CHAPTER X.

THE OBSERVERS OF THE MOON.

Barbican's happy conjecture had probably hit the nail on the head. The divergency even of a second may amount to millions of miles if you only have your lines long enough. The Projectile had certainly gone off its direct course; whatever the cause, the fact was undoubted. It was a great pity. The daring attempt must end in a failure due altogether to a fortuitous accident, against which no human foresight could have possibly taken precaution. Unless in case of the occurrence of some other most improbable accident, reaching the Moon was evidently now impossible. To failure, therefore, our travellers had to make up their minds.

But was nothing to be gained by the trip? Though missing actual contact with the Moon, might they not pass near enough to solve several problems in physics and geology over which scientists had been for a long time puzzling their brains in vain? Even this would be some compensation for all their trouble, courage, and intelligence. As to what was to be their own fate, to what doom were themselves to be reserved--they never appeared to think of such a thing. They knew very well that in the midst of those infinite solitudes they should soon find themselves without air. The slight supply that kept them from smothering could not possibly last more than five or six days longer. Five or six days! What of that? Quand même! as Ardan often exclaimed. Five or six days were

centuries to our bold adventurers! At present every second was a year in events, and infinitely too precious to be squandered away in mere preparations for possible contingencies. The Moon could never be reached, but was it not possible that her surface could be carefully observed? This they set themselves at once to find out.

The distance now separating them from our Satellite they estimated at about 400 miles. Therefore relatively to their power of discovering the details of her disc, they were still farther off from the Moon than some of our modern astronomers are to-day, when provided with their powerful telescopes.

We know, for example, that Lord Rosse's great telescope at Parsonstown, possessing a power of magnifying 6000 times, brings the Moon to within 40 miles of us; not to speak of Barbican's great telescope on the summit of Long's Peak, by which the Moon, magnified 48,000 times, was brought within 5 miles of the Earth, where it therefore could reveal with sufficient distinctness every object above 40 feet in diameter.

Therefore our adventurers, though at such a comparatively small distance, could not make out the topographical details of the Moon with any satisfaction by their unaided vision. The eye indeed could easily enough catch the rugged outline of these vast depressions improperly called "Seas," but it could do very little more. Its powers of adjustability seemed to fail before the strange and bewildering scene. The prominence of the mountains vanished, not only through the foreshortening, but also in the dazzling radiation produced by the

direct reflection of the solar rays. After a short time therefore, completely foiled by the blinding glare, the eye turned itself unwillingly away, as if from a furnace of molten silver.

The spherical surface, however, had long since begun to reveal its convexity. The Moon was gradually assuming the appearance of a gigantic egg with the smaller end turned towards the Earth. In the earlier days of her formation, while still in a state of mobility, she had been probably a perfect sphere in shape, but, under the influence of terrestrial gravity operating for uncounted ages, she was drawn at last so much towards the centre of attraction as to resemble somewhat a prolate spheriod. By becoming a satellite, she had lost the native perfect regularity of her outline; her centre of gravity had shifted from her real centre; and as a result of this arrangement, some scientists have drawn the conclusion that the Moon's air and water have been attracted to that portion of her surface which is always invisible to the inhabitants of the Earth.

The convexity of her outline, this bulging prominence of her surface, however, did not last long. The travellers were getting too near to notice it. They were beginning to survey the Moon as balloonists survey the Earth. The Projectile was now moving with great rapidity--with nothing like its initial velocity, but still eight or nine times faster than an express train. Its line of movement, however, being oblique instead of direct, was so deceptive as to induce Ardan to flatter himself that they might still reach the lunar surface. He could never persuade himself to believe that they should get so near their aim and

still miss it. No; nothing might, could, would or should induce him to believe it, he repeated again and again. But Barbican's pitiless logic left him no reply.

"No, dear friend, no. We can reach the Moon only by a fall, and we don't fall. Centripetal force keeps us at least for a while under the lunar influence, but centrifugal force drives us away irresistibly."

These words were uttered in a tone that killed Ardan's last and fondest hope.

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The portion of the Moon they were now approaching was her northern hemisphere, found usually in the lower part of lunar maps. The lens of a telescope, as is well known, gives only the inverted image of the object; therefore, when an upright image is required, an additional glass must be used. But as every additional glass is an additional obstruction to the light, the object glass of a Lunar telescope is employed without a corrector; light is thereby saved, and in viewing the Moon, as in viewing a map, it evidently makes very little difference whether we see her inverted or not. Maps of the Moon therefore, being drawn from the image formed by the telescope, show the north in the lower part, and vice versa. Of this kind was the Mappa Selenographica, by Beer and Maedler, so often previously alluded to and now carefully consulted by Barbican. The northern hemisphere, towards which they were now rapidly approaching, presented a strong contrast

with the southern, by its vast plains and great depressions, checkered here and there by very remarkable isolated mountains.[A]

At midnight the Moon was full. This was the precise moment at which the travellers would have landed had not that unlucky bolide drawn them off the track. The Moon was therefore strictly up to time, arriving at the instant rigidly determined by the Cambridge Observatory. She occupied the exact point, to a mathematical nicety, where our 28th parallel crossed the perigee. An observer posted in the bottom of the Columbiad at Stony Hill, would have found himself at this moment precisely under the Moon. The axis of the enormous gun, continued upwards vertically, would have struck the orb of night exactly in her centre.

It is hardly necessary to tell our readers that, during this memorable night of the 5th and 6th of December, the travellers had no desire to close their eyes. Could they do so, even if they had desired? No! All their faculties, thoughts, and desires, were concentrated in one single word: "Look!" Representatives of the Earth, and of all humanity past and present, they felt that it was with their eyes that the race of man contemplated the lunar regions and penetrated the secrets of our satellite! A certain indescribable emotion therefore, combined with an undefined sense of responsibility, held possession of their hearts, as they moved silently from window to window.

Their observations, recorded by Barbican, were vigorously remade, revised, and re-determined, by the others. To make them, they had telescopes which they now began to employ with great advantage. To

regulate and investigate them, they had the best maps of the day.

Whilst occupied in this silent work, they could not help throwing a short retrospective glance on the former Observers of the Moon.

The first of these was Galileo. His slight telescope magnified only thirty times, still, in the spots flecking the lunar surface, like the eyes checkering a peacock's tail, he was the first to discover mountains and even to measure their heights. These, considering the difficulties under which he labored, were wonderfully accurate, but unfortunately he made no map embodying his observations.

A few years afterwards, Hevel of Dantzic, (1611-1688) a Polish astronomer--more generally known as Hevelius, his works being all written in Latin--undertook to correct Galileo's measurements. But as his method could be strictly accurate only twice a month--the periods of the first and second quadratures--his rectifications could be hardly called successful.

Still it is to the labors of this eminent astronomer, carried on uninterruptedly for fifty years in his own observatory, that we owe the first map of the Moon. It was published in 1647 under the name of Selenographia. He represented the circular mountains by open spots somewhat round in shape, and by shaded figures he indicated the vast plains, or, as he called them, the seas, that occupied so much of her surface. These he designated by names taken from our Earth. His map shows you a Mount Sinai the midst of an Arabia, an Ætna in the

centre of a Sicily, Alps, Apennines, Carpathians, a Mediterranean, a Palus Mæolis, a Pontus Euxinus, and a Caspian Sea. But these names seem to have been given capriciously and at random, for they never recall any resemblance existing between themselves and their namesakes on our globe. In the wide open spot, for instance, connected on the south with vast continents and terminating in a point, it would be no easy matter to recognize the reversed image of the Indian Peninsula, the Bay of Bengal, and Cochin China. Naturally, therefore, these names were nearly all soon dropped; but another system of nomenclature, proposed by an astronomer better acquainted with the human heart, met with a success that has lasted to the present day.

This was Father Riccioli, a Jesuit, and (1598-1671) a contemporary of Hevelius. In his Astronomia Reformata, (1665), he published a rough and incorrect map of the Moon, compiled from observations made by Grimaldi of Ferrara; but in designating the mountains, he named them after eminent astronomers, and this idea of his has been carefully carried out by map makers of later times.

A third map of the Moon was published at Rome in 1666 by Dominico Cassini of Nice (1625-1712), the famous discoverer of Saturn's satellites. Though somewhat incorrect regarding measurements, it was superior to Riccioli's in execution, and for a long time it was considered a standard work. Copies of this map are still to be found, but Cassini's original copper-plate, preserved for a long time at the Imprimerie Royale in Paris, was at last sold to a brazier, by no less

a personage than the Director of the establishment himself, who, according to Arago, wanted to get rid of what he considered useless lumber!

La Hire (1640-1718), professor of astronomy in the Collège de France, and an accomplished draughtsman, drew a map of the Moon which was thirteen feet in diameter. This map could be seen long afterwards in the library of St. Genevieve, Paris, but it was never engraved.

About 1760, Mayer, a famous German astronomer and the director of the observatory of Göttingen, began the publication of a magnificent map of the Moon, drawn after lunar measurements all rigorously verified by himself. Unfortunately his death in 1762 interrupted a work which would have surpassed in accuracy every previous effort of the kind.

Next appears Schroeter of Erfurt (1745-1816), a fine observer (he first discovered the Lunar Rills), but a poor draughtsman: his maps are therefore of little value. Lohrman of Dresden published in 1838 an excellent map of the Moon, 15 inches in diameter, accompanied by descriptive text and several charts of particular portions on a larger scale.

But this and all other maps were thrown completely into the shade by Beer and Maedler's famous Mappa Selenographica, so often alluded to in the course of this work. This map, projected orthographically--that is, one in which all the rays proceeding from the surface to the eye are supposed to be parallel to each other--gives a reproduction of the lunar

disc exactly as it appears. The representation of the mountains and plains is therefore correct only in the central portion; elsewhere, north, south, east, or west, the features, being foreshortened, are crowded together, and cannot be compared in measurement with those in the centre. It is more than three feet square; for convenient reference it is divided into four parts, each having a very full index; in short, this map is in all respects a master piece of lunar cartography.[B]

After Beer and Maedler, we should allude to Julius Schmitt's (of Athens) excellent selenographic reliefs: to Doctor Draper's, and to Father Secchi's successful application of photography to lunar representation; to De La Rue's (of London) magnificent stereographs of the Moon, to be had at every optician's; to the clear and correct map prepared by Lecouturier and Chapuis in 1860; to the many beautiful pictures of the Moon in various phases of illumination obtained by the Messrs. Bond of Harvard University; to Rutherford's (of New York) unparalleled lunar photographs; and finally to Nasmyth and Carpenter's wonderful work on the Moon, illustrated by photographs of her surface in detail, prepared from models at which they had been laboring for more than a quarter of the century.

Of all these maps, pictures, and projections, Barbican had provided himself with only two--Beer and Maedler's in German, and Lecouturier and Chapuis' in French. These he considered quite sufficient for all purposes, and certainly they considerably simplified his labors as an observer.

His best optical instruments were several excellent marine telescopes, manufactured especially under his direction. Magnifying the object a hundred times, on the surface of the Earth they would have brought the Moon to within a distance of somewhat less than 2400 miles. But at the point to which our travellers had arrived towards three o'clock in the morning, and which could hardly be more than 12 or 1300 miles from the Moon, these telescopes, ranging through a medium disturbed by no atmosphere, easily brought the lunar surface to within less than 13 miles' distance from the eyes of our adventurers.

Therefore they should now see objects in the Moon as clearly as people can see the opposite bank of a river that is about 12 miles wide.