irradiation, it remained absolutely invisible. Another spectacle attracted their eyes, presented by the southern region of the moon, brought by the telescopes to within half-a-mile. They left the port-lights no more, and noted all the details of the strange continent.

Mounts Doerfel and Leibnitz formed two separate groups stretching nearly to the South Pole; the former group extends from the Pole to the 84th parallel on the eastern part of the orb; the second, starting from the eastern border, stretches from the 65th degree of latitude to the Pole.

On their capriciously-formed ridge appeared dazzling sheets of light like those signalised by Father Secchi. With more certainty than the illustrious Roman astronomer, Barbicane was enabled to establish their nature.

"It is snow," cried he.

"Snow?" echoed Nicholl.

"Yes, Nicholl, snow, the surface of which is profoundly frozen. Look how it reflects the luminous rays. Cooled lava would not give so intense a reflection. Therefore there is water and air upon the moon, as little as you like, but the fact can no longer be contested."

No, it could not be, and if ever Barbicane saw the earth again his notes would testify to this fact, important in selenographic observations.

These Mounts Doerfel and Leibnitz arose in the midst of plains of moderate extent, bounded by an indefinite succession of amphitheatres and circular ramparts. These two chains are the only ones which are met with in the region of amphitheatres. Relatively they are not very broken, and only throw out here and there some sharp peaks, the highest of which measures 7,603 metres.

The projectile hung high above all this, and the relief disappeared in the intense brilliancy of the disc.

Then reappeared to the eyes of the travellers that original aspect of the lunar landscapes, raw in tone, without gradation of colours, only white and black, for diffused light was wanting. Still the sight of this desolate world was very curious on account of its very strangeness. They were moving above this chaotic region as if carried along by the breath of a tempest, seeing the summits fly under their feet, looking down the cavities, climbing the ramparts, sounding the mysterious holes. But there was no trace of vegetation, no appearance of cities, nothing but stratifications, lava streams, polished like immense mirrors, which reflect the solar rays with unbearable brilliancy. There was no appearance of a living world, everything of a dead one, where the avalanches rolling from the summit of the mountains rushed noiselessly. They had plenty of movement, but noise was wanting still.

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 taken 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."

However that may be in its actual condition, this world was the image of death without it being possible to say that life had ever animated it.

Michel Ardan, however, thought he recognised a heap of ruins, to which he drew Barbicane's attention. It was situated in about the 80th parallel and 30° longitude. This heap of stones, pretty regularly made, was in the shape of a vast fortress, overlooking one of those long furrows which served as river-beds in ante-historical times. Not far off rose to a height of 5,646 metres the circular mountain called Short, equal to the Asiatic Caucasus. Michel Ardan, with his habitual ardour, maintained "the evidences" of his fortress. Below he perceived the dismantled ramparts of a town; here the arch of a portico, still intact; there two or three columns lying on their side; farther on a succession of archpieces, which must have supported the conduct of an aqueduct; in another part the sunken pillars of a gigantic bridge run into the thickest part of the furrow. He distinguished all that, but with so much imagination in his eyes, through a telescope so fanciful, that his observation cannot be relied upon. And yet who would affirm, who would dare to say, that the amiable fellow had not really seen what his two companions would not see?

The moments were too precious to be sacrificed to an idle discussion. The Selenite city, whether real or pretended, had disappeared in the distance. The projectile began to get farther away from the lunar disc, and the details of the ground began to be lost in a confused jumble. The reliefs, amphitheatres, craters, and plains alone remained, and still showed their boundary-lines distinctly.

At that moment there stretched to the left one of the finest amphitheatres in lunar orography. It was Newton, which Barbicane easily recognised by referring to the *Mappa Selenographica*.

Newton is situated in exactly 77° south lat. and 16° east long. It forms a circular crater, the ramparts of which, 7,264 metres high, seemed to be inaccessible.

Barbicane made his companions notice that the height of that mountain above

the surrounding plain was far from being equal to the depth of its crater. This enormous hole was beyond all measurement, and made a gloomy abyss, the bottom of which the sun's rays could never reach. There, according to Humboldt, utter darkness reigns, which the light of the sun and the earth could not break. The mythologists would have made it with justice hell's mouth.

"Newton," said Barbicane, "is the most perfect type of the circular mountains, of which the earth possesses no specimen. They prove that the formation of the moon by cooling was due to violent causes, for whilst under the influence of interior fire the reliefs were thrown up to considerable heights, the bottom dropped in, and became lower than the lunar level."

"I do not say no," answered Michel Ardan.

A few minutes after having passed Newton the projectile stood directly over the circular mountain of Moret. It also passed rather high above the summits of Blancanus, and about 7.30 p.m. it reached the amphitheatre of Clavius.

This circle, one of the most remarkable on the disc, is situated in south lat. 58° and east long. 15°. Its height is estimated at 7,091 metres. The travellers at a distance of 200 miles, reduced to two by the telescopes, could admire the arrangement of this vast crater.

"The terrestrial volcanoes," said Barbicane, "are only molehills compared to the volcanoes of the moon. Measuring the ancient craters formed by the first eruptions of Vesuvius and Etna, they are found to be scarcely 6,000 metres wide. In France the circle of the Cantal measures five miles; at Ceylon the circle of the island is forty miles, and is considered the largest on the globe. What are these diameters compared to that of Clavius, which we are over in this moment?"

"What is its width?" asked Nicholl.

"About seventy miles," answered Barbicane. "This amphitheatre is certainly the largest on the moon, but many are fifty miles wide!"

"Ah, my friends," exclaimed Michel Ardan, "can you imagine what this peaceful orb of night was once like? when these craters vomited torrents of lava and stones, with clouds of smoke and sheets of flame? What a prodigious spectacle formerly, and now what a falling off! This moon is now only the meagre case of fireworks, of which the rockets, serpents, suns, and wheels, after going off

magnificently, only leave torn pieces of cardboard. Who can tell the cause, reason, or justification of such cataclysms?"

Barbicane did not listen to Michel Ardan. He was contemplating those ramparts of Clavius, formed of wide mountains several leagues thick. At the bottom of its immense cavity lay hundreds of small extinct craters, making the soil like a sieve, and overlooked by a peak more than 15,000 feet high.

The plain around had a desolate aspect. Nothing so arid as these reliefs, nothing so sad as these ruins of mountains, if so they may be called, as those heaps of peaks and mountains encumbering the ground! The satellite seemed to have been blown up in this place.

The projectile still went on, and the chaos was still the same. Circles, craters, and mountains succeeded each other incessantly. No more plains or seas--an interminable Switzerland or Norway. Lastly, in the centre of the creviced region at its culminating point, the most splendid mountain of the lunar disc, the dazzling Tycho, to which posterity still gives the name of the illustrious Danish astronomer.

Whilst observing the full moon in a cloudless sky, there is no one who has not remarked this brilliant point on the southern hemisphere. Michel Ardan, to qualify it, employed all the metaphors his imagination could furnish him with. To him Tycho was an ardent focus of light, a centre of irradiation, a crater vomiting flames! It was the axle of a fiery wheel, a sea-star encircling the disc with its silver tentacles, an immense eye darting fire, a nimbo made for Pluto's head! It was a star hurled by the hand of the Creator, and fallen upon the lunar surface!

Tycho forms such a luminous concentration that the inhabitants of the earth can see it without a telescope, although they are at a distance of 100,000 leagues. It will, therefore, be readily imagined what its intensity must have been in the eyes of observers placed at fifty leagues only.

Across this pure ether its brilliancy was so unbearable that Barbicane and his friends were obliged to blacken the object-glasses of their telescopes with gas-smoke in order to support it. Then, mute, hardly emitting a few admirative interjections, they looked and contemplated. All their sentiments, all their impressions were concentrated in their eyes, as life, under violent emotion, is

concentrated in the heart.

Tycho belongs to the system of radiating mountains, like Aristarchus and Copernicus. But it testified the most completely of all to the terrible volcanic action to which the formation of the moon is due.

Tycho is situated in south lat. 43° and east long. 12°. Its centre is occupied by a crater more than forty miles wide. It affects a slightly elliptical form, and is inclosed by circular ramparts, which on the east and west overlook the exterior plain from a height of 5,000 metres. It is an aggregation of Mont Blancs, placed round a common centre, and crowned with shining rays.

Photography itself could never represent what this incomparable mountain, with all its projections converging to it and its interior excrescences, is really like. In fact, it is during the full moon that Tycho is seen in all its splendour. Then all shadows disappear, the foreshortenings of perspective disappear, and all proofs come out white--an unfortunate circumstance, for this strange region would have been curious to reproduce with photographic exactitude. It is only an agglomeration of holes, craters, circles, a vertiginous network of crests. It will be understood, therefore, that the bubblings of this central eruption have kept their first forms. Crystallised by cooling, they have stereotyped the aspect which the moon formerly presented under the influence of Plutonic forces.

The distance which separated the travellers from the circular summits of Tycho was not so great that the travellers could not survey its principal details. Even upon the embankment which forms the ramparts of Tycho, the mountains hanging to the interior and exterior slopes rose in stories like gigantic terraces. They appeared to be higher by 300 or 400 feet on the west than on the east. No system of terrestrial castrametation could equal these natural fortifications. A town built at the bottom of this circular cavity would have been utterly inaccessible.

Inaccessible and marvellously extended over this ground of picturesque relief! Nature had not left the bottom of this crater flat and empty. It possessed a special orography, a mountain system which made it a world apart. The travellers clearly distinguished the cones, central hills, remarkable movements of the ground, naturally disposed for the reception of masterpieces of Selenite architecture. There was the place for a temple, here for a forum, there the foundations of a palace, there the plateau of a citadel, the whole overlooked by a central mountain

1,500 feet high--a vast circuit which would have held ancient Rome ten times over.

"Ah!" exclaimed Michel Ardan, made enthusiastic by the sight, "what grand towns could be built in this circle of mountains! A tranquil city, a peaceful refuge, away from all human cares! How all misanthropes could live there, all haters of humanity, all those disgusted with social life!"

"All! It would be too small for them!" replied Barbicane simply.

CHAPTER XVIII

.

GRAVE QUESTIONS.

In the meantime the projectile had passed the neighbourhood of Tycho. Barbicane and his two friends then observed, with the most scrupulous attention, those brilliant radii which the celebrated mountain disperses so curiously on every horizon.

What was this radiating aureole? What geological phenomenon had caused those ardent beams? This question justly occupied Barbicane. Under his eyes, in every direction, ran luminous furrows, with raised banks and concave middle, some ten miles, others more than twenty miles wide. These shining trails ran in certain places at least 300 leagues from Tycho, and seemed to cover, especially towards the east, north-east, and north, half the southern hemisphere. One of these furrows stretched as far as the amphitheatre of Neander, situated on the 40th meridian. Another went rounding off through the Sea of Nectar and broke against the chain of the Pyrenees after a run of 400 leagues; others towards the west covered with a luminous network the Sea of Clouds and the Sea of Humours.

What was the origin of these shining rays running equally over plains and reliefs, however high? They all started from a common centre, the crater of Tycho. They emanated from it.

Herschel attributed their brilliant aspect to ancient streams of lava congealed by

the cold, an opinion which has not been generally received. Other astronomers have seen in these inexplicable rays a kind of _moraines_, ranges of erratic blocks thrown out at the epoch of the formation of Tycho.

"And why should it not be so?" asked Nicholl of Barbicane, who rejected these different opinions at the same time that he related them.

"Because the regularity of these luminous lines, and the violence necessary to send them to such a distance, are inexplicable.

"_Par bleu_!" replied Michel Ardan. "I can easily explain to myself the origin of these rays."

"Indeed," said Barbicane.

"Yes," resumed Michel. "Why should they not be the cracks caused by the shock of a bullet or a stone upon a pane of glass?"

"Good," replied Barbicane, smiling; "and what hand would be powerful enough to hurl the stone that would produce such a shock?"

"A hand is not necessary," answered Michel, who would not give in; "and as to the stone, let us say it is a comet."

"Ah! comets?" exclaimed Barbicane; "those much-abused comets! My worthy Michel, your explanation is not bad, but your comet is not wanted. The shock might have come from the interior of the planet. A violent contraction of the lunar crust whilst cooling was enough to make that gigantic crack."

"Contraction let it be--something like a lunar colic," answered Michel Ardan.

"Besides," added Barbicane, "that is also the opinion of an English _savant_, Nasmyth, and it seems to me to explain the radiation of these mountains sufficiently."

"That Nasmyth was no fool!" answered Michel.

The travellers, who could never weary of such a spectacle, long admired the splendours of Tycho. Their projectile, bathed in that double irradiation of the sun and moon, must have appeared like a globe of fire. They had, therefore,

suddenly passed from considerable cold to intense heat. Nature was thus preparing them to become Selenites.

To become Selenites! That idea again brought up the question of the habitability of the moon. After what they had seen, could the travellers solve it? Could they conclude for or against? Michel Ardan asked his two friends to give utterance to their opinion, and asked them outright if they thought that humanity and animality were represented in the lunar world.

"I think we cannot answer," said Barbicane, "but in my opinion the question ought not to be stated in that form. I ask to be allowed to state it differently."

"State it as you like," answered Michel.

"This is it," resumed Barbicane. "The problem is double, and requires a double solution. Is the moon habitable? Has it been inhabited?"

"Right," said Nicholl. "Let us first see if the moon is habitable."

"To tell the truth, I know nothing about it," replied Michel.

"And I answer in the negative," said Barbicane. "In her actual state, with her certainly very slight atmosphere, her seas mostly dried up, her insufficient water, her restricted vegetation, her abrupt alternations of heat and cold, her nights and days 354 hours long, the moon does not appear habitable to me, nor propitious to the development of the animal kingdom, nor sufficient for the needs of existence such as we understand it."

"Agreed," answered Nicholl; "but is not the moon habitable for beings differently organised to us?"

"That question is more difficult to answer," replied Barbicane. "I will try to do it, however, but I ask Nicholl if movement seems to him the necessary result of existence, under no matter what organisation?"

"Without the slightest doubt," answered Nicholl.

"Well, then, my worthy companion, my answer will be that we have seen the lunar continent at a distance of 500 yards, and that nothing appeared to be moving on the surface of the moon. The presence of no matter what form of

humanity would be betrayed by appropriations, different constructions, or even ruins. What did we see? Everywhere the geological work of Nature, never the work of man. If, therefore, representatives of the animal kingdom exist upon the moon, they have taken refuge in those bottomless cavities which the eye cannot reach. And I cannot admit that either, for they would have left traces of their passage upon the plains which the atmosphere, however slight, covers. Now these traces are nowhere visible. Therefore the only hypothesis that remains is one of living beings without movement or life."

"You might just as well say living creatures who are not alive."

"Precisely," answered Barbicane, "which for us has no meaning."

"Then now we may formulate our opinion," said Michel.

"Yes," answered Nicholl.

"Very well," resumed Michel Ardan; "the Scientific Commission, meeting in the projectile of the Gun Club, after having supported its arguments upon fresh facts lately observed, decides unanimously upon the question of the habitability of the moon--'No, the moon is not inhabited.'"

This decision was taken down by Barbicane in his notebook, where he had already written the _procès-verbal_ of the sitting of December 6th.

"Now," said Nicholl, "let us attack the second question, depending on the first. I therefore ask the honourable Commission if the moon is not habitable, has it been inhabited?"

"Answer, Citizen Barbicane," said Michel Ardan.

"My friends," answered Barbicane, "I did not undertake this journey to form an opinion upon the ancient habitability of our satellite. I may add that my personal observations only confirm me in this opinion. I believe, I even affirm, that the moon has been inhabited by a human race organised like ours, that it has produced animals anatomically formed like terrestrial animals; but I add that these races, human or animal, have had their day, and are for ever extinct."

"Then," asked Michel, "the moon is an older world than the earth?"

"No," answered Barbicane with conviction, "but a world that has grown old more quickly, whose formation and deformation have been more rapid. Relatively the organising forces of matter have been much more violent in the interior of the moon than in the interior of the celestial globe. The actual state of this disc, broken up, tormented, and swollen, proves this abundantly. In their origin the moon and the earth were only gases. These gases became liquids under different influences, and the solid mass was formed afterwards. But it is certain that our globe was gas or liquid still when the moon, already solidified by cooling, became habitable."

"I believe that," said Nicholl.

"Then," resumed Barbicane, "it was surrounded by atmosphere. The water held in by the gassy element could not evaporate. Under the influence of air, water, light, and heat, solar and central, vegetation took possession of these continents prepared for its reception, and certainly life manifested itself about that epoch, for Nature does not spend itself in inutilities, and a world so marvellously habitable must have been inhabited."

"Still," answered Nicholl, "many phenomena inherent to the movements of our satellite must have prevented the expansion of the vegetable and animal kingdoms. The days and nights 354 hours long, for example."

"At the terrestrial poles," said Michel, "they last six months."

"That is not a valuable argument, as the poles are not inhabited."

"In the actual state of the moon," resumed Barbicane, "the long nights and days create differences of temperature insupportable to the constitution, but it was not so at that epoch of historical times. The atmosphere enveloped the disc with a fluid mantle. Vapour deposited itself in the form of clouds. This natural screen tempered the ardour of the solar lays, and retained the nocturnal radiation. Both light and heat could diffuse themselves in the air. Hence there was equilibrium between the influences which no longer exists now that the atmosphere has almost entirely disappeared. Besides, I shall astonish you--"

"Astonish us?" said Michel Ardan.

"But I believe that at the epoch when the moon was inhabited the nights and days did not last 354 hours!"

"Why so?" asked Nicholl quickly.

"Because it is very probable that then the moon's movement of rotation on her axis was not equal to her movement of revolution, an equality which puts every point of the lunar disc under the action of the solar rays for fifteen days."

"Agreed," answered Nicholl; "but why should not these movements have been equal, since they are so actually?"

"Because that equality has only been determined by terrestrial attraction. Now, how do we know that this attraction was powerful enough to influence the movements of the moon at the epoch the earth was still fluid?"

"True," replied Nicholl; "and who can say that the moon has always been the earth's satellite?"

"And who can say," exclaimed Michel Ardan, "that the moon did not exist before the earth?"

Imagination began to wander in the indefinite field of hypotheses. Barbicane wished to hold them in.

"Those," said he, "are speculations too high, problems really insoluble. Do not let us enter into them. Let us only admit the insufficiency of primordial attraction, and then by the inequality of rotation and revolution days and nights could succeed each other upon the moon as they do upon the earth. Besides, even under those conditions life was possible."

"Then," asked Michel Ardan, "humanity has quite disappeared from the moon?"

"Yes," answered Barbicane, "after having, doubtless, existed for thousands of centuries. Then gradually the atmosphere becoming rarefied, the disc will again be uninhabitable like the terrestrial globe will one day become by cooling."

"By cooling?"

"Certainly," answered Barbicane. "As the interior fires became extinguished the incandescent matter was concentrated and the lunar disc became cool. By degrees the consequences of this phenomenon came about--the disappearance of organic beings and the disappearance of vegetation. Soon the atmosphere

became rarefied, and was probably drawn away by terrestrial attraction; the breathable air disappeared, and so did water by evaporation. At that epoch the moon became uninhabitable, and was no longer inhabited. It was a dead world like it is to-day."

"And you say that the like fate is reserved for the earth?"

"Very probably."

"But when?"

"When the cooling of its crust will have made it uninhabitable."

"Has the time it will take our unfortunate globe to melt been calculated?"

"Certainly."

"And you know the reason?"

"Perfectly."

"Then tell us, sulky _savant_--you make me boil with impatience."

"Well, my worthy Michel," answered Barbicane tranquilly, "it is well known what diminution of temperature the earth suffers in the lapse of a century. Now, according to certain calculations, that average temperature will be brought down to zero after a period of 400,000 years!"

"Four hundred thousand years!" exclaimed Michel. "Ah! I breathe again! I was really frightened. I imagined from listening to you that we had only fifty thousand years to live!"

Barbicane and Nicholl could not help laughing at their companion's uneasiness. Then Nicholl, who wanted to have done with it, reminded them of the second question to be settled.

"Has the moon been inhabited?" he asked.

The answer was unanimously in the affirmative.

During this discussion, fruitful in somewhat hazardous theories, although it

resumed the general ideas of science on the subject, the projectile had run rapidly towards the lunar equator, at the same time that it went farther away from the lunar disc. It had passed the circle of Willem, and the 40th parallel, at a distance of 400 miles. Then leaving Pitatus to the right, on the 30th degree, it went along the south of the Sea of Clouds, of which it had already approached the north. Different amphitheatres appeared confusedly under the white light of the full moon--Bouillaud, Purbach, almost square with a central crater, then Arzachel, whose interior mountain shone with indefinable brilliancy.

At last, as the projectile went farther and farther away, the details faded from the travellers' eyes, the mountains were confounded in the distance, and all that remained of the marvellous, fantastical, and wonderful satellite of the earth was the imperishable remembrance.

CHAPTER XIX

.

A STRUGGLE WITH THE IMPOSSIBLE.

For some time Barbicane and his companions, mute and pensive, looked at this world, which they had only seen from a distance, like Moses saw Canaan, and from which they were going away for ever. The position of the projectile relatively to the moon was modified, and now its lower end was turned towards the earth.

This change, verified by Barbicane, surprised him greatly. If the bullet was going to gravitate round the satellite in an elliptical orbit, why was not its heaviest part turned towards it like the moon to the earth? There again was an obscure point.

By watching the progress of the projectile they could see that it was following away from the moon an analogous curve to that by which it approached her. It was, therefore, describing a very long ellipsis which would probably extend to the point of equal attraction, where the influences of the earth and her satellite are neutralised.

Such was the conclusion which Barbicane correctly drew from the facts observed, a conviction which his two friends shared with him.

Questions immediately began to shower upon him.

"What will become of us after we have reached the neutral point?" asked Michel Ardan.

"That is unknown!" answered Barbicane.

"But we can make suppositions, I suppose?"

"We can make two," answered Barbicane. "Either the velocity of the projectile will then be insufficient, and it will remain entirely motionless on that line of double attraction--"

"I would rather have the other supposition, whatever it is," replied Michel.

"Or the velocity will be sufficient," resumed Barbicane, "and it will continue its elliptical orbit, and gravitate eternally round the orb of night."

"Not very consoling that revolution," said Michel, "to become the humble servants of a moon whom we are in the habit of considering our servant. And is that the future that awaits us?"

Neither Barbicane nor Nicholl answered.

"Why do you not answer?" asked the impatient Michel.

"There is nothing to answer," said Nicholl.

"Can nothing be done?"

"No," answered Barbicane. "Do you pretend to struggle with the impossible?"

"Why not? Ought a Frenchman and two Americans to recoil at such a word?"

"But what do you want to do?"

"Command the motion that is carrying us along!"

"Command it?"

"Yes," resumed Michel, getting animated, "stop it or modify it; use it for the

accomplishment of our plans."

"And how, pray?"

"That is your business! If artillerymen are not masters of their bullets they are no longer artillerymen. If the projectile commands the gunner, the gunner ought to be rammed instead into the cannon! Fine _savants_, truly! who don't know now what to do after having induced me--"

"Induced!" cried Barbicane and Nicholl. "Induced! What do you mean by that?"

"No recriminations!" said Michel. "I do not complain. The journey pleases me. The bullet suits me. But let us do all that is humanly possible to fall somewhere, if only upon the moon."

"We should only be too glad, my worthy Michel," answered Barbicane, "but we have no means of doing it."

"Can we not modify the motion of the projectile?"

"No."

"Nor diminish its speed?"

"No."

"Not even by lightening it like they lighten an overloaded ship?"

"What can we throw out?" answered Nicholl. "We have no ballast on board. And besides, it seems to me that a lightened projectile would go on more quickly."

"Less quickly," said Michel.

"More quickly," replied Nicholl.

"Neither more nor less quickly," answered Barbicane, wishing to make his two friends agree, "for we are moving in the void where we cannot take specific weight into account."

"Very well," exclaimed Michel Ardan in a determined tone; "there is only one thing to do."

"What is that?" asked Nicholl.

"Have breakfast," imperturbably answered the audacious Frenchman, who always brought that solution to the greatest difficulties.

In fact, though that operation would have no influence on the direction of the projectile, it might be attempted without risk, and even successfully from the point of view of the stomach. Decidedly the amiable Michel had only good ideas.

They breakfasted, therefore, at 2 a.m., but the hour was not of much consequence. Michel served up his habitual _menu_, crowned by an amiable bottle out of his secret cellar. If ideas did not come into their heads the Chambertin of 1863 must be despaired of.

The meal over, observations began again.

The objects they had thrown out of the projectile still followed it at the same invariable distance. It was evident that the bullet in its movement of translation round the moon had not passed through any atmosphere, for the specific weight of these objects would have modified their respective distances.

There was nothing to see on the side of the terrestrial globe. The earth was only a day old, having been new at midnight the day before, and two days having to go by before her crescent, disengaged from the solar rays, could serve as a clock to the Selenites, as in her movement of rotation each of her points always passes the same meridian of the moon every twenty-four hours.

The spectacle was a different one on the side of the moon; the orb was shining in all its splendour amidst innumerable constellations, the rays of which could not trouble its purity. Upon the disc the plains again wore the sombre tint which is seen from the earth. The rest of the nimbus was shining, and amidst the general blaze Tycho stood out like a sun.

Barbicane could not manage any way to appreciate the velocity of the projectile, but reasoning demonstrated that this speed must be uniformly diminishing in conformity with the laws of rational mechanics.

In fact, it being admitted that the bullet would describe an orbit round the moon, that orbit must necessarily be elliptical. Science proves that it must be thus. No

mobile circulation round any body is an exception to that law. All the orbits described in space are elliptical, those of satellites round their planets, those of planets around their sun, that of the sun round the unknown orb that serves as its central pivot. Why should the projectile of the Gun Club escape that natural arrangement?

Now in elliptical orbits attracting bodies always occupy one of the foci of the ellipsis. The satellite is, therefore, nearer the body round which it gravitates at one moment than it is at another. When the earth is nearest the sun she is at her perihelion, and at her aphelion when most distant. The moon is nearest the earth at her perigee, and most distant at her apogee. To employ analogous expressions which enrich the language of astronomers, if the projectile remained a satellite of the moon, it ought to be said that it is in its "aposelene" at its most distant point, and at its "periselene" at its nearest.

In the latter case the projectile ought to attain its maximum of speed, in the latter its minimum. Now it was evidently going towards its "aposelene," and Barbicane was right in thinking its speed would decrease up to that point, and gradually increase when it would again draw near the moon. That speed even would be absolutely *nil* if the point was coexistent with that of attraction.

Barbicane studied the consequences of these different situations; he was trying what he could make of them when he was suddenly interrupted by a cry from Michel Ardan.

"I'faith!" cried Michel, "what fools we are!"

"I don't say we are not," answered Barbicane; "but why?"

"Because we have some very simple means of slackening the speed that is taking us away from the moon, and we do not use them."

"And what are those means?"

"That of utilising the force of recoil in our rockets."

"Ah, why not?" said Nicholl.

"We have not yet utilised that force, it is true," said Barbicane, "but we shall do so."

"When?" asked Michel.

"When the time comes. Remark, my friends, that in the position now occupied by the projectile, a position still oblique to the lunar disc, our rockets, by altering its direction, might take it farther away instead of nearer to the moon. 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 let its lower end fall towards the earth. It is probable that at the point of equal attraction its conical summit will be rigorously directed towards the moon. At that moment it may be hoped that its speed will be *nil*. That will be the time to act, and under the effort of our rockets we can, perhaps, provoke a direct fall upon the surface of the lunar disc."

"Bravo!" said Michel.

"We have not done it yet, and we could not do it as we passed the neutral point, because the projectile was still animated with too much velocity."

"Well reasoned out," said Nicholl.

"We must wait patiently," said Barbicane, "and put every chance on our side; then, after having despaired so long, I again begin to think we shall reach our goal."

This conclusion provoked hurrahs from Michel Ardan. No one of these daring madmen remembered the question they had all answered in the negative--No, the moon is not inhabited! No, the moon is probably not inhabitable! And yet they were going to do all they could to reach it.

One question only now remained to be solved: at what precise moment would the projectile reach that point of equal attraction where the travellers would play their last card?

In order to calculate that moment to within some seconds Barbicane had only to have recourse to his travelling notes, and to take the different altitudes from lunar parallels. Thus the time employed in going over the distance between the neutral point and the South Pole must be equal to the distance which separates

the South Pole from the neutral point. The hours representing the time it took were carefully noted down, and the calculation became easy.

Barbicane found that this point would be reached by the projectile at 1 a.m. on the 8th of December. It was then 3 a.m. on the 7th of December. Therefore, if nothing intervened, the projectile would reach the neutral point in twenty-two hours.

The rockets had been put in their places to slacken the fall of the bullet upon the moon, and now the bold fellows were going to use them to provoke an exactly contrary effect. However that may be, they were ready, and there was nothing to do but await the moment for setting fire to them.

"As there is nothing to do," said Nicholl, "I have a proposition to make."

"What is that?" asked Barbicane.

"I propose we go to sleep."

"That is a nice idea!" exclaimed Michel Ardan.

"It is forty hours since we have closed our eyes," said Nicholl. "A few hours' sleep would set us up again."

"Never!" replied Michel.

"Good," said Nicholl; "every man to his humour--mine is to sleep."

And lying down on a divan, Nicholl was soon snoring like a forty-eight pound bullet.

"Nicholl is a sensible man," said Barbicane soon. "I shall imitate him."

A few minutes after he was joining his bass to the captain's baritone.

"Decidedly," said Michel Ardan, when he found himself alone, "these practical people sometimes do have opportune ideas."

And stretching out his long legs, and folding his long arms under his head, Michel went to sleep too.

But this slumber could neither be durable nor peaceful. Too many preoccupations filled the minds of these three men, and a few hours after, at about 7 a.m., they all three awoke at once.

The projectile was still moving away from the moon, inclining its conical summit more and more towards her. This phenomenon was inexplicable at present, but it fortunately aided the designs of Barbicane.

Another seventeen hours and the time for action would have come.

That day seemed long. However bold they might be, the travellers felt much anxiety at the approach of the minute that was to decide everything, either their fall upon the moon or their imprisonment in an immutable orbit. They therefore counted the hours, which went too slowly for them, Barbicane and Nicholl obstinately plunged in calculations, Michel walking up and down the narrow space between the walls contemplating with longing eye the impassible moon.

Sometimes thoughts of the earth passed through their minds. They saw again their friends of the Gun Club, and the dearest of them all, J.T. Maston. At that moment the honourable secretary must have been occupying his post on the Rocky Mountains. If he should perceive the projectile upon the mirror of his gigantic telescope what would he think? After having seen it disappear behind the south pole of the moon, they would see it reappear at the north! It was, therefore, the satellite of a satellite! Had J.T. Maston sent that unexpected announcement into the world? Was this to be the _dénouement_ of the great enterprise?

Meanwhile the day passed without incident. Terrestrial midnight came. The 8th of December was about to commence. Another hour and the point of equal attraction would be reached. What velocity then animated the projectile? They could form no estimate; but no error could vitiate Barbicane's calculations. At 1 a.m. that velocity ought to be and would be *nil*.

Besides, another phenomenon would mark the stopping point of the projectile on the neutral line. In that spot the two attractions, terrestrial and lunar, would be annihilated. Objects would not weigh anything. This singular fact, which had so curiously surprised Barbicane and his companions before, must again come about under identical circumstances. It was at that precise moment they must act.

The conical summit of the bullet had already sensibly turned towards the lunar

disc. The projectile was just right for utilising all the recoil produced by setting fire to the apparatus. Chance was therefore in the travellers' favour. If the velocity of the projectile were to be absolutely annihilated upon the neutral point, a given motion, however slight, towards the moon would determine its fall.

"Five minutes to one," said Nicholl.

"Everything is ready," answered Michel Ardan, directing his match towards the flame of the gas.

"Wait!" said Barbicane, chronometer in hand.

At that moment weight had no effect. The travellers felt its complete disappearance in themselves. They were near the neutral point if they had not reached it.

"One o'clock!" said Barbicane.

Michel Ardan put his match to a contrivance that put all the fuses into instantaneous communication. No detonation was heard outside, where air was wanting, but through the port-lights Barbicane saw the prolonged flame, which was immediately extinguished.

The projectile had a slight shock which was very sensibly felt in the interior.

The three friends looked, listened, without speaking, hardly breathing. The beating of their hearts might have been heard in the absolute silence.

"Are we falling?" asked Michel Ardan at last.

"No," answered Nicholl; "for the bottom of the projectile has not turned towards the lunar disc!"

At that moment Barbicane left his window and turned towards his two companions. He was frightfully pale, his forehead wrinkled, his lips contracted.

"We are falling!" said he.

"Ah!" cried Michel Ardan, "upon the moon?"

"Upon the earth!" answered Barbicane.

"The devil!" cried Michel Ardan; and he added philosophically, "when we entered the bullet we did not think it would be so difficult to get out of it again."

In fact, the frightful fall had begun. The velocity kept by the projectile had sent it beyond the neutral point. The explosion of the fuses had not stopped it. That velocity which had carried the projectile beyond the neutral line as it went was destined to do the same upon its return. The law of physics condemned it, in its elliptical orbit, *to pass by every point it had already passed*.

It was a terrible fall from a height of 78,000 leagues, and which no springs could deaden. According to the laws of ballistics the projectile would strike the earth with a velocity equal to that which animated it as it left the Columbiad--a velocity of "16,000 metres in the last second!"

And in order to give some figures for comparison it has been calculated that an object thrown from the towers of Notre Dame, the altitude of which is only 200 feet, would reach the pavement with a velocity of 120 leagues an hour. Here the projectile would strike the earth with a velocity of 57,600 *leagues an hour*.

"We are lost men," said Nicholl coldly.

"Well, if we die," answered Barbicane, with a sort of religious enthusiasm, "the result of our journey will be magnificently enlarged! God will tell us His own secret! In the other life the soul will need neither machines nor engines in order to know! It will be identified with eternal wisdom!"

"True," replied Michel Ardan: "the other world may well console us for that trifling orb called the moon!"

Barbicane crossed his arms upon his chest with a movement of sublime resignation.

"God's will be done!" he said.

CHAPTER XX

.

THE SOUNDINGS OF THE SUSQUEHANNA.

Well, lieutenant, and what about those soundings?"

"I think the operation is almost over, sir. But who would have expected to find such a depth so near land, at 100 leagues only from the American coast?"

"Yes, Bronsfield, there is a great depression," said Captain Blomsberry. "There exists a submarine valley here, hollowed out by Humboldt's current, which runs along the coasts of America to the Straits of Magellan."

"Those great depths," said the lieutenant, "are not favourable for the laying of telegraph cables. A smooth plateau is the best, like the one the American cable lies on between Valentia and Newfoundland."

"I agree with you, Bronsfield. And, may it please you, lieutenant, where are we now?"

"Sir," answered Bronsfield, "we have at this moment 21,500 feet of line out, and the bullet at the end of the line has not yet touched the bottom, for the sounding-lead would have come up again."

"Brook's apparatus is an ingenious one," said Captain Blomsberry. "It allows us to obtain very correct soundings."

"Touched!" cried at that moment one of the forecastle-men who was superintending the operation.

The captain and lieutenant went on to the forecastle-deck.

"What depth are we in?" asked the captain.

"Twenty-one thousand seven hundred and sixty-two feet," answered the lieutenant, writing it down in his pocket-book.

"Very well, Bronsfield," said the captain, "I will go and mark the result on my chart. Now have the sounding-line brought in--that is a work of several hours. Meanwhile the engineer shall have his fires lighted, and we shall be ready to start as soon as you have done. It is 10 p.m., and with your permission, lieutenant, I shall turn in."

"Certainly, sir, certainly!" answered Lieutenant Bronsfield amiably.

The captain of the Susquehanna, a worthy man if ever there was one, the very humble servant of his officers, went to his cabin, took his brandy-and-water with many expressions of satisfaction to the steward, got into bed, not before complimenting his servant on the way he made beds, and sank into peaceful slumber.

It was then 10 p.m. The eleventh day of the month of December was going to end in a magnificent night.

The Susquehanna, a corvette of 500 horse power, of the United States Navy, was taking soundings in the Pacific at about a hundred leagues from the American coast, abreast of that long peninsula on the coast of New Mexico.

The wind had gradually fallen. There was not the slightest movement in the air. The colours of the corvette hung from the mast motionless and inert.

The captain, Jonathan Blomsberry, cousin-german to Colonel Blomsberry, one of the Gun Club members who had married a Horschbidden, the captain's aunt and daughter of an honourable Kentucky merchant--Captain Blomsberry could not have wished for better weather to execute the delicate operation of sounding. His corvette had felt nothing of that great tempest which swept away the clouds heaped up on the Rocky Mountains, and allowed the course of the famous projectile to be observed. All was going on well, and he did not forget to thank Heaven with all the fervour of a Presbyterian.

The series of soundings executed by the Susquehanna were intended for finding out the most favourable bottoms for the establishment of a submarine cable between the Hawaiian Islands and the American coast.

It was a vast project set on foot by a powerful company. Its director, the intelligent Cyrus Field, meant even to cover all the islands of Oceania with a vast electric network--an immense enterprise worthy of American genius.

It was to the corvette Susquehanna that the first operations of sounding had been entrusted. During the night from the 11th to the 12th of December she was exactly in north lat. 27° 7' and 41° 37' long., west from the Washington meridian.

The moon, then in her last quarter, began to show herself above the horizon.

After Captain Blomsberry's departure, Lieutenant Bronsfield and a few officers were together on the poop. As the moon appeared their thoughts turned towards that orb which the eyes of a whole hemisphere were then contemplating. The best marine glasses could not have discovered the projectile wandering round the demi-globe, and yet they were all pointed at the shining disc which millions of eyes were looking at in the same moment.

"They started ten days ago," then said Lieutenant Bronsfield. "What can have become of them?"

"They have arrived, sir," exclaimed a young midshipman, "and they are doing what all travellers do in a new country, they are looking about them."

"I am certain of it as you say so, my young friend," answered Lieutenant Bronsfield, smiling.

"Still," said another officer, "their arrival cannot be doubted. The projectile must have reached the moon at the moment she was full, at midnight on the 5th. We are now at the 11th of December; that makes six days. Now in six times twenty-four hours, with no darkness, they have had time to get comfortably settled. It seems to me that I see our brave countrymen encamped at the bottom of a valley, on the borders of a Selenite stream, near the projectile, half buried by its fall, amidst volcanic remains, Captain Nicholl beginning his levelling operations, President Barbicane putting his travelling notes in order, Michel Ardan performing the lunar solitudes with his Londrès cigar--"

"Oh, it must be so; it is so!" exclaimed the young midshipman, enthusiastic at the ideal description of his superior.

"I should like to believe it," answered Lieutenant Bronsfield, who was seldom carried away. "Unfortunately direct news from the lunar world will always be wanting."

"Excuse me, sir," said the midshipman, "but cannot President Barbicane write?"

A roar of laughter greeted this answer.

"Not letters," answered the young man quickly. "The post-office has nothing to do with that."

"Perhaps you mean the telegraph-office?" said one of the officers ironically.

"Nor that either," answered the midshipman, who would not give in. "But it is very easy to establish graphic communication with the earth."

"And how, pray?"

"By means of the telescope on Long's Peak. You know that it brings the moon to within two leagues only of the Rocky Mountains, and that it allows them to see objects having nine feet of diameter on her surface. Well, our industrious friends will construct a gigantic alphabet! They will write words 600 feet long, and sentences a league long, and then they can send up news!"

The young midshipman, who certainly had some 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 communications could also be established--in fact, these rays would be as visible on the surface of Venus or Mars as the planet Neptune is from the earth. He ended by saying that the brilliant points already observed on the nearest planets might be signals made to the earth. But he said, that though by these means they could have news from the lunar world, they could not send any from the terrestrial world unless the Selenites have at their disposition instruments with which to make distant observations.

"That is evident," answered one of the officers, "but what has become of the travellers? What have they done? What have they seen? That is what interests us. Besides, if the experiment has succeeded, which I do not doubt, it will be done again. The Columbiad is still walled up in the soil of Florida. It is, therefore, now only a question of powder and shot, and every time the moon passes the zenith we can send it a cargo of visitors."

"It is evident," answered Lieutenant Bronsfield, "that J.T. Maston will go and join his friends one of these days."

"If he will have me," exclaimed the midshipman, "I am ready to go with him."

"Oh, there will be plenty of amateurs, and if they are allowed to go, half the inhabitants of the earth will soon have emigrated to the moon!"

This conversation between the officers of the Susquehanna was kept up till about

1 a.m. It would be impossible to transcribe the overwhelming systems and theories which were emitted by these audacious minds. Since Barbicane's attempt it seemed that nothing was impossible to Americans. They had already formed the project of sending, not another commission of _savants_, but a whole colony, and a whole army of infantry, artillery, and cavalry to conquer the lunar world.

At 1 a.m. the sounding-line was not all hauled in. Ten thousand feet remained out, which would take several more hours to bring in. According to the commander's orders the fires had been lighted, and the pressure was going up already. The Susquehanna might have started at once.

At that very moment--it was 1.17 a.m.--Lieutenant Bronsfield was about to leave his watch to turn in when his attention was attracted by a distant and quite unexpected hissing sound.

His comrades and he at first thought that the hissing came from an escape of steam, but upon lifting up his head he found that it was high up in the air.

They had not time to question each other before the hissing became of frightful intensity, and suddenly to their dazzled eyes appeared an enormous bolis, inflamed by the rapidity of its course, by its friction against the atmospheric strata.

This ignited mass grew huger as it came nearer, and fell with the noise of thunder upon the bowsprit of the corvette, which it smashed off close to the stem, and vanished in the waves.

A few feet nearer and the Susquehanna would have gone down with all on board.

At that moment Captain Blomsberry appeared half-clothed, and rushing in the forecastle, where his officers had preceded him--

"With your permission, gentlemen, what has happened?" he asked.

And the midshipman, making himself the mouthpiece of them all, cried out--

"Commander, it is 'they' come back again."

CHAPTER XXI

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J.T. MASTON CALLED IN.

Emotion was great on board the Susquehanna. Officers and sailors forgot the terrible danger they had just been in--the danger of being crushed and sunk. They only thought of the catastrophe which terminated the journey. Thus, therefore, the moat audacious enterprise of ancient and modern times lost the life of the bold adventurers who had attempted it.

"It is 'they' come back," the young midshipman had said, and they had all understood. No one doubted that the bolis was the projectile of the Gun Club. Opinions were divided about the fate of the travellers.

"They are dead!" said one.

"They are alive," answered the other. "The water is deep here, and the shock has been deadened."

"But they will have no air, and will die suffocated!"

"Burnt!" answered the other. "Their projectile was only an incandescent mass as it crossed the atmosphere."

"What does it matter?" was answered unanimously, "living or dead they must be brought up from there."

Meanwhile Captain Blomsberry had called his officers together, and with their permission he held a council. Something must be done immediately. The most immediate was to haul up the projectile--a difficult operation, but not an impossible one. But the corvette wanted the necessary engines, which would have to be powerful and precise. It was, therefore, resolved to put into the nearest port, and to send word to the Gun Club about the fall of the bullet.

This determination was taken unanimously. The choice of a port was discussed. The neighbouring coast had no harbour on the 27th degree of latitude. Higher up, above the peninsula of Monterey, was the important town which has given its name to it. But, seated on the confines of a veritable desert, it had no telegraphic

communication with the interior, and electricity alone could spread the important news quickly enough.

Some degrees above lay the bay of San Francisco. Through the capital of the Gold Country communication with the centre of the Union would be easy. By putting all steam on, the Susquehanna, in less than two days, could reach the port of San Francisco. She must, therefore, start at once.

The fires were heaped up, and they could set sail immediately. Two thousand fathoms of sounding still remained in the water. Captain Blomsberry would not lose precious time in hauling it in, and resolved to cut the line.

"We will fix the end to a buoy," said he, "and the buoy will indicate the exact point where the projectile fell."

"Besides," answered Lieutenant Bronsfield, "we have our exact bearings: north lat. 27° 7', and west long. 41° 37'."

"Very well, Mr. Bronsfield," answered the captain; "with your permission, have the line cut."

A strong buoy, reinforced by a couple of spars, was thrown out on to the surface of the ocean. The end of the line was solidly struck beneath, and only submitted to the ebb and flow of the surges, so that it would not drift much.

At that moment the engineer came to warn the captain that he had put the pressure on, and they could start. The captain thanked him for his excellent communication. Then he gave N.N.E. as the route. The corvette was put about, and made for the bay of San Francisco with all steam on. It was then 3 a.m.

Two hundred leagues to get over was not much for a quick vessel like the Susquehanna. It got over that distance in thirty-six hours, and on the 14th of December, at 1.27 p.m., she would enter the bay of San Francisco.

At the sight of this vessel of the national navy arriving with all speed on, her bowsprit gone, and her mainmast propped up, public curiosity was singularly excited. A compact crowd was soon assembled on the quays awaiting the landing.

After weighing anchor Captain Blomsberry and Lieutenant Bronsfield got down

into an eight-oared boat which carried them rapidly to the land.

They jumped out on the quay.

"The telegraph-office?" they asked, without answering one of the thousand questions that were showered upon them.

The port inspector guided them himself to the telegraph-office, amidst an immense crowd of curious people.

Blomsberry and Bronsfield went into the office whilst the crowd crushed against the door.

A few minutes later one message was sent in four different directions:--1st, to the Secretary of the Navy, Washington; 2nd, to the Vice-President of the Gun Club, Baltimore; 3rd, to the Honourable J.T. Maston, Long's Peak, Rocky Mountains; 4th, to the Sub-Director of the Cambridge Observatory, Massachusetts.

It ran as follows:--

"In north lat. 20° 7', and west long. 41° 37', the projectile of the Columbiad fell into the Pacific, on December 12th, at 1.17 am. Send instructions.--BLOMSBERRY, Commander Susquehanna."

Five minutes afterwards the whole town of San Francisco knew the tidings. Before 6 p.m. the different States of the Union had intelligence of the supreme catastrophe. After midnight, through the cable, the whole of Europe knew the result of the great American enterprise.

It would be impossible to describe the effect produced throughout the world by the unexpected news.

On receipt of the telegram the Secretary of the Navy telegraphed to the Susquehanna to keep under fire, and wait in the bay of San Francisco. She was to be ready to set sail day or night.

The Observatory of Cambridge had an extraordinary meeting, and, with the serenity which distinguishes scientific bodies, it peacefully discussed the scientific part of the question.

At the Gun Club there was an explosion. All the artillerymen were assembled. The Vice-President, the Honourable Wilcome, was just reading the premature telegram by which Messrs. Maston and Belfast announced that the projectile had just been perceived in the gigantic reflector of Long's Peak. This communication informed them also that the bullet, retained by the attraction of the moon, was playing the part of sub-satellite in the solar world.

The truth on this subject is now known.

However, upon the arrival of Blomsberry's message, which so formally contradicted J.T. Maston's telegram, two parties were formed in the bosom of the Gun Club. On the one side were members who admitted the fall of the projectile, and consequently the return of the travellers. On the other were those who, holding by the observations at Long's Peak, concluded that the commander of the Susquehanna was mistaken. According to the latter, the pretended projectile was only a bolis, nothing but a bolis, a shooting star, which in its fall had fractured the corvette. Their argument could not very well be answered, because the velocity with which it was endowed had made its observation very difficult. The commander of the Susquehanna and his officers might certainly have been mistaken in good faith. One argument certainly was in their favour: if the projectile had fallen on the earth it must have touched the terrestrial spheroid upon the 27th degree of north latitude, and, taking into account the time that had elapsed, and the earth's movement of rotation, between the 41st and 42nd degree of west longitude.

However that might be, it was unanimously decided in the Gun Club that Blomsberry's brother Bilsby and Major Elphinstone should start at once for San Francisco and give their advice about the means of dragging up the projectile from the depths of the ocean.

These men started without losing an instant, and the railway which was soon to cross the whole of Central America took them to St. Louis, where rapid mail-coaches awaited them.

Almost at the same moment that the Secretary of the Navy, the Vice-President of the Gun Club, and the Sub-Director of the Observatory received the telegram from San Francisco, the Honourable J.T. Maston felt the most violent emotion of his whole existence--an emotion not even equalled by that he had experienced when his celebrated cannon was blown up, and which, like it, nearly cost him his

life.

It will be remembered that the Secretary of the Gun Club had started some minutes after the projectile--and almost as quickly--for the station of Long's Peak in the Rocky Mountains. The learned J. Belfast, Director of the Cambridge Observatory, accompanied him. Arrived at the station the two friends had summarily installed themselves, and no longer left the summit of their enormous telescope.

We know that this gigantic instrument had been set up on the reflecting system, called "front view" by the English. This arrangement only gave one reflection of objects, and consequently made the view much clearer. The result was that J.T. Maston and Belfast, whilst observing, were stationed in the upper part of the instrument instead of in the lower. They reached it by a twisted staircase, a masterpiece of lightness, and below them lay the metal, well terminated by the metallic mirror, 280 feet deep.

Now it was upon the narrow platform placed round the telescope that the two *savants* passed their existence, cursing the daylight which hid the moon from their eyes, and the clouds which obstinately veiled her at night.

Who can depict their delight when, after waiting several days, during the night of December 5th they perceived the vehicle that was carrying their friends through space? To that delight succeeded deep disappointment when, trusting to incomplete observations, they sent out with their first telegram to the world the erroneous affirmation that the projectile had become a satellite of the moon gravitating in an immutable orbit.

After that instant the bullet disappeared behind the invisible disc of the moon. But when it ought to have reappeared on the invisible disc the impatience of J.T. Maston and his no less impatient companion may be imagined. At every minute of the night they thought they should see the projectile again, and they did not see it. Hence between them arose endless discussions and violent disputes, Belfast affirming that the projectile was not visible, J.T. Maston affirming that any one but a blind man could see it.

"It is the bullet!" repeated J.T. Maston.

"No!" answered Belfast, "it is an avalanche falling from a lunar mountain!"

"Well, then, we shall see it to-morrow."

"No, it will be seen no more. It is carried away into space."

"We shall see it, I tell you."

"No, we shall not."

And while these interjections were being showered like hail, the well-known irritability of the Secretary of the Gun Club constituted a permanent danger to the director, Belfast.

Their existence together would soon have become impossible, but an unexpected event cut short these eternal discussions.

During the night between the 14th and 15th of December the two irreconcilable friends were occupied in observing the lunar disc. J.T. Maston was, as usual, saying strong things to the learned Belfast, who was getting angry too. The Secretary of the Gun Club declared for the thousandth time that he had just perceived the projectile, adding even that Michel Ardan's face had appeared at one of the port-lights. He was emphasising his arguments by a series of gestures which his redoubtable hook rendered dangerous.

At that moment Belfast's servant appeared upon the platform--it was 10 p.m.--and gave him a telegram. It was the message from the Commander of the Susquehanna.

Belfast tore the envelope, read the inclosure, and uttered a cry.

"What is it?" said J.T. Maston.

"It's the bullet!"

"What of that?"

"It has fallen upon the earth!"

Another cry; this time a howl answered him.

He turned towards J.T. Maston. The unfortunate fellow, leaning imprudently

over the metal tube, had disappeared down the immense telescope--a fall of 280 feet! Belfast, distracted, rushed towards the orifice of the reflector.

He breathed again. J.T. Maston's steel hook had caught in one of the props which maintained the platform of the telescope. He was uttering formidable cries.

Belfast called. Help came, and the imprudent secretary was hoisted up, not without trouble.

He reappeared unhurt at the upper orifice.

"Suppose I had broken the mirror?" said he.

"You would have paid for it," answered Belfast severely.

"And where has the infernal bullet fallen?" asked J.T. Maston.

"Into the Pacific."

"Let us start at once."

A quarter of an hour afterwards the two learned friends were descending the slope of the Rocky Mountains, and two days afterwards they reached San Francisco at the same time as their friends of the Gun Club, having killed five horses on the road.

Elphinstone, Blomsberry, and Bilsby rushed up to them upon their arrival.

"What is to be done?" they exclaimed.

"The bullet must be fished up," answered J.T. Maston, "and as soon as possible!"

CHAPTER XXII

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PICKED UP.

The very spot where the projectile had disappeared under the waves was exactly

known. The instruments for seizing it and bringing it to the surface of the ocean were still wanting. They had to be invented and then manufactured. American engineers could not be embarrassed by such a trifle. The grappling-irons once established and steam helping, they were assured of raising the projectile, notwithstanding its weight, which diminished the density of the liquid amidst which it was plunged.

But it was not enough to fish up the bullet. It was necessary to act promptly in the interest of the travellers. No one doubted that they were still living.

"Yes," repeated J.T. Maston incessantly, whose confidence inspired everybody, "our friends are clever fellows, and they cannot have fallen like imbeciles. They are alive, alive and well, but we must make haste in order to find them so. He had no anxiety about provisions and water. They had enough for a long time! But air!--air would soon fail them. Then they must make haste!"

And they did make haste. They prepared the Susquehanna for her new destination. Her powerful engines were arranged to be used for the hauling machines. The aluminium projectile only weighed 19,250 lbs., a much less weight than that of the transatlantic cable, which was picked up under similar circumstances. The only difficulty lay in the smooth sides of the cylindro-conical bullet, which made it difficult to grapple.

With that end in view the engineer Murchison, summoned to San Francisco, caused enormous grappling-irons to be fitted upon an automatical system which would not let the projectile go again if they succeeded in seizing it with their powerful pincers. He also had some diving-dresses prepared, which, by their impermeable and resisting texture, allowed divers to survey the bottom of the sea. He likewise embarked on board the Susquehanna apparatuses for compressed air, very ingeniously contrived. They were veritable rooms, with port-lights in them, and which, by introducing the water into certain compartments, could be sunk to great depths. These apparatuses were already at San Francisco, where they had been used in the construction of a submarine dyke. This was fortunate, for there would not have been time to make them.

Yet notwithstanding the perfection of the apparatus, notwithstanding the ingenuity of the *savants* who were to use them, the success of the operation was anything but assured. Fishing up a bullet from 20,000 feet under water must be an uncertain operation. And even if the bullet should again be brought to the

surface, how had the travellers borne the terrible shock that even 20,000 feet of water would not sufficiently deaden?

In short, everything must be done quickly. J.T. Maston hurried on his workmen day and night. He was ready either to buckle on the diver's dress or to try the air-apparatus in order to find his courageous friends.

Still, notwithstanding the diligence with which the different machines were got ready, notwithstanding the considerable sums which were placed at the disposition of the Gun Club by the Government of the Union, five long days (five centuries) went by before the preparations were completed. During that time public opinion was excited to the highest point. Telegrams were incessantly exchanged all over the world through the electric wires and cables. The saving of Barbicane, Nicholl, and Michel Ardan became an international business. All the nations that had subscribed to the enterprise of the Gun Club were equally interested in the safety of the travellers.

At last the grappling-chains, air-chambers, and automatic grappling-irons were embarked on board the Susquehanna. J.T. Maston, the engineer Murchison, and the Gun Club delegates already occupied their cabins. There was nothing to do but to start.

On the 21st of December, at 8 p.m., the corvette set sail on a calm sea with a rather cold north-east wind blowing. All the population of San Francisco crowded on to the quays, mute and anxious, reserving its hurrahs for the return.

The steam was put on to its maximum of tension, and the screw of the Susquehanna carried it rapidly out of the bay.

It would be useless to relate the conversations on board amongst the officers, sailors, and passengers. All these men had but one thought. Their hearts all beat with the same emotion. What were Barbicane and his companions doing whilst they were hastening to their succour? What had become of them? Had they been able to attempt some audacious manoeuvre to recover their liberty? No one could say. The truth is that any attempt would have failed. Sunk to nearly two leagues under the ocean, their metal prison would defy any effort of its prisoners.

On the 23rd of December, at 8 a.m., after a rapid passage, the Susquehanna ought to be on the scene of the disaster. They were obliged to wait till twelve o'clock to take their exact bearings. The buoy fastened on to the sounding-line

had not yet been seen.

At noon Captain Blomsberry, helped by his officers, who controlled the observation, made his point in presence of the delegates of the Gun Club. That was an anxious moment. The Susquehanna was found to be at some minutes west of the very spot where the projectile had disappeared under the waves.

The direction of the corvette was therefore given in view of reaching the precise spot.

At 12.47 p.m. the buoy was sighted. It was in perfect order, and did not seem to have drifted far.

"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 perfectly motionless.

Before trying to grapple the projectile, the engineer, Murchison, wished to find out its exact position on the sea-bottom. The submarine apparatus destined for this search received their provision of air. The handling of these engines is not without danger, for at 20,000 feet below the surface of the water and under such great pressure they are exposed to ruptures the consequences of which would be terrible.

J.T. Maston, the commander's brother, and the engineer Murchison, without a thought of these dangers, took their places in the air-chambers. The commander, on his foot-bridge, presided over the operation, ready to stop or haul in his chains at the least signal. The screw had been taken off, and all the force of the machines upon the windlass would soon have brought up the apparatus on board.

The descent began at 1.25 p.m., and the chamber, dragged down by its reservoirs filled with water, disappeared under 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 of the submarine apparatus. These latter forgot themselves, and, glued to the panes of the port-lights, they

attentively observed the liquid masses they were passing through.

The descent was rapid. At 2.17 p.m. J.T. Maston and his companions had reached the bottom of the Pacific; but they saw nothing except the arid desert which neither marine flora nor fauna any longer animated. By the light of their lamps, furnished with powerful reflectors, they could observe the dark layers of water in a rather large radius, but the projectile remained invisible in their eyes.

The impatience of these bold divers could hardly be described. Their apparatus being in electric communication with the corvette, they made a signal agreed upon, and the Susquehanna carried their chamber over a mile of space at one yard from the soil.

They thus explored all the submarine plain, deceived at every instant by optical delusions which cut them to the heart. Here a rock, there a swelling of the ground, looked to them like the much-sought-for projectile; then they would soon find out their error and despair again.

"Where are they? Where can they be?" cried J.T. Maston.

And the poor man called aloud to Nicholl, Barbicane, and Michel Ardan, as if his unfortunate friends could have heard him through that impenetrable medium!

The search went on under those conditions until the vitiated state of the air in the apparatus forced the divers to go up again.

The hauling in was begun at 6 p.m., and was not terminated before midnight.

"We will try again to-morrow," said J.T. Maston as he stepped on to the deck of the corvette.

"Yes," answered Captain Blomsberry.

"And in another place."

"Yes."

J.T. Maston did not yet doubt of his ultimate success, but his companions, who were no longer intoxicated with the animation of the first few hours, already took in all the difficulties of the enterprise. What seemed easy at San Francisco

in open ocean appeared almost impossible. The chances of success diminished in a large proportion, and it was to chance alone that the finding of the projectile had to be left.

The next day, the 24th of December, notwithstanding the fatigues of the preceding day, operations were resumed. The corvette moved some minutes farther west, and the apparatus, provisioned with air again, took the same explorers to the depths of the ocean.

All that day was passed in a fruitless search. The bed of the sea was a desert. The day of the 25th brought no result, neither did that of the 26th.

It was disheartening. They thought of the unfortunate men shut up for twenty-six days in the projectile. Perhaps they were all feeling the first symptoms of suffocation, even if they had escaped the dangers of their fall. The air was getting exhausted, and doubtless with the air their courage and spirits.

"The air very likely, but their courage never," said J.T. Maston.

On the 28th, after two days' search, all hope was lost. This bullet was an atom in the immensity of the sea! They must give up the hope of finding it.

Still J.T. Maston would not hear about leaving. He would not abandon the place without having at least found the tomb of his friends. But Captain Blomsberry could not stay on obstinately, and notwithstanding the opposition of the worthy secretary, he was obliged to give orders to set sail.

On the 29th of December, at 9 a.m., the Susquehanna, heading north-east, began to return to the bay of San Francisco.

It was 10 a.m. The corvette was leaving slowly and as if with regret the scene of the catastrophe, when the sailor at the masthead, who was on the look-out, called out all at once--

"A buoy on the lee bow!"

The officers looked in the direction indicated. They saw through their telescopes the object signalled, which did look like one of those buoys used for marking the openings of bays or rivers; but, unlike them, a flag floating in the wind surmounted a cone which emerged five or six feet. This buoy shone in the

sunshine as if made of plates of silver.

The commander, Blomsberry, J.T. Maston, and the delegates of the Gun Club ascended the foot-bridge and examined the object thus drifting on the waves.

All looked with feverish anxiety, but in silence. None of them dared utter the thought that came into all their minds.

The corvette approached to within two cables' length of the object.

A shudder ran through the whole crew.

The flag was an American one!

At that moment a veritable roar was heard. It was the worthy J.T. Maston, who had fallen in a heap; forgetting on the one hand that he had only an iron hook for one arm, and on the other that a simple gutta-percha cap covered his cranium-box, he had given himself a formidable blow.

They rushed towards him and picked him up. They recalled him to life. And what were his first words?

"Ah! triple brutes! quadruple idiots! quintuple boobies that we are!"

"What is the matter?" every one round him exclaimed.

"What the matter is?"

"Speak, can't you?"

"It is, imbeciles," shouted the terrible secretary, "it is the bullet only weighs 19,250 lbs!"

"Well?"

"And it displaces 28 tons, or 56,000 lbs., consequently _it floats_!"

Ah! how that worthy man did underline the verb "to float!" And it was the truth! All, yes! all these *savants* had forgotten this fundamental law, that in consequence of its specific lightness the projectile, after having been dragged by its fall to the greatest depths of the ocean, had naturally returned to the surface;

and now it was floating tranquilly whichever way the wind carried them.

The boats had been lowered. J.T. Maston and his friends rushed into them. The excitement was at its highest point. All hearts palpitated whilst the boats rowed towards the projectile. What did it contain--the living or the dead? The living. Yes! unless death had struck down Barbicane and his companions since they had hoisted the flag!

Profound silence reigned in the boats. All hearts stopped beating. Eyes no longer performed their office. One of the port-lights of the projectile was opened. Some pieces of glass remaining in the frame proved that it had been broken. This port-light was situated actually five feet above water.

A boat drew alongside--that of J.T. Maston. He rushed to the broken window.

At that moment the joyful and clear voice of Michel Ardan was heard exclaiming in the accents of victory--"Double blank, Barbicane, double blank!"

Barbicane, Michel Ardan, and Nicholl were playing at dominoes.

CHAPTER XXIII

.

THE END.

It will be remembered that immense sympathy accompanied the three travellers upon their departure. If the beginning of their enterprise had caused such excitement in the old and new world, what enthusiasm must welcome their return! Would not those millions of spectators who had invaded the Floridian peninsula rush to meet the sublime adventurers? Would those legions of foreigners from all points of the globe, now in America, leave the Union without seeing Barbicane, Nicholl, and Michel Ardan once more? No, and the ardent passion of the public would worthily respond to the grandeur of the enterprise. Human beings who had left the terrestrial spheroid, who had returned after their strange journey into celestial space, could not fail to be received like the prophet Elijah when he returned to the earth. To see them first, to hear them afterwards, was the general desire.

This desire was to be very promptly realised by almost all the inhabitants of the Union.

Barbicane, Michel Ardan, Nicholl, and the delegates of the Gun Club returned without delay to Baltimore, and were there received with indescribable enthusiasm. The president's travelling notes were ready to be given up for publicity. The *New York Herald* bought this manuscript at a price which is not yet known, but which must have been enormous. In fact, during the publication of the *Journey to the Moon* they printed 5,000,000 copies of that newspaper. Three days after the travellers' return to the earth the least details of their expedition were known. The only thing remaining to be done was to see the heroes of this superhuman enterprise.

The exploration of Barbicane and his friends around the moon had allowed them to control the different theories about the terrestrial satellite. These *savants* had observed it *de visu* and under quite peculiar circumstances. It was now known which systems were to be rejected, which admitted, upon the formation of this orb, its origin, and its inhabitability. Its past, present, and future had given up their secrets. What could be objected to conscientious observations made at less than forty miles from that curious mountain of Tycho, the strangest mountain system of lunar orography? What answers could be made to *savants* who had looked into the dark depths of the amphitheatre of Pluto? Who could contradict these audacious men whom the hazards of their enterprise had carried over the invisible disc of the moon, which no human eye had ever seen before? It was now their prerogative to impose the limits of that selenographic science which had built up the lunar world like Cuvier did the skeleton of a fossil, and to say, "The moon was this, a world inhabitable and inhabited anterior to the earth! The moon is this, a world now uninhabitable and uninhabited!"

In order to welcome the return of the most illustrious of its members and his two companions, the Gun Club thought of giving them a banquet; but a banquet worthy of them, worthy of the American people, and under such circumstances that all the inhabitants of the Union could take a direct part in it.

All the termini of the railroads in the State were joined together by movable rails. Then, in all the stations hung with the same flags, decorated with the same ornaments, were spread tables uniformly dressed. At a certain time, severely calculated upon electric clocks which beat the seconds at the same instant, the inhabitants were invited to take their places at the same banquet.

During four days, from the 5th to the 9th of January, the trains were suspended like they are on Sundays upon the railways of the Union, and all the lines were free.

One locomotive alone, a very fast engine, dragging a state saloon, had the right of circulating, during these four days, upon the railways of the United States.

This locomotive, conducted by a stoker and a mechanic, carried, by a great favour, the Honourable J.T. Maston, Secretary of the Gun Club.

The saloon was reserved for President Barbicane, Captain Nicholl, and Michel Ardan.

The train left the station of Baltimore upon the whistle of the engine-driver amidst the hurrahs and all the admiring interjections of the American language. It went at the speed of eighty leagues an hour. But what was that speed compared to the one with which the three heroes had left the Columbiad?

Thus they went from one town to another, finding the population in crowds upon their passage saluting them with the same acclamations, and showering upon them the same "bravoes." They thus travelled over the east of the Union through Pennsylvania, Connecticut, Massachusetts, Vermont, Maine, and New Brunswick; north and west through New York, Ohio, Michigan, and Wisconsin; south through Illinois, Missouri, Arkansas, Texas, and Louisiana; south-east through Alabama and Florida, Georgia, and the Carolinas; they visited the centre through Tennessee, Kentucky, Virginia, and Indiana; then after the station of Washington they re-entered Baltimore, and during four days they could imagine that the United States of America, seated at one immense banquet, saluted them simultaneously with the same hurrahs.

This apotheosis was worthy of these heroes, whom fable would have placed in the ranks of demigods.

And now would this attempt, without precedent in the annals of travels, have any practical result? Would direct communication ever be established with the moon? Would a service of navigation ever be founded across space for the solar world? Will people ever go from planet to planet, from Jupiter to Mercury, and later on from one star to another, from the Polar star to Sirius, would a method of locomotion allow of visiting the suns which swarm in the firmament?

No answer can be given to these questions, but knowing the audacious ingenuity of the Anglo-Saxon race, no one will be astonished that the Americans tried to turn President Barbicane's experiment to account.

Thus some time after the return of the travellers the public received with marked favour the advertisement of a Joint-Stock Company (Limited), with a capital of a hundred million dollars, divided into a hundred thousand shares of a thousand dollars each, under the name of _National Company for Interstellar Communication_--President, Barbicane; Vice-President, Captain Nicholl; Secretary, J.T. Maston; Director, Michel Ardan--and as it is customary in America to foresee everything in business, even bankruptcy, the Honourable Harry Trollope, Commissary Judge, and Francis Dayton were appointed beforehand assignees.

THE END.

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