

CHAPTER XII.

A BIRD'S EYE VIEW OF THE LUNAR MOUNTAINS.

I am rather inclined to believe myself that not one word of Ardan's rhapsody had been ever heard by Barbican or M'Nicholl. Long before he had spoken his last words, they had once more become mute as statues, and now were both eagerly watching, pencil in hand, spyglass to eye, the northern lunar hemisphere towards which they were rapidly but indirectly approaching. They had fully made up their minds by this time that they were leaving far behind them the central point which they would have probably reached half an hour ago if they had not been shunted off their course by that inopportune bolide.

About half past twelve o'clock, Barbican broke the dead silence by saying that after a careful calculation they were now only about 875 miles from the Moon's surface, a distance two hundred miles less in length than the lunar radius, and which was still to be diminished as they advanced further north. They were at that moment ten degrees north of the equator, almost directly over the ridge lying between the Mare Serenitatis and the Mare Tranquillitatis. From this latitude all the way up to the north pole the travellers enjoyed a most satisfactory view of the Moon in all directions and under the most favorable conditions. By means of their spyglasses, magnifying a hundred times, they cut down this distance of 875 miles to about 9. The great telescope of the Rocky Mountains, by its enormous magnifying power of 48,000, brought the Moon,

it is true, within a distance of 5 miles, or nearly twice as near; but this advantage of nearness was considerably more than counterbalanced by a want of clearness, resulting from the haziness and refractiveness of the terrestrial atmosphere, not to mention those fatal defects in the reflector that the art of man has not yet succeeded in remedying. Accordingly, our travellers, armed with excellent telescopes--of just power enough to be no injury to clearness,--and posted on unequalled vantage ground, began already to distinguish certain details that had probably never been noticed before by terrestrial observers. Even Ardan, by this time quite recovered from his fit of sentiment and probably infected a little by the scientific enthusiasm of his companions, began to observe and note and observe and note, alternately, with all the sangfroid of a veteran astronomer.

"Friends," said Barbican, again interrupting a silence that had lasted perhaps ten minutes, "whither we are going I can't say; if we shall ever revisit the Earth, I can't tell. Still, it is our duty so to act in all respects as if these labors of ours were one day to be of service to our fellow-creatures. Let us keep our souls free from every distraction. We are now astronomers. We see now what no mortal eye has ever gazed on before. This Projectile is simply a work room of the great Cambridge Observatory lifted into space. Let us take observations!"

With these words, he set to work with a renewed ardor, in which his companions fully participated. The consequence was that they soon had several of the outline maps covered with the best sketches they could make of the Moon's various aspects thus presented under such favorable

circumstances. They could now remark not only that they were passing the tenth degree of north latitude, but that the Projectile followed almost directly the twentieth degree of east longitude.

"One thing always puzzled me when examining maps of the Moon," observed Ardan, "and I can't say that I see it yet as clearly as if I had thought over the matter. It is this. I could understand, when looking through a lens at an object, why we get only its reversed image--a simple law of optics explains that. Therefore, in a map of the Moon, as the bottom means the north and the top the south, why does not the right mean the west and the left the east? I suppose I could have made this out by a little thought, but thinking, that is reflection, not being my forte, it is the last thing I ever care to do. Barbican, throw me a word or two on the subject."

"I can see what troubles you," answered Barbican, "but I can also see that one moment's reflection would have put an end to your perplexity. On ordinary maps of the Earth's surface when the north is the top, the right hand must be the east, the left hand the west, and so on. That is simply because we look down from above. And such a map seen through a lens will appear reversed in all respects. But in looking at the Moon, that is up from down, we change our position so far that our right hand points west and our left east. Consequently, in our reversed map, though the north becomes south, the right remains east, and--"

"Enough said! I see it at a glance! Thank you, Barbican. Why did not they make you a professor of astronomy? Your hint will save me a world

of trouble."[C]

Aided by the *Mappa Selenographica*, the travellers could easily recognize the different portions of the Moon over which they were now moving. An occasional glance at our reduction of this map, given as a frontispiece, will enable the gentle reader to follow the travellers on the line in which they moved and to understand the remarks and observations in which they occasionally indulged.

"Where are we now?" asked Ardan.

"Over the northern shores of the Mare Nubium," replied Barbican. "But we are still too far off to see with any certainty what they are like. What is the Mare itself? A sea, according to the early astronomers? a plain of solid sand, according to later authority? or an immense forest, according to De la Rue of London, so far the Moon's most successful photographer? This gentleman's authority, Ardan, would have given you decided support in your famous dispute with the Captain at the meeting near Tampa, for he says very decidedly that the Moon has an atmosphere, very low to be sure but very dense. This, however, we must find out for ourselves; and in the meantime let us affirm nothing until we have good grounds for positive assertion."

Mare Nubium, though not very clearly outlined on the maps, is easily recognized by lying directly east of the regions about the centre. It would appear as if this vast plain were sprinkled with immense lava blocks shot forth from the great volcanoes on the right, Ptolemaeus,

Alphonse, Alpetragius and Arzachel. But the Projectile advanced so rapidly that these mountains soon disappeared, and the travellers were not long before they could distinguish the great peaks that closed the "Sea" on its northern boundary. Here a radiating mountain showed a summit so dazzling with the reflection of the solar rays that Ardan could not help crying out:

"It looks like one of the carbon points of an electric light projected on a screen! What do you call it, Barbican?"

"Copernicus," replied the President. "Let us examine old Copernicus!"

This grand crater is deservedly considered one of the greatest of the lunar wonders. It lifts its giant ramparts to upwards of 12,000 feet above the level of the lunar surface. Being quite visible from the Earth and well situated for observation, it is a favorite object for astronomical study; this is particularly the case during the phase existing between Last Quarter and the New Moon, when its vast shadows, projected boldly from the east towards the west, allow its prodigious dimensions to be measured.

After Tycho, which is situated in the southern hemisphere, Copernicus forms the most important radiating mountain in the lunar disc. It looms up, single and isolated, like a gigantic light-house, on the peninsula separating Mare Nubium from Oceanus Procellarum on one side and from Mare Imbrium on the other; thus illuminating with its

splendid radiation three "Seas" at a time. The wonderful complexity of its bright streaks diverging on all sides from its centre presented a scene alike splendid and unique. These streaks, the travellers thought, could be traced further north than in any other direction: they fancied they could detect them even in the Mare Imbrium, but this of course might be owing to the point from which they made their observations. At one o'clock in the morning, the Projectile, flying through space, was exactly over this magnificent mountain.

In spite of the brilliant sunlight that was blazing around them, the travellers could easily recognize the peculiar features of Copernicus. It belongs to those ring mountains of the first class called Circuses. Like Kepler and Aristarchus, who rule over Oceanus Procellarum, Copernicus, when viewed through our telescopes, sometimes glistens so brightly through the ashy light of the Moon that it has been frequently taken for a volcano in full activity. Whatever it may have been once, however, it is certainly nothing more now than, like all the other mountains on the visible side of the Moon, an extinct volcano, only with a crater of such exceeding grandeur and sublimity as to throw utterly into the shade everything like it on our Earth. The crater of Etna is at most little more than a mile across. The crater of Copernicus has a diameter of at least 50 miles. Within it, the travellers could easily discover by their glasses an immense number of terraced ridges, probably landslips, alternating with stratifications resulting from successive eruptions. Here and there, but particularly in the southern side, they caught glimpses of shadows of such intense blackness, projected across the plateau and lying there like pitch spots, that they could not tell

them from yawning chasms of incalculable depth. Outside the crater the shadows were almost as deep, whilst on the plains all around, particularly in the west, so many small craters could be detected that the eye in vain attempted to count them.

"Many circular mountains of this kind," observed Barbican, "can be seen on the lunar surface, but Copernicus, though not one of the greatest, is one of the most remarkable on account of those diverging streaks of bright light that you see radiating from its summit. By looking steadily into its crater, you can see more cones than mortal eye ever lit on before. They are so numerous as to render the interior plateau quite rugged, and were formerly so many openings giving vent to fire and volcanic matter. A curious and very common arrangement of this internal plateau of lunar craters is its lying at a lower level than the external plains, quite the contrary to a terrestrial crater, which generally has its bottom much higher than the level of the surrounding country. It follows therefore that the deep lying curve of the bottom of these ring mountains would give a sphere with a diameter somewhat smaller than the Moon's."

"What can be the cause of this peculiarity?" asked M'Nicholl.

"I can't tell;" answered Barbican, "but, as a conjecture, I should say that it is probably to the comparatively smaller area of the Moon and the more violent character of her volcanic action that the extremely rugged character of her surface is mainly due."

"Why, it's the Campi Phlegraei or the Fire Fields of Naples over again!" cried Ardan suddenly. "There's Monte Barbaro, there's the Solfatara, there is the crater of Astroni, and there is the Monte Nuovo, as plain as the hand on my body!"

"The great resemblance between the region you speak of and the general surface of the Moon has been often remarked;" observed Barbican, "but it is even still more striking in the neighborhood of Theophilus on the borders of Mare Nectaris."

"That's Mare Nectaris, the gray spot over there on the southwest, isn't it?" asked M'Nicholl; "is there any likelihood of our getting a better view of it?"

"Not the slightest," answered Barbican, "unless we go round the Moon and return this way, like a satellite describing its orbit."

By this time they had arrived at a point vertical to the mountain centre. Copernicus's vast ramparts formed a perfect circle or rather a pair of concentric circles. All around the mountain extended a dark grayish plain of savage aspect, on which the peak shadows projected themselves in sharp relief. In the gloomy bottom of the crater, whose dimensions are vast enough to swallow Mont Blanc body and bones, could be distinguished a magnificent group of cones, at least half a mile in height and glittering like piles of crystal. Towards the north several breaches could be seen in the ramparts, due probably to a caving in of immense masses accumulated on the summit of the precipitous walls.

As already observed, the surrounding plains were dotted with numberless craters mostly of small dimensions, except Gay Lussac on the north, whose crater was about 12 miles in diameter. Towards the southwest and the immediate east, the plain appeared to be very flat, no protuberance, no prominence of any kind lifting itself above the general dead level. Towards the north, on the contrary, as far as where the peninsula jutted on Oceanus Procellarum, the plain looked like a sea of lava wildly lashed for a while by a furious hurricane and then, when its waves and breakers and driving ridges were at their wildest, suddenly frozen into solidity. Over this rugged, rumped, wrinkled surface and in all directions, ran the wonderful streaks whose radiating point appeared to be the summit of Copernicus. Many of them appeared to be ten miles wide and hundreds of miles in length.

The travellers disputed for some time on the origin of these strange radii, but could hardly be said to have arrived at any conclusion more satisfactory than that already reached by some terrestrial observers.

To M'Nicholl's question:

"Why can't these streaks be simply prolonged mountain crests reflecting the sun's rays more vividly by their superior altitude and comparative smoothness?"

Barbican readily replied:

"These streaks can't be mountain crests, because, if they were, under certain conditions of solar illumination they should project shadows--a thing which they have never been known to do under any circumstances whatever. In fact, it is only during the period of the full Moon that these streaks are seen at all; as soon as the sun's rays become oblique, they disappear altogether--a proof that their appearance is due altogether to peculiar advantages in their surface for the reflection of light."

"Dear boys, will you allow me to give my little guess on the subject?" asked Ardan.

His companions were profuse in expressing their desire to hear it.

"Well then," he resumed, "seeing that these bright streaks invariably start from a certain point to radiate in all directions, why not suppose them to be streams of lava issuing from the crater and flowing down the mountain side until they cooled?"

"Such a supposition or something like it has been put forth by Herschel," replied Barbican; "but your own sense will convince you that it is quite untenable when you consider that lava, however hot and liquid it may be at the commencement of its journey, cannot flow on for hundreds of miles, up hills, across ravines, and over plains, all the time in streams of almost exactly equal width."

"That theory of yours holds no more water than mine, Ardan," observed

M'Nicholl.

"Correct, Captain," replied the Frenchman; "Barbican has a trick of knocking the bottom out of every weaker vessel. But let us hear what he has to say on the subject himself. What is your theory. Barbican?"

"My theory," said Barbican, "is pretty much the same as that lately presented by an English astronomer, Nasmyth, who has devoted much study and reflection to lunar matters. Of course, I only formulate my theory, I don't affirm it. These streaks are cracks, made in the Moon's surface by cooling or by shrinkage, through which volcanic matter has been forced up by internal pressure. The sinking ice of a frozen lake, when meeting with some sharp pointed rock, cracks in a radiating manner: every one of its fissures then admits the water, which immediately spreads laterally over the ice pretty much as the lava spreads itself over the lunar surface. This theory accounts for the radiating nature of the streaks, their great and nearly equal thickness, their immense length, their inability to cast a shadow, and their invisibility at any time except at or near the Full Moon. Still it is nothing but a theory, and I don't deny that serious objections may be brought against it."

"Do you know, dear boys," cried Ardan, led off as usual by the slightest fancy, "do you know what I am thinking of when I look down on the great rugged plains spread out beneath us?"

"I can't say, I'm sure," replied Barbican, somewhat piqued at the little attention he had secured for his theory.

"Well, what are you thinking of?" asked M'Nicholl.

"Spillikins!" answered Ardan triumphantly.

"Spillikins?" cried his companions, somewhat surprised.

"Yes, Spillikins! These rocks, these blocks, these peaks, these streaks, these cones, these cracks, these ramparts, these escarpments,--what are they but a set of spillikins, though I acknowledge on a grand scale? I wish I had a little hook to pull them one by one!"

"Oh, do be serious, Ardan!" cried Barbican, a little impatiently.

"Certainly," replied Ardan. "Let us be serious, Captain, since seriousness best befits the subject in hand. What do you think of another comparison? Does not this plain look like an immense battle field piled with the bleaching bones of myriads who had slaughtered each other to a man at the bidding of some mighty Caesar? What do you think of that lofty comparison, hey?"

"It is quite on a par with the other," muttered Barbican.

"He's hard to please, Captain," continued Ardan, "but let us try him again! Does not this plain look like--?"

"My worthy friend," interrupted Barbican, quietly, but in a tone to

discourage further discussion, "what you think the plain looks like is of very slight import, as long as you know no more than a child what it really is!"

"Bravo, Barbican! well put!" cried the irrepressible Frenchman. "Shall I ever realize the absurdity of my entering into an argument with a scientist!"

But this time the Projectile, though advancing northward with a pretty uniform velocity, had neither gained nor lost in its nearness to the lunar disc. Each moment altering the character of the fleeting landscape beneath them, the travellers, as may well be imagined, never thought of taking an instant's repose. At about half past one, looking to their right on the west, they saw the summits of another mountain; Barbican, consulting his map, recognized Eratosthenes.

This was a ring mountain, about 33 miles in diameter, having, like Copernicus, a crater of immense profundity containing central cones. Whilst they were directing their glasses towards its gloomy depths, Barbican mentioned to his friends Kepler's strange idea regarding the formation of these ring mountains. "They must have been constructed," he said, "by mortal hands."

"With what object?" asked the Captain.

"A very natural one," answered Barbican. "The Selenites must have undertaken the immense labor of digging these enormous pits at places of

refuge in which they could protect themselves against the fierce solar rays that beat against them for 15 days in succession!"

"Not a bad idea, that of the Selenites!" exclaimed Ardan.

"An absurd idea!" cried M'Nicholl. "But probably Kepler never knew the real dimensions of these craters. Barbican knows the trouble and time required to dig a well in Stony Hill only nine hundred feet deep. To dig out a single lunar crater would take hundreds and hundreds of years, and even then they should be giants who would attempt it!"

"Why so?" asked Ardan. "In the Moon, where gravity is six times less than on the Earth, the labor of the Selenites can't be compared with that of men like us."

"But suppose a Selenite to be six times smaller than a man like us!" urged M'Nicholl.

"And suppose a Selenite never had an existence at all!" interposed Barbican with his usual success in putting an end to the argument. "But never mind the Selenites now. Observe Eratosthenes as long as you have the opportunity."

"Which will not be very long," said M'Nicholl. "He is already sinking out of view too far to the right to be carefully observed."

"What are those peaks beyond him?" asked Ardan.

"The Apennines," answered Barbican; "and those on the left are the Carpathians."

"I have seen very few mountain chains or ranges in the Moon," remarked Ardan, after some minutes' observation.

"Mountains chains are not numerous in the Moon," replied Barbican, "and in that respect her oreographic system presents a decided contrast with that of the Earth. With us the ranges are many, the craters few; in the Moon the ranges are few and the craters innumerable."

Barbican might have spoken of another curious feature regarding the mountain ranges: namely, that they are chiefly confined to the northern hemisphere, where the craters are fewest and the "seas" the most extensive.

For the benefit of those interested, and to be done at once with this part of the subject, we give in the following little table a list of the chief lunar mountain chains, with their latitude, and respective heights in English feet.

Name.	Degrees of Latitude.	Height.
{ Altai Mountains	17° to 28	13,000ft.
Southern { Cordilleras	10 to 20	12,000
Hemisphere. { Pyrenees	8 to 18	12,000

	{ Riphean	5 to 10	2,600
	{ Haemus	10 to 20	6,300
	{ Carpathian	15 to 19	6,000
	{ Apennines	14 to 27	18,000
Northern	{ Taurus	25 to 34	8,500
Hemisphere.	{ Hercynian	17 to 29	3,400
	{ Caucasus	33 to 40	17,000
	{ Alps	42 to 30	10,000

Of these different chains, the most important is that of the Apennines, about 450 miles long, a length, however, far inferior to that of many of the great mountain ranges of our globe. They skirt the western shores of the Mare Imbrium, over which they rise in immense cliffs, 18 or 20 thousand feet in height, steep as a wall and casting over the plain intensely black shadows at least 90 miles long. Of Mt. Huyghens, the highest in the group, the travellers were just barely able to distinguish the sharp angular summit in the far west. To the east, however, the Carpathians, extending from the 18th to 30th degrees of east longitude, lay directly under their eyes and could be examined in all the peculiarities of their distribution.

Barbican proposed a hypothesis regarding the formation of those mountains, which his companions thought at least as good as any other. Looking carefully over the Carpathians and catching occasional glimpses of semi-circular formations and half domes, he concluded that the chain must have formerly been a succession of vast craters. Then had

come some mighty internal discharge, or rather the subsidence to which Mare Imbrium is due, for it immediately broke off or swallowed up one half of those mountains, leaving the other half steep as a wall on one side and sloping gently on the other to the level of the surrounding plains. The Carpathians were therefore pretty nearly in the same condition as the crater mountains Ptolemy, Alpetragius and Arzachel would find themselves in, if some terrible cataclysm, by tearing away their eastern ramparts, had turned them into a chain of mountains whose towering cliffs would nod threateningly over the western shores of Mare Nubium. The mean height of the Carpathians is about 6,000 feet, the altitude of certain points in the Pyrenees such as the Port of Pineda, or Roland's Breach, in the shadow of Mont Perdu. The northern slopes of the Carpathians sink rapidly towards the shores of the vast Mare Imbrium.

Towards two o'clock in the morning, Barbican calculated the Projectile to be on the 20th northern parallel, and therefore almost immediately over the little ring mountain called Pytheas, about 4600 feet in height. The distance of the travellers from the Moon at this point could not be more than about 750 miles, reduced to about 7 by means of their excellent telescopes.

Mare Imbrium, the Sea of Rains here revealed itself in all its vastness to the eyes of the travellers, though it must be acknowledged that the immense depression so called, did not afford them a very clear idea regarding its exact boundaries. Right ahead of them rose Lambert about a mile in height; and further on, more to the left, in the

direction of Oceanus Procellarum, Euler revealed itself by its glittering radiations. This mountain, of about the same height as Lambert, had been the object of very interesting calculations on the part of Schroeter of Erfurt. This keen observer, desirous of inquiring into the probable origin of the lunar mountains, had proposed to himself the following question: Does the volume of the crater appear to be equal to that of the surrounding ramparts? His calculations showing him that this was generally the case, he naturally concluded that these ramparts must therefore have been the product of a single eruption, for successive eruptions of volcanic matter would have disturbed this correlation. Euler alone, he found, to be an exception to this general law, as the volume of its crater appeared to be twice as great as that of the mass surrounding it. It must therefore have been formed by several eruptions in succession, but in that case what had become of the ejected matter?

Theories of this nature and all manner of scientific questions were, of course, perfectly permissible to terrestrial astronomers laboring under the disadvantage of imperfect instruments. But Barbican could not think of wasting his time in any speculation of the kind, and now, seeing that his Projectile perceptibly approached the lunar disc, though he despaired of ever reaching it, he was more sanguine than ever of being soon able to discover positively and unquestionably some of the secrets of its formation.