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MARK WICKS



TREDITION CLASSICS

To Mars via The Moon

An Astronomical Story

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The punctuation and spelling from the original text have been faithfully preserved. Only obvious typographical errors have been corrected.

Plate XVI is missing from the scanned image files. The reference within the Maps and Plates list has been preserved.


TO MARS
via
THE MOON
MARK WICKS



TO MARS *via* THE MOON





Drawn by M. Wicks

View from the Air-ship, over the Canals a

"What a splendid view we then had over the country all around us!... Ac
which we had been so anxious to see, extending as far as the eye could reac

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To Mars *via* The Moon

AN ASTRONOMICAL STORY

By
MARK WICKS

"It is astronomy which will eventually be the chief educator and emancipator of the human race."—Sir EDWIN ARNOLD.

WITH ILLUSTRATIONS

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TO

PROFESSOR PERCIVAL LOWELL

A.B., LL.D.

Director of the Observatory at Flagstaff, Arizona

TO WHOSE CAREFUL AND PAINSTAKING
RESEARCHES,
EXTENDING OVER MANY YEARS, THE WORLD
OWES
SO MUCH OF ITS KNOWLEDGE OF

THE PLANET MARS,

THIS LITTLE BOOK IS RESPECTFULLY INSCRIBED
BY
ONE WHO HAS DERIVED INFINITE PLEASURE
FROM
THE PERUSAL OF HIS WORKS ON
THE SUBJECT

PREFACE

In the course of my experience as an occasional lecturer during the past twelve years, I have been

much impressed by the keen interest evinced, even by the most unlettered persons, when astronomical subjects are dealt with in plain untechnical language which they can really grasp and understand.

The pertinent questions which have been addressed to me privately by members of my audiences have clearly indicated that there is ample scope for writers in satisfying a widespread desire for fuller and clearer information upon such subjects. I have observed that particular interest is taken in the planet Mars and also in the moon, but ordinary persons usually find astronomical text-books too technical and too difficult to master; whilst, as regards Mars, the information they contain is generally meagre and sometimes not up-to-date.

Scientific readers are already provided for: and it occurred to me that it would be much more useful and appeal to a more numerous class if, instead of writing a book on the usual lines, I wrote a narrative of events which might be supposed to occur in the course of an actual voyage to Mars; and describing what might be seen on the planet during a short visit.

This is the genesis of the story; and, in carrying out my programme, I have endeavoured to convey by means of natural incidents and conversations between the characters portrayed, the most recent and reliable scientific information respecting the moon and Mars; together with other astronomical information: stating it in an interesting form, and in concise, clear, and understandable language.

Every endeavour has been made to ensure that this scientific information shall be thoroughly accurate, so that in this respect the book may be referred to with as much confidence as any ordinary textbook.

Apart from my own studies and work, all these facts have been carefully verified by reference, as regards the moon, to the works of such well-known authorities as Neison, Elger, Proctor, Sir Robert Ball, &c., whilst, with respect to Mars, the works of Professor Lowell, Flammarion, Professor Langley, and other writers, as well as practical papers by other actual observers of the planet, have been studied.

The personal opinions expressed are entirely my own, and the technical writers above mentioned are in no way responsible for them. I do not, however, expect my readers to accept all my views, as they relate to matters in which there is ample room for differences of opinion.

The reader will, of course, understand that whilst the astronomical information is, in all cases, scientific fact according to our present knowledge, the story itself—as well as the attempt to describe the physical and social conditions on Mars—is purely imaginative. It is not, however, merely random imagining. In a narrative such as this some matters—as, for instance, the "air-ship," and the possibility of a voyage through space—must be taken for granted; but the other ideas are mainly logical deductions from known facts and scientific data, or legitimate inferences.

Many years' careful study of the various theories which have been evolved has convinced me that the weight of evidence is in favour of Professor Lowell's conceptions, as being not only the most reasonable but the most scientific; and that they fit the observed facts with a completeness attaching to no other theory. These conceptions I have endeavoured to present fully and clearly; together with my own views as an entirely independent writer.

In dealing with the conditions on a distant and inaccessible world the farthest flight of imagination might fall short of the reality, but I have preferred to treat these matters somewhat restrainedly. Whilst no one can say positively that the intelligent inhabitants of Mars do not possess bodies resembling our own, it is very probable that they differ from us entirely; and may possess forms which would appear to us strange and weird. I have, however, thought it desirable to endow the Martians with bodies resembling ours, but glorified in form and features. The powers ascribed to the Martians are really only extensions of powers which some amongst us claim to possess, and they fall short of what more than one modern scientific writer has predicated as being within the possibilities of science at a not very distant future.

During the past few years I have been greatly indebted to Professor Lowell for his kindness and ready courtesy in furnishing me with information on obscure matters connected with Mars; and my thanks are also due to the Rev. Theodore E.R. Phillips, of Ashstead, who was good enough to read the manuscript of this book, and whose great

observational experience enabled him to make valuable suggestions in regard to the scientific matters dealt with therein.

Truly "a labour of love," this little book—which Professor Lowell has most kindly permitted me to dedicate to him—is now submitted to the public, in the sincere hope that its perusal may serve not only to while away a leisure hour, but tend to nurture a love of the sublime science of astronomy, and at the same time provide some food for thought.

A few maps, plates, and charts have been added to give completeness to the work, and it is hoped that they will aid the reader in understanding the several matters dealt with.

M.W.

1910.

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NOTES ON THE MAPS AND CHARTS

THE maps included in this work have been photographed from a globe of Mars specially made for the purpose from various charts. In all the maps the south is at the top and the north at the bottom; and the series shows the general surface configuration all round the planet, together with the principal canal lines which have been observed; but many other canal lines exist, especially on the dark areas near the south pole. These lines are usually straight and uniform in width throughout their whole length: indeed it is difficult to mark them upon a globe so that they shall appear as regular and uniform as they are actually seen on the planet.

The names on the maps are those now generally accepted and used by astronomers.

The "Greenwich" of Mars, *i.e.* the point on the Meridian from which astronomers reckon the Martian longitudes, is indicated by the apex of the small triangular light area just above the equator in Map I. It is marked on the map as "Fastigium Aryn," and is chosen as longitude "0," because from its general outline it cannot be mistaken by observers.

"Sirapion," the supposed landing-place of the travellers mentioned in the story, is shown on Map III., just above the central and lowest point of the dark area at the top of the map. This name will not be found upon any other map of Mars.

The chart showing the relative positions of the Earth and Mars during the years 1909–10 is reduced and modified from one prepared accurately to scale by the author for his own use in connection with the book. From it the reader will gain a clear idea of the shape of the two orbits and how they are placed with regard to each other.

It also shows the course supposed to be taken by the air-ship on its outward and homeward journeys, and the point reached when one of the travellers desired to turn back; together with the alternative routes which were then discussed.

This chart, and the other one showing the positions of the two planets at different oppositions of Mars, will enable the reader to understand how it is that Mars approaches so much nearer to the earth at some oppositions than it does at others. The positions of the oppositions from 1916 to 1922 are only approximations, as no exact data are yet

available. The earth is closest to the orbit of Mars about the 27th of August each year, and if Mars comes into opposition about that date it is then only about thirty-five million miles away. If, however, the opposition occurs near the 22nd February, the earth is then at its greatest possible distance from the orbit of Mars, and that planet will then be over sixty million miles away: appearing very much smaller than when at its most favourable point of approach.

On the 18th of September, 1909, Mars was only slightly over thirty-six million miles from the earth, and it will be fifteen years before such a favourable situation again occurs.

The nearest point of approach does not necessarily occur on the actual date of the opposition. In 1907 Mars was in perigee, as it is termed, seven days after the opposition; while in 1909, perigee was before opposition.

The diagram showing the positions and movements of the planets during the period covered by the outward voyage of the *Areonal* is sufficiently explained by the notes printed thereon. It may, however, be pointed out that though the orbits of the planets are all elliptical, especially those of Mercury and Mars, they are so nearly true circles that, when reduced to the scale of these diagrams, they practically become circles. The exaggerated ellipses so often found in astronomical books are very misleading. The orbits of Mercury and Mars have an appearance of ellipticity because the sun does not occupy the central point in the diagram.

The view of the moon is photographed from a large coloured drawing by the author, which occupied many months in preparation and execution. It shows all the principal formations seen through the telescope as the moon passes through its various phases, but it must be understood that the formations can never all be seen at one view as shown in this picture. As the sun rises on any particular formation the details are gradually revealed by the long shadows cast by the more elevated portions when the sun is low down in the lunar sky. As the sun rises higher and higher the shadows grow shorter and shorter, and when the sun is vertically over the formation the shadows entirely disappear; all details are thus rendered invisible.

When the moon is full the sun is practically vertical over the whole lunar surface, so the only details then seen are those which are vaguely brought out by differences in tint.

The bright ray-streaks are only suggested in the picture, because, if shown complete, they would have the same effect as upon the moon, viz. they would entirely obliterate all the formations over which they passed.

The Key Map indicates the principal lunar formations, and includes the names of those mentioned in the book.

The last two plates in the book are from drawings made at the telescope (a 12-inch Calver reflector) by the Rev. T. E. R. Phillips. The opposition of 1909 was not favourable for the observation of Martian details

from England; for although the planet was near to us, it was too low down in the sky; and many of the nights were either cloudy or misty.

THE SUN, MOON, AND PLANETS

	Diameter.	Period of Rotation.	D
SUN	865,000 miles	25 to 26 days	92
MOON	2,160 miles	$27^1/_3$ days (It revolves round the earth in the same time.)	

PLANETS.	Diameter in Miles.[1]	Number of Satellites Known.[2]	
Mercury	2,992	None	
Venus	7,660	None	
Earth	7,918	One	
Mars	4,220	Two	
Asteroids	Very tiny planets, hundreds in num		
Jupiter	86,000	Eight	
Saturn	74,000	Ten	
Uranus	31,700	Four	
Neptune	34,500	One	

TO MARS *via* THE MOON

(*Narrative written by Wilfrid Poynders, Esquire, late of Norbury, in the County Borough of Croydon, Surrey*)

CHAPTER I

WE START ON A VERY LONG VOYAGE

"WELL, I suppose it is about time to get ready for starting?"

The speaker was a smart, well-set-up man about forty-three years of age, whose keen and alert expression, clear eyes and well-cut features were a true index to the intellectuality and integrity of his character; whilst his closely compressed lips and the deep vertical line down the centre of his forehead betokened a dogged perseverance in carrying into effect anything he might undertake.

John Yiewsley Claxton, for that was his name, was my very intimate friend of at least twenty-five years' standing; and during the greater portion of that time he had been my constant companion. We had passed through many trials and troubles together, but a better friend and companion no man could have desired.

We were just finishing a last quiet smoke and chat in my snuggery at Norbury, near Croydon, preparatory to starting off on a very long journey for which all arrangements had been completed, and we had risen early that morning in order to have everything in readiness.

John took his pipe from his lips as he spoke, then, rising, stretched out his arms and braced himself up like one ready and eager for any emergency; the next

minute he was smoking in his usual calm and thoughtful manner. I rose when he did, then giving a few final instructions to Mrs. Challen, my housekeeper, we bade her "good-bye" and stepped out on to the lawn, thence crossing over to a gate at the far end of the garden, we passed into an extensive field and walked toward a large shed that stood near its centre.

It was a most beautiful evening near the beginning of August 1909, clear and calm. The sun had only just passed below the horizon, the sky immediately above it being a rippled glory of gold, merging higher up into gold flecked with crimson, then into a placid sea of pale apple-green. Above this were fleecy clouds of delicate rose-pink, which reflected their splendours upon the higher parts of the surrounding hills, the latter standing out clear and sharp, and glowing with roseate hues, whilst their bases were seen dimly as through a thin veiling of purple mist.

Surely nothing could be better for the commencement of our long-planned trip. The moon would not rise until about a quarter-past nine, and darkness would have descended by the time we were ready to start. This was exactly what we required, because we did not wish either our preparations or our departure to be observed.

Just as we arrived within hail of the shed the door opened, and a rugged-featured man with sandy hair stepped out. This was Kenneth M'Allister, our engineer and general factotum in all mechanical matters—a typical specimen of a Scotch engineer. He

had followed his profession in its different phases on tramp-steamers, on ocean liners, naval gunboats, and even on battle-ships, besides having served for several years in the workshops of a great firm of electrical engineers.

Whether repairing a broken propeller-shaft two or three scores of tons in weight, the most intricate machinery, or the most delicate electric mechanism, he was equally at home and sure in his work; in fact nothing seemed to come amiss to him. His machinery was always the object of his most anxious care, and, providing that all worked satisfactorily, nothing else troubled him much.

"Well, M'Allister," I called to him, "is everything ready for our trip to-night?"

"Heh, mon," he replied, "everything is all ready; will you look in and take a turn round the ship?"

"Certainly we will," I answered; so we all went into the shed, where we gazed with equal pride and satisfaction upon the splendid shining object which was housed therein. Here, in perfect readiness for its destined service, was our air-ship—if it could be so called—upon which we three had expended years of thought, experiment, and work.

Outwardly it was shaped somewhat like a fish, being constructed of a special metal—our joint invention—which we had named "martalium." The metal was composed of aluminium and two other rarer metals which, when combined together, produced a substance almost as light as aluminium, yet many times harder and tougher than case-

hardened steel; whilst its surface shone like burnished silver and could never in any circumstances become tarnished or affected by rust.

The ship was ninety-five feet in length, and its diameter twenty feet in the broadest part, tapering off to a point at either end.

With the exception of the steering and balancing fans, there was no machinery whatever visible on the exterior of the vessel. Several windows along each side, together with a few at the top and bottom of the vessel, gave light to the interior, and would allow for observations being made in any direction. These windows were all constructed of a special toughened glass obtained from Vienna, very thick and warranted to withstand the hardest blows. Along each side of the vessel there was an observation platform or gallery on to which the exterior doors opened, and each gallery was provided with a protecting railing.

The interior of the ship was divided into five separate compartments, the rear one being the general living and sleeping room, having observation windows so arranged as to command an outlook in all directions. The next compartment was mainly a store-room, but, like all the others, could be used for observation purposes; next to that was a small compartment intended for a special purpose which will hereafter be apparent; then another containing water storage, apparatus for compressing or rarefying air, as well as machinery for producing the latter chemically.

Lastly, right in the forepart of the vessel was M'Allister's special sanctum, containing the driving, lighting, warming, and steering machinery, but electric buttons and switches were also provided for controlling these in every compartment, so that whichever one we happened to be in we were prepared for all emergencies. Periscopes capable of being turned in all directions also communicated with every compartment, thus we could always see what might be around us.

All the machinery was either electric or magnetic, some of it being very simple; other portions were extremely intricate, but nearly all was the outcome of our joint inventions. Such parts as could not profitably be made by ourselves had been carefully distributed between several firms of founders and engineers, in order that none could have any means of discovering the use to which they were intended to be put. The whole of the shell of the vessel was double, with a packed space between the two skins; and each door opened into a small lobby, having another door on the farther side, to ensure that every part might be kept perfectly air-tight when required.

By the time we had completed a thorough inspection of the vessel and its machinery, and overhauled the stores to make sure that everything requisite was on board, it had become nearly dark, so, moving a switch, M'Allister swung open the great doors at the end of the shed. The vessel was standing upon a low trolley having many wheels running on rails, with a small electric motor beneath it, and, upon M'Allister moving the trolley switch, the whole

affair glided smoothly out into the open field. I may as well confess that we owed this trolley and the mode of its working to ideas gained during an inspection of the construction and working of the conduit trams belonging to the London County Council.

When the vessel was out in the open we congratulated ourselves upon its splendid proportions and business-like appearance.

I asked M'Allister whether "he was satisfied with the result of our labours?"

"Mon," he replied, "she's grand, and it's fine to have the handling of such machinery; everything works as slick as grease!" It was a pleasure to hear him talk about his machines, for he was always so enthusiastic where they were concerned.

"Now," I suggested, "before we start we'll give our good ship her name."

"Bravo!" said John Claxton, "and we'll drink to her success, a good voyage and a safe return"; and he was so struck by the brilliancy of his idea that he actually took his pipe from his lips, and, holding it in his hand, regarded it with thoughtful contemplation for quite three minutes.

I accordingly went to the store-room and brought out two bottles of champagne. Directly M'Allister saw them he entered a vigorous and emphatic protest, saying, "Heh, Professor! you're surely not going to celebrate this most auspicious event with such poor fizzy stuff as champagne? Let's have a wee drop of

good old Scotch whisky, and do the thing properly!"

John Claxton here interposed: "Let M'Allister have his whisky if he prefers it, and we'll have the 'fizz'!" So I went laughing to the store again and returned with a bottle of special Scotch, whereat M'Allister's eye gleamed as he smiled approval.

Then, taking up a bottle of the champagne, I broke it over the prow of the vessel, and we solemnly christened her the *Areonal* in honour of the planet for which we were bound.

Raising high our glasses we gave the toast of "*The Areonal*; may she and her passengers have a good voyage and a safe return home!" M'Allister peered over the rim of his glass, and, with upturned eyes, remarked that "his old wife in Glasgow would be looking for his safe return in a few months' time"; then his glass slowly tipped up, and the old Scotch whisky disappeared.

Claxton and I at once stepped on board the vessel, and having just set the machinery slowly moving so as to raise the vessel a few feet, I put on the neutral power so that the ship remained poised in the air. M'Allister ran the trolley back into the shed, closed the doors, and switched off the electric current; then climbed the extending ladder, and came on board, John steadying the vessel by an anchor rope in the meantime.

M'Allister took over the command of the machinery, and, setting it in motion, the *Areonal* at once rose slowly and gracefully straight up into the air.

John and I were standing outside on the platform, from whence, looking toward the house, we could plainly see Mrs. Challen at the open door of our sitting-room waving farewell to us—her figure silhouetted against the bright light of the room. We waved back to her in response, but I am very doubtful if she could see our signal, as she was looking into the darkness.

We now rose rapidly as M'Allister switched on more power, and far away to the northward we could see over the whole extent of the vast metropolis, with its countless miles of lighted streets. On turning towards the east the Crystal Palace, which was lighted up, was a very conspicuous object against the skyline over the Sydenham hills.

John, when he saw it, remarked that "it would have been an appropriate tribute to our enterprise if the Palace Company had provided one of their grand firework displays as a send-off for us"; "but," he added, "these companies will never do what is expected of them!" On the westward side the lights all along the hill where Sutton lies were clearly visible; farther off was Epsom, and, with the aid of a glass, we could even faintly see the lights of Guildford in the far distance.

Nearly south of us Croydon seemed from our altitude to lie almost beneath our vessel. We directed our course towards the south-east, passing over the railway-station at Thornton Heath, with Croydon to the right of us, just as the clock of the Croydon Town Hall was striking nine. The long lines of lighted

streets made a fine panorama, and we could trace the lights of the moving tram-cars out to Anerley, South Norwood, Purley, Wallington, and Mitcham.

Although we were fully 5000 feet, or nearly a mile, above the earth it was surprising how clearly we could hear the sounds from below—the rumble of the electric tram-cars, the clang of their gongs, the toot-toot of the motor-horns, and, louder still, the whistles of the locomotives on the London and Brighton Railway were borne to us with almost startling distinctness through the still night air.

Our electric lights were now switched on at their full power, their bright beams shining out through the windows all around the vessel. Whilst we were on the ground we only used just sufficient light to see by, as we did not wish to draw attention to our proceedings; but now we were well up and on our way it mattered not who saw us.

With increased speed we passed over South Norwood and the village of Shirley, rising higher and higher as we proceeded on our way. The moon, which was just past the full, had not risen above the horizon of those upon the earth below us; but we had now attained such an altitude that it became visible to us, low down on the horizon and far ahead on our left hand. Owing to our height above the earth it soon became impossible for us to see the places over which we passed, and as we were moving over an open part of Kent there were very few lights which we could have seen in any case. As there was nothing of particular interest to attract our attention which

we had not already seen on our trial trips, we entered our general room and sat down to supper.

The machinery had been set to maintain a speed of 150 miles an hour until we passed beyond the limits of the earth's atmosphere; for though, no doubt, we might safely have travelled faster, we did not intend taking any risk of overheating our vessel by the friction of the atmosphere.

Notwithstanding the speed at which we were travelling we were quite unconscious of any movement in our vessel. The impression we received was not that we were rushing away from the earth, but that the earth was rapidly falling away from our position in space.

It may, perhaps, be desirable that I should now give a little information respecting myself and my friends, together with some explanation of our reasons for embarking upon such a very long voyage.

CHAPTER II

PERSONAL REMINISCENCES—WHY WE DECIDED ON THE VOYAGE

My name is Wilfrid Poynders, and during the greater part of my lifetime of more than sixty-three years astronomy has been my favourite study. For the last

thirty years the planet Mars has been an object of special interest to me, and I have devoted much time to observation of the planet and have endeavoured to make myself fully acquainted with all that has been discovered or surmised respecting it.

My dear wife had died when I was thirty-six years of age, leaving me with one child, my son Mark, then about fifteen years old. In my intense sorrow at my bereavement I should probably have become almost a hermit had it not been for my boy who, having been carefully educated, was a bright and intelligent lad. I now took him under my special care and made it my constant endeavour to impart to him such of my own knowledge as seemed likely to be useful or interesting, hoping to keep him with me for many years as a companion. He soon became imbued with my love of mechanical pursuits and also with my passion for astronomy and allied sciences, developing an interest in Mars equal to if not surpassing my own.

His most intimate schoolfellow was John Claxton, and, as there was a very strong friendship between them, we were so much together that I came to regard him almost as a second son.

When my boy was in his twentieth year I noticed that a great change came over him, for instead of being cheerful and high-spirited he became very quiet and self-absorbed, and there was often a faraway look in his eyes which puzzled me very much. One morning I went to call him at his usual time for rising and found him in a deep sleep from which I was unable to rouse him. After trying some

time without effect his stupor so alarmed me that I immediately sent off for a doctor, who advised that it would be best to let him lie and he would probably awaken naturally in a few hours' time. This indeed proved to be the case; and, as soon as he awoke, the doctor carefully examined him, but could find nothing wrong to account for what had happened. A month later he had a similar seizure, with the same result, but this time his sleep lasted nearly thirty hours. On the doctor's advice I then took him to the seaside for several weeks' stay, and there he soon regained his usual buoyancy of spirits.

Shortly after our return home, however, he had a third seizure from which he never awoke, but, to my profound sorrow, passed quietly away. Just before the end came I noticed his lips move slightly as though he were trying to speak, and on bending down to listen I thought I caught faintly what sounded like the words, "I am coming," but whether this really were so I could not be sure.

I will not dwell upon the pain and sorrow of that dark and dreary portion of my life when I was left quite alone, without a single relative to cheer me, but merely say that my grief at his loss was so overwhelming that it was long before my former mode of living could be resumed. John Claxton was almost as deeply affected as myself, for poor Mark was a most affectionate lad, and had greatly endeared himself to both of us. John also had his own troubles, having lost his father during the previous year, and was then living with an aunt and two cousins, but had never been comfortable with

them, as both the boys were rather wild, and of anything but good dispositions. He had inherited a substantial income from his father, but this piece of good fortune only aroused the jealousy and envy of his cousins, who only seemed to tolerate his presence in their home because of what they could obtain from him by their sponging propensities.

Although I was not rich, my income was amply sufficient to render me quite independent of work, and as I felt most lonely and desolate since Mark's death, I at length begged John to come and live with me. He joyfully agreed, and from that time our relations have practically been those of father and son. As our dispositions and likings are very similar, we are as happy together as past sorrows will permit.

John always had a great fancy for engineering and electrical work, in which, after some years of training, he became an expert. Being well endowed with the faculty of invention, he devised and constructed many new kinds of electric and magnetic machines, and as my tastes also run in the direction of mechanical work, I have also done a great deal in connection with such matters.

About six years ago, when the problem of aerial navigation began to be studied in earnest, John became greatly interested in the matter, devoting all his time and energies to designing and constructing working models of air-ships, aeroplanes, and other flying machines.

At that period I was very keen on Martian matters, to such an extent indeed that my mind was always

occupied with the various problems they presented. One day, in the course of conversation, I suggested that it would be a splendid thing if we could construct a vessel which would enable us to visit Mars and see it for ourselves, and thus settle all our doubts and speculations on the various controversial points which were so much discussed.

The idea soon had him in its grip, and he then immediately commenced a series of experiments with a view to designing machinery capable of carrying a vessel through space. After many failures he thought out a plan for utilising the earth's gravitation and magnetism as a means of obtaining the requisite power and storing it up for future use. This scheme was thoroughly tested and proved to have solved the problem, for the machinery could transform the power from either positive or negative to neutral.

The task of making the vessel and machinery was of course too great for two pairs of hands to undertake, and we were therefore under the necessity of obtaining a third man to help us. John had known M'Allister when he was studying electrical work, and suggested that, if available, he would be just the man to suit us. We at once communicated with him, making a liberal offer for his assistance in our scheme, and as it was a question of dealing with an entirely new kind of machinery it appealed to his professional pride, so, being out of an engagement, he gladly accepted our offer. He came over to my house and has lived with us ever since, apparently quite in his element. M'Allister was about

fifty years of age when he joined us, married, but without children. His wife's home was at Glasgow, and owing to his so often being away at sea for long periods, she had become so accustomed to the separation that she declined our offer to find a home for herself and her husband near us. She paid him a visit occasionally, or he went to spend a few days with her, but as a permanent arrangement she preferred staying with her relatives in Glasgow. It was not exactly my ideal of married life, but as the couple always seemed happy enough when together, and the arrangement appeared to suit them both, it was not my place to make any comment.

My house on the outskirts of Norbury was well situated for securing the privacy we required in carrying on our work and experiments, lying as it did in the valley on the westward side of a small eminence known as Pollard's Hill, which effectually screened us from observation by the inhabitants of the houses in the London Road. Thus we enjoyed complete seclusion, although not more than a quarter of a mile from that busy thoroughfare.

Notwithstanding that Pollard's Hill is only a small elevation, and its rise scarcely noticed when approached from the London Road, when its summit is gained one is astonished by the extensive and splendid view it commands over hills and valleys, town and country; and it breaks upon one almost as a startling surprise when its beauties are seen for the first time. It is, indeed, so very unexpected to come upon such a fine and far-spreading view so suddenly and so close to bricks and mortar. Alas! the latter are

fast encroaching upon this delightful but somewhat neglected spot, and unless the Croydonians are wise enough to secure the acquirement of the summit of the hill as a public open space, this splendid view will be entirely lost to future generations.

A further advantage of our situation was its nearness to Croydon and Wallington, where there were engineering and electrical machinery works; besides which we also had convenient and easy means of reaching the metropolis, from whence we could travel to any other town to purchase or order anything we might require.

Once we had fairly set to work our progress was rapid and our vessel had practically been complete nearly a year, since when we have undertaken many voyages at night in order to test its powers and to ascertain where improvements were needed.

We were much amused to find in the newspapers of this period, especially in the London Press, numerous letters from various parts of England describing the appearance of a strange and very brilliant star in the sky, either at night or in the morning hours before sunrise. Some described the star as moving in one direction, others stated that it passed in quite another direction; though it does not appear to have occurred to any one that stars do not move in this eccentric fashion, nor at the rapid rate at which this peculiar star was stated to travel. No one guessed that it was the light of our air-ship which they saw as we flitted about the country in the dark hours, and often at extremely high altitudes.

Three extensive fields were occupied by me in connection with my residence, and these afforded plenty of room for our large shed and workshops; whilst as north, south, and west of us there was a large stretch of open country, extending in some directions for miles, there was little risk of our operations attracting attention. Moreover, we were always careful not to prepare for any ascent until it was fairly dark.

Our establishment was a small one, Mrs. Challen being our only indoor servant. She came to me as a young widow after my wife's death, and has proved an excellent manager and a most trustworthy servant. I have therefore left my house in her charge with a feeling of entire certainty that it will be well looked after in my absence. My solicitors have a sealed packet containing full instructions as to what is to be done in the event of my not returning home or communicating with them within fifteen months from the date of our departure.

Altogether, our little party of three has been a very agreeable one up to the present. John Claxton is a splendid fellow—a good talker when in the humour, and an excellent listener when either myself or M'Allister are in the vein for airing our own particular views. He is rather fond of chaffing M'Allister, who has a quiet humour of his own, and takes it all in good part. John has only one weakness—he has become a most inveterate smoker, and we have learned by experience that in this matter his wishes must never be opposed. Both M'Allister and myself are also smokers, though to a much less

extent; the former, indeed, more often prefers to chew navy plug-tobacco—a habit which I am glad to say I never acquired, but it is a pretty general one amongst those who have been employed on sea-going vessels. In these matters it is an understood thing that each is to do as he pleases, without let or hindrance.

One more point and then I will finish this rather long but very necessary digression. In conversation I am generally addressed by my colleagues as "Professor." Not that I ever occupied a Professorial Chair at a university or elsewhere, but it arose in this way: When John first came to live with me he felt a diffidence, owing to the disparity between our ages, in addressing me by my Christian name; on the other hand, to call me by my surname seemed to him far too cold and formal. So on one occasion, when I had been holding forth on my favourite science, he remarked, "I think, sir, if you will allow me, I shall call you 'Professor' in future; the title seems most appropriate for one who has the power of conveying information on scientific subjects in so clear and interesting a manner."

I was much amused at this proposal, but fully appreciating the difficulty he felt in the matter, replied, "John, you really flatter me too much; but as you seem to think the title fits, you may call me by it if you like." So from that time forth John always addressed me as "Professor," and from hearing him constantly using the term, M'Allister soon acquired the same habit. I am afraid they both credited me with rather more erudition than I really possessed;

but although I should never attempt to talk at large on matters with which I was not fully acquainted, I have lived long enough to know that it is not always wise to go very far in disillusioning others of the favourable opinions they may have formed respecting one's own abilities. It is, perhaps, one of those matters in which "a still tongue makes a wise head"; and, if dealt with in a tactful way, may be of real advantage to both persons. The one will continue to be receptive of the ideas of the person whom he esteems as well qualified to impart sound and reliable information, whilst the other will honestly endeavour to live up to his reputation, and be most scrupulously careful to make sure of the accuracy of the information which he desires to impart.

CHAPTER III

WE APPROACH THE MOON—A MAGNIFICENT SPECTACLE

WHEN we had finished our supper John remarked, "Professor, I am a little mystified in regard to our present position. We have started on a voyage to Mars, but up to the present I have not seen even a glimpse of the planet to-night. How is that?"

"Hear, hear," chimed in M'Allister. "Mon, I've been bothering over the very same thing ever since we

started, and wondering where yon little red star has gone to!"

"The question is very soon answered," I replied: "it is a case of 'the Spanish fleet you cannot see because it's not in sight.' Mars does not rise above our late horizon until about a quarter-past ten, and was therefore hidden by the earth whilst we were out on the platform; so we could not expect to see it then, but if we look out now no doubt we shall see it."

We went over to a window, and I pointed out the planet, remarking, "There it is; that little red star is the world which we hope to land upon in a few weeks' time. You will notice that it does not lie quite in the direction in which we are moving, for I must tell you that we are not on our course to Mars at present. I thought we should all be glad to have a look at the moon from a close point of view now we have the chance, and M'Allister will remember that I gave him instructions just before supper to direct our course so as to head off the moon in its journey."

"Quite right, Professor, so you did," said M'Allister; "but I did not fully understand the reason of your instructions."

"But," interrupted John, "are we not going rather out of our way?"

"Yes, that is so, John," I replied, "but a few thousand miles more or less will make very little difference to us at the rate we shall travel, especially if you allow for the fact that the earth and moon are both moving nearly in the direction we wish to go. Besides, I hope to approach sufficiently near the

moon to enable us to add a little more power to our store, so it will not all be lost time; and we can also use the moon to give us a fresh start. But for the fact that it would be best for us to reach the moon before it has waned to any large extent we might have delayed our start for many days, and, whilst considerably shortening our journey, still arrived at Mars on the date we have fixed."

Our chronometer was housed in a substantial non-magnetic cubicle, with a very thick glass window, in order to protect it from the magnetism and electricity which pervaded our vessel. On looking at the chronometer I found the time was nearly eleven o'clock. We had, therefore, been nearly two hours on our journey and had travelled some three hundred miles, mostly in an upward direction from the earth; so if there were any of the earth's atmosphere around our vessel it must be of the most extreme tenuity, and we might safely increase our speed.

I accordingly gave M'Allister the order to switch on the power gradually, up to our full speed, and it was not long before we were rushing through space at the rate of over eighty-three thousand miles an hour. At this rate, as I told them, we might expect to reach the moon in a little over sixteen hours, allowing for loss in slackening down at the latter part of the journey.

"It so happens," I said, "that the moon's present distance from the earth is rather less than 226,000 miles, being its nearest approach to the earth during this month."

John at once asked, "How it happened that, if the moon were only this comparatively short distance away from us, I reckoned it would require over sixteen hours to reach it at the tremendous speed we were now moving"; and added, "I thought we should be there in about three hours."

"Ah, John," I replied, "you have forgotten that the earth is rushing along and carrying the moon with it nearly as fast as we are travelling, and you are reckoning as though they were standing still all the time. As a matter of fact we are only gaining on the moon by a little over fifteen thousand miles an hour, and we must allow for slackening speed long before we reach the moon, so we cannot expect to cover the distance in less than sixteen hours. You will see that if we did not travel faster than the moon is moving away from us we should never catch it up at all!"

"That explains it all, Professor," said John, "and I must confess I felt rather puzzled at the length of time required to reach the moon, so was altogether out in my calculations."

After we had been proceeding at this rate for nearly two hours, M'Allister came hurrying into our compartment in a state of great excitement.

"Professor," he exclaimed with a gasp, "something's gone wrong altogether, and I don't know what to do!"

"Gone wrong!" I repeated. "Why, what is the matter?"

"Mon," he answered, "everything is the matter! A while back we were rushing towards the moon, but just now when I looked ahead there wasn't any moon to be seen. I happened to go round to the other window and look back and, my word! if there wasn't the moon right behind us! We have been travelling so very fast that we must have run past it without knowing we had done so."

"Oh, we could not possibly have done that!" I exclaimed.

"But there's more to come, Professor," continued M'Allister. "When I last saw the moon it was nearly full and not so very much bigger than when we saw it at starting, but now this moon behind us is an enormous thing; yet it is only a new moon, or rather what folks call a new moon with the old moon in its arms!"

"Oh, now I understand," I replied. "It's all right, M'Allister, and you can make your mind quite easy. You were not able to see the moon when you first looked through the window because it was nearly in a direct line with your course, and therefore just hidden by the prow of the vessel. It's still ahead of us and still nearly full: if you had looked out of the conning tower or used the periscope you would have seen it."

"Heh, Professor," he interjected, "I know I couldn't see the moon if it was straight ahead of our course, but then what about that enormous new moon that's behind us? I saw that right enough."

"That enormous new moon, M'Allister, is only our own little world which we left a few hours ago," I replied.

He stared at me as though bewildered, and after pondering a while, exclaimed, "Losh, mon, you surely don't mean to say that our own little world changes about in the same way as the moon does—sometimes new and sometimes full?"

Here John interposed. "Yes, M'Allister, you can take it from me that it is just what our world does do. I think you are aware that, like the moon, our world simply reflects the light it receives from the sun, and does not shine by its own light. So one side is light and the other side is dark, according to its position in regard to the sun. From our present position we are only able to see a small portion of the lighted side, the remainder being dark except for the moonlight shining upon it, so it looks just like a large new moon. It really serves as a moon to our moon, but its phases follow each other in reverse order. Thus, when the moon is full, the earth's disc is all dark, and when the moon is in its first quarter the earth, as seen from there, would be in its third quarter, and so on through all its phases. Do you follow all that, M'Allister?"

"Well, mon," replied M'Allister, with a sly grin, "I've just heard you say it; but"—and here he turned to me—"is it all correct, Professor?"

"Yes, quite correct," I answered, greatly amused at his distrust of John's statements.

"M'Allister, you're like the Apostle Thomas," commented John, evidently a little nettled; "so you really doubted my word after all!"

"Heh, mon," he answered, "you're not the Professor, you know; and I thought maybe you were pulling my leg!"

"Well," laughed John, "perhaps you *will* get your leg pulled the next time I condescend to give you a lesson in astronomy!"

After this little spar between my two colleagues we proceeded to the machine-room, which John and I carefully inspected, to make sure that all was working properly; and having satisfied ourselves on this point, we gave M'Allister his instructions for the 'night'; though of course there was no night now.

Mounting the steps of the conning turret, we then had a look at the earth, from which we were so rapidly moving away. It appeared about fifteen degrees in angular diameter, showing that we had travelled some thirty thousand miles from it.

The full moon, as seen from the earth, appears just about half a degree in diameter—sometimes a little more, sometimes rather less; so the earth was apparently about thirty times the diameter the moon usually appears to us. It was only a thin crescent where lighted by the sun, but well might M'Allister describe it as "enormous," for it appeared still larger to him when he saw it some thirty minutes earlier and mistook it for the new moon.

When we came down again John, very

thoughtfully, said to me, "Professor, you have had a very long, tiring day; and when we reach the moon, we shall probably stay up several hours to look at it, so you had better take as long a sleep as possible. There will be no need to break your rest, for I'm the younger, and will get about by six o'clock, and relieve M'Allister, who can go on all right up to then, as he has three hours less work to his credit than we have to-day. If your advice is needed, I will call you at once; but, no doubt, we shall do very well till we arrive within a few thousand miles of the moon. We will slacken speed very gradually from about two o'clock in the afternoon, so as not to approach the orb too rapidly."

I had, indeed, as he said, had a long, tiring day, having risen soon after four o'clock yesterday morning, and it was now nearly 2 "A.M." by terrestrial time; so, thanking him for his kind consideration, I bade them both "good night," and gladly proceeded to bed, John following soon after.

He was as good as his word, and actually allowed me to sleep on until nearly half-past three in the "afternoon," when he roused me, and, having dressed, I snatched a hasty meal and then at once proceeded to the machine-room, where my first act was to look at the moon. There it was below us, but still slightly ahead of the *Areonal*; and its magnificence was so overpowering, that it almost seemed to take my breath away, although I was fairly well prepared for the sight. Many times when viewing it through the telescope I have almost lost myself in admiration of the sublime spectacle it

presents; but what I had seen on those occasions could not be compared with the splendour of the view now before us.

Here, without any atmosphere to dim or otherwise mar the view, the brilliancy of the lighted portion of the disc was absolutely dazzling, whilst the extreme delicacy of its varied tints and the subtle nuances of colour, which we now saw to perfection, were most charming and delightful to any one endowed with artistic perceptions. We were only about four thousand miles from this beautiful orb, its angular diameter measuring about thirty degrees, or nearly sixty times its apparent diameter, as seen from the earth; thus it appeared to cover a very large circle on the sky.

John and M'Allister told me they had both been gazing upon the splendid scene for a very long time with astonishment and delight equal to my own; and the latter went on to say, "Professor, did you ever see such a sight in your life? I never did, and could never have imagined that anything could be so beautiful! Mon, it's worth many a journey like this to see such a bonnie thing!"

"You are quite right in saying that, M'Allister," I answered; "it is, indeed, a grand and marvellous sight! I can assure you that when I have been observing the moon in its full and glowing splendour, it has often seemed to me the most exquisitely beautiful object I have ever looked upon; yet now it appears far more beautiful than when seen through the telescope!"

CHAPTER IV

CLOSE TO THE MOON—I GIVE SOME INFORMATION ABOUT IT

WE were now moving at a comparatively slow speed, yet the size of the moon's disc was very rapidly expanding as we approached nearer and nearer to it. In the course of a little over half-an-hour we were within ten miles of its surface, which now seemed to fill the whole space below us; and its rotundity was most impressive. The shadows of the mountains and other elevated portions near the terminator[4] were jet black, owing to the absence of an atmosphere; and, seen contrasted with the brilliant lighting of the parts exposed to the full glare of the sun, appeared almost like deep holes in the lunar surface.

John now remarked, "Professor, you are aware that I have only a rather vague general knowledge of astronomy, although I take an interest in the subject, and that I know still less about the dimensions and physical character of the moon and planets; so perhaps you will be good enough to give us a little detailed information respecting this beautiful orb. Most of it will be news to me, and probably it will all be fresh to M'Allister."

"Heh mon," the latter replied, "just put me among machinery and I'll tell you what's what, but I never learned anything about astronomy, so will not pretend to any knowledge of it, but now I should be very glad to hear what the Professor has to say about it."

"Well, friends," I replied, "it is not my wish to lecture you upon the subject, so I will merely just run over a few of the bare facts.

"To begin with—the moon is very much smaller than the earth, its diameter being only 2160 miles, while the earth's diameter is 7918 miles. Being a smaller globe its mass is much more loosely compacted than that of the earth, so, although it would take nearly fifty globes the same as the moon to make one globe as large as the earth, it would require nearly eighty such globes to make one as heavy as the earth.

"The moon's distance from the earth is generally given as being about 238,000 miles, but this is its mean distance. When farthest away from our world its distance is about 260,000 miles, but at its nearest it is less than 220,000 miles distant. This difference of course arises from the eccentricity of the moon's orbit, and it explains why we sometimes see the moon a trifle larger than it appears at other times. By this I mean that it really is seen larger, because it is closer to us. But you have no doubt often noticed that when the moon is near the horizon it seems to be very large indeed. This apparent increase of size is, however, an illusion, owing to our unconsciously comparing it with the apparent size of terrestrial objects.

"The surface of the moon shows evidence of very violent volcanic action having occurred in every part of it, and astronomers in the past were much puzzled to account for the excessive volcanic energy which was indicated by what they saw, as such a small

globe as the moon would not, in the ordinary course of events, have ever possessed sufficient heat to have developed such violent action. A theory of later years has, however, provided a reasonable explanation. It is that the moon was at one time a part of the same mass as the earth, which became separated from it before the earth had quite cooled down and solidified into its present form, and was then gradually driven farther and farther away from the earth by natural forces. It was therefore originally as hot as the rest of the mass which formed the earth, but being formed into a smaller globe of much less gravity—only one-sixth of that of the earth—volcanic action of the same intensity as that on the earth would have a much more far-reaching effect. A force which on the earth would project volcanic lava and scoriæ a distance of three miles would, on the moon, project it a distance of eighteen miles. This accounts for the very high mountains we see on the moon, some of which are comparatively, for the size of the globe, much higher than those on the earth. It also accounts for the vast size of the lunar craters, ring-plains, and ring-mountains.

"These latter are formations quite unknown upon our earth, but on the moon they are numbered by hundreds of all sizes, from a few miles up to one hundred and fifty miles in diameter. They are large plains, roughly circular in shape, and surrounded by mountains; in a few cases the ring is in some parts a double range of mountains. Sometimes the plain (or 'floor,' as it is termed) is many thousands of feet below the general level of the lunar surface; in a few cases it is raised considerably above it, and in one or

two instances, instead of being flat, the floor is convex. Some of the mountain rings are comparatively low, but in other cases the mountains are fifteen to twenty thousand feet in height, or even higher. Frequently a mountain rises near the centre of the floor, some rings containing more than one such mountain, whilst others have none at all.


H. WICKS



Drawn by M. Wicks

Plate II

Ideal View of Lunar Sc

As there is no atmosphere on the moon, the sky is a dense black, and the typical one, showing numerous craters and cracks, and a small ring-mounta from a few miles to 150 miles diameter, some mountains being nearly 20,0

"There are numerous instances where one mountain ring has overlapped or cut into another, thus indicating that it was a later formation; and in many cases the mountains are 'terraced,'[5] as it is termed, either owing to a series of landslips or to the rise and fall of a sea of lava, which cooled as it sank down, thus forming terraces. Small craters abound all over the surface of the moon and on the floors of the rings; cracks in the lunar surface are also numerous.

"As regards the lunar mountains, it may truly be said that we have a fairly accurate knowledge of peaks and mountains which would either be too precipitous to be climbed, or quite inaccessible to us, if we could actually land upon the moon; and the whole visible surface has been more carefully and thoroughly mapped out and studied than is the case with many parts of our own earth.

"If the moon has any atmosphere it must be so very attenuated indeed that human beings could not possibly live in it at all; but nothing has yet been detected which would enable us to say positively that any atmosphere does exist there, although there have been some indications observed which support

the supposition that there may be an extremely thin air.

"Nor does it appear possible that there is any water upon its surface at the present; in fact, many astronomers are of opinion that the moon never did have any water upon it. Personally, from a study of many of the formations as seen through the telescope, it seems to me quite impossible that they could owe their existence in their present state to anything but the action of water. They present much the same appearance as formations on our own earth which we know have been fashioned by that means. There is no water upon the moon now, I think, though several large depressions are still called oceans, seas, lakes, or marshes, because at one time they were believed to be such. Probably in some of those places, if not in all, water existed millions of years ago; but ages since they must have lost it either by evaporation or by absorption into the soil.

"I will not say any more just now, but as we pass above the lunar surface I will point out a few of the natural features that may be of interest to you."

M'Allister here paid me the compliment of saying, "Well, Professor, I always thought astronomy was a very dry and difficult subject; but your remarks were really very interesting, and quite easy to understand. There is only one thing that seemed to me rather strange as coming from a scientific man, and I would like you to explain that."

"Certainly; if there is anything you do not quite understand, you have only to ask and I will try to

clear the matter up," I answered. "What is it you wish to know?"

"Well," he answered, "I noticed that when you were speaking about the distance of the moon you always said it was *about* so far away. Why didn't you tell us the exact distance? I'm not a scientific man by any means, but if any one were to ask me the length of a connecting rod on one of my machines I should say '25 inches,' not 'about 25 inches,' for that would not do for a practical man!"

"It's like this, M'Allister," I said. "You measure things with a two-foot rule, which is something you can actually handle, and you know it is made according to a standard measure and must contain exactly 24 inches. If, however, your rule was $24^1/_4$ inches long, yet still divided into twenty-four equal parts, you could measure work with it just the same, but would know that every measurement was just a little bit out. If you had no possible means of obtaining another rule, you would have to put up with a little inexactitude.

"That is just the position in which astronomers are placed; they have to put up with a measure which they know is not perfectly accurate, yet it is the best which can be secured.

"Their two-foot rule, so to speak, may be the distance from the earth to the sun, or the length of the whole diameter of the earth's orbit, and these cannot be handled like your rule; and although we know the measurements of these are nearly correct, they are not quite so. Yet the distances of the moon,

planets, stars, &c., have to be measured by these rules, so it is clear we can only know those distances with a near approximation to accuracy.

"For this reason astronomers are always trying different means of ascertaining the sun's exact distance from the earth in order to obtain a perfectly correct measure; but there are so many difficulties and complications which affect the result, that it will be a long time yet before they succeed in their work.

"You will therefore understand that all these figures as to distances and dimensions of planets and stars are only as near approaches to correctness as is possible to attain in our present circumstances. They must not be regarded as literally exact, although they are usually sufficiently accurate for all general purposes. Astronomers know this and allow for it; but general readers of books, when they find figures which do not agree with others they have seen, are apt to regard them as all being mere guesses, and in this they are doing an injustice to the painstaking labours of generations of astronomers and mathematicians.

"I shall presently be mentioning the heights of mountains, the size of ring-plains, craters, &c., but the same reasoning applies to them; the dimensions given are averages of measurements made by different observers, and, though not quite accurate, are as near the truth as the difficult conditions under which they have to be measured will allow."

"Thank you, Professor," said M'Allister as I concluded. "I'm glad I don't have to work with such

rules as those you mention, for measurements a little bit out of correctness would ruin any machine in the world."

"Still, M'Allister," I said, "you would have the advantage over astronomers with your two-foot rule, because you would know that it was a quarter of an inch too long. Their difficulty is that they do not know exactly how much their rule is out of correctness, so cannot obtain absolute accuracy however they may try."

We now set the machines going very slowly and moved toward the northern part of the moon, where I pointed out the position of the lunar north pole, and explained that, owing to the very slight inclination of the lunar axis, there can be but very little variation of seasons in any one particular part of the moon. Thus, if at one place it were spring, it would practically always be spring there, but with very cold nights all through the lunar year. Where it was summer it would practically always be summer, also with very cold nights, and so on.

I further explained that, as the moon revolves on its axis in the same time that it takes to make one revolution round the earth, those on the earth always see the same side of the moon, except when occasionally, owing to inequalities in the lunar motions, they are afforded a peep just round portions of the edges at different periods. The remainder of the other side of the moon has never yet been seen from the earth by human eyes, and in all probability never will be seen for millions of years to come.

John, who as usual was smoking like a factory chimney, here removed his pipe from his mouth and said, "Professor, you stated just now that the nights on the moon would always be intensely cold, and I should like to know whether there is any really reliable information respecting the temperature of the lunar days and nights. I have seen so many contradictory theories on the subject that I scarcely know what to believe."

"In that respect," I answered, "I fear that my position is much the same as yours, for I have absolutely no certain knowledge on the point, but will just state shortly how the matter stands at present.

"During the past century many investigations have been made by scientific men respecting the temperatures on the moon, and their results have differed to an amazing extent. It would take too long, and be too wearisome, to quote all the authorities, so a few must suffice. Lord Rosse, who used a thermopile in his experiments, found that in order to produce the results he obtained, the sunlit surface of the moon must be heated to a temperature of 500 degrees on Fahrenheit's scale. Sir John Herschel had previously concluded that the temperature must be much greater than that of boiling water. On the other hand Ericsson and, more recently, Professor Langley—who used a bolometer of his own invention for measuring the heat of the sun's invisible rays—came to the conclusion that even under continued sunshine the temperature would rarely, if ever, rise above the freezing point of water.

"Professor Very, however, who has continued the delicate experiments with the bolometer, and also made other experiments and calculations of quite recent date, has obtained results more nearly in accordance with those first quoted, for he found that near the end of the second week's sunshine on the moon the temperature of the rocks, soil, &c., must rise to at least 80 degrees Centigrade above the heat of boiling water."

"My word!" said M'Allister, "that's hotter than a ship's engine-room, and I shouldn't care for such a very high temperature."

"As this is so recent," I proceeded, "and the work of one of our highest authorities, I think we must accept it as being more correct, especially as Professor Very has taken into consideration some factors which had not previously been allowed due weight.

"In connection with this matter of temperature it is necessary to remember that the days and nights upon the moon are both very long, for the full lunar 'day' is equal to a month, so the actual lunar day is equal to fourteen of our days, and the lunar night is of the same duration. Our 'day' of twenty-four hours is divided into day and night in unequal proportions, according to the changes in the seasons; but, as I before remarked, the seasonal changes on the moon are very slight, so the variations in the lengths of the days and nights are very small.

"But, whatever may be the difference of opinion as to the heat of the lunar day, there seems to be a

pretty general agreement that, owing to the absence of an atmosphere, the nights must be so intensely cold as to be almost beyond our conception—probably approaching nearly to the absolute zero of outer space. Even with an atmosphere the long nights in our polar regions are so cold that only very strong people can endure them, notwithstanding every device for obtaining warmth.

"You will gather from this that although the moon appears so beautiful from a distance, it must be anything but a desirable place of residence even from a climatic point of view, for we should practically be fried at midday, while at midnight—or even in the daytime when out of the direct rays of the sun—we should soon be frozen stiff."

As I said this John chimed in with: "Professor, all things considered, I think I could smoke my pipe more comfortably upon the earth than upon the moon. I really don't like such extremes of temperature."

"I am of the same mind," I replied, "and it is because I prefer a more equable temperature that I have carefully kept our martalium blinds drawn over those windows of our vessel upon which the sun is shining."

CHAPTER V

WE VIEW THE LUNAR SCENERY IN THE NORTHERN HEMISPHERE

"NOW, Professor," exclaimed M'Allister, jumping up with a shrug of the shoulders, "you've given our friend John a considerable amount of information on a wee bit dry subject, so, mayhap, you will now give us something more interesting, and go on with the description of the natural features of the moon down yonder."

"Yes do, please, Professor," said John; "M'Allister's own temperature is evidently rising rapidly. Strange, isn't it, that a douche of cold facts should make our friend so warm!"

"Well, not altogether," I replied laughingly; "there should always be a healthy reaction after a cold douche. Much depends on the intensity of the cold applied, and you know that if you touch extremely cold metal it burns you like hot iron!"

"Professor," chimed in M'Allister, "maybe I *was* a bit warm, but really your facts were not so cold as to make me hot."

"I'm glad to hear you say so," I answered.

"At all events, Professor," continued John, "whatever may be M'Allister's actual temperature, I'm simply burning to know something about that very striking formation with the steel-grey coloured flooring which is situated not very far down from the North Pole, and a little to the east of the central meridian."

"That," I said, "is a large walled plain called Plato, and, being on a receding curve of the moon, it is seen from the earth foreshortened, so that it appears to be elliptical in shape. It is about sixty miles in diameter, and encloses an area of 2700 square miles, which is just about the area of Lincolnshire. The general height of the mountain walls is over 3600 feet; one mountain on the east is nearly 7500 feet high, and others on the north and west are but little lower.

"You will notice that there are several breaks in the walls, and a large one on the south-west; whilst on the inner slope of the mountains you can see where a great landslide has occurred.

"It is rather singular, John, that in your first selection you have chosen a formation which is one of the lunar mysteries!"

"Ah! Professor," said John, smiling, "I always was lucky! What is this dreadful mystery?" he asked, with an assumed expression of awe.

"Oh, it's not a ghost story, John, nor anything to make your flesh creep," I said rather grimly. "Usually the floor of a walled plain becomes brighter as the sun rises higher and higher in the sky, but Plato actually becomes darker under a high sun. By some it has been thought that this is merely the effect of contrast with the very bright surroundings of this formation, and that there is no actual darkening of the tint. This is certainly not the case, for I have examined it carefully myself with the telescope—shutting out all the bright surroundings from the

field of view, but the floor still appeared equally dark.

"Others have suggested that the hot sun causes the growth of some kind of vegetation all over the plain, the ripening of which makes the floor darker in tint. As regards this suggestion, it is the fact that upon Mars the old sea-beds are the places where vegetation is most luxuriant at the present time; so, if Plato were at one time an enclosed sea, it might not be impossible that vegetation in some low form might grow and be nourished by the crude gaseous remains of a former atmosphere. A greenish tint has occasionally been noticed by some observers, also several light streaks across the floor, as well as several small craterlets, which have been duly noted on the maps.

"But before we go any further we will have a better means of seeing, for it is rather uncomfortable looking directly down upon the moon. So, John, just lend a hand and we'll fetch one of those large mirrors."

This was done, and the mirror suspended with the upper part projecting forward, so that when adjusted at the proper angle we could sit and look straight into the mirror before us and see the reflection of all that was below. We could still look down at the objects, if we wished to do so, without shifting our position.

"There, John," I remarked, as we completed this arrangement, "I have already arranged mirrors in the proper positions at the windows in the forepart of

the vessel, so that in future M'Allister will be able to see what is nearly straight ahead of him. Now you will understand that I had a scientific use for the mirrors I provided, and did not require them merely to admire my beautiful face in as you suggested."

John laughed as I recalled his suggestion, saying, "All right, Professor, I know you generally have a good reason for what you do."

Now, being more comfortably seated, I drew their attention to some small isolated mountains on the area to the south of Plato, pointing out Pico, an isolated mountain over 8000 feet in height, and another with three peaks not very far from it. To the north-east of these, some distance away, are the Teneriffe and Straight Ranges; also isolated groups.

"You will remember," I remarked, "that I said there were several formations which seemed to me to owe their present appearance to the action of water. Now look well at all this district before us—does it not seem to bear out my contention? Those numerous small mountains and isolated groups were not, I think, originally isolated, but connected with the adjoining ranges. If we assume that Plato was once an enclosed sea, or lake, which burst through the mountain walls—possibly owing to their being weakened or broken by volcanic action—there would have been a tremendous outrush of water, which must have carried away a good deal of the softer material of these hills and mountains; whilst, in after years, the continual wash of the waters, combined with aerial denudation, would gradually have worn away all but the hardest parts of these formations.

"Most probably the whole of the surrounding area was also at some time a sea, though volcanic action has since altered its surface conformation, and in places it bears evidence of having been covered with lava. It is not unusual on our world for volcanoes to burst up from under the sea, so even the evidence of volcanic action does not, as some seem to think, negative the possibility of water ever existing here; and it may not be inappropriate to point out that our hydrographers have proved that our ocean-beds are not always smooth, but are often diversified by high hills and deep valleys."

M'Allister here interjected: "Professor, would you kindly tell us something about that fine range of mountains over yonder, just to the right hand?"

"Oh yes," I replied; "I was just about to mention that mountain range, which is called the Alps after those in Switzerland; and that peak on the front portion, just south of the great valley you see, is named Mont Blanc, and is about 12,000 feet in height.

"You will notice a very large number of peaks in this and the other neighbouring ranges—in fact, several thousands have been marked on our large maps.

"Cutting diagonally in a north-westerly direction, completely through the Alps, you will notice a long and deep valley. This is known as the 'Great Alpine Valley,' and is over eighty miles long, and varies from about three miles to six and a half miles in width. At the eastern end it is some 11,000 feet deep,

debouching on to the plain in several comparatively narrow passes, whilst at its north-western extremity it is very shallow, and emerges on to what is known as the Sea of Cold, which covers an area of about 100,000 square miles. This valley seems to afford another example of formation by the action of water.

"Amongst the three thousand peaks comprised in the Apennine range just below the Alps, are several mountains of considerable altitude," I remarked, pointing out Mount Huygens, nearly 20,000 feet high, Mount Hadley, 15,000 feet, and Mount Woolf, 12,000 feet in height. "This range curves round towards the east, and finishes with a fine ring-plain called Eratosthenes—some thirty-seven miles in diameter, with a floor depressed 8000 feet below the lunar surface. It encloses a central mountain, and on the east wall there is one peak which rises 16,000 feet above the floor.

"The ranges in this part of the moon are, perhaps, more like those on our earth than others to be found on its surface, but much more wild and rugged.

"Eastward and northward of these ranges is the Sea of Showers, on which there are several fine ring-mountains and walled plains—notably Autolychus and Aristillus, two very perfect ring-mountains some 9000 feet high.

"One of the most striking, on account of its size and situation, is that large one which is called Archimedes, and is about fifty miles in diameter; and you will notice that a rugged mass of mountains and high hills extends from it to a distance of over a

hundred miles on the south. The floor of this walled plain is only about 600 feet below the general level, and the mountain walls average about 4000 feet in height; but there is at least one peak some 7000 feet high.

"You will see a little below and westward of Archimedes the commencement of a system of large cracks or crevasses in the lunar surface which are known as 'rills.' Many such systems are found in various parts of the moon; some of the cracks are comparatively shallow, but, according to Professor Langley, others are known to be at least eight miles deep, and may be infinitely deeper, though I cannot say I understand how these great depths have been arrived at. The length of the cracks varies from a few miles to over three hundred miles, and from a few hundred yards to some miles in width. They are attributed partly to volcanic action, but mainly to the contraction of the crust of the lunar globe as it became cold. Being so much smaller, the moon would cool much more rapidly than the earth, and the disruptive effects would necessarily be greater."

John here touched my arm, and pointing to some mountains on the borders of a large elongated oval area, close to the north-western terminator where the sun was setting, asked me what they were. I explained that the dark area was known as the Mare Crisium, or Sea of Conflicts, and is possibly the deepest of the large lunar depressions.

"It is about 280 miles long from north to south, and 355 miles wide from east to west, but, owing to its position, the width is seen from the earth very

much foreshortened, so that it really looks nearly twice as long as it is wide. It contains an area of about 75,000 square miles, thus being as large as the combined area of Scotland and Ireland, and the five largest northern counties of England. It is surrounded by mountains, some being over 11,000 feet high, reckoning from the dark floor."

I drew their attention to Proclus—a ring-mountain on the eastern side of this sea—which is about eighteen miles in diameter, and the second brightest of the lunar formations. "From its neighbourhood several bright streaks diverge in different directions, two extending a long way across the dark area, and there is a longer one striking towards the north and another towards the south at an angle of about 120 degrees with each other.

"Seen through the telescope, these ray-streaks often appear very brilliant under a high sun, looking in fact very like electric search-lights; though I notice that the Rev. T.W. Webb has rather curiously remarked that these particular streaks are not very easily seen. Similar ray-streaks, many enormously longer than these, are found in various parts of the lunar surface, but their exact nature and origin has never yet been definitely settled. They only come into view when the sun is beginning to be high up in the lunar sky, and the higher the sun, the brighter the rays appear. Some of the shorter ones are ridges, but this is evidently not the case with the others, for they cast no shadows, as ridges would when the sun is low. Very many radiate from a large ring-mountain called Tycho, in the southern hemisphere; and one of

them extends, with some breaks, nearly three thousand miles, passing northward over the Sea of Serenity and finally disappearing on the moon's north-western edge, or 'limb,' as it is termed.

"Professor Pickering assumes that these rays were caused by volcanic dust or other light reflecting material emitted from a series of small craters, and states that they are really made up of a series of short rays placed or joined end to end. What I have observed myself seems to bear out this latter statement; but the opinion I have formed as to their origin differs from the theory of Professor Pickering. It seems to me more probable that the volcanic dust was carried by a strong wind, split up into two or more separate currents by a succession of peaks. The wind currents swept clean the area over which they actually passed, but dust fell or drifted in the lines between the currents. Exactly the same thing may be observed in connection with snow-storms on our earth when accompanied by a high wind. One part of the earth's surface will be swept clean by the wind current, whilst a long line of the adjoining surface is covered with a thick deposit of snow. I have also noticed that where the ray-streaks impinge upon a mountain, or ring, there is an appearance of spreading out and heaping up of the bright material very much as snow would be spread out or drifted up in similar situations on the earth."

M'Allister here interrupted with the remark that, when we were approaching the moon, he had particularly noticed that all appearance of the face of the "man in the moon" had vanished. He said he had

expected to see that more distinctly as we got nearer.

"That would not be the case, M'Allister," I answered. "The resemblance to a human face which we see from the earth is caused by the combined effect of the bright and dusky areas on the lunar surface as seen from a distance. The depressed dark areas, which we call seas, form the eyes, nose, and mouth of the face, but when we had approached nearer to the moon the details of the surface configuration stood out so much more distinctly that they entirely obliterated the general effect of the markings as seen from a distance."

"Professor," exclaimed John, "I have read that before telescopes were invented it was thought by many that the markings seen on the moon were really the features of our own earth reflected by the moon as in a mirror. Is that correct?"

"Oh yes, John," I said. "It seems to have been a fairly general belief in many parts of the world, and travellers tell us that, even within very recent times, they have found in some of the more out-of-the-way parts of the world that the same idea is still held by uneducated people!"

Objects of interest being so numerous on the lunar surface we could only give a comprehensive glance at many of them, and as we had so many places to inspect, I now gave M'Allister the order to steer eastward.

He accordingly moved his switches and the *Areonal* quickly passed over the Sea of Tranquillity, which has an area of 140,000 square miles; then over

the Sea of Vapours, a smaller area, parts of which have a dusky green tint, from whence to the northward we had a view over the Sea of Serenity, another deep depression nearly as large as the Sea of Tranquillity, and much of which is a light green colour.

Then we came again to the Sea of Showers, a large "sea" having an area of 340,000 square miles; and, still moving eastward, the great lunar "Ocean of Storms" soon came into view. This covers a very large portion of the eastern and north-eastern part of the moon's surface, and, with all its bays and indentations, is estimated to be two million square miles in extent.

I, however, again reminded them that, although these areas are termed seas and oceans, no water exists there now, whatever may have been the case in the long distant past. They are now only large depressions, and not often level but intersected by hills, ridges, and even mountains.

As we passed along I called their particular attention to the magnificent "Bay of Rainbows" on the north-eastern coast of the Sea of Showers. "From Cape Laplace (9000 feet high) on the western extremity, to Cape Heraclides (4000 feet high) on the eastern extremity, this great bay is about 140 miles across, the depth of its curvature being over eighty miles. It bears a very strong resemblance to many large bays on our sea-coasts in various parts of the world, but I am not aware of any such bay which is bordered by a mass of such lofty mountains as this is.

"We are looking at it now under a high sun, but when the sun has only just risen sufficiently high to illuminate all those high mountains, whilst the lower surroundings are still in shadow, the great bay presents in the telescope the appearance of a brilliant luminous arch springing from the lighted part of the moon and extending far out over the dark part of the disc.

"Farther eastward, and lower down on the Ocean of Storms, you will observe what is admitted by all to be the very brightest large formation upon the moon, viz. Aristarchus—a ring-plain nearly thirty miles in diameter, the floor of which is 5000 feet below the surface level. It possesses a central mountain, very difficult to measure on account of the general brightness, but believed to be about 1300 feet high. Well-defined terraces are seen on the mountain walls enclosing the area, and many external ridges are connected with the walls, especially to the south. This formation is evidently covered with some substance which reflects light to a greater extent than that on similar formations; indeed it appears so bright that when the moon is new and the whole of this part of the disc is dark, Aristarchus can still be seen with a telescope, and this gave rise in the past to the idea that it was a volcano in actual eruption. The explanation is, however, more prosaic, because the mountain is really brought into view by earthshine on its bright covering. When the moon is new the earth is almost fully lighted on the side toward the moon, and sheds a faint light on the dark portion of its disc, thus producing the phenomenon known as 'the old moon

in the new moon's arms.'

"Close to Aristarchus you will notice another ring-plain, which is called Herodotus, about twenty-three miles in diameter, with a floor 7000 feet depressed; but this formation is not nearly so bright as its neighbour. That high plateau between them is notable on account of the T-shaped cleft in it, which runs into that other long zig-zag cleft (in some parts two miles wide and 1600 feet in depth), whose direction changes abruptly several times in its length of over one hundred miles.

"Turning from this towards the south-west you will see the most majestic formation to be found upon the moon—the great ring-plain called 'Copernicus,' after the founder of our present system of astronomy. It is about sixty miles in diameter, only roughly circular in shape, and as it stands isolated upon the great ocean-bed it is most favourably situated for observation. A large number of very high ridges, separated by deep valleys, radiate from it in all directions to a distance of hundreds of miles, presenting the appearance of a grand system of buttresses to the mountain walls. These walls are high, and contain a very large number of peaks which, when seen through the telescope as they catch the sunlight, look like a string of bright pearls shining on the border of the ring. A peak on one side is 12,000 feet in altitude, on the other side is one only 1000 feet lower, whilst, rising from near the central part of the floor, are no less than five small mountain peaks. Owing to its size, brightness, and isolated position, this splendid ring-

mountain can be seen from the earth without the aid of a glass; but even a field-glass will reveal much in this and similar formations which cannot be detected by the unaided eye.

"The Rev. T.W. Webb has termed Tycho, in the southern hemisphere, 'the Metropolitan Crater of the Moon,' but, in my opinion, Copernicus is, owing to its position and grandeur, much more worthy of that dignity. Tycho is fine in itself, but is not so favourably situated, being surrounded by other formations somewhat in the same way as St. Paul's Cathedral is surrounded and shut in, for the most part, by other and meaner buildings.

"How much more should we appreciate the splendid proportions and majesty of our Metropolitan Cathedral if we could view it as an isolated building with a fine open space all around it!"

"I quite agree with that, Professor," remarked John, "and I have always thought it a great pity that Sir Christopher Wren was not allowed to carry out his original plan in this respect."

We were looking at the Carpathian range of mountains just to the northward of Copernicus, when M'Allister touched my arm, exclaiming, "Look, Professor, at all those tiny craters near the western side of Copernicus. Why, there are so many of them that the ground for miles round looks like a honeycomb, and in some places there are straight rows of them!"

"Yes," I said, "this part of the lunar surface is

simply riddled with tiny craterlets, and some of them are utilised as tests for the definition of our telescopes. I have heard it remarked that a map of this part of the moon presents almost the appearance of the froth on a glass of stout when it has settled down, the very numerous tiny air-bubbles of different sizes representing the craterlets; and really it does bear such a resemblance.

"Almost due east of Copernicus is another bright and isolated ring-plain named Kepler, after the celebrated astronomer. This is some twenty-two miles in diameter and surrounded by very bright streaks of light, extending in some directions over seventy miles, the whole nimbus of light covering an area of nearly ten thousand square miles. These really are streaks, not ridges, for, as you will see, nearly all the surface surrounding this formation is flat and level.

"Some of the streaks from Kepler radiate in the direction of Aristarchus, others towards Copernicus, cutting right through the rays from those formations. From this it is gathered that Copernicus was formed first, then Aristarchus, and Kepler still later on in the moon's history.

"The surrounding wall of Kepler is comparatively low with respect to the lunar surface level, but the depth of the crater is nearly ten thousand feet below the mountain peaks. The whole formation is covered with the same light-reflecting material as the streaks which surround it."

CHAPTER VI

THE SCENERY OF THE MOON'S SOUTHERN HEMISPHERE

I NOW directed M'Allister to steer across the lunar equator into the southern hemisphere, and our attention was soon attracted by a very large walled plain on the eastward side of our course.

John asked me what it was called, and I explained that it was named Grimaldi, being also well known to observers as the darkest tinted of all the large lunar formations. As seen from the earth it appears a narrow ellipse, but we could see its full width, which is 129 miles, the length being 148 miles. It is also noteworthy as one of the few plains which are convex in section, and it is so large that its area is equal to the combined area of the whole of the counties of England south of the line of the Thames, including Cornwall.

I showed M'Allister this formation on our map, where it appears only a narrow ellipse in consequence of the moon's curvature, and pointed out how very different was its appearance now we could see over its whole extent. Other formations nearer to the moon's limb appear still more foreshortened when viewed from the earth.

John here remarked that "these large ring-plains covered immense areas, and, now that we could actually see them, their magnitude was more

impressive than anything we could have imagined from merely hearing or reading about them."

"Yes, John," I said, "from our altitude of more than ten miles above the lunar surface we command a much more extensive view and gain a better knowledge of details than we could obtain even if we landed on the moon. For instance, if we could stand down in the centre of one of those very large rings, we should imagine we were in the midst of a boundless open plain. The mountains all around us would be so distant that, owing to the sharp curvature of the lunar sphere, they would all be below the horizon, notwithstanding the fact that many of them are several thousands of feet in height. So, for all we could see of them, those mountains might be non-existent.

"In the case of somewhat smaller rings we might perhaps see, here and there above the horizon, just the topmost peaks of some of the more lofty mountains."

M'Allister was now struck with an idea, and exclaimed, "Professor, I notice that many of these great walled plains are very flat, and I should think they would make fine golf-links, for there would be plenty of room to send the ball flying!"

"Undoubtedly," I answered, "you would have plenty of space for that; and I can tell you that you would be able to send the ball flying six times as far as you could on the earth with the same expenditure of force, because the moon's gravitation is only one-sixth of that of the earth."

"That would be grand," said M'Allister. "I should like to have a few turns at golf on the moon."

"Ah, but you would also have extra long tramps after your ball," I told him, "so you would get plenty of exercise; but, for the reason already mentioned, you would be able to get over the ground six times as easily."

"Well, Professor, I should not mind the distance in those circumstances," he answered jauntily.

"Perhaps you like jumping exercise too," I said. "Only fancy, M'Allister, if you wanted to jump across one of those narrower cracks! Why, if you could jump a distance of ten feet on the earth, you could jump sixty feet on the moon just as easily! Some of our athletes have jumped a length of twenty-six feet, so the same persons could with equal ease jump 156 feet on the moon! What do you think of that for a long jump?"

"Heh, Professor," he replied, looking rather bewildered, "what a jump! Why, I should think the mon was never coming down again!"

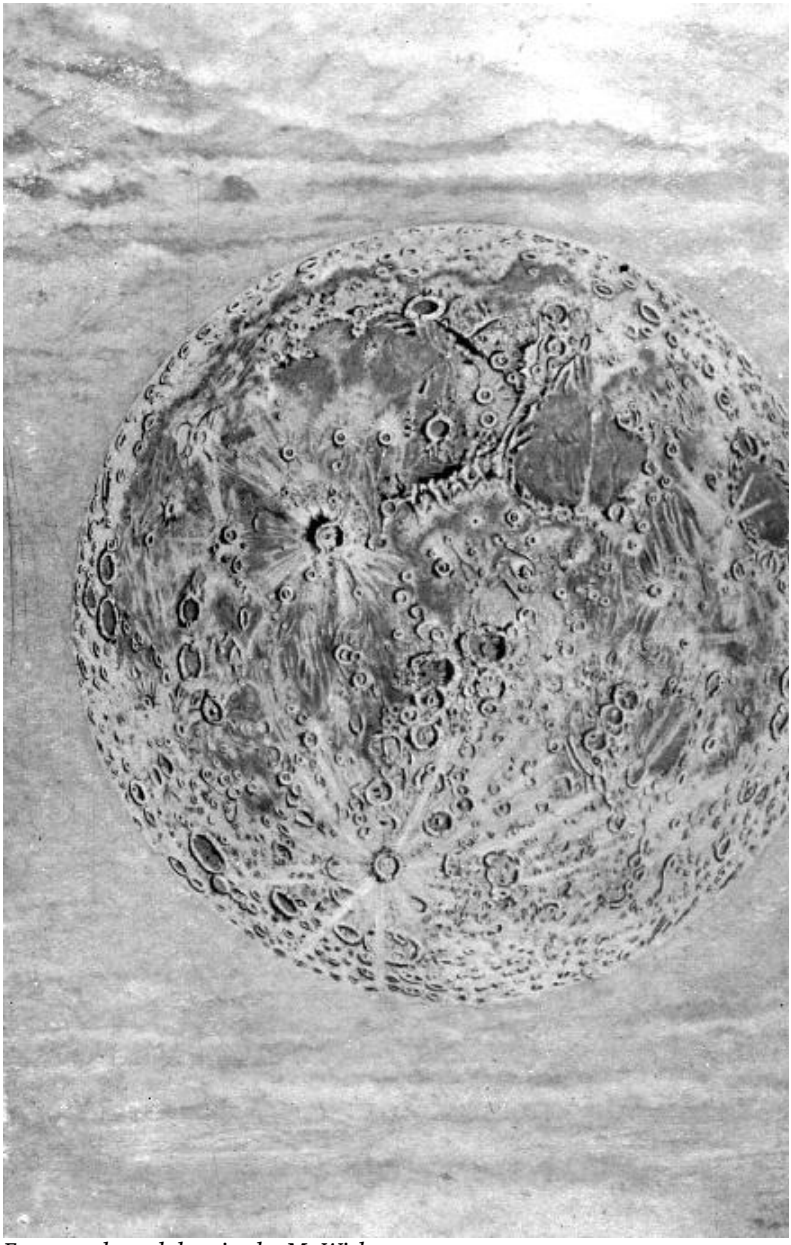
"I say, though, M'Allister, after all I am inclined to think you would not find golf on the moon altogether a pleasant game," said John.

"Why not, mon?" inquired M'Allister.

"Well," answered John, "I was thinking that if you sent your ball flying into one of those cracks which are several miles deep you would find yourself eternally 'bunkered,' for no niblick ever made would

get you out of that."

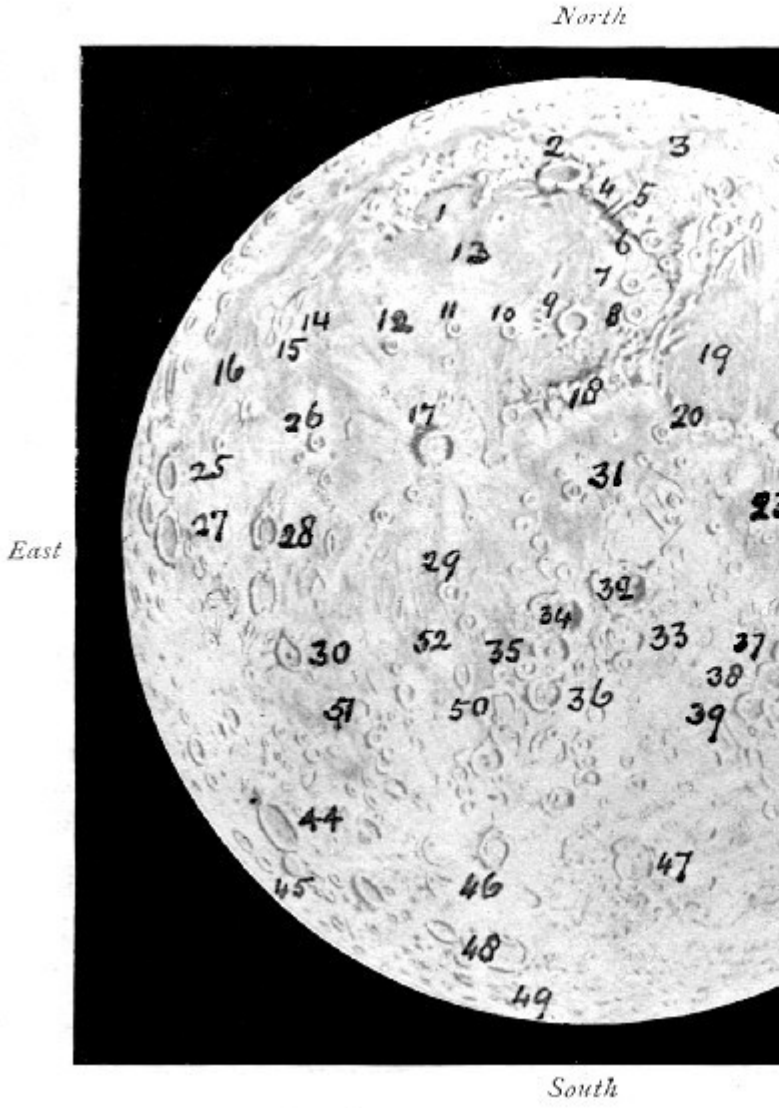
M'Allister laughed so heartily at this idea of John's that we both joined in his mirth; then I recommended him to wait until we reached Mars if he wished to enjoy a game of golf, for there he would be sure to find enormous stretches of level ground.



From a coloured drawing by M. Wicks

Plate III
Chart of the Moon, showing the Principal Fo

The dark areas are termed seas, though there is no water on the moon. T
plains. (The North Pole is at the top.



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50. Straight Wall
51. Sea of Moisture
52. Sea of Clouds

Proceeding on our tour of inspection, we crossed the Ocean of Storms to a point near the central part of the lunar surface, and I showed them the fine

walled plain called Ptolemæus. This is 115 miles in diameter, and contains an area as large as the combined areas of Yorkshire, Lancashire, and Westmorland, its highest peak being 9000 feet in altitude. It forms the most northerly of a line of walled plains, the most southerly being Arzachel, which is sixty-six miles in diameter, and has a very depressed floor; while one peak on the walls rises to a height of 13,000 feet.

Passing farther west, we next examined another splendid group of three ring-mountains, arranged in a line running nearly north and south, viz. Theophilus, Cyrillus, and Catherina. The first is the most northerly, and is about sixty-four miles in diameter, with several very high peaks—one rising as much as 18,000 feet, and two on the opposite side being 16,000 and 14,000 feet high respectively. Even the central mountain is very large in area, and 6000 feet high. "That," I remarked to M'Allister, "is nearly half as high again as Ben Nevis, the highest mountain in Scotland, which is, after all, only 4400 feet high."

"Ben Nevis, Professor, is 4406 feet high!" corrected M'Allister.

"That's right, M'Allister," said John, clapping him on the back, "stick up for bonnie Scotland, and don't let her be robbed of that six feet of mountain!"

Proceeding, I then said that Cyrillus, the middle ring, was, as they could see, very irregular in shape; and the walls were in some parts very much broken and damaged.

Catherina is the largest of the three, being over seventy miles in diameter, and its highest peak is 16,500 feet in altitude.

I should have liked to have shown them the splendid double-walled plain called Petavius, which has a convex floor some 800 feet higher in the centre than at the edges. We were, however, too late both for that and Langrenus, another fine formation on the same meridian, for the sun had set upon them and they were in darkness, so it was no use going any farther in that direction.

We now directed our course over the Sea of Clouds till we arrived at what is known as the "Straight Wall."

"M'Allister," I said, "that ought to interest you, for there is a somewhat similar formation in Scotland. You see this is an escarpment, or cliff, over sixty miles long, and varying from about 600 feet to 900 feet in height.

"This cliff is one of the best known examples on the moon of what in geology is termed a 'fault,' indicating either that one part of the general surface has been greatly elevated, or that the adjoining part has been depressed. We have many examples of such 'faults' on the earth—for instance, one runs a long way across Scotland, from Stonehaven round to Helensburgh, between the Highlands and the Lowlands, and is about 120 miles in length. That is about twice the length of the Straight Wall; so you see that Scotland can beat the moon in that respect!"

This brought M'Allister up to the scratch.

"Scotland," he exclaimed excitedly, "can hold her own in most things! Why, mon, the empire is indebted to her for the finest statesmen, the cleverest lawyers, the best engineers and scientists, and, allow me to say, the bravest soldiers in the whole world! Scotsmen go everywhere, and can do anything!"

"Oh yes, M'Allister," said John, with a laugh, "and a Scotsman has got to the moon! but, please, do not forget that two Englishmen planned the trip, and devised the means of accomplishing the journey!"

M'Allister smiled a rather wintry smile, and then subsided. John was a bit too smart for him that time.

Passing on, we inspected the large cleft running parallel to the Straight Wall, and the small mountain close by named after Birt, the well-known selenographer. We then crossed the Sea of Clouds again, and had a long look at the great system of straight clefts near Campanus and Hippalus, together with the fine walled plain Gassendi, the floor of which is at some parts 2000 feet above the lunar surface. I had often studied this through the telescope, as it is a most interesting formation.

"Well, Professor," remarked M'Allister, "I have travelled nearly all over our own world, but in all my journeyings I have never seen such wild and rugged scenery as I have during the few hours we have been passing over the moon. The mountains seem to be split and rent in all directions, especially where there are volcanic craters in the neighbourhood—and, really, they seem to be everywhere; while landslips are very numerous, and the mountain passes are

extremely rugged and gloomy."

"Yes," I replied, "my telescopic observations had prepared me for a great deal, but the weird ruggedness of the lunar scenery exceeds all my anticipations."

"What is the explanation of it all?" M'Allister inquired.

"I should think, M'Allister, that much of it was originally caused by the extreme violence of volcanic outbursts," I answered; "but the excessive expansion and contraction, resulting from the alternate spells of intense heat and intense cold to which the moon is continually exposed, will account for the formation of many of those tremendous chasms and precipices which we see everywhere around us, as well as for the huge mounds of dislodged rocks and *débris*, which are piled up in such chaotic confusion on the ledges of the mountains and round their bases.

"On the earth such *débris* would very soon have become smoothed by atmospheric erosion, the interstices would have been filled up with dust and soil, while the growth of vegetation would have added a new charm to the effect.

"You have seen the great landslip in the Isle of Wight! When it fell all was wild desolation, but it has become covered with such a luxuriant growth of vegetation that it now presents a scene of beauty.

"On the moon, however, there is neither atmosphere, rain, nor moisture to produce weathering of the rocks or to encourage the growth

of vegetation; so the rocks remain just as sharp, rugged, and bare as they were ages ago when they were first split off from the mountains.

"No doubt very large masses of rocks are still frequently being dislodged, and if we could see them falling from the upper part of a mountain, rebounding along the spurs, with fragments flying in all directions and ultimately dashing to pieces at the base, it would seem to us most uncanny not to hear the slightest sound arising from all this apparent commotion. Without an atmosphere, however, no sound could be produced, no matter how many thousands of tons of rock might fall to the ground.

"Tremendous changes of this nature may be happening on the moon, but our telescopes are not powerful enough to enable us to see the results. They would have to cover an area of miles to be noticeable, unless they presented some particularly striking configuration."

"Professor," exclaimed M'Allister, "how is it that all the shadows on the moon are such a dense black and so sharply defined at the edges?"

"That," I exclaimed, "is entirely owing to the absence of the atmosphere. On the earth, even at night time, some light is diffused by our atmosphere, and shadows are never dense black even when thrown by a bright sun. On the moon it is black darkness everywhere outside the direct rays of the sun, and there is no gradual diminution of the darkness about the edges of shadows such as we see on the earth. The only mitigation of the blackness is

seen where some light is reflected across from the rocky walls on which the sun is shining.

"In those deep recesses down at the bases of the mountains the cold must be most intense and the darkness truly awful. It all looks very nice when the sun is shining, but appearances are often deceptive, and do not improve on a closer acquaintance."

We could not have landed upon the moon if we had desired to do so, for no provision had been made for a supply of air by means of helmets and other apparatus. I kept my own counsel in this matter, as I had very good reasons for discountenancing any proposal to investigate the lunar scenery too closely.

By a curious coincidence, not long after this conversation we had ocular demonstration of the fact that the moon is liable to changes from other agencies than those of expansion and contraction.

We were looking at some distant mountains which were in the full sunshine. Suddenly a dark shadowy looking mass shot across the sky and struck one of the mountain peaks some distance down from the top. The peak seemed to be immediately demolished, and vanished from our sight!

M'Allister gazed spellbound; but John excitedly exclaimed: "Did you see that, Professor? One moment the peak was there, and the next moment it was gone!"

"Yes," I said. "Undoubtedly that dark shadow was a large meteoric stone. Many have fallen on our earth at various times, some being tons in weight.

Usually, however, they are so small that on entering our atmosphere they become fused by the friction and changed to dust. Larger ones are partially fused, and often split into fragments in the upper air. The moon, having no atmosphere, is quite unprotected in this respect; and meteorites moving at enormous speeds, probably over forty miles in a second, travel unchecked and unaltered in character until they strike the lunar surface. It is estimated that immense numbers constantly enter our atmosphere and are destroyed; but the moon must be continually exposed to bombardment by meteorites of considerable size.

"Many of our ships have been lost at sea in calm weather, and their fate has remained a profound mystery; but it is not at all improbable that some of them have been destroyed by large meteorites, for several instances are recorded of ships having very narrow escapes from these dangerous missiles from outer space."

Passing on towards the south-west, we had a long look at the magnificent formation named Tycho. It is a ring-plain nearly fifty-six miles in diameter, the mountain walls having some peaks over 17,000 feet in height. I drew their attention to the long bright ray-streaks which radiate in all directions for many hundreds of miles from the neighbourhood of this formation, to which I alluded when we had been looking at the rays from Proclus. Tycho and these bright streaks can be seen from the earth when the moon is full without the aid of a telescope, if one possesses good eyesight.

An enormous number of ring-plains and ring-

mountains exists all over the southern half of the moon's disc; in many cases there are rings within rings, and others where they have overlapped or cut into previously formed rings.

Moving almost due south, we passed the large but partially ruined walled plain known as Maginus. This ring has a floor which is no less than 14,000 feet below the lunar surface. We then arrived at that favourite object for telescopic observers which is named Clavius. This is an enormous ring-plain, being over 142 miles in diameter, and encloses an area of 16,000 square miles, thus being half the area of Scotland. It has a very depressed floor, and some of the mountains are 16,000 to 17,000 feet in altitude.

Farther on, and close to the south pole, we saw the very deepest of the lunar walled plains, which is named after Newton, who possessed probably the deepest intellect of any of our astronomers. A smaller formation south of Plato was originally named after him, but was not considered worthy of a man of his scientific eminence, so the name was transferred to the formation we were looking upon. It is about 143 miles long and very irregular in shape, and its depth is about 24,000 feet—so deep, in fact, that the sun's light never reaches to the bottom; thus, when we look at it from the earth, the floor is always in shadow.

The Leibnitz Mountains, unfortunately, were not visible, as the sun had set upon them. I, however, mentioned that this range comprises several peaks which are believed to be the highest on the lunar surface, reaching as they do an altitude of 30,000

feet, and, according to some measurements, 40,000 feet. They are very difficult to measure, owing to the fact that they are really situated on the farther side of the moon, extending east and west of the south pole, and are only occasionally brought into view by the moon's libration; even then they are seen in profile, and so situated that they cannot be measured with certainty. They are, however, so high that they blunt the southern cusp of the moon when it is in crescent form.

I now directed M'Allister to turn the vessel in a north-easterly direction, and we moved across to the last objects which I proposed to examine. One was the large walled plain "Schickard"—about 135 miles in diameter—which encloses several other rings; the other, which lies to the south-east of it and close to the moon's south-eastern limb, is probably the most unique object on the lunar surface. As we gazed upon it I explained that the formation, which is known as "Wargentin," would probably in the usual course of events have been a ring-plain about fifty-four miles in diameter, but it really is a high plateau of that size, with very low ramparts. It is evidently a ring-plain which became filled to the brim with lava, or mud, that welled up from the interior of the moon; and the mountain walls, being exceptionally strong and without any breaks or gaps, withstood the enormous pressure of the lava, which therefore solidified and formed the great plateau as we now see it. The low ramparts, which we noticed here and there, are really the isolated peaks and ridges of the mountains forming the walls. This is the only known instance of such a formation; but probably others

would exist had not the walls of the rings given way under the pressure of the lava. The walls of several ring-plains have been quite carried away, and, in some cases so obliterated, that it is now difficult to make out the original shape of the rings.

Having taken a last look at this unique object, I directed M'Allister to set the machinery in motion and rise for the purpose of quitting the moon.

"But," interposed John, "are you not going to have a look at the back of the moon, Professor?"

"No, John," I answered, "only a small portion of it is now in the sunlight, the rest is in the blackest darkness, so we should not be likely to learn much more about it than we know at present."

"Do you think the moon is inhabited?" he then asked.

"No, I do not think it is; no sign of life has ever been discovered, and we have seen nothing to indicate its existence here. The prevailing conditions seem to preclude the possibility. Think, John, if there is any life, what must it be! Without any atmosphere —therefore, not a sound to be heard, for all would ever be in the most deathly silence—no breath of wind; never a cloud nor a drop of refreshing rain, nor even dew; intense heat in the sunlight and the most intense cold everywhere in the shade! If any life does exist, it is most probably down in those gloomy, dark and cold recesses at the bottom of the ring-mountains, where there may possibly be some remains of an atmosphere. It would, however, be life in such a dreadful and debased form that I would

rather not think about it at all.

"For a somewhat similar reason, I have directed M'Allister to keep the *Areonal* at least ten miles above the lunar surface all the time we have been passing over it. When we saw it from a distance it was, as you know, an object of surpassing beauty; and as we have seen it from here it has still been pleasant to look upon. This is truly a case where distance lends enchantment to the view; for, if we went down close to the surface, we should find it a scene of the weirdest and wildest desolation—more horrible than anything seen during a nightmare, and more terrible than anything imagined by the insane!

"No, John," I concluded, "let us retain our memory of the moon as a thing of beauty, and leave it at that."

"I quite agree with your view of the matter, Professor," John replied; so I gave the signal to M'Allister, who was awaiting the result of our discussion, and we soon left the moon far below us.

CHAPTER VII

WE RESUME OUR VOYAGE—THE SUN AND THE SKY AS SEEN FROM SPACE

ALL the time the *Areonal* had been near the moon some of our machines were storing up fresh power,

and we had accumulated a supply amply sufficient to meet any extra requirements in the event of our arrival upon Mars being unduly delayed.

We now turned and looked back at the earth; and, as the moon was so near to it at that time, the earth's disc appeared very nearly two degrees in diameter, or nearly four times the usual apparent diameter of the full moon as seen from the earth. The crescent of light on its right-hand side was rather wider than when we last looked at it; but so many clouds hung over it, that we could not see what countries were comprised in the lighted portion of its surface. Owing to the light of the stars behind the earth being diffused by the dense atmosphere—in the same way as it would be diffused by a large lens—there was a ring of brilliant light like a halo all round the earth's disc.

Having passed away from the moon, I now gave M'Allister the necessary directions in order to keep the *Areonal* on a course which would enable us to head off the planet Mars at, as near as I could reckon, the point it would reach in fifty days' time. The course having been set, M'Allister was free to join us again, as the machinery required very little attention.

When he did so, M'Allister at once asked me a question. "Professor, can you tell me when it's going to be daylight? The sun has been shining for hours and hours, yet it's still night; the sky is blacker than the blackest night I ever saw, and the stars are all out!"

John laughed heartily, and said, "M'Allister, this is daylight! and all the daylight you will get until we reach Mars."

M'Allister turned to me with a perplexed look on his face and asked, "Is that right, Professor, or is he trying to pull my leg, as he said he would?"

"Oh yes! It's quite right, M'Allister," I replied. "It is now full daylight, and we shall have no more night until we reach Mars. That, as you know, will be seven weeks from the present time."

"Well, Professor," he exclaimed, "then how is it the sky is so densely black and the stars all shining so brightly? I never saw the stars in the daytime before, yet these are shining brighter than they do on the earth at night."

"Simply," I said, "because upon the earth we were surrounded by a dense atmosphere, which so diffused the sun's light that the whole sky appeared bright. The stars were there all the time, but their light was so overpowered by the brilliancy of the atmosphere that they were quite invisible to us.

"Now, we are out in space where there is no atmosphere at all, so the sky appears a very dense black; and the stars, having nothing to obscure their light, shine out more brilliantly than they do on the earth. They appear as bright points of light, and even the sun does not shed a general light over the sky, there being no atmosphere to diffuse it."

"Yes," he persisted, "but you said we should have no more night until we got to Mars!"

"Certainly," I answered. "Surely, M'Allister, you must have forgotten that night is brought about by the earth's rotation on its axis, and that the part which is turned away from the sun is in darkness because its light is hidden by the solid body of the earth, while the earth's shadow darkens all the sky. When, by the earth's rotation, that part is again turned to the sun then it becomes daylight. Remember we are not now on the earth, but out in space!"

"Of course I did know all that, Professor," he exclaimed, "but, just for the time, I had forgotten."

"Never mind, M'Allister, we all forget such matters sometimes, and this is quite a new experience for you. But just take a good look at the sun—have you noticed any difference in its appearance?"

"Yes, Professor, it doesn't look the same colour as when we saw it from the earth; it seems to have a violet tinge, like some of the electric lights in our streets. There are also long streamers of light around it, and coloured fringes close to the sun!"

"Yes, that is so," I said; "and we can see all those things now because there is no atmosphere. No doubt you have noticed that on the earth the sun appeared red when low down in the sky, and during a fog it appeared redder and duskier still."

"Oh yes, I've often noticed that," he answered.

"That was caused by our atmosphere which, when thick, absorbs all but the red rays of light. On a clear day the sun appears an extremely pale yellow, or

very nearly white; still the atmosphere absorbs some of the light rays, so we cannot see its true colour as we do now. Those coloured fringes round the edges can only be seen from the earth by the aid of a special instrument, and then they do not show all their true colours.

"That pearly light all round the sun, and the long streamers that give it the appearance of an enormous star with six long points, form what is termed the solar corona, and this can only be seen from our earth during the very few minutes when an eclipse of the sun is at its totality. It is to see the corona and other surroundings of the sun, in order to study them, that astronomers go such very long distances—often thousands of miles—when there is a total eclipse expected, and not merely to see the eclipse itself. They hope, in time, to learn much from such observations; but if it happens that the sky is over-clouded during the period of total eclipse, then all their expense, and the time spent in preparations and rehearsals of their procedure, are, unfortunately, entirely wasted.

"Now, M'Allister, if you will take my glass you will be able to look at the sun and examine it without any risk to your eyesight, for it is provided with a dark glass to shut out all the dangerous glare. You will then see what the fringes and inner and outer coronas really are like."

He took the glass and looked for a long time at the sun, and, judging from his exclamations of surprise and astonishment, he was extremely interested and delighted with what he saw. John was also

examining it at the same time through his own glass.

Presently the latter turned to me saying, "Professor, I no longer wonder that astronomers are prepared to travel long distances, and to risk a great deal of discomfort, and even hardship, in order to view and study the sun's surroundings. Of course to them it is not merely a sight to be seen, but the only means by which they can acquire a knowledge of solar physics. Merely as a sight, however, it is most wonderful. At many places all round the edge of the sun's disc I can see what look like coloured flames—pink, pea-green, carmine, orange, or yellow, all in incessant movement—shooting out at times, or waving and shimmering in a manner that is indescribable. The changes in form and colour are as sudden, yet as definite, as the changes produced by turning a kaleidoscope; while the intermingling of the various colours frequently produces an effect which I can only compare to the iridescent colours on mother o' pearl. Then all around and beyond the coloured fringe there is the light of the pearly inner corona; beyond that are pearly and violet-tinged rays curling away in both directions from the poles, whilst outside all are the long, pearly, and violet-tinted streamers which assume the shape of a large many-pointed star; and even these do not seem at rest. Though astronomers cannot see all that we do now, there must be sufficient visible to them to afford opportunity for a most interesting study."

"That is indeed the case, John," I replied. "Those coloured flames, for instance, form a study in themselves, which some observers make their

particular hobby. As seen from the earth, they all appear some tint of red; and, normally, according to measurements, they seem to extend a distance of some 20,000 miles above the sun. They shift their position very rapidly indeed; movements at the rate of 100 miles a second are quite moderate compared with some which have been noted, yet one can scarcely realise such rapidity of motion. Frequently, however, these flames are seen to rise in immense masses to tremendous heights above the sun's surface, evidently driven upwards by explosions of the most intense energy. In 1888, for instance, one was observed which, in the course of two hours, rose to a height of 350,000 miles before it broke up; that is, at the rate of 50 miles a second all the time; but, as the force would become less and less as the distance increased, at the earlier part of the time the movement must have been far more rapid. When the impetus derived from the explosive force is quite exhausted, the top part of the mass of flame often spreads out like the top of a tree, then breaks up and falls back into the sun in large flakes of flame.

"It is supposed that these violent explosions are the cause of the spots we so often see on the sun when observing it with our telescopes; and, when looking at them in their earliest stage, we are probably looking at a mass of flame *end on*, instead of seeing it in profile, as is the case when the explosion occurs near the edge of the disc. The flames, as examined by the spectroscope, appear to be largely composed of hydrogen gas; and no doubt many other gases—some quite unknown to us—enter into their composition. They are termed flames, but

are more probably immense volumes of incandescent gases. The corona itself is never seen twice alike; its shape and size vary at every eclipse, but the variation runs in a regular cycle from maximum to minimum.

"You will also observe that all around the corona, and extending a vast distance beyond it on both sides, is a fainter pearly light. This is what is termed the zodiacal light, and is believed to be the thinner portion of the sun's atmosphere. We can see it from the earth occasionally after the sun has set, extending far up into the sky in the form of a semi-ellipse, the base of which is over the place where the sun is."

M'Allister here asked me to tell him "What was supposed to be the actual size of our sun, and how far it was away from the earth?"

I answered that "The sun is about 865,000 miles in diameter; and that he would have some idea of what an immense body it is if he remembered that it would require 64,000,000 globes the size of the moon to make one globe the size of the sun! Yet, notwithstanding this immense size, our sun is quite a small body as compared with some of the fixed stars, which, as perhaps you may know, are really suns at an inconceivable distance from us. The bright star Sirius, which is visible during our winter time, is not only very much brighter in reality than our sun, but must be many times larger; and there are others known to be very much larger than Sirius. It has been computed that Arcturus is in mass 500,000 times as large as our sun!

"The sun revolves on its axis in a little over twenty-five days, but the exact period of its revolution is difficult to determine. The mean distance of the sun from the earth is about 92,800,000 miles. When we are farthest from it its distance is 94,600,000 miles, and when nearest, 91,000,000 miles—these differences, of course, arising from the eccentricity of the earth's orbit.

"The sun's density is only about one-fifth of the earth's density; so it is evidently mainly gaseous—at all events in the outer envelopes.

"The spots upon the sun often cover such an immense area, that if our earth were dropped into the cavity, it would be like placing a pea in a teacup! Some of the spots entirely close up in a short time, but others last for weeks."

We now turned from the sun and looked at the stars. Such a multitude were visible as we had never seen from the earth; for small stars, which there required a telescope to bring them into view, could now be plainly seen without any such aid, and their various colours were seen much more clearly. They all shone with a clear and steady light; the twinkling and scintillation of the stars, as seen from the earth, being caused by the vibrations and movements in our own atmosphere. We also saw many nebulæ without using a glass.

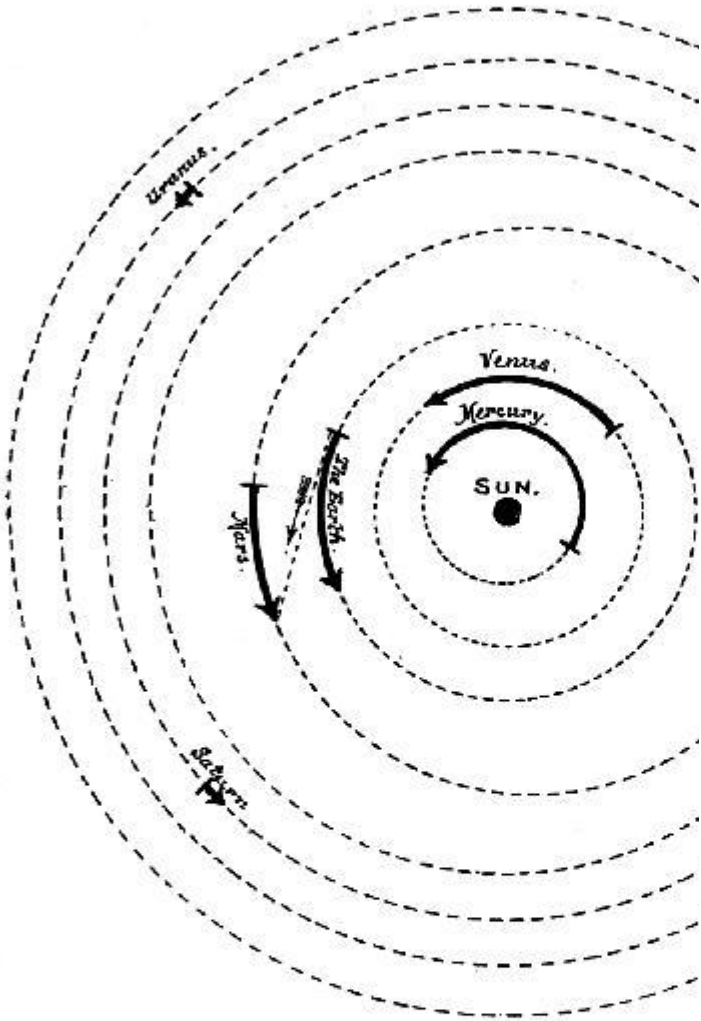
The Milky Way was a most gorgeous spectacle, and its beauty utterly beyond description, as such an immense number of its component stars, and their different colours, were visible to the unaided eye;

besides, we could trace wisps and branches of it to regions of the sky far beyond the limits within which it is seen from the earth.

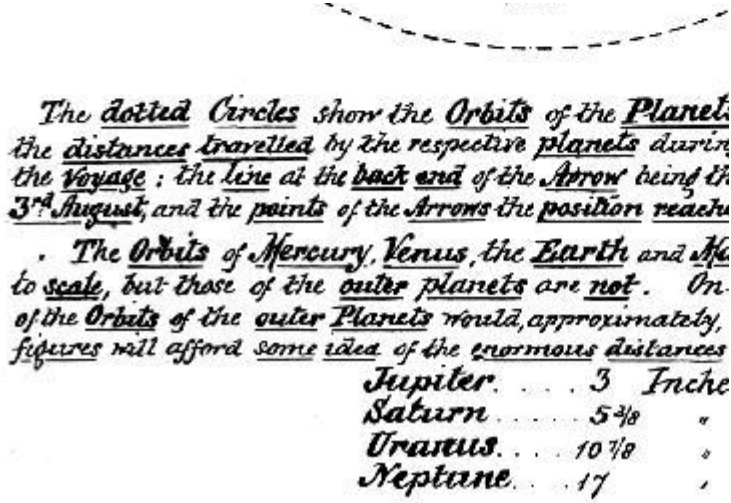
We noted that the planets were also much more clearly seen; and the orange-red disc of Mars, of course, received our particular attention.

We had spent very many hours in viewing the moon, and a long time in examining the sun and stars; so we now sat down to a hearty meal, and, after a short time spent in conversation, we made our arrangements for taking turns in attending to the machinery, and then retired to bed.

DIACRAM, showing the **Positions** and **Move**
between the 3rd of August and the 24th of Septe
Course taken by the "Arconal" on the **Voya**
The dotted line joining the **Earth** to **Mars** sh



The dotted Circles show the **Orbits** of the **Planet**
the **distances** travelled by the respective **planets** durin
the Voyage. The line at the back end of the Arrow being th



Drawn by M. Wicks

Pla

CHAPTER VIII

JOHN INSISTS ON GOING BACK AGAIN—A STRANGE, BUT AMUSING INCIDENT OCCURS

WHEN we rose the next day the moon was a considerable distance away from us, but not so far off as might at first be imagined if one only considered the speed at which we were travelling; for, although moving at our full speed, the earth was following us up pretty closely, as the curve of its orbit would, for several days, run nearly in the same direction as we were going. Still, 2,000,000 miles a

day was sufficient to make a diminution in the apparent sizes of the sun and Venus; and there was a gradual increase in the size of the planets, Mars and Saturn, towards which we were moving. As regards the fixed stars, however, there was no change in our surroundings, as they are such an immense distance away—the nearest being, at least, twenty billions of miles from the earth, that a few million miles more or less make no difference in their apparent size, or in their positions in regard to each other in the constellations as we know them in our maps.

As we were now fairly on our way, and moving rapidly in the direction we wished to travel, I thought it quite time to put into operation a scheme which John and I had previously decided upon, so I told M'Allister that he must be prepared to take a little change of air.

"Why, Professor," he exclaimed, "that sounds almost like a proposal for going to the seaside!"

"We certainly are not going there," I replied, "for we are rapidly moving away from all seaside resorts, and you are not likely to visit any of those places for a very long time to come."

"Well, mon, where are we going to get our change of air then?" he inquired; "you know there's no air at all outside of this vessel."

"Quite true," I answered; "so we must get our change of air inside the vessel."

"Yes," interposed John, "and, Kenneth M'Allister,

you will have to make up your mind to have rather short commons of it; the same as we shall!"

"Whatever do you mean?" he inquired, now appearing really scared—for a dreadful thought had crossed his mind. "Mon, you surely do not mean that our machinery is giving out!"

"Oh no! not at all, M'Allister," I replied; "but perhaps I had better give you a full explanation of the matter:—

"You know we are bound for the planet Mars, where the air is very much thinner than that which we have been accustomed to breathe, and very probably it is composed of somewhat different constituents. In these circumstances you will understand that, if we landed upon Mars without having taken proper precautions, such thin air might make us very ill, even if it did not kill us.

"That little compartment next the store-room was arranged and fitted up for the special purpose of supplying a thin air in which we could prepare ourselves for the atmosphere of the red planet. So we are really going into training. The machines in that room will generate an attenuated atmosphere somewhat similar to our own, and this will be automatically mixed in a cylinder with a little oxygen and nitrous oxide gas, so as to make it as near as possible like what we expect to find upon Mars. When we commence it will be only slightly different from our own air; then gradually we shall reduce its density and change its quality until it is as thin as we shall require. Each of us must spend about

eight hours a day in that little compartment, though it will not be necessary to take the eight hours continuously, for we may spend a few intervals in the other rooms.

"John and I will take general charge of the machinery in that room, and he will also look after your machines whilst you are with me in our Martian air-chamber. In addition to these arrangements, we have prepared a concentrated air of the same kind which we can carry about with us in bottles, so that by simply opening a little valve in the bottle we can inhale some of the air now and then when we are in the other rooms. By adopting this plan, I hope when we reach Mars we shall all have become so acclimatised that we shall be able to breathe the Martian air without much inconvenience."

"Heh, Professor," said M'Allister, "what a mon you are for planning things out; I would never have thought of that!"

"John had quite as much to do with the planning out as I had," I replied; "and as you now understand what we propose to do, we will at once commence our training, but we shall not feel much difference in the air for the next day or two."

We accordingly put our plan into operation, each of us making up at least eight hours' time every day in the Martian air-chamber, with the result that we gradually became accustomed to the thinner air, and could breathe it without any feeling of inconvenience.

As the days went on I began to notice that John

was becoming very irritable; and so was I, though to a lesser extent. The closer confinement to one room was evidently beginning to tell upon us, and day by day the effects were more apparent on both of us, especially in the case of John; but, strangely enough, whilst we were becoming more depressed and irritable, M'Allister's spirits seemed to be rising every day!

It has often been remarked that if two or three people are shut up together for a considerable time, with no other companionship or change, sooner or later they are bound to fall out with each other.

Up to the present we had all agreed splendidly, but now John's irritability seemed to increase hourly; and as regards myself, I often found it necessary to exercise very great self-control to avoid giving very sharp and snappish answers to John's peevish and querulous remarks.

But the inevitable explosion came at last, and, like all explosions, was very sudden and unexpected when it did happen.

All the morning of the 2nd of September John had been wandering in and out of the various rooms, and frowning as though very displeased about something. I gave him a hint or two that he ought to put in more time with me in the air-chamber, but he took no notice of my suggestions. Presently, whilst I was in there alone, he came through, but, without speaking to me, went on into the store-room; and I heard him in there opening and shutting the lockers and cupboards, generally closing the doors with a loud

bang, as persons do when in a very bad temper.

These bangs became more frequent and more violent, and at last succeeded each other with such rapidity that it seemed almost as though a vigorous cannonade were in progress.

I was wondering what could be the meaning of all this commotion, when suddenly the door opened, and John rushed into the room looking very cross indeed.

"I'm sorry, Professor," he cried, "though it's no use saying so; but we must go back to England again at once!"

"Good gracious, John!" I exclaimed, "what do you mean, and whatever has happened to upset you so and cause you to change your mind in this extraordinary way?"

"The deluge has happened," he replied, very crossly. "Professor, *I've left all my stock of tobacco behind*!"

"Never, John," I replied. "Why, you packed it up yourself; and I remember that when we overhauled the stores on our departure I saw the large tin of tobacco in your cupboard."

"I thought I packed it up," he answered, "but it's nowhere to be found now. As my tobacco supply had nearly run out I went to the cupboard this morning to get some more, and took down the big tin of twenty-six pounds labelled 'Tobacco.' I opened it, and what do you think it contained? You would never

guess—well, it was tapioca!

"I've looked everywhere I can think of, without finding a trace of the weed."

Just then M'Allister came into the room, and, noticing John's vicious frown and my troubled look, asked what was wrong. We told him the news, but he only laughed, and, turning to John, exclaimed, "Heh, John, don't fash yourself about the tobacco, mon; we'll find you a substitute. There's more kinds than one."

"Substitute, indeed!" said John snappishly, "no substitutes for me!"

"Well, John," I interposed, "you can have as much of my tobacco as you like; it's a good brand, you know, and I shall not mind a shorter allowance, for it does not mean much to me."

"No," he exclaimed sharply, "I can't take yours, Professor; it's your own special brand!"

"Well, John," said M'Allister, "you're as welcome to mine as if it were your own, and it's fine strong stuff too. And you can have some of my Navy plug as well," he added with a grin; "you'll find it rare good chewing."

"I simply cannot take the Professor's tobacco," said John; then, angrily turning upon poor M'Allister, he cried, "And as for your filthy stuff, it's a downright insult to offer it to me!"

"John! John!" I implored, "do be reasonable; it's

not at all like you to talk in this rude way, and you must know we really cannot go back now!"

"Reasonable!" he sneered. "Do you call it reasonable, Professor, to ask a man who is a lover of his pipe to go all the way to Mars and stay there for months without any tobacco!"

"Well, you will not accept mine, although you know perfectly well that you are heartily welcome to it. It's not your own particular brand, it is true, but it is a real good one. However, most likely you will find some on Mars; there's plenty of vegetation on that planet, without a doubt."

"Vegetation be hanged!" he angrily exclaimed. "What am I to do in the meantime? As for tobacco growing upon Mars—why, sir, I'd bet my bottom dollar that, outside our own world, there's no place in the whole universe where anything equal to my superb mixture can be produced. It's no use talking, Professor; as I said before, we must go back."

"We cannot go back," I replied sternly, for by this time I was becoming very irritated at his obstinacy. "The idea of going back so many million miles merely to fetch tobacco! Remember, we have travelled at least 57,000,000 miles on the way to our destination!"

John strode up and down, becoming more and more excited every minute, and was soon quite raging; yet it seemed most singular that the more John raged the more M'Allister laughed. I looked from one to the other in amazement and the most utter perplexity at this extraordinary change in their

behaviour. Then all at once I saw a gleam of light, so to speak, and the solution of the mystery became clear to me.

The air we had so long been breathing when in the air-chamber, and when we made use of our air-bottles, was very similar to what is popularly known as "laughing-gas"; and undoubtedly we were all more or less experiencing the cumulative effects of the constant mild doses we had inhaled. Laughing-gas acts in a different manner upon persons of different temperaments: some will keep laughing, moderately or immoderately; others will become irritable, angry, or even pugnacious; whilst others again will weep copiously.

M'Allister was now talking rapidly and quietly to himself, laughing all the while, his eyes shining and twinkling merrily as though something intensely amusing were being enacted.

This seemed to react upon John, who apparently was irritated beyond control, and presently he roared out, "Kenneth M'Allister, stop that infernal grinning and chattering like a monkey! Stop it, I say! stop it directly!" But M'Allister took no notice and laughed louder than ever.

"Why, you confounded baboon," shouted John, "you're worse than any laughing hyena! Stop it, stop it at once, or I shall do you some mischief!" And he advanced towards M'Allister in such a menacing attitude that I had to rush between them to keep them apart.

He was now raging up and down the room,

looking as angry as a hungry lion which has just had a long expected dinner suddenly snatched away from it; but the worse he became the louder M'Allister shrieked with laughter. The latter was now simply rolling about the room—for it could not be termed walking, it was so erratic—holding his sides and laughing, whilst the tears were chasing each other down his cheeks. He kept trying to speak, but had no sooner stuttered out the words, "Heh, mon! heh, mon!" than he was off again into another wild paroxysm of laughter, and was rapidly becoming exhausted.

Things were really becoming very serious indeed, and I saw that something must be done at once to put an end to this disturbance. So, going over to M'Allister, I took him gently by the shoulders and pushed him out of the room, saying quietly, "Go to your own room at once; but for goodness' sake don't touch the machinery until the air has had time to put you right again. Leave me to deal with John." He rolled off through the doorway, still laughing "fit to split" as people say.

Returning to John, I tried to calm him down; but it proved a long and difficult task, though at last I succeeded in persuading him to go with me into our living-room and sit down quietly.

After sitting there some time, puffing away at his pipe, the fresher air began to have its effect; and soon I judged that he was calm enough to talk the matter over and discuss the situation more reasonably.

Then I said: "John, my dear fellow, please listen to me. You know we have now travelled quite 57,000,000 miles on our journey, and that all our arrangements have been made with a view to reaching Mars not later than the 24th of September, because it will then be at the point where it is in opposition to the sun as seen from the earth. It is merely a sentimental reason so far as the opposition is concerned, but there are substantial reasons for not delaying our arrival.

"You say we must go back, but please consider all that such a course must involve. Though the earth has been following us up pretty closely on a slightly different course it is at the present about 13,000,000 miles away from us. You will see it out there on our left hand towards the rear of the *Areonal*; but we cannot go direct across to where it is now, for by the time we reached that point the earth would have gone ahead several million miles. Our only course is to head it off, and, taking the shortest line, that means a journey of over 12,000,000 miles. Therefore, we cannot reach England until the 8th of September at the earliest, and as we shall require at least a week to lay in fresh stores, it will be the 15th before we can start again.

"Starting on the 15th September we should have to travel at least 54,000,000 miles before we could catch up Mars, and as that will take twenty-eight days, we could not arrive there before the 13th of October. (See the chart.)

"Thus, we must sacrifice our chance of being upon Mars on the date of opposition, and also the

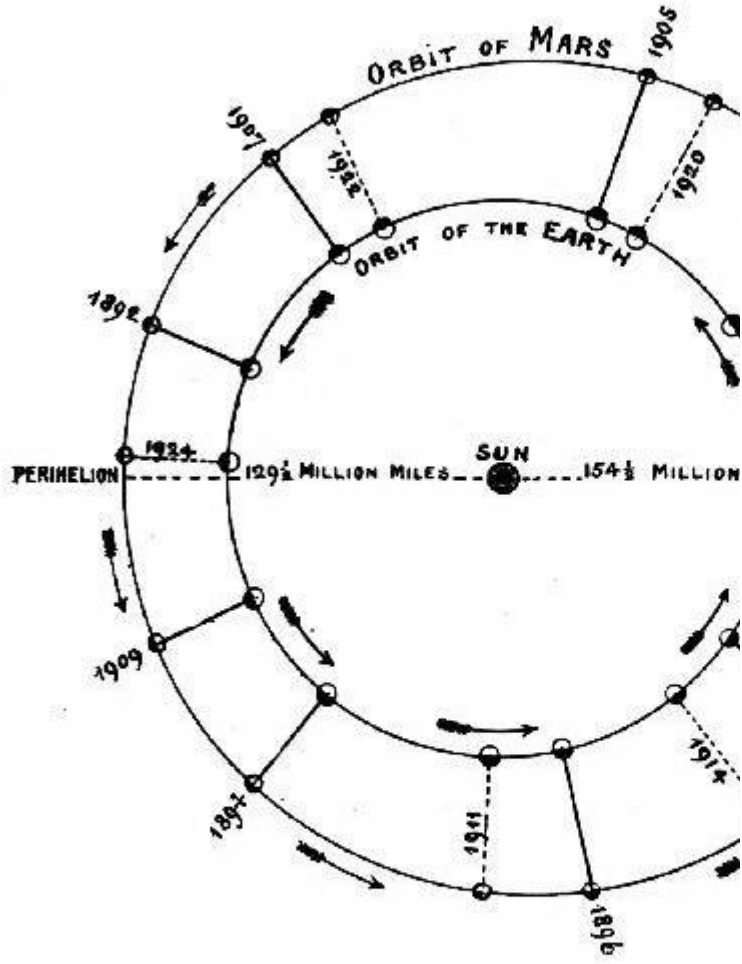
opportunity of catching the first glimpse of our earth a few days later. If we continue our journey now and reach Mars on the 24th of September the earth will then be only 37,000,000 miles away; but by the 13th October it will be over 40,000,000 miles distant. There is the further objection that to get back again in reasonable time we must leave Mars by the 1st of December, and the loss of three weeks' time will deprive us of many opportunities of learning what there is to be found on the planet.

"Now, John, like a good fellow, just think over the matter quietly and reasonably; you will then realise that it is quite impossible to interrupt our journey and return to England as you suggest."

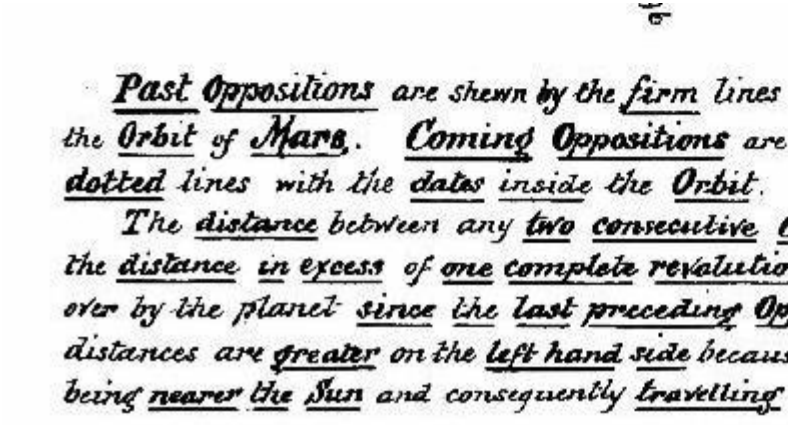
"I have thought it all out again and again," he replied, "and can only repeat, Professor, that it is quite impossible for me to go on minus my tobacco!"

"Was there ever such an obstinate and unreasonable man!" I thought to myself. "What can I do to put an end to this absurd difficulty?"

DIAGRAM showing the relative positions of Mars at the various Oppositions from 1892 to 1924.



Past Oppositions are shewn by the firm lines the Orbit of Mars. Coming Oppositions are



Drawn by M. Wicks.

Pla

Resuming the conversation, and keeping as calm as I could in the circumstances, I placed the matter before him in all its aspects, and after we had been talking together for a long time, he seemed to be able to take a more reasonable view of the position. In order that something might be done to keep his mind from dwelling upon his proposal to return to England, I suggested that we should go to the store-room and thoroughly overhaul it.

He agreed to this, accompanying me to the store-room and pointing out the different places he had searched. The tins were in several sizes, but all were made square in order that not an inch of the available space might be wasted. We looked into a large number of tins which had not previously been examined, but without finding what we wanted.

At last a thought occurred to me, and I said: "You tell me, John, that you are quite certain you put up the tobacco and labelled the tin yourself, yet the tin

so labelled was found to contain tapioca! Do you remember where the tapioca was stowed away?"

He pondered awhile, with his chin resting upon his fingers, then suddenly replied, "Yes, I think I know where it is," and, taking me over to another cupboard at the far end of the room, we made a further search and at last found the tapioca tin, opened it, and lo, there was the missing tobacco!

"Well, I'm blest!" said John, very slowly drawing out the words; then all his ill-humour suddenly vanished, and he burst into a most hearty laugh, in which I joined. Our laughter, indeed, was so mutually contagious, and so often renewed, that we had to sit down to finish it and recover ourselves.

Then John remarked, "Now, Professor, I think I can explain it all. You see I prepared and labelled those confounded tins before loading them up; so I suppose that when stowing away the parcels of tobacco I just glanced at the label on the tin and saw the letter T followed by the right number of other letters, and, taking it for granted that it was the tobacco tin, placed the tobacco in it. The only other tin left to pack was the one I supposed to be labelled 'Tapioca,' and no doubt, without troubling to look at the label at all, I put the tapioca into it; but, of course, it must really have been the tin labelled 'Tobacco.'"

Thus the matter was satisfactorily cleared up. John, having found his beloved weed and recovered from the effects of our patent Martian air, was now quite himself again, seeming very contrite, and

apologising repeatedly for his rude conduct.

"That's enough, John," I said, as I laid my hand on his arm; "it is quite clear that what you did was mainly the result of the peculiar air you had been breathing, so I cannot blame you much. If I had not taken so many intervals in the purer air, I might perhaps have been equally affected; as it was, my temper was none of the sweetest."

M'Allister had also quite recovered by this time, and bore no ill-will towards John; indeed, I doubt whether he had any very clear recollection of what had occurred.

So that ended the matter; and this little explosion having cleared the air, we all settled down to our old amicable relationship. We, however, took the precaution of reducing the amount of nitrous-oxide gas in our mixture of air, with a view to preventing any similar untoward results in future.

CHAPTER IX

A NARROW ESCAPE FROM DESTRUCTION—I GIVE SOME PARTICULARS ABOUT MARS AND MARTIAN DISCOVERY

THINGS now went on quietly and, in fact, rather monotonously for several days; and then we met with another rather startling experience.

We were all sitting together in our living-room on the 9th of September, whiling away the time in a game of whist, and, as it was the final rubber and we were running very close together, we were quite absorbed in the play; although, of course, it was a dummy game.

Suddenly we heard a most tremendous crash, apparently from the right-hand side of the air-chamber, the vessel giving a violent lurch sideways, then shivering and trembling from end to end. The crash was immediately followed by a sharp rattling on the top and side of the *Areonal*, just as though a fusillade of good-sized bullets had been fired at us.

"My word! whatever's that?—one of the cylinders must have exploded," cried M'Allister, jumping up in alarm and running into the air-chamber. We followed him, and looked all round the room at the different machines and apparatus, but could find nothing wrong.

John, chancing to look up, however, at once noticed a large bulge on the inner shell of the vessel, high up on the right-hand side; and then, turning to me, pointed it out, saying, "I think, Professor, it is pretty clear now what has happened."

"Yes, that huge bulge explains itself," I replied; "undoubtedly a fair-sized meteoric stone has collided with our vessel. It is very fortunate that the stone was not much larger, or there would have been an end to the *Areonal* and to us as well. These meteorites travel at such tremendous speed that, on entering the earth's atmosphere, they become

incandescent owing to the friction of the air, and, unless very large, are entirely consumed and dissipated into dust before they can reach the earth. Those that do fall are always partially fused on the outside by the tremendous heat generated by the friction of our atmosphere. These meteorites are what people call 'shooting stars,' and many are under the impression that they really are stars, until the difference is explained to them."

John said, "We ought to congratulate ourselves upon such a lucky escape from annihilation; for had our vessel been constructed of any metal less hard and tough than our 'martalium,' and without a double and packed shell, it must have been wrecked and entirely destroyed by the shock of the tremendous concussion it had sustained. Even the very metal of the casing might have been completely melted by the intense heat generated by the impact of the meteorite."

"Heh, mon!" exclaimed M'Allister; "it's all very well talking about our lucky escape, and putting it all down to your own cleverness in designing and constructing the *Areonal*; but you should rather give thanks to Providence for saving us, and for enabling you to take the precautions you did. I say, 'Thank God!'" he remarked, and he solemnly raised his right hand as he spoke.

"Quite right, M'Allister," replied John: "we are all too prone to credit ourselves with more than we are entitled to. At the same time, M'Allister, you must remember that we Englishmen recognise as fully as you do the over-ruling power of Providence,

although we may not be quite so free in speaking about it in ordinary conversation."

"Yes," I added, "you may be quite sure, M'Allister, that we are equally as grateful as yourself for the mercy which has preserved us all from an awful death. My very first thought on realising our extremely narrow escape from destruction was to say 'Thank God!' but I did not say it aloud as you did. It is in matters like these that people differ according to their temperament and training; and it is not safe to judge another because, in any particular circumstances, he does not act in precisely the same way as we ourselves would."

Thus we travelled on and on, each day bringing us more than two million miles nearer to our destination. Mars was apparently increasing in diameter the nearer we drew to it, and the dark blue line around the south polar snow-cap, indicating the lake of water from the melting snow, was very conspicuous. The snow-cap had recently decreased rapidly, being now near its minimum and irregular in shape, for in the southern hemisphere it was now late in June. Pointing to the planet, I remarked, "There is our destination! We see it now as the poet pictured it for us, and the words of Dr. Oliver Wendell Holmes are very appropriate to the present circumstances:

> 'The snow that glittered on the disc of Mars
> Has melted, and the planet's fiery orb
> Rolls in the crimson summer of its year!'"

On the 18th of September we passed between the earth and Mars, nearly in a line with the sun. On that date Mars was in perigee, or at its nearest point to the earth during the present year. Its distance from the earth was then 36,100,000 miles, and it will not be so close again until the 24th of August 1924. We could not see the earth, as its dark side was turned towards us, and it was also lost in the brilliancy of the sun.

At this date we had travelled 88,000,000 miles since we left the earth, yet we knew it was there, level with our vessel, and only about 29,000,000 miles distant on our left hand, whilst Mars was only 7,000,000 miles from us on our right-hand side.

Our position now was as follows:—Taking an imaginary line drawn from the *Areonal* to Mars as the base line of an isosceles triangle, we were moving along the left side of the triangle, and Mars was moving in a slightly curved line along the right side. Our paths were therefore converging, and if all went well we should both meet at the apex of the triangle on the 24th September, as we had originally intended.

We therefore had six clear days to cover the distance of less than 12,000,000 miles, so we should have sufficient time to slacken speed at the end of the journey. (See the chart.)

Mars was rapidly growing in size and brightness, for the distance between the planet and the *Areonal* was quickly diminishing as our paths converged, and the various markings on its almost full round disc

formed the subject of continual observation and conversation. We had noticed on several occasions a mistiness on some parts of the planet, which I attributed to the vapours raised from the canals by the heated atmosphere.

On the 21st of September, when we were all enjoying a smoke in the "evening," and conversation had dragged somewhat, John started us off on a fresh tack and gave us something to talk about for a very long time.

He winked at M'Allister and, looking at me with a knowing smile, said: "Professor, as we are nearing our destination it might perhaps be well if you now gave us some detailed information respecting the planet, similar to that which you gave us when we were approaching the moon. It would be both interesting and useful; for we should learn much more from an orderly statement of the facts than we should from several long but desultory conversations."

"Yes, Professor," chimed in M'Allister, "I'm quite ready to learn something definite about Mars, for I can't say I really know much about it at present."

"Very well then," I replied, "it is upon your own heads, and if you are willing to listen to a rather long story, I am prepared to do the talking. Please remember, however, that it will require some time to make matters clear and understandable."

"Fire away, mon," cried M'Allister, "we will listen as long as you care to talk."

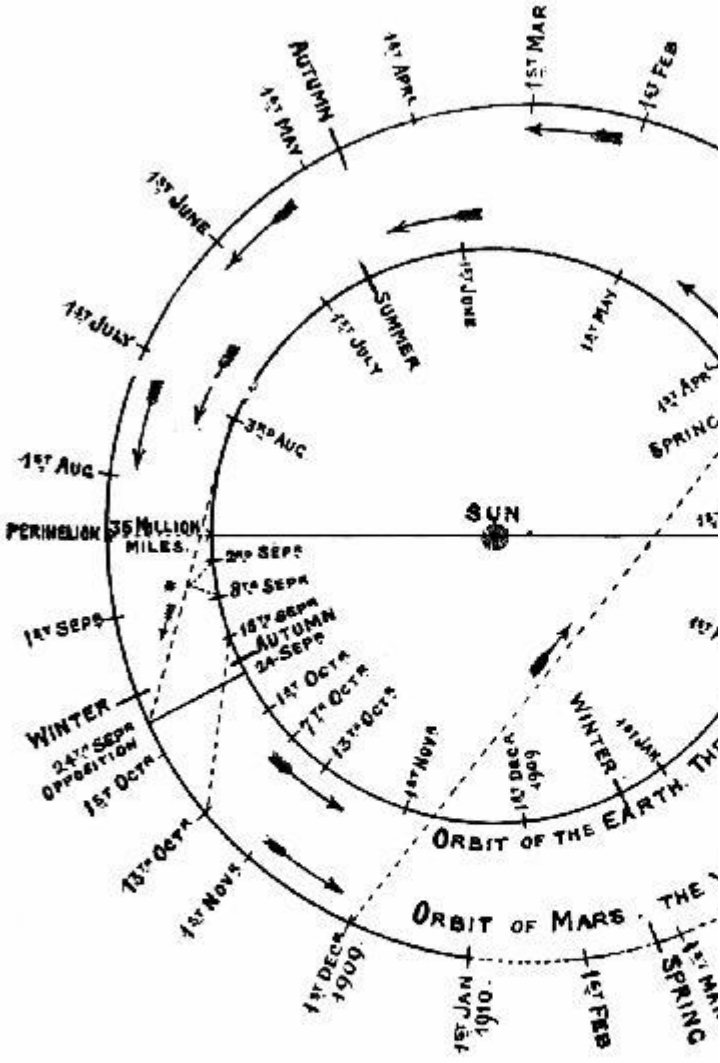
So I began—"Mars, as no doubt you are aware, is a much smaller planet than the earth, its diameter being only 4220 miles, which is a little less than twice the diameter of our moon.

"It would require nine and a half globes the size of Mars to make one globe the size of the earth; and even then it would not be so heavy, because the average density of Mars is only about three-fourths of that of the earth. Mars is the next planet outside the earth's orbit, so is the fourth from the sun. The orbit in which Mars moves in its journey round the sun is very much more eccentric than the earth's orbit; in fact it is more eccentric than the orbits of any of the larger planets. As a consequence, the planet's distance from the sun varies greatly according to the particular part of the orbit in which it may be moving. Its mean distance from the sun is 141,500,000 miles, its greatest distance over 154,000,000, and at its nearest approach to the sun, or 'perihelion,' as it is called, its distance is only 129,500,000 miles. Mars travels in its orbit at a mean rate of 15 miles a second.

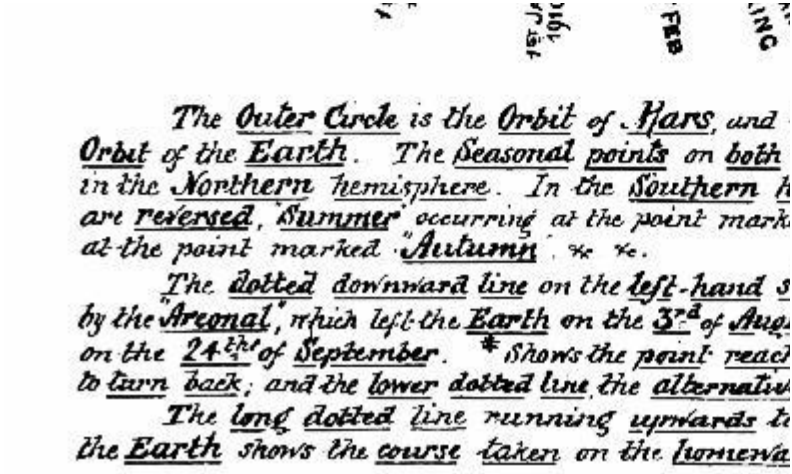
"As its orbit is also eccentrically placed in relation to the earth's orbit, it follows that its nearest distance from us in any particular years may vary greatly. The nearest possible approach it can make in regard to the earth is a little under 35,000,000 miles; when at the opposite point of its orbit its nearest approach is about 62,000,000 miles from the earth. As the years of Mars and the earth differ greatly in length, and the two planets move at different speeds, the very favourable oppositions can only occur about once

every forty-five years; though a comparatively near opposition occurs about every fifteen years. Such a close approach we have just witnessed, and it will be fifteen years before Mars is again so near to the earth!

CHART : showing the Orbits of the Ea
the relative positions of the two Planets duri
Mars passed over the dotted portion of its Orbit



The Outer Circle is the Orbit of Mars, and
Orbit of the Earth. The Seasonal points on both


The Outer Circle is the Orbit of Mars, and
Orbit of the Earth. The Seasonal points on both
in the Northern hemisphere. In the Southern h
are reversed, "Summer" occurring at the point mark
at the point marked "Autumn" &c &c.
The dotted downward line on the left-hand s
by the "Arconal", which left the Earth on the 3rd of Aug.
on the 24th of September. * Shows the point reac
to turn back; and the lower dotted line the alternativ
The long dotted line running upwards t
the Earth shows the course taken on the homewa

Drawn by M. Wicks.

Pla

"The Martian year is equal to 687 of our days, but as the Martian days are slightly longer than ours, this really represents 668 Martian days.

"The entire surface of Mars contains an area of about 56,000,000 square miles, which is about one-fourth of the area of the earth's surface.

"Its gravity is only three-eighths of the earth's gravity, thus everything upon Mars would weigh proportionately lighter than on the earth, and the amount of labour required to do such work as digging or lifting would be lessened. There would, for the same reason, be greater ease of movement in walking, jumping, or running, and large bulky animals like our elephants could move with almost the same ease and freedom as our goats.

"Theoretically, we should expect to find the atmosphere upon Mars very much thinner than our atmosphere, and actual observation proves this to be

the case. We are able to see details on the surface of Mars with very much greater distinctness than would be the case if its atmosphere were as dense as ours. Moreover, clouds are comparatively rarely seen; and the majority that are observed present more the appearance of clouds of sand than rain clouds. Usually, also, they float very much higher above the planet's surface than our clouds are above the earth's surface; ten miles high is quite an ordinary altitude, and some have been estimated as quite thirty miles above the planet.

"Many theorists have attempted to prove that, owing to the planet's distance from the sun, and the thinness of its atmosphere, the temperature of Mars must be very low, probably below freezing-point even at the equator. Dr. Alfred Russel Wallace has gone further than this, and suggests that the temperature must be eighty degrees Centigrade below freezing-point; that there is no water or water vapour on the planet; and that it is quite impossible for life to exist there!

"However, as the result of delicate bolometric experiments, careful calculations, and consideration of conditions affecting the result which have not previously received so much attention, Professor Very has arrived at a different opinion; and actual observation has shown that there is very little indication of frost outside the frigid zones. Even in the polar regions it is at times evidently warmer than at the earth's poles, because during the spring and summer the snow-caps upon Mars not only melt more rapidly, but melt to a much greater extent than

our polar caps do. In 1894 the southern polar snow-cap of Mars was observed almost continuously during the melting period, and it was actually observed to dwindle and dwindle until it had entirely disappeared. It is rather strange to think that we know more about the snow-caps of that far-distant world than we do about those on our own earth.

"Owing to the lesser gravity on Mars the snow and ice which forms the caps would certainly be lighter and less closely compacted than the snow and ice upon our earth; but it is quite clear that it could not melt to any extent unless the temperature remained above freezing-point for a considerable length of time.

"It has, however, seriously been contended that the Martian polar caps are not snow at all, but frozen carbon dioxide—the poisonous dregs of what once was an atmosphere. Carbon dioxide, however, melts and becomes gaseous almost suddenly, but these polar snow-caps melt gradually, exactly as frozen snow would; so this theory fails altogether to fit the circumstances.

"Moreover, the water which accumulates all round the base of the melting snow-cap has been carefully observed on many occasions, and in the early stage of melting it appears blue in tint, but later on, as upper layers of snow dissolve and those nearer the soil are reached, the water presents a turbid and muddy appearance; exactly what might be expected when water has been contaminated by the surface soil.

"Dr. Alfred Russel Wallace declines to accept the blue tint as any proof that the liquid is water, and contends that shallow water would not appear that colour when viewed from a distance. You will, however, have observed that the water in all our shallow reservoirs appears intensely blue when observed from any distant and elevated point of view. It seems to me that when, as in the case of Mars, we have a very thin atmosphere laden with sand particles, we have exactly the conditions which would produce a very blue sky, and cause the water to appear a deep blue colour when viewed from a distance.

"It is also contended that water cannot be present on Mars, because none of our skilled spectroscopists has yet been able to demonstrate by the spectroscope that there is any water vapour in the Martian atmosphere.

"This, however, is generally acknowledged to be a very difficult and delicate operation; and, in any case, it is purely negative evidence, and cannot be accepted as final. I feel quite confident that sooner or later a means will be found of definitely proving the presence of water vapour upon Mars by the aid of the usual lines in the spectrum. There are too many evidences of its presence, such as clouds, hoarfrost, snow, and seasonal changes in vegetation, to warrant the rejection of the idea of its existence merely because it has not been detected by the particular means hitherto used by the spectroscopists.

"Mr. Slipher, of Flagstaff Observatory, has made many experiments with specially sensitised

photographic plates. He has taken several photographs of the spectrum of the moon and others of the spectrum of the planet Mars. The plates of the lunar spectrum show a darkening of the 'a' band, which indicates the presence of water vapour, and we know that is due to the water vapour in our own atmosphere. The plates of the spectrum of Mars show a much more definite darkening of the 'a' band, and Professor Lowell contends that this can only be due to water vapour in the atmosphere of Mars.

"Professor Campbell has, however, made similar experiments, and is of opinion that Professor Lowell has been deceived by the water vapour in our own atmosphere. Thus the matter stands at the present time, and we must await the result of further investigation before we can consider the matter settled.

"I, however, regard it as a certainty that improved means will definitely show that water vapour undoubtedly exists in the Martian atmosphere, and it is not unlikely that other constituents of that atmosphere may also be identified, and possibly even the relative quantities may be ascertained."

John here remarked that he had read of it being contended that life could not exist on Mars because as water would boil at a temperature a hundred degrees lower than it did on the earth, it would be impossible to boil a potato properly, or make a good cup of tea. He thought, however, that if water boiled at such a low temperature, then the proportion of water vapour in the air would be increased, as

evaporation would be more rapid than on the earth.

"Undoubtedly so," I replied. "The first argument, however, is very weak. For many thousands of years the people on the earth not only managed to live, but attained a high state of civilisation, yet we have no reason to believe that they ever ate potatoes or drank tea! Even in England we have only known and used these articles for about three hundred years! The inhabitants of any world would be suited to their environments.

"The polar-caps on Mars are shown on very early drawings of the planet; but, up to the year 1877, little was known of the general surface details beyond the fact that the general colour was orange-red, diversified by dark patches of blue-green in some parts, and some narrow, serpentine markings here and there. All these markings are now much more accurately drawn, as the result of more careful and continuous observation. Sir William Herschel suggested that the red colour was attributable to the vegetation of Mars being red, instead of green as on our earth; but it was generally considered that the red areas indicated land and the dark areas water. The work of our modern observers has, however, resulted in a general revision of our ideas on these points.

"It had long been reasoned that, as the earth was accompanied by a moon, and Jupiter had at least four, Mars, the intermediate planet, might be expected to possess a satellite. The planet itself being small, its moon would probably be very small, and

likely to be overlooked when observing with the telescope, because its light would be overpowered by the light of the planet, which would make the telescopic field of view very bright. Up to the year 1877 the most powerful instruments had been used without success in the search for the supposed satellite.

"In that year Mars made an exceptionally near approach to the earth, and Professor Asaph Hall, of Washington Observatory, took up the search, using a splendid refracting telescope having an object-glass 26 inches in diameter. The methods he adopted were rewarded with success, for he discovered not only one, but two satellites of Mars, and they were given the names of Phobos and Deimos.

"Both these satellites are very close to the planet and extremely small, Phobos being less than 4000 miles from the planet's surface, and Deimos only 12,300 miles from it. As seen in the telescope, they are very faint points of light which cannot be measured by ordinary means, and the estimation of their size was a matter of great difficulty.

"Professor Langley gives an interesting account of the endeavour to estimate their size by the amount of light reflected, as compared with the light afforded by our own moon when full. It was a most difficult task, as the comparison had to be made by means of tiny holes drilled in metal plates; and for a long time it was impossible to find a workman who could drill a hole sufficiently small for the purpose, although one of those employed had succeeded in drilling a hole through a lady's thin cambric needle

from end to end, thus converting it into a tiny steel tube. One would have thought such a feat impossible; yet what was now required was a hole smaller than the one thus made through the tiny needle."

"My word!" said M'Allister, "I would like to see the mon who did that piece of work, and shake hands with him; he must be a rare clever fellow!"

"Yes," said John, "and I would like to see the drill he used; for such a long and extremely slender tool, to be effective, must be as clever a piece of work as the steel tube."

"I may tell you," I proceeded, "that success was at last attained; and as a result of the comparison of our moon's light with that of Deimos, it was shown that if the general surface brightness of the latter were equal to that of our moon, then Deimos must be only 18 miles in diameter, or about a 15,000th part of the area of our moon's disc.

"To state the matter in another way—supposing our moon were only 18 miles in diameter, and was removed to the same distance as Deimos is from us, then it would appear only the very faint point of light that Deimos appears when viewed through the telescope.

"By the same means Phobos, the satellite nearest to Mars, was estimated to be about $22^1/_2$ miles in diameter. These dimensions, however, depend on the brightness of these satellites being exactly the same as the general brightness of our moon; and later experiments have fixed the sizes as 36 miles for

Phobos, and 10 miles as the diameter of Deimos.

"I will not detain you much longer on this subject, as we shall be able to discuss it further when we arrive upon Mars; but I may now mention that, in one respect, the little satellite named Phobos is unique. It is the only satellite we know of which revolves round its primary planet in less time than it takes the planet itself to make one revolution on its axis.[6]

"Mars revolves on its axis in 24 hours, 37 minutes, and 22 seconds, thus the 'day' on Mars is nearly 38 minutes longer than our 'day.' Phobos revolves round the planet in the very short period of 7 hours, 39 minutes, and 14 seconds, and therefore makes more than three complete revolutions round the planet in the course of a single Martian day. The peculiar phenomena to which this very rapid motion gives rise, and the numerous eclipses which occur, will be matters of great interest to us all when we reach Mars. Our moon, as you know, takes a month to make one revolution round the earth."

"Professor," said John, "when we get to Mars, it will be rather a curious experience for us to see two moons shining in the sky at the same time!"

"My word!" exclaimed M'Allister, "two moons shining at once! If I go out and see such a sight as that, I shall think the whisky has been a wee bit too strong for me!"

"Well," replied John, "if your usual drink has the effect of making you see double, take good advice,

and leave the whisky severely alone when you are on Mars, or else you will be seeing *four* moons all at once, and receive such a shock that you will never get over it!"

M'Allister laughed pleasantly as John said this. He is a real good fellow, and takes all John's chaff with the utmost good-humour; but, in justice to him, I must say that, although he sticks to his national drink like a true Scot, I have never once seen him any the worse for it. He knows his limitations, and always keeps within them.

CHAPTER X

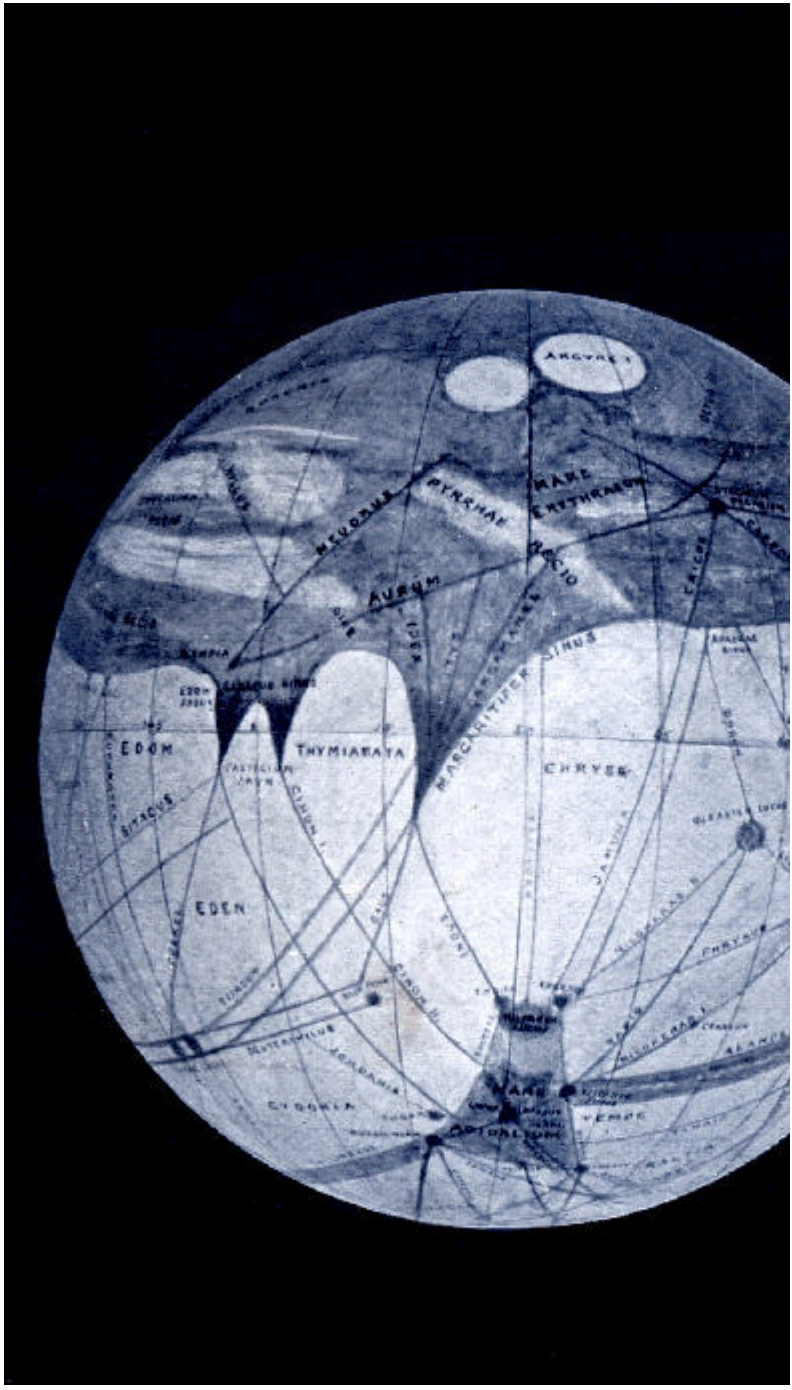
THE DISCOVERY OF LINES UPON MARS—THE GREAT MARTIAN CONTROVERSY

AFTER the little interlude with M'Allister, I resumed my remarks by saying that "The year 1877, so memorable for the near approach of Mars and the discovery of its two tiny satellites, was also the year in which a still more important discovery was made—a discovery, in fact, which has much enlarged our knowledge of the planet, and has also resulted in an entire revision of our conceptions respecting it.

"An Italian astronomer, Signor Schiaparelli, took advantage of the favourable position of Mars to observe it very carefully, and some time afterwards

announced that he had seen upon its surface a number of very fine lines which had not previously been noticed, and these he had carefully charted upon his drawings and maps.

"This announcement started one of the most acrimonious discussions that the astronomical world has ever known; and although it is now over thirty years since it commenced, astronomers are still divided into two parties—one accepting the lines as demonstrated facts, the other either denying their existence, or endeavouring to explain them away by various more or less ingenious or fanciful theories.


ARGYRE I
MARE ERYTHRAEUM
PYRRHAE
AURUM
IDAE
EDOM
THYMIAMATA
CHRYSE
EDEN
MARE
CIMMERIUM
VENUS



From a Globe made by M. Wicks

Plate VIII
Mars. Map I

In all these maps the south is at the top. The dark shaded portions are ve the canals, and the round dots the oases. The light areas are deserts. Longitu of the "Sabaeus Sinus."

"When Signor Schiaparelli's statements and drawings were first discussed, it was declared by some to be quite impossible that these fine lines could really have been seen by him: either his eyes must have been overstrained, or he claimed to see more than he actually did see. So warm did the discussion become that he soon withdrew from it altogether, but devoted himself to his work. As time went on, he not only verified his previous discoveries, but found numerous fresh lines, all of which appeared to run straight and true over many hundreds of miles on the planet.

"Milan then had a good clear atmosphere which was favourable for the observation of delicate planetary markings, and other observers who were well situated were able to see and draw many of the lines which Schiaparelli had discovered.

"It was, however, contended that such lines could

not have any real existence, as it was asserted that they were too straight. It is quite true that straight lines on a rotating globe would appear curved when seen from some points of view, but if the objectors had carefully studied complete sets of drawings, they would have seen that the lines did assume a curved form in certain aspects of the planet.

"Then the very same people who denied the actuality of the lines because they were too straight, eagerly took up a suggestion that they were not actually narrow lines, but the edges of diffused shadings on the planet, apparently quite oblivious of the fact that the same objections must apply to them. Moreover, if there was difficulty in accepting the actuality of narrow lines, there must be immensely greater difficulty in believing that shadings could, in such a very large number of cases, all end in straight lines many hundreds or thousands of miles long, and always appear uniformly true, no matter upon what portion of the disc they might be seen, and whatever might be the angle of illumination.

"Besides, only a small proportion of the lines are connected with shadings. The shadings are more likely to be the result of the canals than the cause of the formation of illusory lines in so many cases.

"I have listened to many of these discussions, and have often been much amused at the tangle of inconsistencies in which some have involved themselves, by taking up fresh theories without regard to their previous contentions.

"As time went on each opposition of Mars brought

the discovery of fresh lines, and numerous observers confirmed the reality of Schiaparelli's work.

"Professor Lowell, the well-known American astronomer, took up the study of Mars in a most thorough and systematic manner, and has since practically made it his life's work. An observatory was built at Flagstaff, Arizona, far away from towns and smoke, at an altitude of over 6000 feet above the sea-level, the site being specially selected on account of the clearness and purity of its atmosphere; while the observatory, being high up above the denser and more disturbed strata of air, afforded the most favourable situation possible for the proper observation of delicate planetary detail.

"There he continued the work which Schiaparelli had commenced, and, together with the colleagues with whom he has been associated, has, by long-continued and most systematic work, added greatly to our knowledge of Mars. Year after year has seen the addition of more lines on our maps of the planet, whilst many interesting discoveries have been made —one being that some of the fine lines were double, the second line always being equidistant from the first one throughout its whole length, no matter whether the lines were straight or curved.

"This caused a further outcry of objection. The observers were told that they had been overstraining their eyesight so that they 'saw double,' and also that they had been using telescopes not properly focussed. Such objections seem almost beyond argument, for no practical observer could use an improperly focussed instrument without at once

discovering the defect.

"Besides, if the double lines were the result of eye-strain, or any other defect which might cause such illusions, all the lines would have been seen double, or at least all the lines running at the same angles; but as a matter of fact only a very small proportion of the lines were so seen, and it made no difference what position they occupied on the disc, or at what angles they were presented. Some of the doubles were, in fact, curved lines; and another point was that in some cases they were only doubled at certain seasons of the year.

"Other observers who saw the lines were charged with having studied the maps of Schiaparelli and Lowell until they had become obsessed with the lines, and when they looked through the telescope simply fancied they saw them!

"In England our atmospheric conditions are seldom really favourable to the proper seeing of the finer detail, and the very faint lines cannot be seen at all. The lines that are visible do not appear thin and sharp as they do to observers in more favoured climes, but rather as diffused smudgy lines, and so they are drawn by the observers. On a few occasions of exceptionally good seeing they have, however, been seen and drawn as finer and sharper lines.

"The visibility of the lines was, however, confirmed by so many observers of known integrity, and from so many different parts of the world, that the objectors were at last compelled to abandon the position they had occupied. Then a new theory was

started, viz. that the lines were actually seen but did not actually exist, being really optical illusions arising from the apparent integration, or running together in linear form, of various small disconnected markings which were viewed from beyond the distance of clear seeing.

"The manner in which it was sought to prove the correctness of this theory appeared to me at the time (and still does so) as most weak and fallacious, and certain experiments I made only strengthened that opinion. However, scientific people accepted it as proof.

"In making this experiment schoolboys were seated in rows at different measured distances from a map of Mars, which they were told to copy. The map showed all the well-known dark patches and markings, but no fine lines. About the places where some of those lines should have been, dots, curls, wisps, &c., were inserted at irregular distances, and not always exactly where the lines should have been shown. The inevitable result was that the boys who were too far away to see clearly saw these small markings as continuous straight lines, and so drew them. In the circumstances they could not do otherwise; for if sufficient marks were inserted nearly in alignment, they would necessarily produce the effect of lines.

"These drawings were then acclaimed as *proving* that the lines seen on Mars were only discrete markings viewed from beyond the distance of clear seeing, and that the network of lines seen and drawn by so many skilled and careful observers of Mars had

no actual existence upon the planet. Thus all their work was completely discredited.

"Experiments like these could not possibly prove any such thing, because it would be easy to insert in a map various markings which, when viewed from a distance, would appear to form almost any design that one might choose to depict. Any desired effect might thus be obtained; and I have seen many pictures so formed in which the illusion was perfect. When viewed from a distance each appeared to be a picture of something entirely different from what was seen when it was viewed from a near standpoint.

"The linear illusion could not arise from a mere multiplicity of faint scattered markings, but all the more conspicuous markings must be in alignment. It seems impossible to imagine that so many hundreds of lines on Mars could thus fortuitously be formed by illusion, and *every* line be connected to some definite point at each end.

"To argue that because illusory lines can be formed as in these experiments proves that the Martian lines are also illusions is claiming far too much. For instance, if I drew what was actually a map of South Africa, and was so seen at close quarters, yet in consequence of the insertion of numerous small marks and shadings formed a portrait of Lord Blank when viewed from a distance, it would be very far indeed from proving that every map of South Africa was a portrait of the noble lord, or that his portraits were all maps of South Africa.

"Moreover, as I myself saw, some of the boys were

so unskilled that they had not even drawn correctly the outlines of the dark patches about which there was no dispute.

"It is obvious that such erroneous and unreliable work as this could not be regarded as evidence upon which truly scientific argument could be founded for the purpose of deciding such a contentious question; yet mainly upon this very slender and unreliable evidence meetings of two of our leading astronomical associations endorsed the illusion theory, and for a long time it held the field.

"M. Flammarion made some similar experiments in Paris, and even inserted spaced dots along the sites of canal lines on the map put up as a copy, yet not one boy drew a canal. M. Flammarion evidently was rather too sparing with his dots and marks.

"A long series of experiments was carefully carried out by Professor Lowell and his colleagues, from which it was deduced that if in any line on Mars there was a gap of sixteen miles in length, our present telescopes would suffice to discover it. It is most improbable that in so many hundreds of lines, several of which are over two thousand miles in length, there would not be numerous gaps over sixteen miles long if the lines were made up of separate markings.

"Yet it is found that every line is perfect in its continuity, and not only so, but uniform in width throughout its whole length, which would be impossible if the lines were made up of separate markings not in alignment.

"The illusion theory may, however, to a certain extent be correct, but this will prove exactly the opposite of what its supporters contend. It appears to have been quite overlooked that as there are so many thousands of miles of canals it is utterly impossible to suppose that the vegetation, which is all that we really see, is continuous and without breaks. It would indeed be most extraordinary if there were not very many long stretches of land which, for some natural or utilitarian reasons, were either bare of vegetation or so sparsely covered as to appear bare when viewed from the earth through a telescope. Some parts of the canals in hilly or rocky ground may pass through tunnels, and thus cause apparent gaps in the lines; or ground may be incapable of bearing vegetation, or purposely left fallow.

"It would, therefore, be no matter of surprise if more powerful instruments should, in moments of perfect seeing, reveal numerous apparent gaps in the lines. So far from proving they were not canals, such gaps are exactly what we should expect to find in connection with canals; and the lines would probably appear as irregular light and dark patches in alignment, because we do not see the canals themselves, but only the vegetation on the land which they traverse. Probably there are also many oases yet to be discovered along the canal lines.

"As I have already stated, it was asserted that the double lines were illusions arising from the causes already mentioned, with the probable addition of eye-strain and bad focussing. Assuming that the single lines are, as it is declared, illusions, we are

confronted with the assumption that the doubles are illusions of illusions, and this is more than I can follow, it seems so improbable.

"Professor Lowell has devoted some sixteen years to close and continuous observation of Mars whenever it has been in a position to be observed, and many thousands of drawings have been made, the results being plotted down on a globe. In reply to the statements of occasional observers that the lines cannot be seen, he testifies that they are not difficult to see; and that any one who saw them in his exceptionally good atmosphere, and through his instruments, could have no doubt of their actuality. He rather caustically, but very justly, remarks in one of his books that his many years of personal experience in viewing these lines almost entitle him to an opinion on the subject equal to those who have had none at all!

"The proof of their existence, however, no longer rests only on the corroborative evidence of other observers, for, after years of experiment, Professor Lowell and his staff have succeeded in taking direct photographs of Mars, which show several of the disputed lines. One would have thought that would settle the question, but, although some of the more reasonable of the objectors have been convinced by the evidence of the photographs, many others still maintain their attitude of scepticism, especially those who have not themselves seen the photographs. They declare it to be quite impossible for any such photographs to be taken, because our atmosphere would prevent any photographic definition of fine

detail on such small pictures; yet about ten thousand of these tiny photographs were taken during the near approach of Mars in 1907.

"As I possess a number of these photographs I can testify that they do show some of the lines, and persons who disbelieved have expressed surprise at their excellence. Success was only obtained by means of specially sensitised plates, for the ordinary photographic rays and ordinary plates were found useless, whilst the process of photographing so small and distant a planet is surrounded with difficulties.

"Even when attached to a telescope giving an equivalent focal length of nearly 150 feet, the camera only gives a very tiny image of the planet. The lighting of the small image is faint, but if additional power were used on the telescope to obtain a larger image, then its light must be still fainter, and thus a longer exposure would be required to obtain a picture on the plate. As Mars moves in its orbit and rotates on its axis, and our atmosphere is subject to continual movement and disturbance, any long exposure would result in a blurred picture, which would show no fine detail. So, as a short exposure is essential, only a small picture can be taken. Nothing is gained by any subsequent great enlargement of the picture, because the grain of the film of a quick plate is coarse; and, if enlarged, this also blurs out the detail.

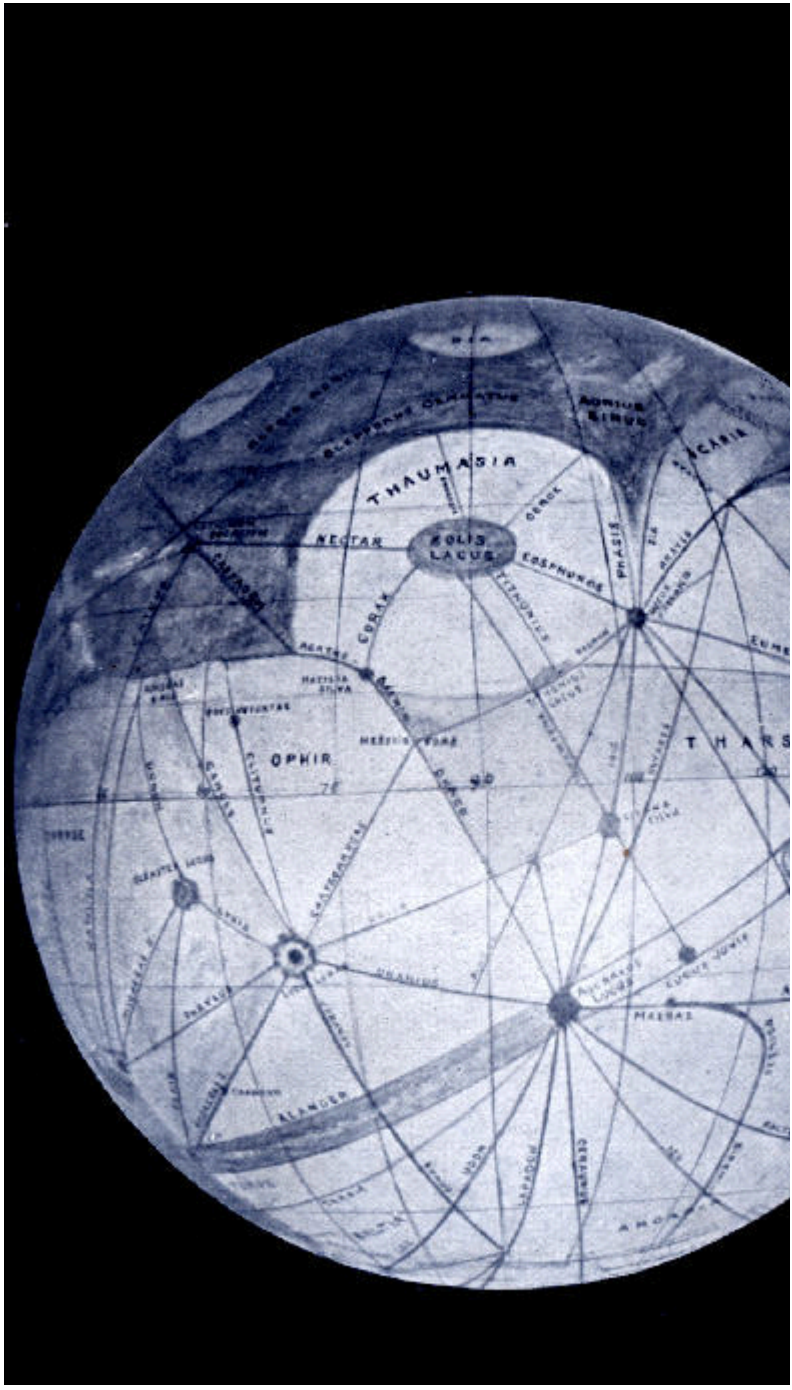
"Having regard to all the difficulties which had to be surmounted, it was a great and undoubted triumph to secure detail on such tiny photographs of

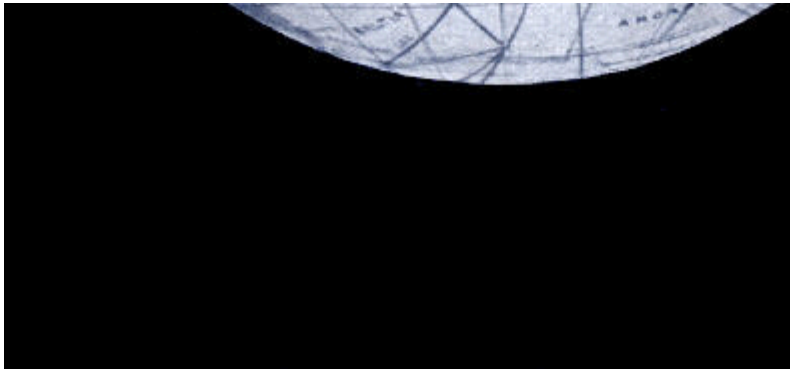
this distant world. As time goes on improvements will probably be effected and still better pictures secured; but enough has now been accomplished to prove that the lines cannot be illusions, but really exist upon the planet. If the eye can be deceived in this respect, the camera cannot.

"When Professor Lowell first took up the work of Martian observation only 113 lines had been discovered by Schiaparelli, but the number has gradually been added to from time to time, as the result of the work done at Flagstaff Observatory and elsewhere, and has now reached a total of considerably more than 600, the lines forming a fine network extending all over the planet.

"Mr. Slipher, who accompanied Professor Todd's expedition to Alianza in Chili, at the opposition of 1907, together with the observers at Flagstaff, discovered no less than 85 new canals, including some doubles, nearly all being in the more southern portions of the southern hemisphere.

"In addition to the discovery of so many fine lines, we also owe to the acumen of Professor Lowell a reasonable explanation of what they really are. Schiaparelli termed them 'canali,' an Italian term for 'channels,' but, popularly, this soon became corrupted into the term 'canals,' and this has turned out to be a much more appropriate word than such corruptions usually are.


THAUMASIA
NECTAR
SOLIS LACUS
OPHIR
THARS
ACIDALIA



From a Globe made by M. Wicks

Plate IX
Mars. Map II

The Solis Lacus is seen as an oval patch near the top, and many long can
proportion of the area on this map is desert land.

CHAPTER XI

THE GREAT MARTIAN CONTROVERSY
(*continued*)

"As the result of very long continued and systematic observation of the lines on Mars, together with carefully plotting them down on a globe, it was found that every line was continuous, uniform in width, and went straight from one definite point to another, not one breaking off in open space. Moreover, on being tested, nearly all were found to be arcs of great circles, and therefore the shortest possible lines which could connect any two points on a sphere. This fact strongly supports the idea that they are not natural but artificial formations. For a long time the lines were only seen on the red, or

lighter, parts of the planet, but in 1892 an expedition was sent from Harvard Observatory to Arequipa, in Peru, for the purpose of observing the planet under very favourable conditions, and this resulted in important discoveries. Professor W.H. Pickering, who accompanied the expedition, was fortunate enough to observe that the canal lines extended over the dark or blue-green portions of the disc; and later observations have proved that this is the case all over the planet, and the lines are visible from pole to pole.

"These observations also led Professor Pickering to the important conclusion that all the dark areas were covered with vegetation, and that the bright or red areas were deserts, the colour of the latter being exactly that of our deserts when viewed from a great distance. Herschel's idea had been that the red areas were land covered with vegetation of a red colour, and that the dark areas were seas.

"It was, however, now quite clear that permanent lines in such numbers and length could not exist in seas; and other observations have demonstrated that, instead of appearing smooth and uniform as water would, these areas are full of detail and variations, and that they pass through all the changes of colour, according to seasons, that land covered with vegetation does upon our earth. In the winter time, when the land is fallow, it appears brown or chocolate colour; in the spring, the time of early vegetation, it becomes a pale blue-green tint; as the season advances the blue-green becomes darker; whilst in the autumn it tends to a light brown, and at

length changes into chocolate colour in the winter. This has been carefully noted time after time when the planet has been in a position to be observed; and the same sequence of change—which can only be associated with vegetation—has always occurred.

"It may, therefore, now be accepted as a proved fact that the dark areas are land upon which vegetation grows, ripens, and dies away according to the seasons of the Martian year.

"Professor Pickering also made another discovery, viz. a large number of isolated, round, darkish spots, most of which occurred where canal lines joined or crossed each other. Some of these had been seen much earlier by other observers, but Professor Pickering was the first to see them in large numbers and call attention to them. He termed them 'lakes,' but later discoveries from continued observation showed that they were not water, and they were then given the name of 'oases.' Some are seventy or eighty miles in diameter, and nearly two hundred are now marked on the maps. They mostly occur in certain definite positions—in the point where single canals join or cross each other, or, in the case of double canals, between the two lines. It has been noted that they undergo the same seasonal changes as the dark areas do, but only as regards the outer portion of the circle, which gradually fades away in the latter part of the Martian year; whilst the central portion becomes fainter but does not disappear.

"Of course it was at once declared that these oases were illusions which would naturally be seen where two lines crossed each other and were viewed from a

great distance. But they only occur in some cases at such crossings, and there are many junctions without any oases. Moreover, they are also seen between the double canals where there are no junctions nor anything which could give rise to illusion.

"At Flagstaff Observatory it was also noted that the canal lines themselves underwent seasonal changes. Those viewed during the winter season were always so faint as to be scarcely discernible, but at the period when vegetation would naturally begin to grow they became more easily visible, and still more distinct as the season advanced.

"Then Professor Lowell announced his great conception, which has given rise to so much controversy, and has also been much misunderstood and misrepresented.

"Briefly, his conclusions were as follows:—'Science teaches that a small planet will become cool and develop life much sooner than a large one. Similarly a small iron casting will become cool in a few days, whilst a large one will be many weeks or even months in cooling. A small planet will also develop more rapidly, and reach its final stage when it will be incapable of supporting life, very long before a larger planet like our earth will have reached that stage. Applying this to Mars, a much smaller planet than our earth, it is scientifically reasoned that Mars has passed through nearly all its stages and is approaching its last. It has lost much of its atmosphere, all its large bodies of water, such as oceans or seas, and, as regards the land, that has become levelled by erosion, and about five-eighths of

the whole area has become desert.

"'Science also shows that in such circumstances rain would cease to fall over the larger part of the planet, but the water vapour in the air would be carried by natural circulatory currents of air to the polar regions, and there deposited in the form of snow or hoarfrost, thus forming a large snow-cap at the north pole in one season of the year, and a still larger snow-cap at the south pole in the opposite portion of the year.

"'These snow-caps would begin to melt in the spring as soon as the tilt of the planet brought the pole to the position where the sun would take effect, and would continue during the early summer. As there is no permanent glaciation on a planet which has lost its water, the snow-cap would melt to a very large extent, and the resultant water must go somewhere.

"'The inhabitants of the planet could not exist without water, and their land would become entirely desert unless supplied with moisture. It will, therefore, be seen that the only thing possible, as a means of self-preservation, would be for them to make channels to carry the water in the most economical way from the poles to the parts where it was needed. Unless they found a means of doing this death stared them in the face. What greater incentive could there be!'

"This is what Professor Lowell is convinced has actually been accomplished upon Mars, with the result that there is a network of canals all over the

planet by which water is conveyed from each pole and carried across from one hemisphere into the other. The lines seen show where the canals are, but not the canals themselves, because they are too narrow to be seen. The lines really are broad bands of vegetation irrigated by the canals which run through them, hence the seasonal changes which have been noted in their colour.

"All this seems very reasonable, deduced as it is from scientific fact and from the many different things which have actually been seen and confirmed by many thousands of observations, but it has met with the most bitter opposition on the part of many astronomers, both professional and amateur. Theory after theory has been brought forward with the object of disproving the existence of the canal lines; some of these, such as eye-strain, diplopia, bad focussing, illusion, and imagination, have already been mentioned.

"Proofs of the reality of the lines having become too strong for most of the objectors, they then turned their endeavours to the overthrowing of the theory that the lines were canals, suggesting that they were all of natural origin.

"Amongst these suggestions it was stated they were edges of shadings, natural growths of long lines of trees and vegetation, cracks in the surface of the planet or foldings caused by contraction, trap-dykes, &c., but not one of these suggestions will bear investigation. I have already pointed out the impossibility of shadings having straight edges for thousands of miles in so many hundreds of cases. It is

equally impossible to imagine natural growths of trees and vegetation in bands of uniform width and thousands of miles long, and nearly all forming arcs of great circles.

"They cannot be cracks, for they are of uniform width throughout their length, and always run direct from one definite point to another, no matter how distant apart they may be.

"Cracks, such as we see on the moon, though sometimes straight, are usually wide near the centre of disturbance which caused them, and narrow off to a fine point, and often end anywhere out in open space; moreover, they are usually very irregular in width, and take a zig-zag course instead of a straight one. This, as I have said, is not the case with a single canal line on Mars. If they were cracks, some at least would be irregular and end in open space. The same remarks apply in the case of foldings or ridges.

"The oases, once declared to be illusions, were then said to be large openings in the soil at the junctions of the cracks; or they might be craters, and so on. But this does not account for the appearance of the oases between twin canals, or the systematic manner in which the canals effect a junction with the oases. Again, therefore, the theory fails to fit the known circumstances of the case.

"Dr. A.R. Wallace rather favours the idea of natural cracks or faults in the surface of the planet; and suggests that the outer crust of Mars may be a crystalline or similar formation which would lend itself to the production of numerous cracks in the

surface. He points to a few cracks and faults in the earth's surface, all of small size, as confirming this idea; but the cases he adduces only seem to prove that there is on our earth absolutely no natural formation which can in any way properly be compared with the lines seen on Mars. Moreover, there seems to me no ground whatever, beyond the needs of the theory, for supposing that the crust of Mars is of a crystalline nature, or such as would predispose to the formation of cracks. On the contrary, all the evidence is against it—the existence of vegetation in some parts, the general appearance of the red portion, and the large clouds of sand which have been observed, all being indicative of a sandy formation, in the red portion at least.

"The theory also fails to take into consideration the most important point of all, viz. that every canal runs direct from one definite point to another, perhaps over two thousand miles distant. In very many cases numerous lines connect with one small area, or even with one point. The Lucus Ascræus has no less than seventeen of these canals connecting with it, and appears to be a kind of Martian Clapham Junction.

"The deserts on Mars serve the same purpose as our seas, as lines of communication may be established anywhere across them. A map of Mars, showing the canals converging towards some one part, bears a great resemblance to our maps showing the courses taken by vessels from different parts all converging upon one seaport.

"Much has also been said about the widths of the

canals as rendering them impossible of construction, so let us consider how wide they are.

"The lines seen vary from two or three miles up to nearly thirty miles in width; but there are only one or two of the latter, and the majority are five to ten miles wide. Notwithstanding Professor Lowell's repeated statements that they represent bands of vegetation, these widths are often referred to as the widths of his canals. I have frequently seen them described as 'fifty miles,' a 'hundred miles,' and even as 'hundreds of miles' wide. These exaggerations usually appear in newspapers and journals, and evidently arise from insufficient knowledge on the part of the writers.

"Owing to the small gravitation upon Mars, the work of digging canals would be extremely easy upon that planet (even assuming the Martians to be without machinery) as compared with the same work on our earth; but there is neither necessity nor reason for the construction of such enormously wide canals as those mentioned. Moreover, it seems to me that very wide canals would defeat the object for which they were constructed; and Professor Lowell does not regard the widest lines as being canals. They may be remains of natural channels or arms of the seas, as they do not run so straight as the canal lines proper.

"Our people," I remarked, "have argued both against the possibility of constructing such canals and of forcing water along them, because, as they say, none of our engineers would be able to accomplish such work. I certainly have more

confidence in the skill and capabilities of our engineers, and doubt not that if they were required to solve a similar problem they would overcome all difficulties and carry out the work successfully."

"I'm with you there, mon!" exclaimed M'Allister.

"I may remind you," I proceeded, "that when steam navigation was first mooted, it was confidently asserted that no steamship would ever succeed in crossing the Atlantic Ocean, and I can remember when it was learnedly demonstrated that it would be quite impossible to construct a canal across the Isthmus of Suez! How small the prophets must have felt when the work was accomplished!

"I am afraid it is usual to take a very limited view of all such matters, and we judge of them entirely from what we know ourselves, never looking ahead, as it is considered unscientific to go beyond our own knowledge. Because something may be quite impossible to us, it does not follow that it is impossible to more advanced people.

"Think how many great scientific facts which are quite commonplace at the present time were unknown and undreamed of even so recently as our grandfathers' time! Who then can forecast what may be possible five hundred years, or even a century hence; and who will be bold enough to fix a limit to the possibilities of science! I freely admit I am an optimist in these matters."

"I think, Professor," said John, "that your view is really the more scientific of the two. While it may not be possible accurately to forecast all the facts,

intelligent anticipations may logically be formed from a survey of our own past history."

Proceeding, I then remarked, that "Another discovery made at Flagstaff Observatory was that at the ends of certain canals, where they joined the dark areas, were small **V**-shaped dark markings which Professor Lowell has termed carets. From their occurrence in these positions only, and from his observations of the peculiar and extremely systematic manner in which the canals, especially the double ones, run into the carets, he has concluded that they must serve some special and important purpose.

"We have been told upon high authority that the carets are illusions, and could not possibly be seen, as the planet is so distant from us. But the fact remains that they have frequently been seen and drawn; they always appear the same, and are never seen except in connection with canals which join dark areas. These dark areas, I may say, are believed to be the beds of ancient seas, from which the water has long since departed.

"In connection with all these disputed lines and markings it has often been urged that though they are seen through comparatively small telescopes they are not seen when a very large instrument is used; and it has also been said that observers, knowing what they wished to see, simply imagined they did see it. We have, however, abundant proof that both these arguments are unreliable and incorrect.

"It is a well-known fact that when a faint object

has been once seen through a telescope, others are able to see it through a smaller instrument. This was the case with the satellites of Mars, which have been seen with much smaller instruments than that used to discover them.

"The fact that such objects are really seen is proved by the observer marking them on his drawing in their correct position, although they may have moved from the point at which they were originally seen.

"I will give you an illustration of the ease with which it is possible to overlook something that should be clearly visible to you, yet it is not seen by you until your attention is called to it by some one else. Almost every one has had some such experience:—

"You may have on the front of your coat a small stain, or grease-spot, in a position where you could plainly see it, yet might wear the coat for days or even weeks in complete unconsciousness of the existence of the stain until some one pointed it out to you. After that you cannot look at the coat without seeing the stain, and it becomes so persistently obtrusive that you are compelled to have it removed. There is, however, no imagination about your seeing the mark."

John here said to me: "Professor, I noticed you said that many who do not believe in the actuality of the lines and markings on Mars frequently refer to the fact that, while they are stated to be seen through small telescopes, they are quite invisible

through a very large instrument, and they regard this as proving that the lines or markings do not exist. Is there not something in this argument?"

"Well, John," I replied, "the argument sounds not only plausible, but reasonable, and inexperienced persons might use the argument, believing it to be a sound and good one. I must, however, confess that I have been surprised to see this argument used by persons who must surely know that there is no weight in it at all.

"It is well known to all practical observers, and indeed to all who have studied optical matters, that, for several reasons, very large telescopes are quite unsuited for the observation of fine planetary detail.

"The real advantage of these enormous instruments lies in their great 'light-grasp,' which enables observers to see very faint points of light, such as small satellites of planets, faint stars, double stars, distant comets, or nebulæ, which could not be seen with a smaller instrument necessarily having less 'light grasp.' Yet this very excess of light, which is the great advantage of a large instrument, is one of the things that spoils the definition of faint planetary details; it drowns them all out, or 'breaks them up.'

"Again, these large instruments are much more liable than smaller ones to what is termed 'chromatic' and 'spherical' aberration; and this also is detrimental to definition. No very large refractor is entirely free from these defects.

"Another objection is that, in using such large and long-focussed instruments, a much higher power

must necessarily be employed than in the case of smaller instruments. This high power magnifies all the little movements and disturbances in our atmosphere to exactly the same extent as it magnifies the object looked at, with the result that these disturbances blur out all fine detail. The canal lines on Mars could never be seen in such circumstances. If the object were looked at through a smaller instrument, with lower power, it might be fairly well seen, for the atmospheric disturbances would not be magnified to such an extent as to spoil definition.

"There are very few nights in the year when these immense instruments can be used to advantage on the planets, whilst a smaller instrument might define well three or four nights out of every six. It is on record that the user of Lord Rosse's great reflector stated that there were only about three nights in the year when its best definition could be obtained; and its use has produced very meagre results, compared with what had been anticipated.

"It is also almost universally recognised that in using these great instruments, whether for photography or for the visual observation of fine detail, it is absolutely necessary to stop down the aperture to a very large extent, by reducing it to about 12 inches in diameter or even less. The big telescope is thus really converted into a small one of long focus.

"There is, in addition, the acknowledged fact that nearly every discovery of new detail on planets has been made with a comparatively small telescope, although the same objects may have been under

constant observation for years with big telescopes. The new detail was never noticed until after it had been seen with a smaller instrument, and perhaps only then when atmospheric conditions were unusually good.

"As an instance, I may mention that the faint 'crape ring' of Saturn was seen by Dawes when using an 8-inch aperture to his telescope; yet it had never been discovered with the large instruments, although the planet is one that is under constant observation when in a position to be seen.

"I could give innumerable instances of similar cases, but enough has been said to show that because some object cannot be seen in a very large telescope, it is no proof at all that the object does not exist.

"Amid the chaos of varied, and often self-contradictory, theories respecting Mars—some abandoned by their own authors; others in which facts and conditions had to be assumed for which there was not only no evidence, but actual disproof by many recorded observations—Professor Lowell's conceptions stand out clearly and boldly.

"They are all founded on the results of prolonged and systematic work in the observation of the planet, not only by himself but by numerous colleagues—work in which many of his critics have had little or no experience under favourable conditions. His conceptions fit in with observed facts with all the

accuracy of the pieces in a child's picture puzzle; whilst his logical deductions are supported and enhanced by his wide knowledge of physical science and planetology.

"Yet, as I have both heard and read, his views and discoveries have been described as 'sensational,' 'fanciful,' 'fairy tales,' and by other terms which I would rather not quote.

"Underlying some of these objections there seems to be an idea that some reason *must* be found for opposing anything and everything which would tend to indicate the possibility of intelligent life existing upon any other planet than the earth; although it is difficult to understand why such a possibility should be so abhorrent. It is a view that does not commend itself to me, but I need not say more on that point.

"Nicola Tesla, the great electrician, is, however, convinced of the existence of life upon Mars, and he has expressed in very emphatic terms his opinion of the opposite view, which, however, I refrain from quoting. He says that Mars must have passed through all terrestrial changes and conditions, and that the whole arrangement of the canals, as depicted by Professor Lowell, would seem to be artificially designed. He then goes on to state that he has discovered electrical disturbances on the earth which must have come from Mars and no other planet.

"In the treatment he has received from some of his smaller critics (whose vehemence is usually in inverse proportion to their knowledge of his work and writings) Professor Lowell has had an experience

similar to that of many other observers who have done good work.

"If an observer be blessed with the happy combination of good eyesight, a good instrument, and favourable atmospheric conditions, and publishes writings and drawings showing that he has seen something which has not previously been observed, he at once becomes a target for captious critics who seem to be under the impression that all astronomical knowledge begins and ends with themselves, and that anything they cannot see does not exist. It matters not that the observer attacked may have given months to particular observations where his critics have only spent a few hours: he is told that his drawings are incorrect and do not represent the planet; that they may be works of art, but do not represent facts; that he possesses a very vivid imagination, and so on. This procedure may be persisted in until at last the victim either turns and rends his critics or ceases to publish his drawings or records, to the great loss of many others who take an intelligent interest in his work.

"Professor Lowell's telescope is over 32 feet in focal length, and has an object glass of excellent quality 24 inches in diameter, the work of the celebrated Alvan Clark. Thus, whilst not one of the giants, it is not exactly what would be termed a small instrument, and few indeed of the critics have anything approaching it in capacity, while none enjoys the advantage of such ideal conditions in the situation of his observatory.

"I was therefore much amused in reading an

effusion by one critic who, in discussing the question of the canal lines, remarked that he could not accept 'these one-man discoveries,' oblivious of the fact that they are the discoveries of many observers. He then very naïvely gives the illuminating information that his astronomical experience is confined to the 'observation' of the *moon* for about six months, by the aid of a $1^1/_4$-*inch hand-telescope*! Surely, when confronted with a critic of such vast experience and so wonderfully equipped, Professor Lowell must retire discomfited from the field!"

At the conclusion of my remarks both John and M'Allister expressed their thanks, saying that "Now they were informed as to the points on which our scientists were not agreed, they would look forward with still greater interest to our arrival at our destination, for they were as anxious as I was to solve the mysteries of the red planet."

CHAPTER XII

WE ARE MYSTERIOUSLY PREVENTED FROM APPROACHING MARS

THE days then passed uneventfully until at last the long-looked-for day arrived, and on the 24th September we were so close to Mars that we hoped to be able to land on the planet by two o'clock in the afternoon. We made ourselves a little sprucer than

usual, as we wished to do credit to our own world; and M'Allister wore his overalls to protect his clothes, although our machinery was not nearly so messy to handle as steam-engines usually are.

We had already examined our three machine-guns so that they might be in readiness for any emergency, if some of the ideas of which we had read as to the probable ferocity of the Martians should prove correct. It had, however, been definitely agreed between us that the guns were only to be used as a last resort to defend our lives against a wanton attack, and were to be kept out of sight until they were really required. My own conception of the Martians was, however, a very different one, though I thought it quite right to be prepared for anything which might happen.

As Mars was only about twenty-five miles distant, its surface details could be fairly well seen through the clear thin atmosphere; and, with the aid of a glass, one question at least was definitely settled—the numerous lines of vegetation were fairly continuous; but there were no large canals to be seen, though we thought we could trace some narrow ones.

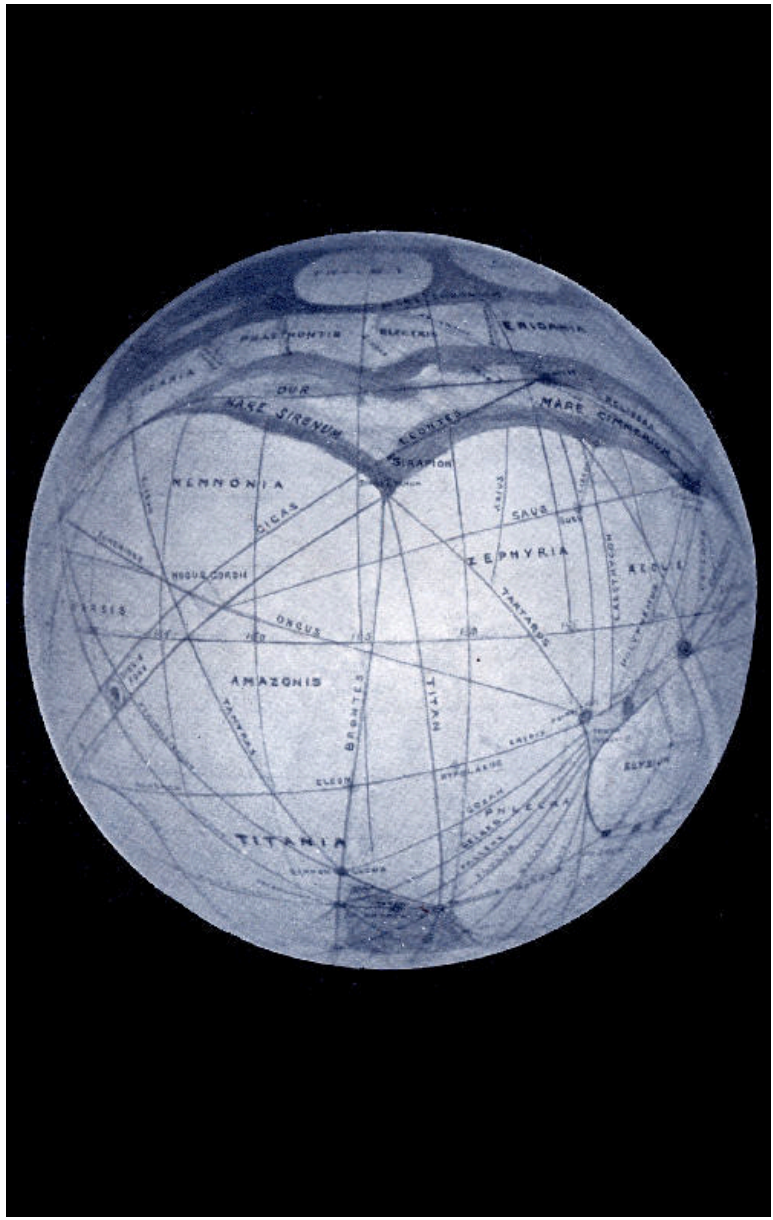
We could also see several rapidly moving specks in the sky, which, we suggested, might be air-ships of some kind; but they were so far off and indistinct, that we were unable to arrive at a definite conclusion.

Our speed having been gradually reduced, we were now only moving at the rate of twenty-five

miles an hour, and it was therefore time to decide on a landing-place. John and M'Allister pointed out a conspicuous spot not very far from the centre of the visible surface of the planet, John remarking that we should be about right if we landed there, because several canals converged to it, and it must, therefore, be a place of some importance. On looking at the map we found that it was marked as the Nodus Gordii, or "Gordian Knot"; so, really, it seemed an appropriate landing-place for travellers who were desirous of solving mysteries.

"Very well, then," I said, "we'll land there if you like, but I had rather a fancy for a different spot, which is on the Sinus Titanum. It is that place over there, near the point where the vegetation curves down in both directions," I remarked, as I pointed out the spot.

"Your place is rather nearer to the equator, and is probably pretty warm; but really it does not matter where we land so long as we arrive on the planet. Your votes are two to my one; so, as you have a thumping majority, go ahead, M'Allister, for the place you have chosen! We will see whether we can cut the Gordian Knot, if we cannot undo it!"



From a Globe made by M. Wicks

Plate X
Mars. Map III

"Sirapion," the landing-place of the "Areonal," is shown just above the pc
Gordii," where John wished to land, is seen between the double canal just a

He accordingly directed his course towards the chosen spot; but we had not proceeded very far before everything below us suddenly disappeared, being quite blotted out by something of an ochre tint, which entirely obscured our view of the country.

"Professor," exclaimed M'Allister, "what is the matter? I cannot see where we are going!"

"I can guess what it is," I replied; "we have run into one of those sand-clouds I told you of the other evening, and until we get through, or it passes away, we shall see nothing else. Perhaps we had better go on very slowly."

We went on accordingly, but instead of our getting through it, the cloud seemed to become denser and denser. However, we still pressed on, and, after what seemed quite a long time, we emerged into somewhat clearer air, although there was still a thin yellow cloud below us. Our course had been well maintained, for we seemed to be within ten miles of our destination, which we could just make out through the thin dust-cloud.

Presently M'Allister called out to me, "Professor, I don't know what is wrong, but the machinery is slowing down so much that I am afraid we shall soon come to a dead stop! I have switched on more power, but it does not seem to make any difference!"

"Well, try a little stronger current," I suggested; "but be careful not to overdo it, or we may land upon Mars more suddenly than we shall like."

He tried this, but we had not moved more than a hundred yards when he found that farther progress was impossible. So here we were, only a few miles from our destination, yet prevented by an impalpable and unknown obstacle from reaching it!

We consulted together, but could find no solution of the mystery of this invisible barrier to our progress. Then John suggested that, as we could not go straight on, we should try a different course. So M'Allister altered our course a few points, and once more put on the speed power, only to be brought to a standstill again after a very short spurt.

"My word!" he exclaimed, "I'll not be beaten like this. I've driven an old iron tramp-steamer through scores of miles of thick seaweed out in the tropics, although the machinery was almost worn out and the engines leaking at every joint. Here goes for full speed ahead!" he cried; and, so saying, he switched on full power, quite heedless of my shout of "Do be careful, M'Allister, or we shall all be smashed to pieces!"

"She's got to go!" he replied grimly, "smash or no smash! I never was beaten yet when pushing my way through obstacles, and I'm too old a hand to be beaten now!"

However, he found he was beaten this time, for although he switched on the utmost power, it refused to give any evidence of its existence, and we had to

rely on our neutral power in order to maintain our position in the air; though, as events proved, we could not have fallen.

The excitement and tension of the work had thrown M'Allister into a profuse perspiration; and, as he stood moodily mopping his brow with his handkerchief, I heard him muttering and swearing softly to himself. His blood was evidently up, for he made another desperate attempt to get the *Areonal* to move forward, wrenching his switches with angry jerks, but it all proved labour in vain.

"Well, what is to be done now, John?" I asked; "we have tried two courses without any effect!"

"I would suggest, Professor, that we should go up higher," he replied, "so as to enable us to try again from another altitude, then, perhaps, we may pass above the obstacle."

"A good thought that, John!" I cried. So up we went, the machinery working all right now, and our spirits rose as we soared higher; but, alas! after rising a few hundred yards, the machines began to slow down, and soon stopped altogether.

"The de'il himself must be taking a hand in this business!" exclaimed M'Allister, "for this beats the worst experience I ever had! We can't go up, we can't go down, and we can't go forward! Whatever can we do, Professor? You're a scientific man; can't you suggest something which might help?"

"It's a profound mystery to me, M'Allister," I replied, "but we certainly do not want to remain

hung up in space, so I suggest you should try several different courses. Surely, in some direction we shall find a way out of this, and get to our destination."

This plan was tried, M'Allister doggedly setting his course first in one direction, then in another, and trying to put on enough power to force the vessel along; but time after time we came to a standstill after moving very slowly for a short distance.

"It looks as though we were to be hung up here indefinitely," said John. "We do not seem able to get through this mysterious obstacle, whatever it may be, or whatever course we may try."

"Oh, we've not tried all points yet," I said. "We must not give up now we have got so close to the object of our trip. Take a fresh course, M'Allister."

He took a fresh course, and another after that, but with exactly the same result.

I had never seen M'Allister in such a perturbed state before; he actually trembled all over with the intensity of his feelings, and his face had an expression of grim determination such as I should imagine might be seen on the face of a soldier at bay with his back to a wall, and fighting for his life against overwhelming numbers of assailants.

"My word!" he exclaimed, "yon's Mars, and here's us, but it doesn't seem as if we should ever come together. Losh mon, bonnie Scotland for ever! Here goes for another try!" and he switched on the current again with a vicious pull.

We watched the machines with intense anxiety, wondering whether this new course would be any better than the others we had tried—whether the machines would keep moving, or slow down and stop as before.

No, we kept moving; and soon it was evident we were gaining speed rapidly.

"Hurrah, hurrah!" I cried in exultation. "We are doing it this time. Slow down, M'Allister, we are going too fast now!"

"Scotland for ever!" he shrieked. "That did it, Professor!"

Strangely enough, John, usually the most excitable member of our party, was the calmest of the three, and simply remarked quietly, "We've done it this time."

Yes, we had indeed done it this time, but our attention had been so taken up with our anxious watching of the machines that none of us had noticed the direction we were taking.

We had passed entirely through the last remnant of the sand clouds, and it was now beautifully clear, the thin air enabling us to see over a very large area of country. For the first time since leaving the earth I now opened one of the doors very slightly indeed, and tested the effect of the real Martian atmosphere.

It seemed to us rather sharp, with a taste something like that of a tonic medicine, but we were all able to breathe it without any serious

inconvenience, though at first it made us gasp.

Being assured there was no danger, I stepped out on to the platform and looked down, then started back in utter astonishment, exclaiming to the others, "Why, look! look! See where we are!"

CHAPTER XIII

WE ARRIVE ON MARS AND MEET WITH A STARTLING SURPRISE

ON hearing my excited exclamation, John and M'Allister at once stepped on to the platform and, having looked down, were as much surprised as I was, for lo! we were heading direct for the very spot which I had previously told them it was my fancy to land upon, and we were not three miles away from it. We also saw a large town or city close by our proposed landing-place.

"One would almost imagine you were a magician, Professor," said John, "and that this affair was all your work, and intended to secure a landing only where you thought proper."

"No, John," I answered, "I had nothing to do with our coming to this spot, and it is still a mystery to me how it was we were not able to continue on our original course. The Gordian Knot was too much for us after all."

"Well," John said, "it does not matter so long as we succeed in landing somewhere.

"By Jove!" he exclaimed suddenly, "look through the glass over there," pointing forwards as he spoke. "I can see enormous crowds of people evidently watching our vessel."

It really was so, for, as we drew nearer and nearer, we could plainly see an enormous multitude of people who seemed to be drawn up along the four sides of an immense square open space, and they were all looking upwards towards the *Areonal*.

"Go and have a wash," I said to M'Allister, who had become quite grimy from the perspiration occasioned by his exciting work just previously. "We will see to the machines, if necessary. You must not descend amongst such an assembly of the natives with dirty hands and face."

"No," he replied, "Kenneth M'Allister will not disgrace old Scotland by doing such a thing as that."

"Look sharp, then, M'Allister," John called after him; then, peeping down again, he pointed to the farther side of the square, saying, "Look, Professor, I can see some pavilions over there, and a large daïs affair, with a canopy over it! Look at the flags and banners too!" he cried; "and there seems to be a large number of officials round the daïs. Perhaps that's the Emperor of Mars sitting there!"

"I doubt that, John," I replied; "but probably he is some very important personage. How singular," I added, "that this spot which I selected should be the

only one toward which we were able to steer our vessel!"

"Well, we shall soon know something about that, I expect," replied John.

"Heh, mon!" exclaimed M'Allister, who had now rejoined us, looking spick and span, and with his face shining from the fresh application of soap and water, "I believe they are all down there watching for our arrival."

"It really looks like it," I said; "but how could they have known we were coming? So many scores of thousands could not have been gathered together at a few minutes' notice. Well, you can see to the machines, and take us gently down into that square."

"Professor," remarked John, "those people are not the big, ugly giants, nor the strange animals which some of our folks have imagined the inhabitants of Mars to be. They appear a bit tall; but, so far as I can see from here with the glass, they are a fairly good-looking lot. They seem quite friendly too," he added, "and we shall not require those guns after all."

"No, certainly not," I replied, for now we were close enough to see that the people were waving their hands towards us, and that children were waving bright-coloured flags. Just then a welcoming shout came up to us from below, and we made friendly signs to the people in response. Then they cheered us again and again, so we knew we could safely descend amongst them.

With skilful manœuvring M'Allister soon brought

our vessel down near the centre of the square, and we were all ready to step out. John judiciously, but rather reluctantly, ceased smoking and put away his pipe, not knowing what kind of reception he might have if he appeared amongst these strangers with a pipe in his mouth.

A line of officials was arranged in a curve on each side of the daïs, and three of them came towards us from either side, making signs of friendliness and welcome.

Seeing that we had nothing to fear, we at once stepped on to the ground and advanced to meet them. In spite of weighted boots, which we had taken the precaution to wear, we had some difficulty in walking properly; the gravitation being so much less than on the earth we had an irresistible tendency to lift our feet much too high at every step we took.

As we met, each official made a very graceful and courteous inclination of his body, and we all bowed in response. The first couple of officials then conducted me towards the daïs, and I could now see that they were very much taller than myself, being quite seven feet nine inches in height. They were, however, so splendidly proportioned that at first their stature had not impressed me as being much above our ordinary standard; whilst their features were most beautifully formed and regular, their complexions being very clear and fresh-looking.

One great peculiarity I noticed in all around us, and that was a peculiar soft and liquid glow in their eyes, which seemed to light up the whole of their

features, adding greatly to their beauty and nobility of appearance.

As we approached the daïs, its occupant rose and came down the steps to meet us on the level ground. Whatever his rank, he was a most magnificent figure, his whole bearing being serenely dignified, majestic and impressive; whilst the expression upon his radiantly glowing countenance was benign and intelligent beyond anything I had imagined or anticipated, though I had expected much.

What followed, however, was surprising beyond measure, and it was startling and electrifying in the suddenness with which it came upon me; for, as this splendid being moved towards me with stately steps, and both hands outstretched in greeting, he said to me in *English*, "Welcome to Mars! welcome to my country, oh stranger from a far-off world! In the name of the whole people, I bid you welcome to *our* world, which we call 'Tetarta,' and to this city of Sirapion!"

CHAPTER XIV

I MAKE A MOST AMAZING DISCOVERY

I WAS so utterly taken aback at this most unexpected greeting in my own native language by one who was apparently the chief inhabitant of this other world

that I found it very difficult to collect my thoughts and make a suitable reply.

I know I stammered out something; but, really, the more I tried to speak coherently the more confused I became. This was indeed a very bad beginning for a visitor from a distant world who wished to show to the best advantage in such an august presence, and before such a great assemblage of the people; but it is useless to attempt to conceal the truth, however humiliating it may be. Observing my embarrassment, however, the high personage smiled upon me pleasantly and, after saying a few reassuring words, he gave a signal to the two officials, so we moved aside for John and M'Allister to approach him.

The people, who had remained perfectly silent during this interview—if it can be dignified by that term—now burst out into a volume of acclamation; but I must say that never upon our earth had I seen a multitude so orderly. Everything seemed to be arranged and carried out with military precision, yet I saw no one with arms or weapons nor anything indicating the presence of either military or police. A few individuals, indeed, seemed to be giving some directions; but whatever movements were made by the people were accomplished without crowding, pushing, or jostling.

The Martians, too, evidently possessed fine artistic tastes and ideas, as well as excellent judgment for colour effects. Colour was apparent in great variety in the dresses of both sexes, yet nothing looked tawdry or overdone; for the whole mass presented a

perfect and harmonious blending of tints; while the designs on the banners were most artistic and effective, many of the devices being of an astronomical character.

Whilst I was thus engaged in observing the people, one of the officials respectfully saluted me and made a sign that I was to accompany him. I bowed and turned in the direction he indicated, when he conducted me to one of the pavilions near the daïs, motioned me to pass through the doorway, then, gravely saluting again, turned and went away.

On entering I found the pavilion fairly large and chastely decorated, but it had only one occupant, who rose and saluted as I entered. He was a splendidly built young man, with a radiant countenance, and when he advanced towards me with both hands outstretched, as the other high personage had done, I noticed the same peculiar soft and luminous glow in his eyes that I had observed in the other Martians.

As he took my hands within his, the young man looked straight into my eyes, his own beaming with pleasure: then said in English, "Welcome, sir, most welcome to Mars!"

As he stood gazing at me and I at him, something in his features struck me as being familiar. Where had I seen a face like that before? Then suddenly my thoughts flew back to a long-buried past. Gracious heavens! I must be dreaming—it can never be! Still he gazed intently into my eyes, seeming to penetrate my very soul; then I saw his expression change into

one of ineffable tenderness, and a beautiful smile rippled over his face.

All doubt was now at an end; this was indeed no dream, no hallucination. I had seen that face before —seen those features in a less glowing and glorified form than that in which they now shone upon me, and *I knew where I had seen them*!

Something, which I had vaguely imagined might just be within the bounds of possibility, was now proved to be not only possible, but an accomplished fact.

Memories of the past rushed over me like swelling waves, and I seemed swept away by their surging billows. I gazed and gazed, in almost incredulous wonder, at that glorious being who stood there regarding me with an expression of ineffable affection; and my heart seemed to melt within me as the re-awakened love for a long-lost form stirred every fibre of my body and thrilled me through and through. Then, overwhelmed by the intensity of my emotions, I threw myself into his arms, crying aloud, "Oh, Mark! my boy! my boy!"

CHAPTER XV

WHAT IS IN A NAME!—THE STORY OF MERNA

YES, this glorious being was indeed the son whom I

had lost on the earth! It would be utterly impossible for me to describe the pathos and affection of that meeting with one whom I thought had passed for ever out of my present life, or the intensity of my emotions and the overflowing gratitude with which I gazed once more upon the face of my lost loved one, now so unexpectedly and wonderfully restored to me. Such emotions as I then experienced are beyond description by any pen or any tongue.

Whilst I was thus overwhelmed with emotion, my son exhibited the most dignified calm; yet his words and sympathy were as tender as those of a mother soothing a suffering child. Having at last brought me into a calmer state of mind, he said: "Yes, I, who am now called Merna, am indeed he who was once your son upon the earth; and I am indeed he who in heart and soul is at this moment as truly and affectionately your son, though living in another world, possessing another body, and called by another name!

"Oh, how I have yearned for this meeting, and through what long years have I studied and striven to bring it about!"

"You have brought it about, my boy!" I cried in amazement. "Why, how was that?"

"It is too long a story to narrate now," he replied, "for we have a duty to perform, and must not stay here. We must now show ourselves to the people outside, who have long waited to greet you! You shall hear more to-night; but, in the meantime, do not make known my identity to my old friend, John, until after I have left you. You may tell him then and

prepare him for our meeting to-night."

I noticed when he was speaking that sometimes he lapsed into a phrase or two of the Martian language, and that his English was spoken as it would be by a foreigner not fully acquainted with our language.

Before we left the pavilion I asked him to tell me what office was held by the high personage who had occupied the daïs on our arrival, and he explained that "he was Soranho, the present ruler of Mars!"

"Emperor or King?" I inquired.

"We have neither of those dignitaries here," he answered. "He is the Chief of the General Council of the entire world of Mars, elected to that office for a certain term by the whole body of the people. But now we must not keep the Chief waiting any longer."

So we passed out together to join the Chief of the Council on the daïs, and, standing near it, we saw John and M'Allister, who were gazing around with intense interest upon the assembled multitude.

The Chief advanced to meet us, and greeted me with even more cordiality than at first, if that were possible; then he said a few words of congratulation to Merna, and conducted us to the front of the daïs.

The people were now all massed together before the daïs in long parallel lines, or ranks, and, as the Chief brought me forward, there came a tremendous shout of welcome from the multitude.

The Chief made a brief speech in the Martian

language (which of course neither I nor my two companions understood), in which, as Mark afterwards explained to me, he gave a short account of how I had arrived there from the earth with my two colleagues—the first inhabitants of that world to set foot upon Mars! He told them that my coming was all owing to the devoted love and influence of Merna, who in a former life upon the earth had been my son.

What Mark did not tell me was that the Chief had spoken in terms of very high appreciation of the talents Mark had displayed, and of the success which had attended his great endeavour to exert his influence over that immense distance of space which separated the two worlds, and practically compel me to obey his wishes by undertaking a journey to Mars.

I learnt this afterwards from others, and found that a similar modesty and reticence was a general characteristic of the Martians.

The acclamations of the people at the conclusion of the Chief's speech were almost deafening, and I frequently distinguished the name of "Merna" amongst their ejaculations. Whatever was the purport of the Chief's statement, it undoubtedly afforded the most intense satisfaction to all those who heard it.

The assembly now began to disperse in the most orderly manner, many of the people gathering round the *Areonal*, and apparently discussing with interest its construction and equipment, but none pressed upon our little party. There was neither rude

curiosity nor any embarrassing attentions bestowed upon us, such as would have been so unpleasantly in evidence in any similar circumstances upon the earth.

"Merna" asked me to be good enough to excuse him for the present as he had something to attend to urgently; then he took leave of us for the time, remarking that we need have no anxiety about the *Areonal*, for it would be perfectly safe and well looked after.

The Chief, and some of the officials to whom he now introduced us, then accompanied us to another pavilion, where we partook of a little light refreshment. The chief then took his leave, after promising that we should meet again to-morrow.

One of the officials informed me that a residence was in readiness for our occupation, and that it was situated within a very short distance from where we stood. He asked whether we would proceed there in an electric carriage, or whether we would prefer to walk; and, as we wished to get accustomed to walking on our new world, we decided to go on foot.

We saw around us in every direction large numbers of flying machines of all descriptions, also electric and other motors, which had conveyed the people to our landing-place. Most of the motors were very light and elegant in appearance, and those intended for conveying only a single person were but little larger than our motor tricycles. There was not the slightest noise from the machinery, nor any fumes emitted like those we had found so great a

nuisance on the earth. The Martians had evidently overcome all such difficulties, if they had ever experienced them; and their methods were doubtless far in advance of the use of evil-smelling petrol.

We noticed that very many of the people were walking in a manner which suggested that they had a long journey before them; and, on mentioning this to the official in attendance, he told us that walking was so easy on Mars, both on account of the small gravitation and the generally level surface of the country, that most Martians preferred walking unless much pressed for time, or the distance to be traversed was very great.

Though the sun was shining brilliantly the heat was not at all oppressive. As we passed along we noticed that the buildings all stood separate from each other, open spaces or trees, flowers or shrubs being around each of them.

We saw no evidence of overcrowding of buildings on small areas of land like there was in the world we had left. Plenty of air and open space seemed to be the general rule, at least upon this part of Mars.

After a very short walk we arrived at our dwelling, an elegant little building of white stone, and only two storeys in height. There was such a general appearance of comfort and homeliness about it, both inside and out, that M'Allister exclaimed: "Professor, I never thought coming to Mars meant a reception like this. I rather expected to have had a fight when we landed!"

John, too, expressed his delight at the kind

manner in which we had been received, then asked me, "Who was that splendid young fellow who came out of the pavilion with me, and stood by my side on the daïs?"

"I'll tell you presently, John," I replied, "after we have had some solid refreshment, and are quite alone."

"One would think there was some mystery about him, Professor, by the way you speak," he answered.

"Perhaps there is a little more mystery in the whole affair than you dream of," I remarked.

"Anyhow," said John, "you seem very pleased over it, whatever it may be, Professor; for I never saw you so delighted in your life as you have appeared during the last hour."

"Yes, John, I am indeed pleased," I replied, "and so will you be when you know what I know."

"You quite arouse my curiosity," he said; "still, I suppose I must wait a little longer to be enlightened; but we came to Mars to find out secrets."

Just then we had to cease our conversation, for we were conducted into a room where we found a most tempting looking repast ready for our delectation, and the attendants showed us to our respective seats.

All the comestibles were fruits, nuts, or vegetables of various kinds, and I saw nothing there in the nature of flesh meat. Some of the fruits and nuts resembled the products of our own world, especially

some of our eastern products; but most of them were entirely unknown to us, though they all looked tempting and good.

We certainly did full justice to them, and were particularly attracted by some large bunches of what were evidently Martian grapes, each grape being as large as one of our egg-plums. We tried some of these, and found them most delicious, as indeed were all the other eatables we consumed.

Though used to a meat diet, we found this meal most satisfying; the fruits being so refreshing that we had neither desire nor need for drink, though it stood there ready for us if we wished to take it. The attendants waited upon us assiduously, bringing us the various dishes in what was apparently their regular order of courses.

Both John and M'Allister appeared to enjoy their first Martian meal as much as I did, and when we adjourned to another room at its conclusion, were loud in their expressions of appreciation.

When this topic had died down, I thought the time had arrived to make the important disclosure of the first results of our visit to the red planet.

They listened to my story in amazement, and with many exclamations of surprise; whilst, as for John, he was almost beside himself with delight on learning that he would once more meet his long-lost friend, and he rose and shook hands with me, at the same time warmly congratulating me on my wonderful reunion with my son.

"Professor," said M'Allister, also rising and shaking my hand, "I'm as glad for your sake as if I had found a son of my own!"

I thanked them both very heartily for their kind congratulations. Then John said to me—

"Professor, it is, without exception, the most extraordinary thing I ever heard of in my life; but what strikes me as most singular about it is the strange coincidence connected with your son's name!"

I did not understand this allusion to Mark, so asked what was the strange coincidence to which he referred.

"Well, Professor," he said, "excuse me if I answer your question by asking another one. How was it you gave your son the name of Mark, and what was the particular reason for your doing so?"

"No particular reason, John, so far as I am aware," I replied, "except that it always seemed to me a good, plain, and honest sort of a name."

"Do you know the meaning of the name?" he then asked.

"Well, yes, I think so; for one thing, I believe it means 'polite,'" I said; "and another meaning I have read is a 'hammer.' But really, John, I had no thought of meanings at all when I chose that name for him."

"That only makes it all the more strange," John answered. "I have seen those meanings you mention

as attached to the name; but you seem to have quite missed the most important one of all, for I can tell you, Professor, that the name 'Mark' means 'Son of Mars!' Now don't you see the coincidence, when you find that he really has become a son of Mars!"

"Really, John," I answered, "I assure you that I never heard of that before; the coincidence is, as you say, most singular and extraordinary; but, taking all things into consideration, I am inclined to think there must be something more than coincidence when they work out like this. You know your Shakespeare, John, and he says most truly: 'There's a divinity that shapes our ends, rough-hew them how we will.' I will not repeat the hackneyed phrase about 'more things in heaven and earth——'"

Just then Merna (as I suppose I must now call him, though he will always be "Mark" to me) arrived amongst us, and I at once introduced him to John and M'Allister.

The meeting between the two old friends was delightful to witness, for both seemed over-joyed; and they had so much to say to each other—so many questions to ask.

When the excitement had passed I asked Mark—you see I cannot help calling him by his old name—if he could now furnish me with the further information he had promised, for I was longing to hear all he had to tell.

"Yes," he replied, "I am quite ready, sir;" and then he proceeded to give us details of his life upon Mars. It is too long a story to tell exactly as he told it—and

sometimes he was at a loss to express himself appropriately in English—but, shortly, it was as follows:—

His birth upon Mars, as we found from a comparison of dates, must have followed almost immediately after his passing from the earth; and he said he thought that his two previous seizures were probably abortive attempts of his spirit to depart earlier.

His Martian father was the brother of Soranho, the present Chief of the Council; both his father and mother, however, had died when Merna was quite a child, and the Chief had since brought him up like his own son, and was very much attached to him.

When Merna was still very young he was extremely fond of looking at the stars in the clear Martian skies, being especially attracted by the earth, which was a very brilliant star in those skies when the planet was in the most favourable position for viewing it. He used to watch the earth pass through its various phases, the same as we see Venus; and as time went on he had a strong feeling or intuition that, at some unknown period, he had been upon, or in some way connected with, the earth!

This feeling became more and more intense, so that his thoughts were constantly directed towards our world, and ultimately he became firmly convinced that he had once lived upon the earth.

He told us, amongst other things, that the Martians possess senses and powers which we do not possess, and know nothing of. For instance, he said

that any Martian of ordinary intelligence always knew what was in the mind of any one with whom he was speaking; therefore any attempt to prevaricate or mislead was folly and useless. In some cases this power extended over a long distance, and the thoughts of others could be read as easily as when they were close at hand. So for this reason, and not only because it is considered wrong, prevarication is never practised on Mars.

Again, a Martian can transmit his thoughts over any distance upon the planet, and influence thereby any one whom he could influence in ordinary conversation.

Some, who had given especial attention to the training and development of this faculty, could even transmit their thoughts to other worlds; but the influence exercised in such cases depended entirely upon whether the inhabitants of other worlds had attained not only a sufficient degree of intelligence, but also the power to assimilate and make use of such outside influences, either consciously or unconsciously.

Having become convinced that he had once lived upon the earth, his interest in it was greatly intensified, and he felt a consuming desire to know more. He therefore used his utmost endeavours to train and develop his faculties, with a view to finding out something more definite. His uncle was informed of his desires in this respect, as well as of his reasons for them; and he placed Merna under the tuition of two Martians who had developed these special faculties to the highest degree then possible.

After pursuing this course of instruction and training for some time, Merna found that he was gradually becoming more and more acquainted with details of his former life, and was also gradually relearning the language he had spoken upon the earth.

Soon he was able to recall from his sub-consciousness the names of persons, and also of places and things, with which he had been acquainted in his previous life; and what he thus learnt he imparted to his uncle, his two teachers, and to a few other Martians.

The knowledge thus very slowly acquired and gradually built up led to a thirst for still further knowledge; so he then tried to transmit his thoughts to the earth, and, if possible, to influence me, his father, whom he felt certain was still living.

He paused in his statement, and then asked me to tell him "When I first thought of making a trip to Mars, and also whether I had not, long before then, constantly been in the habit of thinking about the planet?"

I told him the date when I first made the suggestion of our trip to John, and added that he was quite right in supposing I had long previously been occupied with thoughts about Mars.

"Yes," he replied, "the date you give is quite correct. I had for years been trying to influence you to take a deep interest in this planet, and after that to influence you to build a vessel which would bring you here; and, on the very day you mention, I felt

quite certain I had succeeded."

"My two friends then joined me in transmitting further influences to enable you to conceive the proper kind of vessel and machinery, and how it should be constructed. These latter influences seem, from what you have told me, to have been assimilated by John to a larger extent than by yourself; and this, no doubt, was owing to his higher development of engineering and mechanical genius. The result, however, has been most satisfactory. You, whom I had so long yearned to see, were brought to embark upon this long voyage through space; I knew when you had done so, and also that John and another accompanied you. I also knew exactly when you would arrive here, for mentally I saw your chart and knew many of your thoughts."

"But," interposed John at this stage, "was it not rather a risky and dangerous experiment to influence inhabitants of another world to make what was practically an invasion of Mars? Even if it were possible, we should be afraid to do such a thing upon our earth, for fear of disastrous developments later on."

"There was no danger at all," he replied. "I think you found you could not land here just where you pleased!"

"Ah, that we did," said M'Allister; "and we were never so mystified in our lives."

"So, Mark," I said, laughing as I spoke, "that was your work, was it?"

"I certainly helped in doing it," he replied smilingly. "We have the means of electrifying a very large area of space anywhere, either upon our planet or at any required height above it, in such a manner as to neutralise the power of any vessel that could possibly come here, and thus stop its progress entirely when we so desired. We let you go on a short distance and then stopped you, again and again; and when we stopped you, we took care to arrange the forces so that you could not in any event fall to the planet even if the whole of your machinery failed to act. You were, as you know, compelled to descend exactly where we wished you to; and, in fact, exactly where we had previously decided you should land!"

"Well," exclaimed M'Allister excitedly, "if this doesn't beat all I ever experienced! To think now that all our movements and impulses have been engineered and controlled from Mars; not only just recently, but for months and years past. Mon, it's marvellous!"

"Marvellous to you, no doubt," said Merna, "but only a commonplace happening here. It is very satisfactory to us that our endeavours to influence you to come to this planet have proved successful in the main essentials. The influence does not, however, appear to have been quite effective as regards your steering to the landing-place we had decided upon. We had hoped there would have been no necessity for interfering with your movements by means of the electrical waves."

"Well, Merna," I answered, "you certainly

succeeded in imbuing me with a desire to land at Sirapion, but my two companions were more attracted by the 'Gordian Knot'; and it was only because I subordinated my own inclinations to theirs that you were compelled to use force to make us proceed in the right direction. However, it has resulted in our having one of the most exciting and mystifying experiences of our lives; and, now all has ended happily, I do not think any one of us regrets that the incident occurred."

"Certainly I do not," John remarked.

"Neither do I," said M'Allister; "although I must confess I never felt so entirely beaten in my life."

"Well, now you understand that it had to be done," said Merna. "As I remarked, there was no danger to us in your coming here; for, if we had desired it, we could have utterly destroyed your vessel before it reached the planet, just as easily as we stopped your progress; or we could have destroyed it with equal ease and without any risk to ourselves after you had landed."

"My word," said M'Allister, "I'm right glad we did not come here as enemies!"

"Yes," replied Merna; "it was just as well you did not. We do not make war, but we have full means of protecting ourselves against attack if it should ever be necessary to do so. So you will understand that no invasion of Mars from outer space is possible."

I then turned to Merna and said, "There is one

question I should like to ask you before we part this evening: Can you tell me the meaning of the word 'Tetarta,' which Soranho, your chief, told me was the name by which your world is known to its inhabitants?"

"Oh yes, sir," he answered; "'Tetarta' means 'the fourth world,' and thus indicates our position in the solar system. Sometimes, however, the name 'Tetartœcumene' is used; but this does not find general acceptance amongst us, as it means 'the fourth *inhabited* world,' and therefore assumes rather too much.

"We know the earth is inhabited, and have some reason to believe that Venus is also; but with regard to Mercury we have no knowledge at all upon this point. Mercury, as seen from Mars, is always too close to the sun for us to learn much about it by optical investigation; and we have never been certain that we have either received influences from there or been able to transmit influences to the planet."

"Thank you, Merna," I replied, "that clears up the matter; and it seems to me that your names are much more appropriate than the one by which your world is known to us on the earth; for, on account of its red colour, we have, as you are aware, named it 'Mars,' after our mythical god of war. I gather from what you have told us that war is now quite unknown upon your planet, so our name is quite inappropriate."

"Yes, that is so, sir," he answered; "and, later on, I hope you will learn much more concerning our social

conditions, and that you will find we are a fairly developed and civilised people."

He then took leave of us, promising to see us again in the morning for the purpose of showing us about our new world.

It was now rather late, so, after discussing for a while the events of this most exciting day, we retired to rest. My thoughts, however, were so many and so tumultuous that it is scarcely a matter of wonder that a very long time elapsed before sleep came to me.

CHAPTER XVI

WE LEARN SOMETHING ABOUT THE POWERS OF THE MARTIANS

THE next morning Merna arrived early, and breakfasted with us; and, as soon as the meal was over, we started out. The air was bracing and exhilarating, and we felt so extremely light and buoyant that we almost seemed to want to run, skip, and jump, as we did in our early childhood's days.

We went first to have a look at the *Areonal*, but, on arriving at the open space where we had left it, were unable to see it! The daïs had been cleared away, also the pavilions; whilst in the centre of the open space there was a large building.

We felt rather puzzled at this change, for we were sure no such building stood there yesterday. Merna, however, led us across to it, and touched a switch, which swung open a pair of large doors so that we could see into the interior of the building.

There we saw our own good ship, the *Areonal*, safely housed in a substantial-looking building, which had apparently sprung up in a single night.

We all looked at Merna inquiringly, and he smiled, saying, "Ah, you are not used to the Martian way of doing things! This seems to you very quick work, no doubt; but the erection of the building was not such a heavy and laborious task as it would have been upon the earth. Owing to the lesser gravitation here, and to the larger physical development of our people on Mars, one man can accomplish in the same time what it would require many men to achieve upon the earth. Besides, we have labour-saving machinery and apparatus which your scientific men have not yet even dreamt of.

"Thus, what seems to you an extraordinary piece of work to be finished in so short a time, is really nothing out of the common here, especially as the structure is only of a temporary character."

"Mon," said M'Allister, turning to John, "if our earth had been like Mars we wouldn't have taken so many months to build our vessel and its shed!"

John answered him, and turning to Merna, said, "There is something I am very anxious to ask you about, as it concerns myself and my relations with the inhabitants of this planet. I do not wish to

infringe any of their regulations here, or to give any cause of offence, but——"

Then Merna held up his hand, and smiling, said, "You need not say any more, John; I know exactly what you wish to ask me; and, without it being said, can reply to you. You may smoke as much as you like when out-doors, without fear of offending any one here; but in public or private assemblies, notice what others do, and act accordingly. It is true only a small proportion of our population indulge in smoking, except in the colder regions; but please understand that amongst us Martians there are few restrictions as to conduct or custom, and, provided that nothing really dangerous or annoying to the community is done, every one can please himself.

"We leave all such things to the good sense of the individual, and a Martian can be trusted to regulate his habits and conduct without needing penalties to compel the observance of regulations or restrictions."

We looked at each other significantly, but without saying anything; for we all realised the truth of Merna's statement of the previous evening to the effect that the Martians were able to divine what might be in the mind of another without his having to speak. Not one of us had mentioned smoking before Merna, yet he knew exactly what John had upon his mind and was about to ask him.

I thought it was my turn now to obtain some information, so said to Merna, "There is also something which I am very anxious to ask you about."

"Oh yes, sir," replied he, again smiling; "you are anxious to know whether we really possess an elaborate system of canalisation upon Mars, and I can soon set your mind at rest upon that point. Indeed, it was in order to make arrangements for conducting you to inspect some of the canals that I left you yesterday after parting with the Chief.

"Our seas and other large bodies of water have long ceased to exist, and we are therefore dependent upon the water arising from the dissolving snow of our polar snow-caps for a supply of that prime necessary of life. Our canal system is, therefore, the most supremely important work which we have to maintain and develop, so that every part of the planet may be supplied with water, and also kept in touch with the rest of the planet. You must clearly understand that upon the adequacy and perfect working of the canals all life here is dependent; so every other matter is regarded as of lesser importance."

I may here say that we afterwards learnt that the positions of the higher officials connected with the administration of the canal system are regarded as amongst the highest and most honourable offices that a Martian can aspire to; and, moreover, that Merna himself held a very responsible position in the engineering department connected with the canals.

Merna then went on to say: "You will see for yourselves, presently, what our canals are like; for I am about to take you across to a point where you will have a good view over the country.

"As our canals are such conspicuous features upon our planet, especially where they cross the deserts, our experts have long been endeavouring, by various means, to transmit influences to the earth, in order to direct your people's attention to the regular lines they form, and thus convince them that Mars is inhabited by intelligent beings. Probably it is the case that very few of your scientific men are endowed with intelligences both sufficiently advanced, and sufficiently adaptable and receptive of new ideas, to enable them to assimilate and make use of the influences thus transmitted; but still we know that some must have grasped the situation."

"Merna," I answered, "that is quite true; but, of course, I cannot say whether it has been the result of Martian influences. Thirty years ago one of our great observers saw and mapped many of the canal lines; and years before that, others had seen them imperfectly, and drawn portions of them on their maps. Our first and greatest exponent of the idea that they were really canals was, however, Professor Lowell, an American astronomer, whose fame has spread all over our world. He has not only been a constant observer of Mars for many years, but has mapped out your canal systems from observations made by himself and his colleagues. He has also formulated a reasonable and, as it now appears, true explanation of their object and purpose; as well as demonstrating their existence to be a prime necessity for the well-being of your people.

"It is true he has met with much opposition; not only from those who have but limited knowledge,

and refuse to believe anything they cannot see themselves, but from the older school of astronomers, who are not very receptive of new ideas; and who are, perhaps, naturally reluctant to admit the inadequacy or inaccuracy of their early theories. This is a very common failing with experts of all kinds, and we have had many instances of it in connection with astronomy all through our history; but we have amongst us many intelligent persons who are open to conviction, being unfettered in regard to particular theories. They are, therefore, not only willing, but eager to examine the evidence which has been collected, and to form their own opinions on the subject."

"I am very glad to hear you say so, sir," replied Merna; "and now I would like to ask you whether, during the last thirty-five years or so, there has not been an extraordinary advance in knowledge amongst your people in connection with such sciences as electricity, telegraphy, light and engineering, as well as in astronomy?

"I ask because our experts have been most earnestly endeavouring during that time to transmit some of their knowledge on these subjects to your scientific people on the earth, and we have some reason to believe that their efforts have been, at least, partially successful."

I assured him that our advance in regard to these subjects had really been phenomenal during the period he mentioned. Probably during no previous period in the history of our world had so many useful, important, and even amazing discoveries

been made during such a short space of time.

I gave particulars of the great discoveries and rapid developments in connection with electricity, wireless telegraphy, the telephone, Hertzian waves, X and N rays, spectroscopy, colour-photography, and telectrography. I also mentioned the discovery of radium, helium, and argon; the medical use of light and bacteriology; together with the invention of the turbine engine, motor cars, flying machines; also phonographs and other kinds of talking machines.

Merna expressed himself as very gratified at this information; and remarked that our progress would be still more rapid in the future, as it was quite evident that there were terrestrial intelligences which were readily receptive, and capable of high development. He promised that what I had told him should be made known in the proper quarters; and added that the Martians would be encouraged to persevere in their efforts to impart such knowledge as would aid in the general advancement of science in our world.

He then asked me, "Whether, in connection with new discoveries, it had been found that more than one person had developed the new ideas about the same time?"

"Yes, Merna," I replied; "it has often been observed that similar inventions have been made by several people at the same time: although they have worked quite independently, and were totally unaware of what was being done by each other."

"That," said Merna, "is a natural consequence of

these influences; for they are in the air, so to speak, and have only to be brought into connection with the appropriate intellects to be assimilated and carried into effect."

I then asked him if he could explain how the influences acted; and he replied that in most cases they formed a sort of mental picture, which would be mentally seen and understood by a person sufficiently endowed with the necessary knowledge; but if he were not so endowed, or not receptive of new ideas, then he would learn nothing from the influences.

Thus a mental picture of some new and unknown piece of machinery would mean nothing to an unmechanical mind, or even to a mechanical mind which was not endowed also with the inventive faculty. In other cases only thoughts in the abstract could be sent, and these were more likely to remain unassimilated than the mental pictures, as a very high order of intellect was required to receive such thoughts.

I then informed him that our greatest and most daring electrician, Nicola Tesla, was firmly convinced that he had discovered planetary disturbances of an electrical nature which had reached our world. This occurred as far back as the year 1899; and, in the course of later scientific investigations, he found that the disturbances could not have come from the sun, the moon, or Venus. Further study has, he says, quite satisfied him that they must have emanated from Mars.

I added that Tesla was at work perfecting an apparatus which he was convinced would be the means of putting him into communication with other planets, by means of a wireless transmitter. This, he states, will produce vibrations of enormous power, and he has devised a means of producing oscillations of the most tremendous intensity. He states that he has actually passed a current round the earth which attained many millions of horse-power, and feels assured that he has already succeeded in producing electrical disturbances on Mars by the aid of this current. "Those disturbances," he adds, "are much more powerful than anything which could be obtained by means of light reflectors, no matter how large such reflectors might be, or how wide an area they might be made to cover."

At the same time I pointed out that these are Tesla's own statements, and not mere second-hand reports or newspaper inventions!

Merna said that this information was really very gratifying, and gave him the greatest satisfaction; for it showed that the Martians' endeavours to communicate with us would ultimately be successful, because there was at least one man upon the earth capable of devising the necessary apparatus for receiving and transmitting such communications. He further remarked that it was quite true that electrical disturbances had reached Mars from another planet, but added that no effective communication was possible by means of light rays, as the two planets were never so situated in regard to each other as to render such a mode of signalling practicable.

I was just about to speak when Merna held up his hand to enjoin silence, and stood as though he were listening attentively to some communication.

After a minute or so he told us he had just received a mental communication from Soranho, stating that he had despatched a messenger to us with an urgent letter. Then he added, "We had better wait here until the messenger arrives."

"So," I said, "your wireless telegraphy is evidently much in advance of ours, for you seem to dispense with apparatus altogether!"

"Yes, sir," he replied; "you see this is one of the senses I told you we Martians possessed; but some of our people who are somewhat deficient in this sense still use the small pocket receivers and transmitters which have long become obsolete amongst the generality of our population.

"I have already given you two illustrations of the truth of my statement, that we are able to divine what is in each other's mind without it being necessary to speak. Still, I wish you to understand that we never allow this power to spoil conversation. You might, perhaps, think that because we know what each was about to say, the words would remain unsaid, and we would, therefore, be a rather taciturn people. That is not so. The faculty is a very useful one to us on many occasions; but, as I remarked, we never allow it to spoil conversation."

"That seems to me a very sensible and practical arrangement," remarked John.

"Well," replied Merna, "I hope, and I think, you will find us a very sensible and practical nation."

At this moment an official came up to us, and after saluting, handed Merna a packet. Having opened and read the communication it contained, he turned to us and gave each a document which had been enclosed; at the same time saying that it was a formal invitation for our attendance at a banquet in the evening, for the purpose of meeting the Chief of the Council and other high personages, and for social intercourse.

We all expressed our thanks, and, of course, accepted the invitation. The official, having received the requisite reply from Merna, again saluted, and then retired.

CHAPTER XVII

WE VISIT THE CANALS AND DISCOVER THEIR SECRET—MARTIAN VIEWS OF LIFE AND DEATH

ON Merna's suggestion we walked through the town with the object of inspecting the canals on the outskirts; and we needed no pressing, as we were all eager to see what the canals were like.

We again noted how every house, and almost every building, was isolated from its neighbours.

Many of them were very large and exceedingly handsome specimens of architecture, and the streets were wide, straight, and remarkably clean and well kept. The official and administrative buildings were near the centre of the town; their general arrangement and design appearing most excellently adapted to the special requirements of their respective purposes.

Most of them were built of white stone, resembling our marble, which was very hard, and appeared clean and unaffected by weather, although some of the buildings were of considerable age. Others were built of stones of various colours, which added a pleasing variety to the general effect; whilst many were adorned with noble and beautiful domes, towers, and airy-looking minarets.

As we did not propose to inspect these in detail now, we passed on to the outskirts of the town, soon reaching the air-ship station, where we found a vessel in readiness for our trip. We all entered; the ship was at once started, and we proceeded swiftly on our journey.

Merna then told us that all public means of transit, over the whole area of the planet, were provided and maintained by the State, for the free use of all who needed to travel. The passengers neither paid fares nor received tickets; they simply stepped into the proper conveyance and went wherever they desired to go. A record was kept of the number of passengers carried; for, as each passenger entered, a number was automatically registered by a small machine under the footboard,

the exit being by another door.

Small air-ships, motors, and boats could be engaged by single persons or small parties who did not wish to travel in the larger public conveyances; and any person was at liberty to provide a private conveyance for his own use, but the public ones were so numerous and convenient that very few people kept their own.

"Hey, mon!" said M'Allister, "the Martians can teach us something. I would like to see such a system at work in our own country!"

"I am afraid you are not likely to see that," said John, "while we have to spend so much upon warlike preparations. If war could be abolished, all the millions of money thus expended could be made available for purposes which would be of real and permanent benefit to the people."

We travelled a distance of some miles, and then the vessel was brought to a standstill.

What a splendid view we then had over the country all around us! the air being so thin and clear that there was very little dimming of the objects in the far distance. Across the country, in line after line, were the canals which we had been so anxious to see, extending as far as the eye could reach! With our glasses we made a detailed examination of several.

Our sensational newspapers have had paragraphs about Martian canals a hundred miles, or even hundreds of miles, wide! Scientific men have also similarly exaggerated, and made remarks about the

absurdity of the supposition that such canals really existed.

There is very little excuse for such statements, because Professor Lowell has always been careful to point out that the lines represented broad bands of vegetation, and not the width of the canals.

Now the secret was out! What we actually saw was this: not a single wide canal but a series of comparatively narrow canals, running parallel to each other, with a very wide strip of vegetation between each. Usually the canals were linked together in pairs by smaller cross canals running diagonally from one canal to the other in alternate order. These were the irrigation trenches. Thus from one of a pair of canals an irrigation trench would branch out at an angle of about fifty degrees, and enter the second canal. Higher up, on the same side, another trench would run from the second canal at a similar angle, and enter the first canal, and so on—*ad infinitum*. In the case of single canals curved loops branched out and re-entered higher up, these loops being made on either side, and similar loops were made on the outsides of paired canals.

As a result of this arrangement it did not matter whether the water passed up the canal at one season of the year or down it at another season, it could always move straight ahead; the irrigation trenches were thus constantly flushed by one or other of the pairs, and there could be no stagnation anywhere. Merna also told us that some canals are provided with a network of trenches, whilst others are embanked so that the water can be let out through

sluices when necessary, and thus flood the surrounding land. Thus every requirement can be met.

So far from being a hundred miles wide, it was exceptional for the canals to have a width of more than two hundred yards. Most of those we were looking at were only about sixty feet wide! and only the wider ones are used for navigation purposes. Merna explained why this was so, saying that as the main use of the canals was for irrigation purposes very wide ones were not required; for not only would they be wasteful, but as it was necessary to force the water along by artificial means, it could more conveniently be accomplished in the case of narrow canals, as the wider the canal the more difficult it became to force the water along.

We also observed many splendid wide motor-roads running between the single canals, as well as others running straight across the system, being carried over the canals by the most beautiful and fairy-like bridges that we had ever seen. They were all constructed of a metal identical with our "martalium," which we had used in the construction of the *Areonal*; so that was undoubtedly another invention which we owed to Martian influences transmitted to us across space!

Nothing more beautiful or graceful than these bridges could be imagined, so light were they in construction, so elegant and varied in design, and every part shining in the sun like burnished silver; they looked like structures composed of rays of light rather than substantial metal! They were a perfect

dream of beauty, and we stood a long time examining their elegant construction through our glasses.

"Well," remarked John, "some of our millionaires would give half their fortunes to have such lovely bridges as these in their private parks!"

"Heh, mon!" replied M'Allister, "it's very clear the Martians could teach our engineers something about bridge-building, if nothing else!"

"Wait and see our water-lifting and water-propelling machinery," said Merna; "I think that will be something which will suit you as an engineer!"

I noticed that many of the lines were apparently groves of trees, and asked Merna whether they were canals or not.

"Yes," he replied, "they are canals. You will understand that in the hotter parts of our world it is necessary to protect the water from too rapid evaporation, or else the canals would be almost run dry long before the need for their use ceased at the end of the season. Some are arched over entirely, but in most cases it is sufficient to plant trees along each side. Would you like to examine one?" he asked; "we can do so very soon, if you wish?"

I said I should be glad to do so, and our course was accordingly directed to one of the groves, which appeared to be about two miles distant. It, however, proved to be more than six miles away, for we had not yet become accustomed to the effect of the clear Martian air in making distant objects appear much

closer than they really were. However, it did not take long for our air-ship to reach it; and we descended in the space between the canals and then walked over into the grove. When we turned into it, we were greatly surprised at the charming effect of the trees over the canal.

The trees were something like our willows, but taller than elms, and had a multitude of very long, thin, and supple branches, with very little bare trunk. They were planted rather close together, all along each side of the canal, with their trunks sloping slightly towards the water. The long branches thus met at the sides and high overhead, intertwining together, and forming a high leafy archway extending all along the canal in both directions as far as the eye could see. The thick, soft Martian grass along each side of the canal was like a velvet-pile carpet to walk upon; the sunlight filtering between the green leaves of the trees cast bright flecks of light on the clear shimmering water which ran beneath them; whilst water-fowl swimming here and there gave a bright touch of colour and the animation of life which so adds to the general charm of such scenery. Some of the water-fowl were very large birds, with brilliant coloured plumage.

"What a delightful place for a quiet walk on a hot day like this," I exclaimed; "plenty of air and no excess of heat!"

"Yes," Merna replied; "these embowered canals are very popular with the Martians, as they furnish such cool and pleasant walks in the summer time. I must also tell you," he added, "that those water-fowl are

looked after with extreme care, because most of our aquatic birds have become nearly extinct since our natural areas of water failed us, and unless they were preserved would die out entirely.

"You will understand that these canals are not liable to excessive evaporation; but, at the same time, it would not do to prevent evaporation altogether, because we should then fail to obtain a sufficient and fresh supply next spring."

"I quite see that, Merna," I said; "but one of our scientific men has said that it would be madness to construct canals on Mars, because the water would all quickly evaporate, especially in the warmer regions, and thus be wasted."

"Well, as you see, sir, we manage to prevent evaporation to any extent we may desire," replied Merna with a smile; "and even scientific men seem liable to omit some important matters from their theories and calculations."

"How do you manage the irrigation?" I inquired; "the trenches seem rather wide apart to supply such a large area!"

"The upper layer of soil is very porous, and the water soaks along it," he answered; adding that "where necessary it was assisted by porous pipes laid beneath the surface.

"Besides," he proceeded, "we have small portable electric engines, with which water from the trenches can be distributed in the form of spray over wide areas. Our vegetation, too, has adapted itself to the

conditions of the planet in the course of the changes which have taken place during past ages, and now requires very little water or moisture to maintain it in vigorous and healthy growth."

One more question was put to him by John, who asked, "Do these canals constitute your whole supply of water for drinking, as well as for all other purposes?"

"Oh no, John!" exclaimed Merna. "We draw all our pure water from deep wells. The soil of Mars, being much more lightly compacted than that of the earth, has absorbed an immense proportion of the water which was formerly upon its surface. Instead of having lost it by evaporation and radiation into space, we still have it below the surface, stored up ready for use in our time of need.

"For this reason, and also in consequence of the small amount of our planet's internal heat, the water has not undergone chemical change, and mostly lies at great depths; but, of course, well-boring is much easier work than on your world, and I expect our methods are rather in advance of yours.

"Your scientists seem to have overlooked some of these points altogether. You need not pity us for lack of water, as I have heard you doing, for we have an ample supply for many centuries to come; especially as we can purify water which has been used for general purposes, and store it up for use, over and over again. Our canals are only drawn upon for purposes connected with irrigation, or when absolutely pure water is not needed."

"Well," M'Allister exclaimed, "it doesn't seem that the Martians are so badly off for water as some of our clever people imagine! Why, I've read that the need of water here must be so great that the people, driven to desperation, must be fighting each other to extermination in order to get it."

"That is an entirely erroneous idea, sir," replied Merna; "and you may be quite sure that such a state of affairs will never be witnessed upon this planet. We know the time must come when our water supply will cease to be, but your people are needlessly pessimistic, and imagine terrors where we see none.

"In actual time, the end of Mars is still far distant; but, as compared with that of your world, it is very near. It will be possible, later on, to forecast, by means of our records of the rate of decrease, the time when our water supply will come to an end; but even now it is well understood how the crisis will be met. As the final period draws nearer, families will become smaller and smaller, and in the last Martian century no children will be born; so the diminishing water supply will suffice for the needs of the dwindling population. Thus the race will gradually die out naturally, and become extinct long before the conditions of our world can make life a terror. There will, therefore, be no self-slaughter, nor murderous extermination, amongst ourselves—we shall simply die out naturally.

"The planet will roll on, devoid of all life, so the loss of water and air will then be of no consequence. It will be a dead world; until, perhaps æons hence, a collision with some other large body may transform

both into a nebula; and thus once more start them on the way to develop into a world capable of sustaining life. Thus nothing in the Universe really dies; the apparent death is only the preparation for a newer and higher life.

"We Martians have no fear or dread of death, such as I have heard you say is so prevalent in your world even amongst religious people. With us death, in the ordinary way, is merely like going to sleep; and it is only the portal through which we pass to another life on another planet. Why, then, should we dread it? It is simply a removal to another dwelling-place!"

"I quite agree with that view, Merna," said John; "and our religion teaches us a somewhat similar idea; yet few of its professors look forward with anything but dread to the time when they must pass from their present life."

"Yes, John," said Merna. "What your people really only profess to believe we Martians accept as an actual certainty, for we know it is so; and, as you are aware, sir, I am a living witness of the truth of what I say.

"You know I once lived upon the earth. I died; or, as I prefer to say, I 'passed' from thence, and was born again upon Mars. Some day I must also pass from here; whither I know not, but to another life in some other world; and the Great Father of All will provide for me!

"There are many other planets which are worlds capable of sustaining life at the present time, or which will develop into such worlds. Some of them,

which we can see, are planets belonging to our own solar system, but doubtless there are myriads of planets which revolve round those millions of distant suns which we call fixed stars. If we have made good use of our talents and opportunities for development we shall no doubt pass to a world where that development may be continued on a higher plane. If, however, we have made bad use of them, it is possible that we may have to purge ourselves by a life on a planet where the conditions are the reverse of pleasant; and so on through eternity, each rising to a higher and higher plane according to the manner in which he has worked out his own salvation.

"Amongst those myriads of planets, probably there is not one which is identical in all respects with any other, and there must be an infinity of variety; some excelling to an incalculable extent the conditions of our present world, and others where the conditions are very much worse!"

"Yes, Merna," I replied. "There are some upon our world who hold very similar ideas, notably a great French astronomer named Flammarion; but in his view only those who have developed their intelligence in the proper direction will pass to other worlds and enjoy what he terms the *Uranian* life.

"I may also say," I proceeded, "with reference to your remarks respecting the infinite variety of planetary worlds and of their conditions, that one of our great poets has stated the matter very logically, for he says:

'This truth within thy mind rehearse,
That, in a boundless universe,
Is boundless better, boundless worse.'"

"Sir," said Merna, "that is really very much as a Martian would state the case; and what I have told you is our faith, our hope, and our certainty."

As we passed along on the area outside the grove we noticed that the vegetation bordering the outermost canal did not show a mathematically straight edge as the canal lines do when seen by us through our telescopes. The edges, as a rule, were very irregular: in some places there were large areas of fallow land, and others were very sparsely covered with vegetation.

John remarked that if any of these bare or sparsely-covered places were large enough to be detected by our telescopes, in moments of extremely good seeing, we should no doubt be told that they afforded absolute proof that the canal lines are only disconnected markings, and the canals a myth.

"Very probably," I replied; "yet it should be obvious that vegetation would be sparse, or altogether absent, perhaps, for miles, in many places along the thousands of miles over which the canals extend, and also that it is quite likely, if we could use higher powers so as to get a better view of the lines, the edges would appear irregular. Nature is rarely symmetrical in her work, there is nearly always irregularity of growth; and in artificial cultivation it is neither possible nor desirable to fill up every acre of land simultaneously."

Merna then told us that, owing to extensions of their irrigation system, laterally, and the consequent growth of vegetation, the width of many of the canal lines would be seen to increase.

"Yes," said John, "and when that phenomenon is seen by our observers we shall be informed that such increase in width is still another proof that there are no canals upon Mars."

"Well, John," replied Merna, "it seems to me very strange that your people should so misinterpret the meaning of such indications. Do you really think such a contention would be put forward?"

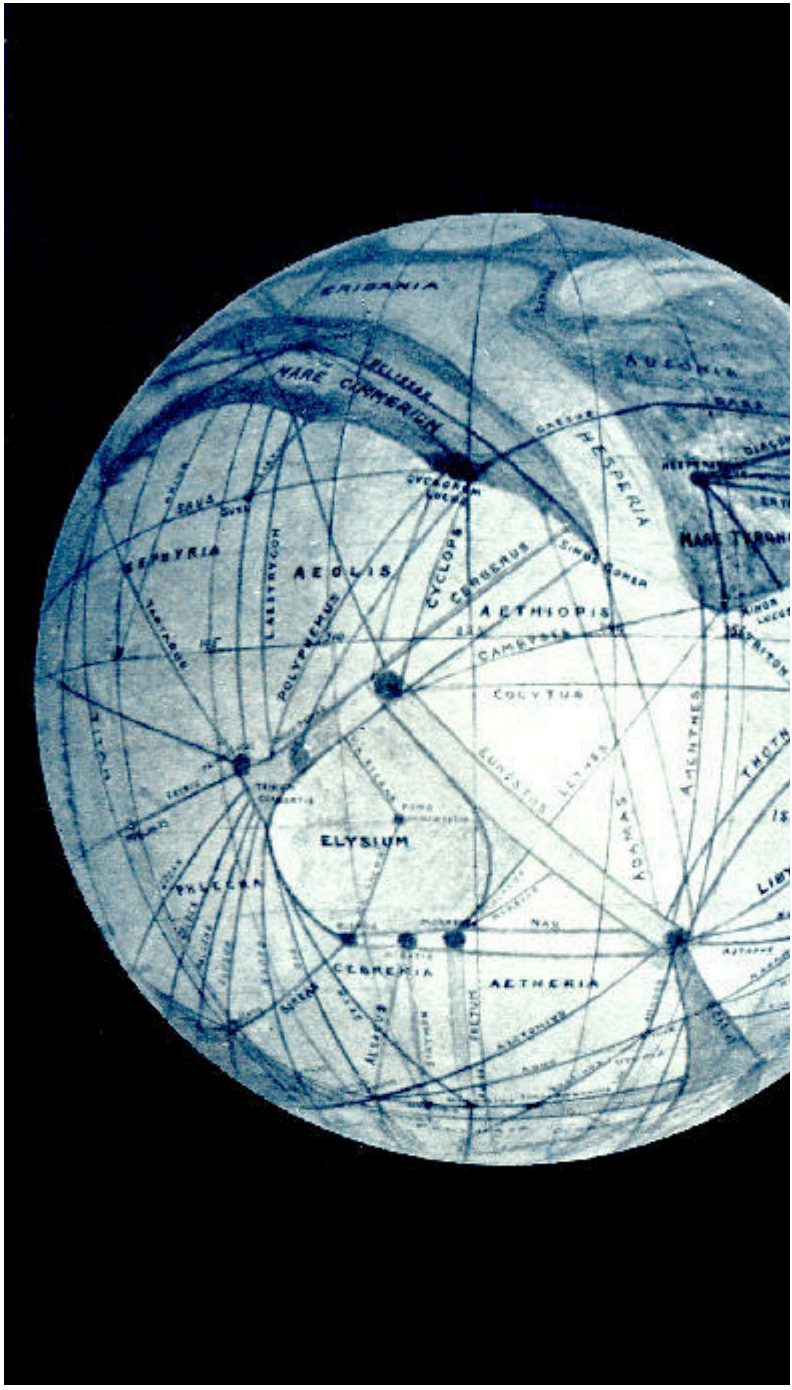
"I'm quite sure of it," said John; "and we should be told that canals could not increase in width! Don't you agree with me, Professor?"

"Yes, John," I answered; "I have seen and heard so many contentions and arguments of a like nature that I cannot say your supposition is not justified.

"I may, however, point out that it is only when the most ideal conditions of seeing exist that we can ever hope to secure a view of the canal lines showing the apparent breaks in their continuity. I have on a previous occasion alluded to the drawbacks connected with the use of very large telescopes, and it may be well to sound a note of warning, for it would be very easy for an observer to be deceived by an illusory appearance of the breaking up of the canal lines into a series of scattered markings. This effect would undoubtedly occur in using a very large telescope in any but ideally favourable atmospheric conditions, for the high powers used with such large

instruments would so exaggerate the most minute atmospheric tremors that any lines on the Martian surface would inevitably appear broken up, and an erroneous deduction might be drawn by the unwary observer. If well seen, the canal vegetation would appear as separate markings in alignment, but no telescope is ever likely to define well enough to show the actual canals, because they are so narrow."

We now returned to our air-ship, and went back to Sirapion; where, after making the necessary changes and preparations, we accompanied Merna to the City Hall, for the purpose of attending the banquet to which we had been invited by Soranho.


ERIDANIA
MARE CIMMERIUM
HESPERIA
HESPERIA
AEOLIS
CYCLOPS
CERBERUS
AETHIOPIS
COLYTUS
ELYSIUM
PHLEGRA
CERBERIA
AETHERIA



From a Globe made by M. Wicks

Plate XI
Mars. Map IV

An intricate network of canals is here seen, especially in the neighbourh "Trivium Charontis."

CHAPTER XVIII

WE ATTEND A MARTIAN BANQUET

On our arrival at the banqueting-hall we were most cordially received by Soranho, as Chief of the Council, who introduced us to a number of persons, several of whom were high officers of state; but, as only two or three of them knew anything of our language, Merna had to act as interpreter. All of them, however, appeared genuinely pleased to meet us.

The hall was a large and very fine one, most chastely decorated in a style which reminded one of the Etruscan. It was beautifully lighted by artificial means, but there were no visible lamps, the light

being diffused over the hall as equally as daylight is diffused.

Many ladies were present, and clearly on entirely equal terms with the sterner sex. They sat down with us at the banquet, and did not remain mere spectators from a distance, as is sometimes the case at our public functions. The dresses of both sexes were very neat, and although there was a more ample and varied display of colour and ornament than is usual in a similar gathering upon our world, especially in the dresses of the males, it was always harmonious and in excellent taste. The costumes reminded me of those in vogue in the south-eastern parts of Europe; the ladies, however, wore rather close-fitting long hose, and no skirts; but their tunics were somewhat longer than those worn by the men, and of thinner material. Many of the dresses looked as though they were woven from semi-transparent shining silver or gold. This style of dress was most becoming to the wearers, setting off their elegant proportions, and at the same time permitting the utmost freedom and grace of movement. Jewellery was clearly only used as a medium for adding to the brilliancy of the general effect, and I saw no one with any lavish or vulgar display of jewels.

Our meal was very similar in character to that of which we had partaken on the previous day, though on a more extended and elaborate scale. This time, however, we partook of the delicious wines which were provided, and found that whilst being most refreshing and exhilarating, they were, as Merna told us, so prepared as to be non-intoxicating. They were

indeed so fine in quality and flavour that, I think, even M'Allister was reconciled to the absence of his own favourite drink.

I occupied a seat of honour next to Soranho, and my two friends were close by. On looking round the hall, and scanning the features of the different individuals present, I was much impressed by the fact that the same regularity, beauty, and symmetry was apparent in all; not one face could be termed "plain," or gave any impression of self-indulgence or sensuality; whilst the soft glowing light in their eyes produced a most indescribable and charming effect upon the whole of their features.

This light is altogether different from the fierce glare seen in the eyes of many of our animals, especially the feline race, which seems to enlarge the eyes to enormous orbs of brilliant light. In the Martians it is simply a colourless, soft, and liquid glow which has a different effect on eyes of different colours; but it is charming in all.

Merna had introduced us to a lady named Eleeta, who sat next to him at the table; and it did not require a Martian intuition to enable me quickly to perceive that the relations in which they regarded each other were something beyond those of ordinary friendship. Their glowing eyes and beaming countenances, and their general animation and exhilaration as they conversed together, told their own tale, for mutual love has much the same indications and attributes everywhere—even upon Mars! But the love-light shining in Martian eyes is something far more entrancing than that seen in the

duller orbs of the inhabitants of our world.

The people of Mars generally have dark hair, dark eyes, and fresh-coloured complexions; the males having no hair upon their faces, beyond a slight moustache. Beards never grow upon their chins, so they have no need to shave, and are spared the work which wastes so much of the time of terrestrials. If we could only count up the time spent in shaving, during fifty years or so, we should find that we have devoted several whole months to that tiresome operation.

Only a few individuals present had light hair and light-coloured eyes, and Eleeta was one of these. She was a most charming and beautiful girl—vivacious, and evidently very intellectual; and I thought that she and Merna would make a most well-matched pair.

The banquet proved an extremely pleasant and sociable function; and, when it was over, the company adjourned to another hall opening out of the banqueting-hall, where they split up into separate groups, and conversation soon became very animated.

On inquiring of Merna, I was informed that music is never performed on such occasions as these, during conversational periods, as it is considered a desecration of a high and noble art.

Merna introduced John and M'Allister to one of the chief engineers of the canal department, who knew a little English, and soon they were discussing with eager interest a collection of pictures and

drawings of the machinery. Seeing that our friends were thus congenially occupied, Merna then took me across to where Eleeta and a girl friend of hers, named Siloni, were sitting.

He told me he had instructed Eleeta in English and she had passed on her knowledge of the language to Siloni; so we were all able to converse together with the occasional aid of Merna's interpretation.

Merna had also acquainted his friends with our usual terms of addressing one another, and it came almost as a surprise to me to be addressed by the Martians as "Mr. Poynders" and "Sir"; for I had become so accustomed to being called "Professor" by my two colleagues that my own name sounded almost strange to me.

We had been chatting together only a short time when John and M'Allister, with their Martian friend, the engineer, came over to us; and soon after that we were joined by Soranho and Merna's tutors, named respectively Corontus and Tellurio, who were followed by a numerous company of Martians of both sexes.

Soranho, addressing me, then said, "Mr. Poynders, I should very much like to know something about terrestrial affairs generally, especially in regard to the methods of government amongst your nations, and the social conditions of the people; and shall therefore be glad if you will be good enough to give me any particulars that may be of interest in connection with these subjects."

He then took a seat, with the tutors on either side of him; and he added that the Martians had not been able to acquire any definite information upon the matters to which he referred, but they knew our people were not so far advanced as the Martians, and he did not therefore expect too much of the terrestrials.

I told him I would endeavour to enlighten him upon these subjects so far as lay in my power; and, as I rose to speak, the general body of the Martians seated themselves a few feet away from us in a large semicircle facing the chief.

I noticed that, against the wall behind the Chief, was a group of beautifully embroidered banners representing the planets, and that those depicting Mars and the Earth were placed in the central positions. These two banners exhibited very graphic representations of the markings on the respective planets.

CHAPTER XIX

THE CHIEF OF THE MARTIAN COUNCIL DISCUSSES THE SOCIAL CONDITIONS OF OUR WORLD AND MARS

IT was a most strange, and, in fact, embarrassing situation for me—an insignificant and very retiring

man in my own country—to be thus called upon to address a large company of the most important inhabitants of another world, and to try to make them understand the social and political systems carried on by the nations on the earth. However, the position had to be faced; so as clearly and concisely as I could I explained to them our various systems of government—our political systems and our social conditions; mentioning in connection with the latter the extremes of wealth and the extremes of poverty which often existed side by side.

I touched upon the rivalries between the various nations, the enormous amounts of money expended in armaments for aggressive and defensive purposes, our hereditary nobility, our land systems, trading, and also the great and difficult problems of poverty, drink, and unemployment with which we had to cope.

Whilst I was speaking, Merna, in a quiet tone of voice, translated to the Martians sitting around us the purport of what I said; and I noticed that often he only had to say a few words and the Martians' sense of intuition enabled them to understand what was in his mind respecting my address and to follow my statements.

Now and then the Chief, or one of the tutors, would put searching and pertinent questions to me on various points, and these often brought out answers which appeared to excite their surprise and interest.

When I had finished, Soranho then took up the

theme, going fully and thoroughly into the several matters I had dealt with; and he concluded by saying, "We must, of course, make every allowance for the present state of development of the terrestrials, but all the same I can scarcely understand how it is they are unable to see that, speaking broadly, their political and social systems are utterly wrong from beginning to end, and must necessarily be disastrous to the welfare of all. Of course, I speak from a Martian point of view.

"Here upon Mars the welfare of the whole community all over our planet is the first and most important consideration. The whole adult population, both male and female, have an equal voice in the discussion of all matters with which the governing Council are concerned. My office, as Chief of the Council, is held for a term of two Martian years; and I am not a ruler imposing my own will upon the people, but their trusted servant, appointed to supervise the carrying into effect of the people's wishes, as expressed by their votes and by their own appointed spokesmen.

"The whole of the land upon Mars belongs to the State, and is utilised strictly in the interests of the whole community; no one can hold it as a private possession, or use it for merely selfish purposes. A necessary corollary to the private ownership of land is the overcrowding of buildings upon small areas; and such general poverty and insanitary conditions as those in which so many of your population have to live in what you have termed your 'slums' are the inevitable outcome of such a system. Private

ownership of large areas of land really involves also the practical ownership of the people upon it!

"I can assure you, Mr. Poynders, that no such overcrowding, poverty, or insanitary conditions will be found upon our planet, go where you will. Our people are well and comfortably housed, and you will find ample air-space and light around every dwelling.

"On Mars no office, rank, or privilege is hereditary. It is true we have amongst us persons of different ranks or grades, but such honours as these can only be gained as the reward of meritorious and useful services, and can only be held by the person who has earned them.

"We have no need of an army or navy, for we are all one united nation; so all the enormous expenditure which is wasted in your world in international rivalry and warfare is entirely avoided here, and schemes for the general welfare of the people benefit instead. Ages ago we abandoned war as a folly and a crime; and our world-wide system of canals, which is a prime essential to our very existence, could never have been accomplished or maintained if one section of our population had been at war, or was likely to be at war, with another.

"Apart from all other considerations then, our vast canal system is a guarantee of unity and of permanent universal peace upon our planet; but, as I have said, we saw the folly of war, and abandoned it ages ago.

"Then, as regards the terrible curse of drink which you have mentioned; if such ever existed on Mars, it must have been in the most dim and distant past, for we have no records of such a dreadful state of affairs as you have described as being even now one of your most difficult problems to deal with. The absence of any excesses of this kind may, perhaps, help to account for the fact that our population is strong and healthy, and few die of anything but old age.

"There is no such thing here as poverty or lack of employment. There is work for all who are able to do it; and those who, by reason of age or infirmity, are unable to work, are all honourably provided for, so that they can live in the same comfort as though they did work. This is not charity or privilege, but the absolute right of all.

"Neither is there any over-working of any individual in our population, for the ordinary working day here is only six hours—about equal to six hours and ten minutes in your world. No one need work longer than this except for his own pleasure; all the remainder of the time can be devoted to rest or recreation. No one need work at all when his powers are failing, as he will be amply provided for."

"But," I asked, "how do you manage with regard to those who will not work? They are our most difficult people to deal with, and constitute a great burden upon the community."

Soranho seemed astounded at this question, and exclaimed, "Is it really possible that such beings can

exist? Here no one able to work would dream of living an idle and useless life; their natural self-respect forbids it!

"I must, as I said, make allowances for your slower rate of development; but I cannot help thinking that for ages past our people must always have been upon a higher plane than terrestrials.

"You have been deploring the decrease in the birth-rate in your country, apparently because it places you, as regards population, in an inferior position to other countries, the inhabitants of which may at some time become your enemies. Yet, at the same time, you have told us that a very large number of your people are living in poverty and misery, that the population is too numerous for work to be found for all, and that many, being unable to find a living in their own country, have gone out, or been sent out, to distant lands.

"What a tragedy this all is! If you had universal peace and reasonable hours of work, as we have, there would be no need for this striving to effect an unnecessary and useless increase in the population; and, by doing so, you are, in fact, only adding to your own poverty and other difficulties. A healthy and hardy population, which can be properly provided for and maintained, is what your country requires. On Mars you will find very few families with more than three children!

"Then, as regards trade. Your international rivalries and systems of what you term 'protection' seem specially designed to hinder trading, and to

make it as difficult as possible, instead of encouraging the free interchange of commodities to the benefit of every one.

"You tell me," he continued, "that it is really the interest and desire of your nations to trade with each other, and that immense sums are spent in building ships and docks, and otherwise in facilitating trade. Yet I learn that tariff barriers are erected between some of the nations, and that tariffs are continually increased, for the purpose of *restricting* trade! As a consequence, goods are either kept out of the countries affected, or artificially increased in price; the poor being half starved, or compelled to live upon inferior food!

"In addition, it appears that the collection of the tariffs involves the upkeep of an army of customs officials, the performance of whose duties is the cause of delay, harassment, and irritation to all who come within the sphere of their powers.

"How much more useful it would be if that expenditure were devoted to the extension of trade and the uplifting of the people!

"Really, Mr. Poynders, when I think of all these things, I can only say you must not expect the Martians to admit your claim that terrestrials are 'highly' civilised; for surely no 'highly' civilised people could act so illogically and so unwisely, or be so wantonly cruel as to tax the food of the poor!

"Such a policy must inevitably result in misery to the many, and reduce the stamina of the present and future generations.

"Your people have attained a high degree of civilisation in some things, but not in others; and as they become more advanced, they will look back on their past policy with feelings of amazement, and will, I am sure, regard it in exactly the same light as the Martians do now. I can only express the hope that their enlightenment will soon come."

It is useful sometimes to be enabled to see ourselves as others see us, and I was now learning how the Martians regarded us.

In defence of my own world and country, however, I pointed out that many of our thinkers and workers saw these matters in much the same light as he did, and were endeavouring to educate their fellows in the same views. Many were opposed to wars, and to the social conditions now prevailing; but it would be vain to look for any great change in the near future. An alteration in human nature must first be effected, and that must necessarily be a matter of very slow growth.

I went on to inform him that one of our great poets had written a splendid "vision of the world and all the wonder that would be," in which he described our world as progressing:

> "Till the war drum throbbed no longer,
> and the battle flags were furl'd
> In the Parliament of Man; the federation
> of the world."

"Mars," I remarked, "had already reached this ideal state of affairs; but it could not possibly be

brought about in our world until a far distant future: for it must be the result of slow development and gradual education of the people to see its necessity and practicability.

"Any attempt to make a sudden change would only result in tumult and worse disasters than we were exposed to at present. Any changes in regard to our land system must also be carried out by degrees, and after the most careful consideration, with the view of preventing any injustice being done to the present holders.

"Our poet," I further said, "evidently had in mind the probability that, before this consummation of universal peace could be reached, wars of a more terrible nature than we have ever known would take place, for he pictures:

> 'A rain of ghastly dew
> From the nations' airy navies grappling in the central blue.'

"It is not unlikely that the possibility, or the actual occurrence, of such horrors as these may eventually bring about the cessation of war between the more civilised nations; and, as the uncivilised are gradually brought under control, there may be federations—not necessarily amalgamations—of two or more nations. In the slow process of time these may unite in larger and more comprehensive federations, until at last the whole world will be embraced within them. This, of course, is looking ages ahead of our present times.

"Few thinking people amongst us can regard war

as anything but a direful necessity arising out of our present conditions; only the thoughtless and those who batten upon such disasters can rejoice in the idea of what I have heard termed 'a jolly good war!'

"Whatever our ideals may be, we must, as sensible people, act in accordance with the demands of existing circumstances. It has been well said that while we have a large criminal population we must protect our persons and property by means of bolts and bars, and the maintenance of a police force; and in a like manner, whilst we are exposed to risk of war breaking out—perhaps through no fault of our own—we must maintain sufficient forces and armaments to cope with any forces which might be likely to be arrayed against us. This, however, does not afford us any excuse for not trying to do all we can to remove the causes which tend to manufacture criminals, or to bring about wars.

"If only as much energy and effort were used with the object of averting wars by smoothing away difficulties and removing causes of friction between the nations as there is effort and persistency on the other side to aggravate, and even invent, conditions likely to cause mutual irritation, distrust, and dislike, much good would accrue. Nations depend largely for their prosperity upon their trade with other nations, and peace is the greatest interest to all; yet the actions of some noisy and hysterical sections amongst them are a constant source of danger, and are calculated to bring about wars which must inevitably prove most disastrous to all concerned.

"Our religion," I told him, "inculcated peace and

goodwill to all men; all of us professed to believe in that. It is a good sign that there is a strong tendency amongst the religious teachers of various bodies to unite in the endeavour to promote peace amongst the nations, and many of them have done much to call attention to the urgent need of social reforms, and have sacrificed their lives in arduous work for the benefit of their fellows.

"On the other hand, some of them are very militant, whilst others seem to regard it as their special mission to keep social matters as they are. If this is the case amongst the teachers, it is no wonder that the people themselves are so slow in progressing!"

The Chief here expressed the hope that I was unduly pessimistic in regard to our rate of progress, and remarked that "He thought a great advance would be made much earlier than I seemed to anticipate. Events," he added, "were evidently likely to move very rapidly indeed in several parts of our world; and he was certain that a great upward movement would soon follow."

I replied that "I sincerely hoped that such was the case, and that the great experience of the Martians with regard to the progress of ideas certainly enabled him to express a truer and more prophetic opinion than I could possibly venture upon. At the same time I knew how difficult it was to bring about changes of ideas and systems amongst large masses of the people; but notwithstanding all these things, I was of the same opinion as a great poetical countryman of my friend M'Allister's, who long ago wrote:

'It's coming yet, for a' that,
That man to man, the whole world o'er,
Shall brothers be, and a' that.'"

Eleeta showed her interest in her own sex by asking what part our women took in the endeavour to improve our social and political conditions; and seemed very surprised when I said they had no voice in the election of members of our Imperial Parliament, although many of them took an active part in any work for the amelioration of our social conditions.

I then gave a short account of the women's suffrage movement, and was speaking of certain unwise actions of the militant party, when she suddenly interrupted me by throwing up her hands and exclaiming—

"Oh, Mr. Poynders, do not say any more upon that point! I wish to think well of your women and to make all allowances for them, but no Martian women could possibly behave in the manner you have described; their innate self-respect is too great to allow such conduct.

"We should all feel degraded in the eyes of our husbands, brothers, and sisters, if any such things occurred here; but they are quite impossible!

"Your women are entitled to a full share of the responsibilities connected with the election of members of your state councils, just the same as we have; but surely there are other and proper means of obtaining their rights and privileges without resorting to such childish and unwomanly tactics as

chaining themselves up, pestering high officers of state, and forcing their way into your council chambers."

I assured her that the majority of our women, both rich and poor, took exactly the same view as she did on this matter, and were utterly opposed to the methods adopted by the few, even where they themselves were in favour of the franchise. Many, however, were so distressed by the conduct of militant women that they opposed the franchise altogether. The pity of it all was that the militant suffragettes seemed to glory in shocking their sisters' susceptibilities.

Eleeta then said that "For the sake of her sex she was glad to learn that such behaviour did not meet with general approval; still, she hoped that before long our women would be enabled to take up their proper position in connection with the election of our state councils."

After a little more desultory conversation, the Chief thanked me for what he was pleased to term "the interesting statement with which I had favoured them."

The meeting then broke up, but I observed that John, who had been sitting with Siloni all the time, seemed to find himself in very congenial company, which he was not at all anxious to quit.

On our way home Merna took me fully into his confidence and told me of his hopes respecting Eleeta, at the same time giving me many particulars

concerning the beautiful young lady upon whom he had bestowed his affections.

CHAPTER XX

THE SECRET OF THE "CARETS"—THE SUN AS SEEN FROM MARS

THE next day, accompanied by Merna and Tellurio, we started off at an early hour on an air-ship trip to the northern edge of the Sinus Titanum.

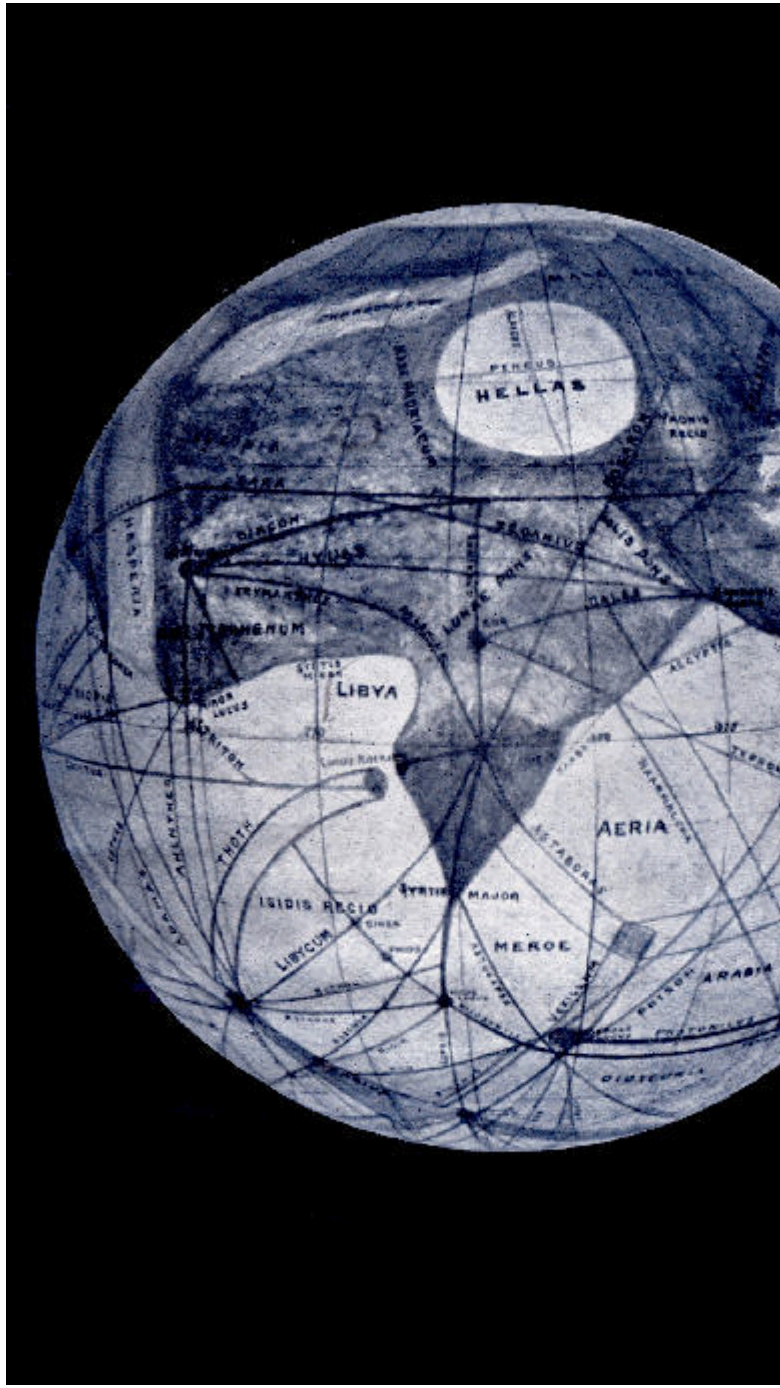
This is really the bed of an ancient sea, from which all water has long since disappeared. Nearly all the blue-green patches which are seen on the planet by our observers are also old sea-beds, and they are now the most fertile areas upon its surface.

The object of our visit was to inspect the machinery and apparatus by which the water is lifted and forced along the canals; and remembering what Merna had told him, M'Allister was looking forward to seeing them with eager anticipation.

Professor Lowell has arrived at the conclusion that, owing to the shape of the planet and other conditions, gravitation upon Mars is in a state of stable equilibrium, and that consequently water would not flow by gravitation, as it does upon our earth, but merely spread out as it would on a level floor. If turned into a canal it would not flow along

without artificial propulsion, except so far as it might be carried by its own "head."

We found, on inquiry, that this conclusion is very nearly correct, but there is just a small amount of gravitation which is sufficient to produce an extremely slow movement of the water in the canals.


HELLAS
LIBYA
AERIA
MERÖE
ARABIA
MARE ACIDALIUM
SYRTIS MAJOR
LIBYCUM
THOTH
ATLANTIS
HESPERIA



From a Globe made by M. Wicks

Plate XII
Mars. Map V.

The dark wedge-shaped area near the centre is "Syrtis Major." It was on
Lowell discovered several new canals on 30th September, 1909.

I have already mentioned the discovery of the "carets" which exist in certain places on the planet. They are seen as small **V**-shaped markings which are dark in tint; and perhaps might better be described as resembling our Government's "broad-arrow," the central line representing the end of a single canal which enters the caret centrally.

Professor Lowell is of opinion that these carets must fulfil some important purpose, as they only appear where some of the canals connect with the dark areas of the old sea-beds. He is quite right in this conclusion, for they are very important indeed in connection with the working of the canal system.

They are, in fact, all situated on or adjoining the slopes of the sea-beds, and the dark sides of the **V** are really two high embankments covered with dense vegetation, and thus are sufficiently conspicuous to be seen through our telescopes. The whole encloses an area on each side of the canals within which large

and important engineering works are situated.

The canals which run along the bottom of the sea-beds are, of course, at a much lower level than the adjoining red area, and the canals on the latter area are therefore at a higher level. Those canals which cross the sea-beds cannot be carried by means of viaducts or embankments so as to place them upon the same level as the canals on the red areas, because that would defeat the purpose of irrigation, which is their chief use. It is therefore necessary to lift the water from the low-level canals and discharge it into those upon the higher ground.

This is accomplished by means of apparatus somewhat resembling an American "grain-elevator," on a large scale; and it consists of a long series of very large buckets, **V**-shaped in cross-section, attached to endless chain-bands, which, as they are carried round by the machinery, scoop up the water from the low-level canals and carry it up to the requisite height, from whence it is automatically discharged into the high-level canals. Of course it will be understood that the ends of the latter canals are entirely closed by embankments so that no water can pass that way.

The buckets are an enormous size, and the electric machinery by which they are kept in motion is of the most ingenious description.

Besides this there is an immense amount of equally ingenious electrical machinery for forcing the water along the canals.

Merna and Tellurio showed us all over the area, and carefully explained the construction and working of the various machines. I do not think M'Allister ever spent a more enjoyable time in his life, for he went about amongst the different machines examining them with the keenest interest and manifestations of delight; and his note-book was in constant requisition for making sketches and notes of what he saw.

We noticed that he was frequently smiling and chuckling to himself as if he were intensely pleased; and presently he came over to us, rubbing his hands together in high glee, and said to John, "Heh, mon, I reckon I see my way to making a fortune when we return home, out of the ideas and wrinkles I'm getting here from the work of the Martian engineers!"

John laughed, and congratulated him heartily on his brilliant outlook for the future, remarking that he did not appear to regret coming to Mars.

"Indeed, I don't," M'Allister replied; "I'm thinking it will prove the very best thing I've done in my life."

"Well, sir," said Merna, "I told you those machines would suit you as an engineer; are you satisfied now you have seen them?"

"More than satisfied," answered M'Allister; "they are the most extraordinary and most ingenious machines I ever saw, and I wouldn't have missed them for anything!"

At the sides of each high-level canal we saw a

series of locks and weirs so constructed that vessels can pass on, in successive stages, from the high-level to the low-level canals, and *vice versâ*.

These locks and weirs are all within the area enclosed by the embankments forming the carets, which accounts for the long and extensive space the latter cover, as the locks are necessarily a considerable distance apart from each other to allow for a length of canal to be traversed before the next lock is reached. They are, however, not in themselves sufficiently conspicuous to be separately discerned from the earth by our telescopic observers.

Machinery for forcing the water along the canals is also provided at most of the junctions everywhere on the planet. In this connection it must be remembered that the water is carried by the canals from one hemisphere to the other, and, after passing the equator, must therefore move in a direction contrary to that of ordinary gravitation.

Thus at one season of the year the water passes from the north polar regions down into the southern hemisphere, and at the opposite period of the year it is carried in the same way from the south polar regions right into the northern hemisphere.

Gravitation being almost non-effective as regards the flow of water on Mars, the movement would be extremely slow everywhere were it not for the machinery, which adds to the speed of the flow. The average rate of the movement of the water in the canals is about fifty-one miles a day, and it takes about fifty-two days for the water to pass from about

latitude 72° down to the equator, a distance of 2650 miles.

This rate of flow, as indicated by the darkening arising from the growth of vegetation which follows the flow of the water down the canals, has been observed and noted many times at Flagstaff Observatory.

It was now perfectly clear to us why the "carets" are only seen in the particular places in which they have been observed by Professor Lowell and his colleagues. They are, in fact, only needed in connection with water-lifting apparatus, and locks and weirs, at the places where high-level canals connect with those at a lower level!

We were all very pleased at finding the solution of a problem which had been much discussed between us without arriving at any satisfactory conclusion.

John then asked Tellurio if he would be good enough to explain to us how it was that our observers on the earth saw some of the Martian canals doubled at some periods of the year and single at other times; and sometimes one of the twin canals was seen alone, and at other times the second one only was visible.

"It is a very simple matter, sir," replied Tellurio. "You will understand that we do not wish to waste any of our water, and as it is quite unnecessary to use all our canals at the same time, we only use those which are actually required. This arrangement also allows us to have a much greater depth of water in the canals than would be the case if they were all

in use at once.

"Many of the canals are only required for irrigating seasonal crops; so as soon as the requisite amount of moisture has been acquired by the soil the water is turned from that canal into another one, passing through an area where a later seasonal crop is to be grown. This arrangement, moreover, applies not only to our double canals, but also to very many of the series which you have regarded as single canals."

Thus the mysteries connected with Mars were being cleared up one after the other; and having regard to the very simple and natural explanations we received, we could not help laughing as we talked the matter over and recalled the immense amount of discussion and wrangling which had occurred amongst our scientific men in connection with these matters, and especially at the difficulty they seemed to experience in believing that the canals could exist at all. Then there were those charges and theories of overstrained eyes, diplopia, and defective focussing, to say nothing of other suggestions. Well, I will not say any more upon this point.

In continuation of our discussion of the canal question, I asked Tellurio "Whether the canals and irrigation system had been the means of reclaiming any large areas of land which had previously been deserts?"

"Oh yes, sir," he answered, "that has been the case in many parts of our world; some very large areas indeed which were once deserts have now become

very fertile. Quite apart from such reclamations, however, our canals and irrigation systems have also effectually checked the spread of desertism. If it had remained unchecked, probably by this time the entire surface of our planet would have become a desert."

I then explained that I asked the question because our observers had seen and noted upon their charts several large areas which seemed to have become fertile. Thus, along the eastern side of Thaumasia it had been noted that, during a period of about twenty-three years, the green area had advanced at least 400 miles nearer to the place we called the "Solar Lake." On measuring this area on the map it appeared to me that at least 200,000 square miles which had previously been desert had become fertile.

Similar extensions of vegetation had also been charted in several other places, for instance, on the east side of the large area known to us as "Syrtis Major." I had, however, been rather surprised not to have come across any comment by our scientists on the significance of this very large increase of fertile land, as, taken in connection with the great canal system, it seemed to me very significant and full of meaning.

Merna, continuing his remarks, then said that "Lately considerable extensions of their canal system had been carried out. New canals had been dug, others altered or extended, and vast areas had been considerably changed by replanting in some places and fallowing in others. The result of all this work," he said, "would produce a striking alteration in the

configuration of some of the dark areas. Such changes," he remarked, "were carried out very rapidly, so rapidly indeed that it would probably be almost incredible to terrestrials; but it must be remembered that excavation, loading and removal of soil, as well as most other operations, were accomplished by special machinery. He had no doubt these changes would be noted by our observers, as Mars was so favourably situated in regard to the earth at the present time. Besides this," he continued, "many of our canals have been dealt with, and some of them will disappear, either temporarily or permanently."

"Well, Merna," said John, "if that is the case our observers will soon miss them; and I can imagine some of them gazing on your planet through their telescopes and exclaiming, 'Lo! here is the symbol of the death of Mars. Where we used to see canals there is now only blank space; the canals are disappearing, and the Martians must be rapidly decreasing in numbers and no longer able to maintain their vast canal system; or perhaps their water supply is diminishing so rapidly that it is becoming insufficient to keep the canals in working order; so ere long all life upon Mars must come to an end!'"

"If that should be so," said Merna, "they will be altogether wrong in their surmises, for the disappearance of several of our canals will not indicate death but life. Some of those canals will only be temporarily put out of use, but others, having served their purpose, will be discontinued permanently. They are like our flowers that have

done blooming, which may be allowed to grow again next season, or the ground may be fallowed and fresh flowers planted elsewhere; so the vanished canals may be succeeded by fresh ones where they are needed; and when your people see these new canals they will *know* that they indicate the continued existence of vigorous and enterprising life upon Mars."

We then started upon our return home, and on the way I drew M'Allister's attention to the smaller size of the sun as we saw it now as compared with the size it appeared to us when on the earth. I told him that Mars was then about 131,000,000 miles from the sun, so the sun's apparent diameter was only about $22^1/_4$ minutes.

On the earth that day the sun's apparent diameter would be about 32 minutes. So to the Martians the sun only appeared about two-thirds the size it appeared to the people on the earth.

When, on 13th August this year, Mars was at its "perihelion," or nearest point to the sun, the latter was 129,500,000 miles distant, and would appear rather more than $22^1/_2$ minutes in diameter.

At the opposite point of its orbit, where it will be in "aphelion," or farthest from the sun, the sun will only appear about 19 minutes in diameter.

I then explained that, although the sun is so distant, Mars receives a very much larger percentage of the total heat and light available than we do on the earth, because of the thinness and generally cloudless condition of the atmosphere. It is estimated

that our atmosphere and clouds shut out nearly 50 per cent. of the light and heat which would otherwise reach us in the course of the year. On the other hand, their "blanketing" effect considerably lessens the amount of heat radiated into space; thus, by keeping in the heat we have received, compensating to some extent for the original loss in quantity.

But, owing to its thin clear atmosphere, Mars receives nearly 99 per cent. of the total amount of heat and light proceeding to it from the sun; so that, although the sun is more distant from the planet, the warmth on Mars does not compare so unfavourably with the warmth on the earth as many have imagined it to do.

M'Allister replied that "He had expected to find it very cold indeed upon Mars in consequence of its distance from the sun, but was surprised to find it so warm," and added, "what you have now told me, Professor, explains why this is so, and I can only say that at present I find the climate a delightful one—pleasantly warm, yet bracing and invigorating. Even in the tropical regions, although it is hot, it is not the oppressive and enervating heat that I have experienced in the tropics on our own world."

He then remarked that "He knew the planets all moved through space and had read that some of the stars did too, and he would like to know whether our sun had any motion in space?"

"Yes," I replied; "as the result of a long series of observations and calculations it has been determined

that the sun is moving through space and carrying with it all the planets in our system. Its rate of movement is not known with certainty, but it is estimated at about 1,000,000 miles a day. Whether it is moving in a straight line or in a vast orbit around some far distant sun is also an open question, and it may take centuries to arrive at a definite result. This motion of our sun, rapid though it is, is very slow compared with the motion of some of the stars. One that appears only a small star to us, but which is probably a sun enormously larger than ours, is moving through space at a rate which cannot be less than 200 miles a second; and unless that movement is direct across our line of sight its rate must be still more rapid. Yet it is so enormously distant that, in 500 years, it would only appear to have moved over a space of one degree on the sky! It is calculated that Arcturus moves still more rapidly.

"The movements of several other stars have been calculated; but the distance of the stars is so enormously great that the majority appear to have no movement at all, though probably not one of the heavenly bodies is at rest.

"It is estimated that the light of the nearest star we know of takes at least four years to reach the earth, yet light travels at the rate of 186,000 miles a second. We know of others whose light takes centuries to reach us, and, with regard to most of the stars, the light we see probably left them thousands of years ago.

"It is only when a star is so near to us that the earth's revolution in its orbit is sufficient to cause a

change in the apparent position of the star which can be measured with our instruments that any calculation can be made to determine its distance from us. In nearly all cases where the distance has been calculated, the change in position is so minute and difficult to measure accurately, that the results obtained can only be regarded as very rough approximations to the real distances.

"The universe is infinite in extent, and the human mind is quite unable to conceive what is really implied in the distances of the planets belonging to our own solar system; yet they are as nothing when compared with the distances of the fixed stars, either from the earth or from each other. We equally fail to realise the immense numbers of the stars. The camera, it is estimated, shows at least one hundred millions in the heavens; and our great telescopes can penetrate through inconceivable distances of space and render visible millions which the smaller instruments fail to reveal. Every increase of instrumental power, however, carries us still farther, and reveals more and more stars in deeper depths of the illimitable abysses of space.

"In these matters there is no finality, for though with telescopic aid:

> 'World after world, sun after sun, star after star are past,
> Yet systems round in myriads rise more glorious than the last:
> The wondrous universe of God still limitless is found,
> For endless are its distances, and none its

depths can sound!'"

CHAPTER XXI

OUR FIRST VIEW OF THE EARTH FROM MARS —A MARTIAN COURTSHIP

WITHIN a few days we had our first glimpse of the earth from Mars. It appeared only as a very thin but bright crescent of light, as the lighted portion was less than one-twelfth part of the whole diameter of the disc, and it was only visible for a very short time.

Owing to the clear and thin atmosphere of Mars there is very little scintillation of the stars, and the crescent form of the earth at such periods as the present can plainly be discerned without the aid of a glass. To the Martians this is more readily seen than by us, as their eyes, being larger than ours, have a much greater light grasp.

For the same reason all the stars shine much brighter than they do in our skies, and many of the smaller ones which can be seen from Mars with the unaided eye, would here require a low power-glass to render them visible to us. The fact that Saturn has a ring is quite apparent to the Martian eye.

Day by day after this we saw the lighted area extending upon the earth, just the same as on the earth Venus can be seen with a telescope gradually

to pass from the crescent phase to the gibbous form, and ultimately become full. Our earth is a morning and evening star to Mars the same as Venus is to the earth, according to its position with regard to the sun.

Whilst we were looking at the earth, I asked Merna "Whether he had ever seen the earth transit the sun as we occasionally see Venus or Mercury do so?"

He answered that "He carefully observed the last transit, which occurred on a date equivalent to our 8th May 1905, and was very interested in watching the earth pass, as a small black spot, across the sun's disc. The moon did not commence to cross until 6 hours and 7 minutes later, by which time the earth had passed over three-quarters of the sun's diameter. The earth was 8 hours and 42 minutes in transit, and the moon, which crossed a little lower down, was 8 hours and 31 minutes in crossing."

"That must have been an interesting sight," said John, "and I should like to have the opportunity of watching a similar transit."

"I am afraid you never will," said Merna, "for the transits only occur at long intervals. The previous transits occurred in November 1879, November 1800, May 1700, and May 1621. There will not be another until May 1984, and the next after that will not occur until November 2084."

"I am sorry to hear that," remarked John, "for even if I stayed here, I should not be likely to live long

enough to see the next transit. Possibly you may do so, Merna; you are so much younger than I am."

"Yes," Merna replied, "it is not unlikely that I may see another such transit, for the average length of our lives on Mars is about equal to one hundred and thirty of your years, so that leaves me an ample margin of time."

I then went on to remark that as another result of the thinness of the Martian atmosphere twilight is much shorter than on the earth, the light being less diffused when the sun is below the horizon, and refraction also considerably less than we experience.

In this connection, I mentioned to M'Allister that we can often see the sun and the moon apparently above the earth's horizon when they are, in fact, below it. This is caused by the refractive power of our dense atmosphere, which has the effect of making both the sun and the moon appear a little higher up than they really are.

"That is something new to me, Professor," exclaimed M'Allister; "and I cannot say I quite understand how refraction, as you term it, has the effect you mention."

"It may help you, then," I answered, "if I tell you that water acts very much in the same way; and there is a simple and fairly well-known experiment you might try for yourself, which would make the matter perfectly clear to you. It is as follows:—

"Take a teacup and place a shilling at the bottom of it, then move back until you quite lose sight of the

coin. Ask some one to pour some clean cold water gently into the cup, and, as it fills, the refraction of the water will apparently reduce the depth of the cup, and thus bring the coin fully into view. In much the same way the refraction of the atmosphere enables us to see the sun or the moon when those bodies are actually below the horizon."

"Thank you, Professor," said M'Allister; "I will try that little experiment at the first opportunity."

I then told him that at the time when the moon is just full it may rise towards the east just as the sun sets towards the west. Both orbs cannot be wholly above the horizon at the same time on such occasions, but, owing to refraction, we are able to see them both.

The sun and moon both appear flattened or oval-shaped just as they are rising or setting, in consequence of the effects of atmospheric refraction. These effects are usually most noticeable near the horizon, because the object is seen through the densest layers of air. But we never see a star in its true place in the sky, because the rays of light which come to us from the star are bent or refracted as they pass through our atmosphere, just as a stick appears to be bent when thrust down into a deep pool of clear water.

All these effects, however, add to the work of astronomers, because they must be taken into account in connection with their calculations.

As the time passed on, I day by day became more interested in Merna's relations with Eleeta.

"All the world loves a lover," and we elderly people are always pleased to note the progress of young folks' love affairs, especially if either of them is a relative of ours. In them we seem to renew our youth, for their entrancements seem to carry us back to the halcyon days when we ourselves were young. When "Love took up the glass of time and turned it in his glowing hands" everything seemed of a roseate hue, and we dwelt in the seventh heaven of delight, at peace with all the world and envying no one—for were we not the most happy and fortunate of mortals!

And then, to look upon a Martian courtship! To see the rich flushes mount to the cheeks of the lovers —their softly glowing luminous eyes, their absorbed attention in each other, and their mutual deference and response to the most slightly indicated wish! Ah, it was indeed a scene to gladden the heart of the father of one of them!

Eleeta's beauty, the sweetness of her disposition, and most charming and lovable ways endeared her so to me that I did not wonder Merna found them so attractive and satisfying; and my most fervent aspirations ascended for their happiness, both now and in the future.

With the Martians there is no false modesty about their courtships; all is natural, proper, and dignified; every one may see and every one enters into the true spirit of the thing. Mere flirtations, such as we are so

familiar with, are quite unknown, as they would be contrary to all the natural instincts of the people. Everything upon Mars is honest, true, and straightforward—open and above-board. This must necessarily be so, in consequence of the Martians' powers of intuition, for any attempt at imposition or deceit would at once be detected.

I had an illustration of this when I asked Merna, "How they dealt with their criminals?"

"We have none to deal with," he replied, "and you will understand why, when I tell you, that if any one committed a crime, however small, and it was desired to find out the offender, it would be impossible to escape detection. He might fly to the other side of our world, but the intuitions of our experts would at once make them aware of his hiding-place; besides, he could not conceal what was on his mind from any one with whom he associated.

"In the earlier times when only a small proportion of the Martians were endowed with these powers to any large extent, there were occasional crimes; but as they were always detected, crime soon ceased to exist.

"Thus you will see that, quite apart from their high standard of morality, the Martians soon found that crime was a folly."

There was another love affair apparently developing which did not afford me so much

satisfaction as that to which I have just alluded.

I noticed that John and Siloni were very frequently together; and, whatever might be the case with the latter, I had very little doubt that John was smitten with his companion's charms. It was, perhaps, nothing to be wondered at, for Siloni was indeed a very nice girl, with beautiful features, dark hair, and dark eyes; whilst John was well-built, fully six feet in height, with black hair and moustache, and very good-looking; altogether a fine and attractive man, and it had often been a matter of surprise to me that he had never married.

Still, such a complication as this had never entered my mind when I came to Mars, and I was rather perplexed to know how best to deal with the situation. However, I thought it would be well to wait a little while and see how the matter shaped itself before taking any action.

CHAPTER XXII

CELESTIAL PHENOMENA SEEN FROM MARS—M'ALLISTER RECEIVES A PRACTICAL LESSON IN GRAVITATION

MARS is really an ideal world for an astronomer to live in, its skies being so clear, the air so thin and pure, and the stars shining so brilliantly.

Besides these advantages, the rapid movements of the two satellites of the planet result in a constant succession of celestial phenomena which afford very frequent opportunities for most interesting observations. Changes in the phases of the two moons, eclipses, occultations, transits, &c., are constantly occurring, so there is nearly always something to attract our attention to the Martian sky.

We have already seen several of these phenomena, and I will now describe what we have observed.

Early one evening when we were out with Merna, we looked up at the sky and saw the two moons a considerable distance apart, but approaching each other from opposite directions, Phobos appearing to move very rapidly. Both were near the full phase, Deimos being more nearly full than Phobos; and we watched them drawing closer and closer together till Phobos passed right in front of Deimos so as to hide it entirely. This is termed an occultation; and both the satellites had become full when the occultation occurred; but when they were again clear of each other both were beginning to wane.

This sight may be seen anywhere near the Martian equator about every ten hours.

The movements of Phobos seemed very peculiar to us who had lived upon the earth and seen all the celestial bodies appearing to move in the same direction.

I have already alluded to the fact that Phobos is only 3700 miles above the surface of Mars, and moves so rapidly that it makes more than three

complete revolutions round the planet whilst the latter is turning only once on its axis.

The effect of this very rapid revolution of the satellite, which has no counterpart, so far as we know, in our Solar system is that, instead of rising in the east and setting in the west as all the other heavenly bodies appear to do, Phobos appears to rise in the west, cross the sky, and set in the east.

The moon and planets all actually move from west to east; the apparent reverse of this being caused by the more rapid movement of the earth on its axis, giving the other bodies the appearance of moving from east to west. If, however, our moon is closely watched, and its position with regard to a fixed star carefully noted, it will be found that in the course of a short time its real movement has been eastward, and that its position with regard to the fixed star has changed, although the revolution of the earth has appeared to carry both westward.

Phobos is 36 miles in diameter. Its actual period of revolution round the planet is 7 hours and 39 minutes, but, owing to the movement of Mars on its axis in the same direction, it appears to take a few minutes over 11 hours to complete one revolution.

Near the equator, Phobos is seen above the horizon for about $4^1/_4$ hours, and is below it about $6^3/_4$ hours. According as the place from which it is viewed is farther from the equator so will the time of visibility of Phobos be decreased, until when latitude 69° is reached in either hemisphere, it will cease to become visible at all. This is owing to its nearness to

the planet; and, Mars being small, the curve of its sphere is sharp, so that the horizon is more limited than on the earth, and the satellite is shut out from view anywhere above latitude 69° by the body of the planet.

Another peculiarity is that, when in the zenith, Phobos appears twice as large in area as it does when near the horizon, and notwithstanding its very small size, Phobos appears rather larger than our moon, because it is so near to the planet.

The length of the Martian "night" is about 12 hours and 20 minutes, and during this very short time Phobos may be seen to rise in the west, set in the east, and rise again once more in the west. Consequently it will be evident that it must travel very rapidly across the sky. It really moves over a space of $32^1/_2^\circ$ in a single hour—a great contrast to the slow and stately movement of our moon, which only passes over half a degree in an hour.

Moreover, Phobos may be seen to rise as a new moon, pass through its phases to the full, wane, and again become new, all in the course of a single Martian night; or it may be seen twice full and once new during the same time.

Even this does not exhaust the list of phenomena, for, being so close to Mars, Phobos is very frequently eclipsed by the shadow of the planet. On the other hand, the sun may be eclipsed by Phobos something like fourteen hundred times in the course of a Martian year; and, as already mentioned, the other satellite is often occulted by Phobos—sometimes

when both may be only at the half full phase, and these occultations look very peculiar.

Deimos, being only 10 miles in diameter and about 12,500 miles from the surface of the planet, does not give rise to so many phenomena as the nearer satellite: still they are very numerous.

It revolves round the planet in $30^1/_4$ hours, but appears to take $131^1/_2$ hours to do so, being above the horizon about 60 hours, and below it nearly 72 hours. These are the times as seen from the equator; but, as in the case of Phobos, the farther the place is from the equator the shorter is the period that Deimos is seen above the horizon, until, when latitude 82° is reached in either hemisphere, it ceases to become visible at all.

Our moon, being so very much more distant from our earth, could be seen from both the poles.

Deimos also passes nearly twice through all its phases whilst it is above the horizon, viz. during about 60 hours, and may be seen twice full and twice new in that time.

Eclipses of Deimos by the planet and occultations of it by the other satellite are very frequent. Being so small, it can never cause an eclipse of the sun, but it transits the sun as a dark spot about one hundred and twenty times during the Martian year.

This is really a very inadequate list of the phenomena connected with the satellites, but it will be seen that the number is enormous compared with the few eclipses of the sun or moon seen on the earth

during the course of one year. Certainly Mars is an astronomer's world!

Merna heard my statements respecting these movements and phenomena as I explained them to my two friends; and when I had finished, he remarked, "You seem to be fairly well posted in these matters, sir?"

"Yes," I said; "thanks to our astronomers, both professional and amateur, all these things have been very carefully calculated; and, with the exception of a few doubtful points, we probably know nearly as much about them as the Martians themselves do."

M'Allister then turned to me and said, "Professor, you told us that the two satellites of Mars revolved round the planet in a certain time, but in each case you afterwards said they appeared to take a much longer time to do so. I'm rather puzzled to understand how that can be."

"It's really a simple matter, M'Allister," I answered, "and I think I can make it clear to you. While the satellite is making one revolution round the planet the latter is turning on its axis in the same direction as the satellite is moving, following it up in fact; and you will I think understand that in these circumstances the people on that part of the planet where the moon is visible must necessarily keep it in view for a longer period than would be the case if the planet were not revolving in the same direction.

"You have been used to being on board a ship; so suppose your vessel was steaming twelve miles an hour and there was another vessel at anchor just

twelve miles ahead of you, you would reach it in just one hour, would you not?"

"Yes, certainly I should," replied M'Allister.

"Now," I continued, "suppose that the other vessel, instead of being at rest, was moving away from you at the rate of six miles an hour; after you had steamed one hour it would still be six miles ahead of you, and it would take you exactly another hour to catch it up. So you would be just double the time reaching it when moving as compared with the time required to do so when it was at anchor. This is very similar to the cases of the satellites of Mars, and much the same thing happens in regard to Mars and the earth. If they are opposite to each other at a certain point, Mars will have taken much more than one revolution round its orbit before they will be opposite to each other again, because they are both moving in the same direction. Do you see it now?" I asked.

"Yes, Professor," he replied. "I know now, because you have cleared it all up. It's simple enough when one understands it."

Merna then asked me if I would like to see some of their astronomical instruments, and, on my replying that I should very much like to do so, he took us to an observatory where Corontus was at work.

I was at once struck by the small size of the telescopes; and, on inquiring about them, Corontus told me that very large instruments had long become obsolete, for these small ones could be used for all

the purposes for which a large one had been required, and gave better results.

I examined one of them and found, to my surprise, that it embodied the very ideas that I had long been trying to carry into effect. With this view I had made many experiments, as it seemed to me that it ought to be possible to construct an instrument of moderate and convenient dimensions which would show as much as our monsters will show, and yet be capable of being used with low powers when occasion required. I had endeavoured to attain this result by the aid of electricity, but failed to do so. Evidently I had missed something, but here was the thing itself in successful working, as I found upon testing it.

On looking at some drawings of Saturn, which were hanging up in the observatory, I noticed that this planet was depicted with two faint outer rings which do not appear on our drawings of the planet. One of these rings has, however, been discovered by M. Jarry-Desloges, but the outermost ring is still unknown to our observers. This ring is a very broad one, its particles being widely scattered, hence its extreme faintness.

The Martians have also discovered two planets far beyond the orbit of Neptune, and their knowledge of the other planets and also of the sun and the stars is far ahead of ours.

I was also shown a comet which had recently become visible through their telescopes, and found from its position that it was undoubtedly Halley's comet, for which our astronomers were so eagerly

watching. I wondered whether any of them had been fortunate enough to discover it early in August, as the Martian astronomers did. Its last appearance was in the year 1835.

John remarked that "He thought Halley's comet might be termed 'Britain's Comet,' for several of its appearances had coincided with the occurrence of very important events and turning-points in our national history, such as the Battle of Hastings, the Reformation, &c.," and he added, "as it will be a conspicuous object in our skies in 1910, I wonder whether any important event will occur in our country? In 1835, when it last appeared, we had a political crisis!"

"Well, John," I replied, "I do not attach much importance to comets as affecting mundane affairs; we have got rather beyond such beliefs as that. Besides, when we left England early in August things were going on all right in our political world, and there was no indication of any serious crisis."

"Still," said John, "it would be rather curious if we did have a crisis next year; and I should not be surprised!"

As we were walking home next day, M'Allister suddenly tripped over some little projection and fell prone to the ground. John ran to his assistance and raised him up, at the same time asking "If he were hurt?"

"No, not at all," said M'Allister; "I seemed to fall so lightly that I scarcely felt it when I touched the ground."

"Ah, M'Allister!" I exclaimed, "if you had fallen like that upon our earth, I think you would not have come off quite scatheless. You see, upon Mars the gravitation is much less than on the earth, being only three-eighths of what it is there, so one does not fall so swiftly, nor so heavily, as on the earth.

"You can prove that very easily. Just take up a stone and hold it out higher than your head, and let it fall; at the same time note, by the second hand of your watch, how long it takes for the stone to reach the ground."

He did so, and said that "As near as he could tell, the stone was just about one second of time in passing from his hand to the ground."

"Just so," I replied. "On Mars a falling body only moves through a space of about six feet in the first second of time. On the earth, however, the gravitation is so much greater that a falling body passes through a space of a little over sixteen feet during the first second.

"In addition to that, although you weighed twelve stones when on the earth, you only weigh about four and a half stones here upon Mars. Now you can understand why it was you seemed to fall so lightly."

"Yes, Professor," he replied, "and I'm glad I fell here, and not upon the earth!"

Then, picking up the stone again and throwing it high in the air, he watched its fall, and turning to me, remarked, "Professor, you were quite right; that stone seemed to be quite a long time coming down

again, much longer than it would have been on our own world."

"Well, M'Allister," I replied, "now you know for certain that upon a small planet gravitation really is much less than upon a larger planet of the same kind.

"That's another little wrinkle for you, and you have found it all out through tripping over a stone!"

"Losh, mon," replied he, "I seem to have learnt something almost every day since I have been here; even a tumble down teaches me something!"

I then drew his attention to the birds flying near us, and pointed out that they had a much wider spread of wing than our birds have, and that this was owing to the fact that the air being so thin a wide spread of wing was absolutely necessary to support them in the air and enable them to fly. I further explained that, if the gravitation upon Mars were as great as upon the earth, the birds' wings must necessarily have been still larger, as the pull of the planet would have been so much the greater, and would thus have prevented the birds from flying at all in such thin air if their wings had been small.

"M'Allister," I then remarked, "you will, no doubt, have noticed the same thing with regard to those large and beautiful butterflies we have seen. Why, the outspread wings of the largest must have measured ten or twelve inches across, and many of the smaller varieties were more than six inches across. I wonder what our naturalists would say if they could see some specimens of these large and

splendidly coloured insects!"

"Well, Professor," he answered, "I never saw such large butterflies anywhere else, not even when I was in the tropics on our own world. It had never occurred to me that gravitation, or even the density of the air, had anything to do with their size. Even now I do not understand how it is the small insects are able to fly, for they are heavy for their size, and do not possess very large wings, yet they can move very swiftly."

"Let me explain then," I answered. "Large birds can only move their wings with comparative slowness, and it is therefore necessary that their wings should be large to enable them to keep their balance and be able to fly. Their wings are somewhat in the nature of aeroplanes, and they shift them to different angles to take advantage of the varying currents of air.

"In the case of humming-birds and small insects, the wings are capable of intensely rapid vibrations, so rapid indeed that, when flying, the wings are almost, if not quite, invisible. This intensely rapid movement enables them to fly, and is somewhat analogous to the rapid movements of the vertical spiral screws, which you have seen on some of the Martian air-ships that screw their way up into the air.

"Such rapid movements would not be suited to larger creatures, because their muscular powers would have to be so enormously great that their bodies would require to be larger and heavier in proportion. They would thus be very unwieldy."

CHAPTER XXIII

I HAVE A SERIOUS TALK WITH JOHN

FOR some days past it had been becoming more and more evident to me that John was quite infatuated with Siloni, and also that she was not unwilling to receive his attentions. I could, therefore, no longer remain a silent spectator, so took the first opportunity of our being alone to broach the subject to him.

I began by saying, "John, have you any idea of remaining upon this planet for the rest of your life?"

He looked round at me and flushed up. Then, after a little hesitation, said, "No, Professor; why do you ask such a question as that?"

"Because, John," I answered, "it seems to me a very necessary question to ask. If you are going away from here very shortly, what is the meaning of your attentions to our handsome young friend Siloni? You must excuse my speaking of this, but I do not like to see you placing yourself in a false position. Don't you think it would be wise to see a little less of the lady in question during the remainder of your stay here?"

"Well, perhaps so, Professor," he replied rather reluctantly. "I never thought it would come to this with me, considering that I am now on the wrong side of forty. It has been said that a man does not know what love really is until he has passed that age, and certainly I never did. Candidly, Professor, I must

confess that I am very hard hit; and I know pretty well now what it means to be over head and ears in love with the most charming girl I ever met in my life!

"Do not imagine I have not seen the difficulty of the situation; but, really, I am puzzled to know what to do for the best. I am sure that dear girl would have me, and if I take her to England——"

"John," I interrupted, "my dear boy, what can you be thinking of? How is it possible that you can take to England as your wife a Martian girl, who stands considerably over seven feet in height!

"Even supposing it were possible that she could live in the atmosphere and climate of our country, she would be entirely isolated from every one, and, moreover, would be an object of public curiosity wherever she went.

"It would really be most unjust, humiliating, and cruel to Siloni; and you would be made very unhappy owing to the way she would be treated."

John looked down and fidgeted his feet about on the floor as he pondered in deep thought for some minutes, then looking up at me, he said, "I suppose you are right, Professor; you generally are; and that I have been rather foolish; but really I was thoroughly caught in the toils before I realised it. Now, what would you advise me to do in the matter?"

"I should advise you now as I did at first," I replied —"see less of Siloni. I suppose you have not actually spoken to her on the subject yet?"

"Oh no," he answered quickly, "I have not gone so far as that; but Siloni must be aware of my regard for her."

"Well, that being the case," I said, "you cannot very well say anything now, for it would place her in a most awkward and unpleasant position. You cannot tell her you were going to propose, but have thought better of it. Your only course, John, is to keep away from her as much as possible without appearing to do so intentionally."

"But won't she think it very strange behaviour on my part if I avoid her now, after being so much in her company?" he asked desperately, as if in hopes that I might not press him to give up the idea of continuing as before.

"No, John, I do not think so," I replied. "You know she is a Martian, and if she has not already some intuition of the situation, the very next time you see her this trouble will be on your mind, and she will become aware of the exact position of affairs; and I have no doubt she will accept the situation, though it will probably cause her considerable pain. You should have thought of all this sooner, my boy. It is a great pity this has happened, but there is no help for it now, and no other honourable way out of it that I can see. I am, however, extremely sorry for you both."

"Thank you, Professor," he exclaimed, grasping me fervently by the hand; "but it is very hard luck indeed."

He was very quiet and self-absorbed for several

days after that, but things turned out just as I anticipated. The next time he and Siloni met and conversed together, she became aware of the change in him, and divined the reason of it. She said nothing, but he knew she understood; and, except that she was quieter, she never made any difference in her behaviour towards him when they met occasionally afterwards.

So, though I was sorry in some respects, I was very glad that this awkward matter was settled.

CHAPTER XXIV

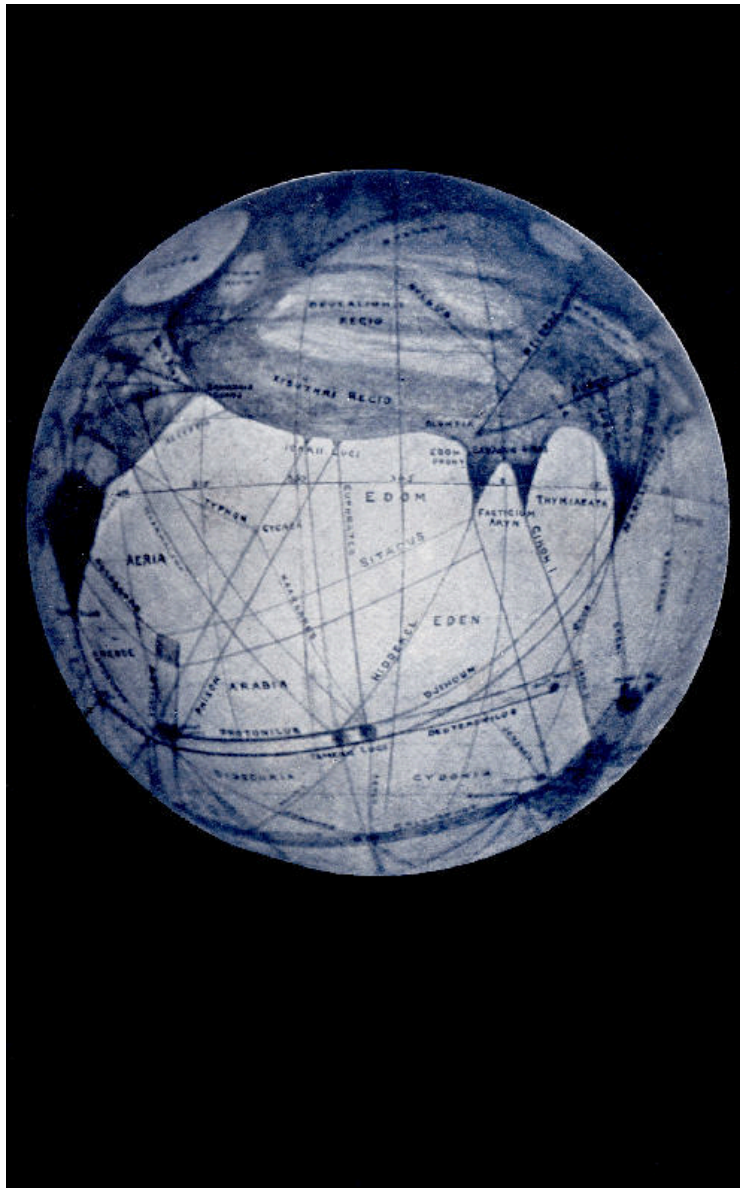
THE MARTIAN SEASONS

OUR earliest records of Mars date back to a very remote period, viz. 2300 years before the birth of Christ! Professor Hilprecht, in the course of his investigations on the site of the ancient city of Nippur, made extensive excavations, and dug down and down through the ruins until he had penetrated through those of no less than sixteen different cities, which, at various times, had been built one over the other. He unearthed the famous Temple of Bel, together with its great library, consisting of over 23,000 tablets, containing the chronicles of Bel.

When a number of these tablets had been deciphered, they were found to contain a complete

system of philosophy, science, and religion, and proved that those ancient people knew many things about astronomy, and in some of the fundamental matters would not have much to learn from astronomers of the present day. These tablets contained, amongst other things, records of observations of Mars! It is claimed that Chinese records go back to a still more remote date.

Since the discovery of the telescope our knowledge of Mars has gradually extended, and its general surface configuration is now well known to all students of the planet.



From a Globe made by M. Wicks

Plate XIII

Mars. Map VI

"Syrtis Major" is seen on the extreme left just below the Equator. "Sabaei centre, thus this map completes the circuit of the Globe of Mars.

The polar snow-caps were early depicted on drawings, also some of the dark areas; especially the striking one which has been known as the Kaiser Sea and the Hour Glass Sea, but is now usually termed Syrtis Major. It has an outline somewhat resembling that of India; and, if we include the southern portion, it is nearly as large in area.

Our maps of Mars are now practically uniform as regards the naming of the places marked upon them. Formerly this was not so, as each country had its own map and the places marked thereon were named after different astronomers, and usually after those belonging to the country in which the map was prepared. Much confusion arose from this practice, because the same spot on Mars might have a different name on each map; thus it was difficult to identify any particular spot when only the name was known.

Some international jealousy also arose owing to the patriotic desire of observers to identify particular spots upon Mars with the names of the great men of their own country.

To remove this cause of friction and misunderstanding a system has now been almost generally adopted of giving classical names to Martian markings. Some of these are of portentous length and strange spelling, but still the adoption of a uniform nomenclature has been a great

convenience to observers and others who have occasion to use or refer to the maps.

On looking at a complete chart of the planet it will be seen that the largest area of dark patches (which are believed to be areas capable of supporting life) is situated in the southern hemisphere, and that several of these are wedge-shaped, with the points trending northward. On the earth it is just the opposite, the largest area of land being in the northern hemisphere, and the wedge-shaped masses trend southward.

Our earth's surface comprises an area of about 193,000,000 square miles, of which some 143,000,000 square miles are water, and the remaining 50,000,000 square miles land.

Mars has a surface area of about 56,000,000 square miles, about 35,000,000 square miles being desert, and the remaining 21,000,000 square miles land which may be habitable, as most of it is covered with vegetation. There are no large areas of water anywhere upon Mars. This calculation, however, makes no allowance for the lines of vegetation which cross the desert, and contain canals, and, with the oases, may have a very large population.

From the 50,000,000 square miles of land upon the earth must be deducted the very large areas which are frozen during the greater part of the year, and also the large areas which are deserts or bare rocks. This would probably bring down the really habitable area to about 30,000,000 square miles.

Making a similar deduction in the case of Mars,

but remembering that more of the regions near the poles would be habitable during part of the year than is the case on the earth (as there is practically no permanent glaciation and the temperate zones extend nearly to the poles) the habitable area would be reduced to, say, 15,000,000 square miles.

It will thus be seen that although the total surface area of Mars is only rather more than one-quarter of that of the earth, the area of its habitable land, even under its present unfavourable circumstances, amounts to about half of the habitable area of the earth.

Looking at Mars from this point of view, it does not contrast so unfavourably with the earth as is usually thought, especially when it is remembered how small a proportion of the earth's area is really populated.

Were it not for the great eccentricity of the planet's orbit, the seasons upon Mars would be very much the same in the different zones as they are on our world, as the inclination of the planet's equator is only very slightly less than that of the earth. According to the latest determination, the inclination in the case of Mars is 23° and 13'.

As the Martian year is nearly twice as long as ours (being 668 Martian days, which are equal to 687 of our days) the seasons are of course proportionately longer in duration. The eccentricity of the orbit, however, causes a much greater difference between the lengths of summer and winter in the two hemispheres.

In the northern hemisphere of Mars, spring lasts 191 Martian days; summer, 181 days; autumn, 149 days; and winter, 147 days.

In the southern hemisphere spring lasts 149 days; summer, 147 days; autumn, 191 days; and winter, 181 days.

Thus, in the northern hemisphere spring and summer together amount to 372 days, and autumn and winter to 296 days.

In the southern hemisphere, however, spring and summer have 296 days, whilst autumn and winter last 372 days; so that the winter period of the year is 76 days longer than in the northern hemisphere.

On the earth the winter portion of the year is seven days longer in the southern hemisphere than it is in the northern hemisphere.

For this reason, our south polar snow-cap is larger than the north polar cap; and we should naturally expect to find a similar condition upon Mars, only greatly accentuated. Astronomical observation shows that this is the case, for while the northern snow-cap on Mars attains a maximum diameter of slightly under 80°, the southern snow-cap attains a maximum diameter of over 96°. The snow-caps are not perfect circles, but irregular in shape, and are, moreover, not exactly opposite to each other.

Notwithstanding its much greater area the southern snow-cap melts to a greater extent than the

northern snow-cap does, owing to the intensity of the heat at the melting period. The northern snow-cap usually melts until the diameter is reduced to about 6°, whilst the much larger southern cap may be reduced to about 5°. In the year 1894 it disappeared entirely! The summer must have been unusually hot.

So far as can be gathered from the records of our whaling and polar expeditions, it would appear that our north polar snow-cap is from 20° to 30° in diameter when at the minimum; whilst the southern snow-cap is nearly 40° in diameter when smallest.

We had arrived upon Mars on the 24th of September 1909, according to terrestrial reckoning; but according to the Martian date it was then the 26th of June in the southern hemisphere, where Sirapion, our landing-place, is situated. The season was, therefore, midsummer, and as Sirapion is in latitude 25° south and in the sub-tropical zone, the temperature was fairly high. The mornings were much more clear and brilliant than those on our earth; the warmth and general "feel" of the air at that time reminding me very much of what it is like in the south of England between seven and eight o'clock on a hot sunny day. Those who enjoy an early morning walk know how delightful and exhilarating it becomes towards that time. There is neither chilliness nor uncomfortable heat; one feels a delightful sense of freedom and that it is good to be alive. This is really the best and most enjoyable time on a summer's day. On Mars there was rather more

warmth but a greater sense of exhilaration. Of course, from near noon to about 3 P.M. it was much warmer.

Usually a lovely rosy effulgence is seen in the atmosphere in the mornings and evenings. As a rule, sunrise and sunset effects are much more ethereal and more beautiful than those on the earth, the tints being more delicate and the whole appearance of the sky less broadly marked. It is as the difference between the crude broad effects of a coloured poster and the delicate effects of a highly-finished painting.

What, in our sunsets, would appear a deep golden colour appears on Mars as a delicate pale gold, merging into bright silver. What with us is a carmine or deep rose, in Martian skies becomes a beautiful rose-pink; whilst the darker, or Indian, red seen for some time at the latter period of our sunsets is carmine in the Martian sky, and Indian red only appears just at the last.

These tints are seen when the skies are of their normal clearness, but after the occurrence of a great sand-storm in the desert and the upper air has become filled with fine sand particles, the Martian sunsets are equal in variety and depth of colour to anything seen on our earth during the months immediately succeeding the Krakatoa eruption. Those strange and intensely coloured sunsets will doubtless be remembered by my readers who had the good fortune to see them during the many months when they were visible after that great volcanic outburst in the year 1883.

Sand-storms have been unusually prevalent on Mars during the present summer, passing over large areas of country and obscuring the sun for considerable periods; so we have had several phenomenal sunsets afterwards.

As the time passed on the days became cooler—the evenings being considerably more so than on our earth in August, and twilight was very much shorter. Towards the end of the Martian August evening dews began to be succeeded by slight hoar frosts.

The heat in the tropics is not nearly so intense as on the earth. On the other hand, in the high latitudes near the poles, the summer temperature is higher than in similar latitudes on the earth, because upon Mars there is no permanent glaciation except right at the poles.

We have, of course, seen the Martian polar stars. The axial tilt of the planet being less than that of ours, and in a different direction, and its orbit being inclined 1° and 51' in regard to the earth's orbit, it follows that the poles of Mars must point to a different part of the sky, and a considerable distance from our polar stars.

In the northern hemisphere of Mars the polar star is a small one marked on our maps in the constellation of Cepheus, and it is almost on the boundary between that constellation and Cygnus. The pole star lies nearly in a line joining the brighter stars α Cephei and α Cygni.

The south polar star is a small one marked  in

that part of the large constellation of Argo Navis which is termed Carnia.

Although the polar stars are very small, they shine more brightly in the Martian skies than the north polar star does to us, and are therefore more easily seen.

CHAPTER XXV

MANY THINGS SEEN UPON MARS—I RECEIVE SOME NEWS

DURING the remainder of our stay upon Mars we visited almost every important place upon the planet, either by means of air-ships, motors, or by travelling along the main canals in splendidly equipped electric boats.

We passed through the whole length of the Eumenides-Orcus, from its starting-point on the Phœniceus Lacus, in the southern hemisphere, to the Trivium Charontis, in the northern hemisphere—a distance of 3540 miles, this being the longest canal on the planet. We visited the Solis Lacus, or "Lake of the Sun" (an area larger than England), situated in the southern hemisphere, which has usually been seen by our observers as a large dark patch, oval in shape. Indications of changes in this area were, however, noted at the time of the opposition in

1907; and it is not improbable that further alterations will be seen shortly.

Numerous important towns exist upon this area, and several canals connect it with surrounding areas.

We visited the north pole in our air-ship, and saw the snow falling thickly, and rapidly adding to the size and thickness of the snow-cap, it being winter time. We visited the south pole and watched the fast-melting snow (the cap being almost at its minimum size) and the distribution of the resultant water down the various broad channels which conduct it to the canals, from whence it is carried all over the planet.

When it is spring in the northern hemisphere the winter snow-cap at the north pole will begin to melt in like manner, and the water be distributed in a similar way. The melting begins about the 1st April and lasts till July, and sometimes considerably later in the year.

Thus, during the Martian year there are two distributions of water—one from the north pole and one from the south pole; and the growth of vegetation follows the passage of the water as it flows downwards from the poles to the equator.

On our earth vegetation progresses in an exactly opposite direction. Beginning near the tropics, where it is always summer, as the sun passes northward of the equator so vegetation gradually appears and develops onwards towards the north pole. It is exactly the same in the southern hemisphere; after the sun crosses the equator into the south the vegetation grows and spreads towards the south

pole.

The reason of this is that on the earth the supply of water by rainfall and snows is abundant, and it only requires the warmth of the sun to cause vegetation to spring up again at the proper season when the winter has passed.

On Mars the sun has the same action, but until the water comes down from the poles and furnishes the necessary moisture, the sun can produce no effect and there can be no fresh vegetation. Thus, on Mars, the flow of water is the determining factor, and vegetation follows its course from the poles towards the equator.

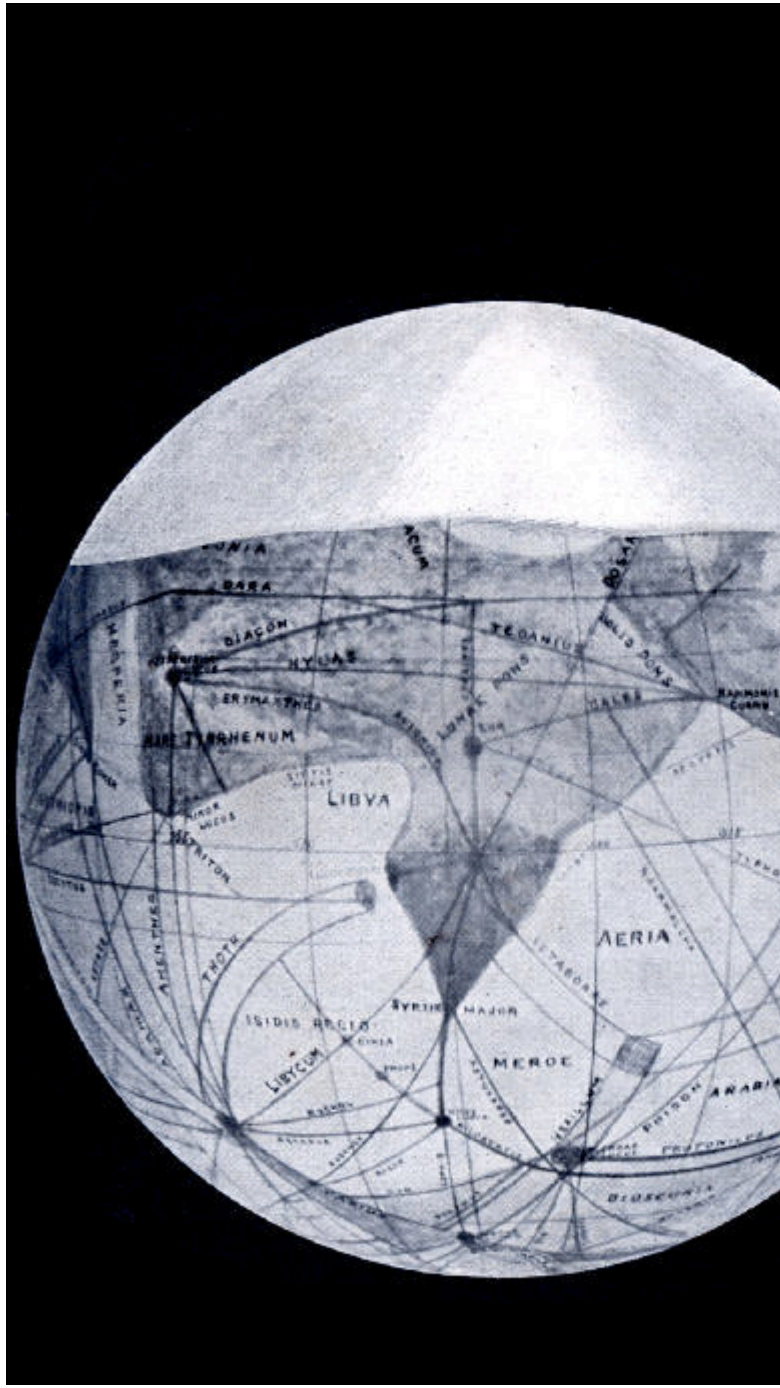
Observation shows that this is the case, and it has formed one of the strongest arguments in support of the idea of water conveyance by means of artificial canals. The opponents of the canal theory seem carefully to avoid any mention of this argument.

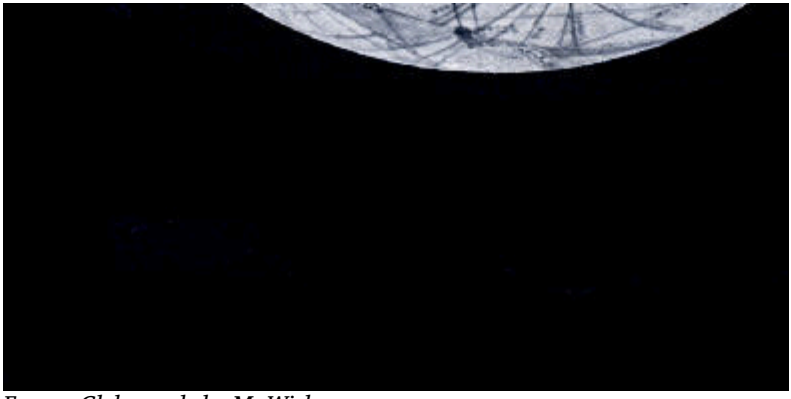
While we were watching the melting of the snow at the south pole, I mentioned to Merna and Tellurio, who accompanied me, that one of our scientific men, relying for support on a speculation by a lady writer, had arrived at the conclusion that the snow-caps could not possibly supply anything like the amount of water required. The writer in question had stated that the maximum area of the southern snow-cap was 2,400,000 square miles; and, assuming it was composed of snow of an average depth of twenty feet, this would only give an average depth of about one foot of water over its whole area.

The whole of the dark areas on the planet covered

at least 17,000,000 square miles, and as this was seven times the area of the snow-cap, it followed that the dark areas could not be covered with more than two inches of water. From this scanty and inadequate supply of two inches of water allowance must be made for an enormous loss by evaporation; so, as the writer said, "the polar reservoirs are despoiled in the act of being opened."

Tellurio at once settled the matter by saying, "Mr. Poynders, it is a very pretty theory, but, unfortunately for its supporters, it is entirely wrong, the figures being inaccurate, and the estimate of the extent of the area to be supplied, as well as the amount of water available, is made under a complete misapprehension of the facts."


ACUM
BARA
DIACON
HYLAS
TEBAN
MARE TYRRHENUM
LIBYA
AERIA
SYRTIS MAJOR
MERCE
ARABIA
PROMONTUM



From a Globe made by M. Wicks

Plate XIV
Mars. Map VII

The white area at the top of this map is the south polar snow-cap, at abc attains a diameter of considerably over 100 degrees.

"The maximum area of the south polar snow-cap is usually more than 10,000,000 square miles instead of less than 2,500,000 as stated, but it is sometimes still greater during a hard winter. Then, where did the writer acquire the notion that the whole of the dark areas had to be covered with water? Only the canals and trenches have to be filled, and, at the highest computation, these would cover only 2,250,000 square miles! So even accepting her average of twenty feet depth of the snow (which would give about one foot of water over the whole area of the snow-cap), there would still be sufficient water to fill every canal and trench upon our planet to a depth of nearly four feet six inches.

"Let us suppose we have 700 series of canals, each averaging 1400 miles in length, and each series having an aggregate width (including the area of the irrigation trenches) of $2^1/_4$ miles. You will see that gives about 2,250,000 square miles to be covered with water. My estimate of the area to be covered is,

however, much in excess of the real amount, as the average aggregate width of the series of canals would be less than I have assumed, and the trenches are shallow.

"I must also point out that only a small proportion of the whole number of canals would be in use at any given time, and the depth of the polar snows averages considerably more than twenty feet; so a very much greater depth of water can be secured in those canals which are in use. The main canals which are used for navigation purposes are, of course, much wider and deeper than the irrigation canals. In the hotter regions many covered compensation reservoirs are provided, and these make good the wastage caused by excessive evaporation where pipes cannot be used."

"Thank you, sir," I said; "the information you have now given me entirely confirms the figures as to the area of the snow-cap, &c., mentioned by Professor Lowell, but as regards the depth of the snow and the size of the area to be covered, he has with scientific caution refrained from estimating to the full extent which the facts you mention seem to warrant. In addition to this, no allowance has been made for the water derived from the northern snow-cap."

Thus vanished the theory which was supposed to support the view that the canals must be hopelessly unworkable, and could never be of any use for irrigation purposes.

It had also been argued that no intelligent beings would construct canals if the planet were generally

flat, as it would only be necessary to let the water flow over the surface as far as it would go, and thus irrigate the parts reached by the water; whilst if it were not flat, the canals could not be constructed at all.

I asked Tellurio "What he thought of this suggestion?"

He replied, "Well, sir—here we have a planet believed to possess only a very scanty supply of water, which must require the most careful husbanding and economy in distribution; yet it seems to have been calmly suggested that we would deliberately waste the precious fluid by allowing it to flow at random over the small portion of our land which it would reach, where it might or might not be required! Our engineers, I may say, are quite capable of overcoming any difficulties arising from inequalities of the ground.

"If, as has been contended, the loss by evaporation would be so great in canals where the water is fairly deep as to result in depletion of the supply, it is clear there must be a hundred times greater loss from the same cause if the water is allowed to spread in a very shallow pool over a large area where it would be totally unprotected from the sun! Then, again, every part of our planet not reached by the water would become desert.

"No, sir," Tellurio added, "the Martians are far too intelligent to waste the water in this fashion: hence their canal system by which the water is economically distributed where required, and also

protected from undue evaporation. It must not be forgotten that our canals are also means of communication across the deserts, and without them distant parts of the planet would be entirely isolated from the rest of our world, except for our air-ships.

"Our canal system has been a matter of slow growth and development. Beginning with the straightening of the beds of old rivers and narrow channels connecting seas, the canals were then constructed where they were most needed; but as time passed on, and our water supply from rainfall became less and less, we were convinced of the necessity of adopting a complete system of canalisation in anticipation of the time when our polar snows would be our only source of supply. This was gradually carried into effect, and even now additional canals are being constructed to meet the requirements of places not reached by existing canals.

"In order to secure the return of the water to the poles, and so ensure a future supply, it is absolutely necessary that, wherever possible, the water should be conveyed in open channels so as to allow evaporation to take place, otherwise much would be lost by soakage into the soil."

"Thank you, sir," I said; "those statements meet another objection which has been urged against the possibility of the canals existing; it apparently being assumed that the whole system must have been carried out simultaneously, and that the population of Mars would have been much too small to admit of that being done."

"Our population is by no means small, sir, having regard to the size of our planet; and the Martians, as intelligent beings, have always been in the habit of looking well ahead to ascertain what provision would be required to satisfy our prospective needs. Your people take far too narrow a view of these matters."

Thus many controversial matters were satisfactorily cleared up by statements of actual facts.

During our journeys over the planet we came across a large number of canals in different parts which have apparently not yet been discovered by our observers. These were not all narrow lines of canals, and many of them were double ones, so our observers have more work yet before them in finding out these lines and recording them on their charts.

Professor Lowell, who has made many experiments in order to determine how distant a fine line of known thickness (such as a telegraph wire) may be situated and yet remain visible to the sight under ordinary atmospheric conditions for clear seeing, has come to the conclusion that when Mars arrives at its most favourable position for observation, and other conditions are satisfactory, it will be possible to see lines on the planet which are not more than one mile in width.

As regards the surface characteristics of Mars, we found that it is generally very flat, and that only here and there one comes across slight undulations, whilst hills and mountains are very few indeed. There are, in fact, no high mountains anywhere; the highest

altitudes rarely approach 2000 feet, and such heights as these are quite exceptional.

This was quite in accordance with our expectations, because no mountains have ever been seen upon Mars, though they have been carefully searched for by our observers. If there were any elevations much exceeding 2000 feet in height they would have been visible sometimes when the planet was passing under the careful scrutiny of our observers, and they could not have entirely escaped observation.

In all probability Mars never at any time possessed mountains whose height would be at all comparable with that of our mountains; for, according to scientific calculation and reasoning, the planet's internal heat was never sufficient to have caused the formation of such high elevations on its crust.

As the planet advanced stage after stage in its development it became colder and colder; all upheavals ceased, and the height of any elevated parts upon its surface would thenceforward be gradually and continuously reduced by weathering and erosion in the same way as has happened in many places on our own world. We have no very high mountains in the British Isles at the present time, but geology and physical geography teach us that many of the low elevations now existing are merely the basic wrecks and remains of mountains which, in ages past, must have been of considerable altitude. As the world ages and becomes colder its surface will tend to become more and more level,

and the rivers will become straighter in consequence.

As regards animals, we discovered that the larger varieties have become extinct, and that there are at present no animals which can properly be termed wild or fierce, for they cannot exist in the deserts without water or vegetation. Numerous animals, however, frequent the irrigated parts where there is vegetation, and, though in a complete state of freedom, have for such an extremely long period been in constant contact with the people that they have become quite tame. The people always treat animals with kindness, and these free creatures are entirely without fear of them.

Most of the animals are different from any we have upon the earth, but some bear a general resemblance to ours of the same species, though they are all of larger size, and differ considerably in details. Like the people, they have developed through the long ages, and have reached a higher point than our animals, and a few have even developed the power of speech.

This may sound exaggerated—but just think! Many of our birds have been taught to speak the human language, and a few have even acquired this power by imitativeness. Who that has kept dogs, cats, monkeys, and horses has not observed the desperate efforts of some of them to make themselves understood. All are not alike, but we often come across an animal which seems to understand almost everything we say, but none has yet developed the power of making an intelligible communication to us, although some try hard to do

so. It does not seem beyond the bounds of possibility that a few thousand years hence some animals, especially the monkey species, may be able to speak a little.

The Martians do not use any of their animals as beasts of burden, and it would be contrary to all their ideas to do so. On Mars nearly all heavy labour is performed by means of electrical machines, thus both the people and the animals are spared much heavy work.

Our animals are often greatly overloaded, but we have a salutary law to protect them from this, as well as from other forms of cruelty; and the persons responsible for the ill-treatment may be punished.

Human beings, however, may be overloaded and, in many cases, overworked with impunity, for there is no law to protect the unorganised workers. Is there not something wrong about this?

It may be argued that whilst animals cannot protect themselves human beings can; but, alas, only too often the force of circumstances compels workers to endure anything so long as they can earn a little to keep body and soul together.

Flowers seem to be very plentiful here, and grow very tall and large. Many varieties bear a strong resemblance to our variegated lilies, the flowers being brilliantly tinted, and often measuring twelve to fifteen inches across. But, as upon the earth,

flowers are found in all colours and sizes, and in infinite variety.

Trees also grow very tall, many varieties resembling our palms, especially in and near the tropics, where there are also many varieties of cactus. In the temperate and cooler zones trees resembling our firs and pines are plentiful; whilst fruits, vegetables, and nuts, as well as cereals, are grown in enormous quantities on the irrigated areas, as these products form the chief articles of food amongst the Martians.

Insects are numerous on Mars, the conditions being very favourable to insect life; and they are all on a very much larger scale than our insects, especially those which fly.

Everywhere we go we are received by the people with the utmost courtesy and kindness, and have become much attached to those with whom we have been more closely associated. They are indeed a most amiable, intelligent, and lovable people—always good tempered—dignified, yet ready to display great enthusiasm when occasion requires.

The marriage tie is sacred and indissoluble on Mars, and divorce is therefore unknown; but it is also quite unnecessary, for no cause ever arises for a dissolution of marriage.

When Merna was telling me about this, I asked him whether any attempt had been made to dispense with marriage in any Martian community, stating that some of our advanced people were disposed to do so.

He answered that "Some such ideas had been in vogue amongst certain of their nations about two thousand years ago, and attempts were also made to abolish religious observances, but they proved complete failures, and engendered strife. No nation adopting these views ever progressed or prospered; the people were soon clamouring for the revival of their old institutions, and since then no one had ever desired to dispense with them. Both religion and marriage are essential to the stability and well-being of all nations, and the people are soon lost without them. You may be assured," added Merna, "that those on your earth who favour such a change are quite mistaken in thinking it would be an advance in civilisation, for, on the contrary, it would result in a reversion to barbarism."

The Martian educational system is very thorough. In their earlier years the children all receive a good education in general and scientific knowledge, then they pass into the technical, trade, and business schools. Every kind of business and trade is thoroughly taught by teachers who are not mere doctrinaire professors, but persons who have made their mark as good, capable, and practical workers in the particular trade or business which they are required to teach.

We went over several of the ordinary and trade schools, and found them fully equipped with everything likely to be required for a thorough educational course of training.

In the warmer zones we found several large open-air amphitheatres capable of accommodating from

10,000 to 100,000 persons. All around the central arenas of these were rings of beautiful scented flowers and shrubs. Both children and adults spend much of their leisure time in open-air recreation and athletic games, and I was therefore not surprised to find them all so bright and happy, as well as robustly healthy in appearance.

As a result of our visit, the Martians now enjoy a new out-door recreation; for M'Allister, pressing John into his service, has initiated them into all the mysteries of golf, for which pastime their level country is well suited. I have been much amused to note that, whilst M'Allister has always expressed great admiration of the mechanical skill of the Martians, they have risen in his estimation at least 100 per cent. since they have taken so enthusiastically to his national game, and he is never tired of telling us what a "sensible" people they are!

He has taken up their training with all his Scottish vim and thoroughness, and has insisted upon the full rigour of the game. All attempts to Martianise its various technical terms he has courteously, but firmly, suppressed; the Martian vocabulary has, therefore, been considerably extended by the addition of the numerous fearsome technicalities which sound so strange, even to an Englishman who is not familiar with the game. Whatever may be the ultimate result to the Martians, there is no doubt but that M'Allister is most thoroughly enjoying himself.

Tellurio informed me that their medical men have very little to do in the way of curing ailments, their studies and efforts being mainly directed to the

prevention of disease; consequently disease and illness are very rare, and many of the diseases which afflicted the people in past ages have been entirely eradicated.

The use of radium as a medical accessory has been known to them for a very long period, and they are able to prepare and utilise it without the slightest risk of any untoward results.

Another large factor in ensuring a strong and healthy population is the methodical system they adopt in planning all their towns. We in England have only recently realised the necessity of town-planning and the advantages of garden cities. On Mars, however, town-planning has been most systematically carried out for centuries; all their towns are glorified garden cities, presenting a happy combination of beauty, utility, and healthfulness.

The general arrangement is as follows: On a circular area, varying from one to five or more miles in diameter, according to circumstances, is the central portion of the town, containing the splendid administrative and business buildings, museums, winter-gardens, educational establishments, and places of amusement, as well as many fine residences. Surrounding this area is a wide ring-canal, on the farther side of which is the outer zone of the town, united to the central portion by many wide and handsome bridges. On the outer zone are extensive residential areas, then a zone of factories and workshops, and beyond that an area often extending for miles, which is covered with cereals and vegetables, fruit trees and nut trees. Outside all

is a zone of timber trees. The town and its surroundings, therefore, cover a vast area.

The canals radiate in all directions from the outer edge of the wide ring-canal, and all quays, wharves, and warehouses are alongside of these canals. Thus the ring-canal is kept quite clear of all such buildings, but all round both sides of it are beautiful terraces of white stone, with numerous pavilions, broad boulevards, winter-gardens, and promenades.

All the buildings have open spaces or gardens around them, thus securing ample allowance of light and air. Smoke is quite unknown; no noxious gases or vapours are discharged into the atmosphere from any of the factories, but all such emanations which cannot be absolutely destroyed are purified, condensed, or otherwise dealt with within the buildings. Thus the air is always kept pure and wholesome.

From this description it will be seen that the planning of a town is very systematic, and that it much resembles a wheel. The hub is the central part of the town; the spokes are represented by the bridges; and the outer rim—a very wide one—contains the outer zones.

Besides the gardens there are large open spaces where air-ships have their stations, from whence they can start, or on to which they can descend. The air-ships, also, are usually constructed so that they can descend into the canals, on which they can not only float but be propelled.

Many of these town areas are the oases, about

which so much has been said, and which, like many other Martian details, have been described as illusions. I only wish we had a plentiful supply of such illusions in our own old country!

One of the oases we visited was the Lucus Ascræus, in the northern hemisphere. A large number of canals converge from all directions on to this spot—seventeen of them are marked on our maps—so I expected to find it a place of considerable importance. It is, in fact, a very thriving business and manufacturing place—the Birmingham of Mars, besides being also one of the many centres of government. Like most of the manufacturing towns, it is near the tropical region—because the Martians derive most of their heat and power from solar emanations which they have discovered, and these they store up and transmit to very distant places for use when required. Nearly all the places on Mars to which several canals converge are busy centres of trade and contain large populations.

There are numerous large towns near the canals on all the dark areas, differing only in detail from those on the oases, the general plan being the same.

I remarked to John that "I thought the towns on the dark areas ought to show as rounded spots slightly darker in tint than the surrounding dark areas. Where several towns were close together they would probably be seen as a single spot, large in area and irregular in shape. It seems strange that, except for a few shown on Professor Lowell's charts, they have not been seen by our astronomers; but perhaps during the present near approach of Mars to the

earth some of our keen-sighted observers who possess large instruments may see and take note of many more of these dark rounded spots, as they are very numerous, and new towns are in course of development."

During the spring and summer a large number of the people find employment in the regions near the poles, especially those whose work is connected with the canal system and who have to see that the water from the melting snow-caps is turned into the proper channels and everything connected therewith kept in good working condition. All these workers, however, migrate to warmer latitudes as the very long and dreary winter approaches.

I have just received some interesting and very unexpected news which, as some writer says, "gives me furiously to think."

John and M'Allister came to me asking anxiously whether I had fixed the date for our departure.

I replied that we should probably keep to our original programme and leave about the beginning of December, but asked John why he was so anxious to know?

"Well, Professor," he answered, "there is more than one reason for my question. I do not think our stay should be prolonged. Haven't you noticed any change in us?"

I replied that "I had not seen any particular change or alteration in them, except that in build and general appearance they were becoming more like the Martians."

"Yes, Professor," exclaimed John, "that's just it. I don't know whether it is the Martian air or the Martian food, or the combination of both, but we certainly are becoming more like Martians every day. Our eyes are becoming luminous, our complexions and features are changing, and, by Jove! if I haven't grown nearly two inches since we came here! If I go on like this I shall soon be such a giant that I shall not care to go back at all."

"Really, John," I said, "is it so bad as that? Now I come to look at you critically you certainly do look taller; and I can see a little luminosity in M'Allister's eyes, and rather more in yours. I suppose, being the youngest, you are more susceptible than M'Allister or myself."

"Yes, I think that must be the case, Professor," remarked John.

"However," I added, looking at him and smiling, "you told me there were more reasons than one, so I suppose you have kept the weightiest reason to the last."

"Well, I don't know about its being the weightiest reason," he answered, "but we shall require nearly four months to accomplish our journey to England after we leave here, and I reckon that by that time my stock of tobacco will be pretty nearly used up. I have given a lot away to our Martian friends, and

I've tried some of the native growth; it's rather decent stuff, but not a patch upon my mixture."

I burst out laughing in such a hearty fashion that it set them off too, as I remarked, "Ah, John, I had a shrewd idea that there was something more behind your anxiety than the fact that you were becoming Martianised."

"Heh, John," exclaimed M'Allister, touching him playfully on the shoulder, "the Professor had you all right that time, I'm thinking!" John blushed up to the eyes, and said no more.

Ultimately it was agreed that it would be well to leave Mars on the 1st December, according to terrestrial reckoning.

So that matter was settled; but, just after they had left, Merna and Eleeta came in, both looking very glowing and happy.

After the usual greetings and a few casual remarks, Merna announced that he and Eleeta were to be united in the coming autumn.

I was a little surprised at the suddenness of the announcement, but at the same time exceedingly pleased; so, embracing them, I congratulated them heartily and wished them every happiness; then they left to tell some one else the news.

But, as I have said, these things "gave me to think."

CHAPTER XXVI

WE WITNESS SOME WONDERFUL AERIAL EVOLUTIONS AND LISTEN TO MARVELLOUS MUSIC

WHEREVER we went we found new subjects for wonder and admiration, and fresh proofs of the high state of civilisation and development attained by the Martians. We had seen many evidences of their genius in engineering and mechanical undertakings, but we found that they excelled in every art and science, and their achievements made terrestrial accomplishments appear poor and even paltry by comparison. Whether we examined their sculpture, paintings, pictures, or photographs—which latter they take direct and at one operation, with all the natural tints—or whether we listened to music, our verdict was perforce the same—"We had not previously known anything to equal it."

We have all become fairly accustomed to seeing numerous air-ships moving in all directions across the sky in the daytime, but it still seems strange to us to see the lights of the air-ships flitting about the nocturnal sky.

I mentioned this to Merna, and he remarked that no doubt it did seem rather strange to us, adding that my mention of air-ships was singularly apropos of what was then in his mind, for he was just about to inform us that an interesting aerial display had been

arranged and was to take place that evening, with the view of affording us some idea of Martian outdoor entertainments.

We all expressed our thanks, and our appreciation of the kindness we were receiving from the Martian nation; and I ventured to suggest that probably we were indebted to him for a considerable proportion of it.

He answered that it was true he had taken some share in this affair and in a few of the arrangements for the functions we had already attended, but that many others had done the same, for it was natural to the Martians to do all in their power when any help was needed. As we were strangers from another world they all vied with each other in making suggestions and arrangements which would afford us pleasure, or help to enable us to see all that was possible in their world.

We were fully aware that this was the case, for we were received with kindness and welcome wherever we went.

Merna's affection for me seemed unbounded, and his love was shown in every action. Yet, like all the other Martians, he was never obtrusively demonstrative, everything being done in a quiet and natural manner. When on the earth his disposition had been very pleasing, but now his Martian nature seemed to have endowed him with a capacity for loving far transcending that of his human nature.

He was the same towards John, and we often spoke about it in Merna's absence, whilst M'Allister

had become as much attached to him as we were.

Just before sunset Merna rejoined us, and we passed out of the city into the open country to a spot not far from the place where we had landed from the *Areonal*. Here we found a large concourse of people assembled, and their numbers were being added to by fresh arrivals every minute. On looking upwards we saw air-ships speeding towards us from every quarter. Some brought passengers and landed them, but it was evident that most of the air-ships were about to take part in the display, as they remained up in the air instead of coming down to the ground.

We met many Martians whom we knew, and were introduced to others, so the time passed quickly in interesting conversation.

As soon as darkness fell Merna informed us that the display was about to commence, adding that he had purposely refrained from giving us any inkling of its nature, as he thought the unexpected would afford us greater pleasure.

We were gazing upwards at the vast assemblage of air-ships, which were lit up by the ordinary lamps used when travelling at night, when suddenly the whole sky became brilliant with the glow of countless thousands of coloured lights, and the air-ships began to move into their allotted positions.

Every ship—and there was a very large number of them—was covered all over with electric lamps. Some of the ships had all red lights, others all blue, others yellow, and so on through the whole range of tints known to us, besides many tints which we had

never seen before.

The evolutions began with the formation of simple geometrical designs, starting with a complete circle of immense diameter. Then, inside this circle of many-coloured lights other ships took up their position, and, before we were prepared for anything, a triangle of lights had been formed. It was clear that even in their amusements the Martians were scientific; for here outlined in glowing colours was the familiar geometrical figure of an equilateral triangle inscribed within a circle, perfectly worked out on a most gigantic scale, and very pretty it was. Quickly, another triangle was formed across the first one, the result being a six-pointed star; and so on with several other more elaborate geometrical figures. The rapidity and certainty with which these air-ships took up the requisite positions and showed their coloured lights in the appropriate places was marvellous to see.

After about a dozen geometrical figures had been formed there ensued a rapid and bewildering movement of the ships towards the southern vault of the sky. Coloured lights flashed and whirled about in what, for a few minutes, seemed chaotic confusion, then suddenly the chaos was transformed into order. The vessels formed up in long rows one below the other, each row having one distinctive colour: a little movement of the ships from the centre to each end, in a downward direction, and the straight rows were transformed into complete semicircles concentric with each other, their bases seeming to reach the ground. Then they closed together, and lo! right

across the sky shone a perfect representation of a rainbow (an extremely rare phenomenon upon Mars) glowing in brilliant light, with every tint and *nuance* accurate, and a thousand times brighter than any rainbow we had ever seen. It was magnificent!

Further rapid movements followed: the semicircles were broken up; the large vessels now being arranged in a long straight line across the sky, with the smaller vessels in another line just below and in front of them. The electric lamps were then instantaneously extinguished, and all was darkness. But only for a moment; then from the top of every vessel numerous immense pillars of coloured lights shot upwards into the sky.

We gazed at this in some perplexity, wondering what it all meant, as the design gradually developed to its completion. Then John touched my arm, excitedly exclaiming, "Look, Professor; it is the spectrum of the sun!" Yes, that it was, and never had we gazed upon such an immense and glorious spectrum. We pointed out to each other the lines of hydrogen, sodium, strontium, and many others, all of which were truly depicted, both in colour and position. These lines were formed by the lights of the smaller vessels shown against the background of the lights on the large vessels, and we noticed that all the Martians around us quickly recognised what the lights represented.

Next we had a representation of the spectrum of Sirius, then that of Aldebaran, and after that a spectrum which we were unable to identify. Merna explained that it was the spectrum of their south

polar star. A few others were shown, then the line arrangement of the ships was again broken up, the search-lights extinguished, and the coloured lamps once more shone out.

Many of the ships now rushed across the sky over our heads in all directions, and, after a few evolutions, the whole were seen arranged so as to form four immense concentric circles, with a considerable space between each ship.

The ships in the two inner circles then began to move slowly, and passed in two wavy lines alternately in front of one ship and behind the next ship in the outer circles, the serpentine movement gradually becoming more and more rapid; and most wonderful changes of colour were produced by the passage of the vessels past those lighted with lamps of another colour. Swifter and swifter became the speed until it seemed utterly impossible that these intricate movements could go on without resulting in a series of collisions and disasters. Yet, with all this bewildering whirling, twisting, and intertwining, the ships were guided on their courses with consummate skill and with an unerring accuracy which was marvellous to behold.

Another shake of the aerial kaleidoscope and the vessels were seen drawn up in three parallel lines on the east and three on the west. Then the search-lights again flashed out, filling the whole intermediate area of the sky with beams of brilliant coloured light, which were caused to oscillate sideways and overlap, producing a most gorgeous intermingling of glowing colours. The Martians certainly had a complete

understanding of all the peculiarities connected with mixtures of coloured lights.

Up to this time silence had reigned, for no sound came to us from this vast aerial fleet; but now there burst forth from both ranks of vessels strains of music of such ravishing sweetness that I and my two colleagues were quite overwhelmed. It seemed as though our mortal bodies were completely etherealised by the thrilling melodies which floated down to us from the upper air.

This was not all. When on the earth we had read of attempts to connect musical tones and chords with the chromatic scale of colour, it being suggested that each musical sound had its own distinctive tone-colouring. Now we saw it practically demonstrated, for each chord of music was accompanied by changes in the colours of the search-light beams; and on comparing notes afterwards John and I found ourselves agreeing that the colours shown appeared exactly to interpret what our inner consciousness seemed to evolve, but which we could not have expressed in words. It was like a scene of enchantment as we watched those immense bands of glowing colours changing so rapidly and synchronising with the chords of music. Merna informed us that the lights of each vessel were electrically controlled from the keyboard of one of the musical instruments on the ship.

This was followed by a piece resembling a grand chorale: then an intricate fugue was performed, the several movements being taken up in succession by the ranks on each side alternately, and apparently

flung to and fro from one side to the other of that vast area in magnificent sequences and variations until it seemed that our human nature was so uplifted, and we were so filled with ecstasy, that we could bear no more.

Many of the instruments were quite different from anything we had known upon the earth, and when some of these were unaccompanied the music sounded exactly like a grand choir of Martians singing in the heavens. It really seemed to us quite impossible that this concord of sweet sounds could be instrumental music, so perfect was the vocal effect.

Several other pieces were played, each having its own distinctive character; then, after a short interval, the search-lights were suddenly flashed on to the city of Sirapion; the beautiful buildings with their domes, towers, and minarets looking exquisitely ethereal as they were bathed in the beams of the glowing and ever-changing prismatic light. The beams were next directed downwards upon the assembly, and we gained a truer appreciation of the immense numbers that were gathered together.

After this short interlude we were entranced by the opening bars of a very grand and majestic composition. As the first strains reached us I noticed that all the Martians who were seated at once rose erect; every Martian bared his head, raised his right hand, and, with an expression of rapt intensity and reverence, gazed towards the heavens. I and my companions immediately adopted a similar attitude, for Merna explained that this piece was the Martian

Hymn of Praise to the Great Ruler of the Universe; and that its performance was regarded as one of their most solemn acts of public worship.

The grandeur and majesty of this music, its melodious themes and thrilling harmonies, are utterly beyond my powers of description; the air and sky seemed filled and pulsating with prayer and praise, then resounding with grand crescendoes of triumphant shouts; each succeeding movement of the music carrying it higher and ever higher in the scale, until at last it seemed to soar and pierce the infinite, the final cadences dying away in melodious strains of celestial beauty and ineffable sweetness.

Finally the air-ships all circled round the sky, then took their departure—darting off in all directions—the sound of their sweet music becoming fainter and fainter in the distance until at last all was solemn silence; then the great assembly slowly and quietly dispersed.

For some minutes none of us spoke, for each was in deep thought, so impressive and exalting had been the effect of that wonderful and majestic hymn. When at length Merna turned to us and asked if we were pleased with what we had seen and heard, we found it very difficult to give adequate expression to our feelings.

Then M'Allister said, "Mon, it was beautiful, most beautiful! and I never felt so nigh to heaven as I have this night!"

I remarked to John that "I had never expected to hear any music that would equal, much more excel,

the incomparable 'Hallelujah Chorus' in Handel's 'Messiah.' It had always seemed to me impossible that any music could ever be composed which would even approach it in majesty and power; but what we had heard that night certainly surpassed it."

On looking at my watch I found that the musical portion of this feast of tone and colour had occupied nearly three hours; yet, as I remarked, it had seemed to me only a few minutes!

"Yes," John replied, "to me it has been an experience like that of the monk Felix in Longfellow's 'Golden Legend.' The monk went out into the woods one day, where he saw a snow-white bird, and listened to its sweet singing until the sound of the convent bell warned him that it was time to return. When he reached the convent he was amazed to find the faces of the monks were all strange to him; he knew no one, and no one knew him, or had ever even heard of him. At last one very old monk, who had been there over a hundred years, said he remembered seeing a monk Felix when he first entered the convent. The records were searched, and it was found that Brother Felix had left the convent a hundred years before, and as he had never returned he had been entered in the list of the dead. So then

'They knew, at last,
That such had been the power
Of that celestial and immortal song,
A hundred years had passed,
And had not seemed so long
As a single hour.'

"That has really been something like my own experience to-night," continued John; "for I have scarcely been conscious of the passage of time, and hours have seemed only minutes! I trust, Merna, that you will convey to your friends our most grateful thanks for all the pleasure we have derived from this magnificent display of Martian attainments."

M'Allister and I joined in this request, and Merna promised to comply with our wishes. He seemed very pleased at our appreciation; and he told John that his quotation had recalled to his memory the beautiful poem by Longfellow, which had been a favourite with him during his earthly school-days, but had lain entirely dormant in his mind until now.

We all agreed that, however long we might live, the memory of that evening's events—the magnificent display of aerial skill, the glorious harmonies of colour, and, above all, the majestic and incomparable music—could never be effaced from our minds. We wondered whether aerial flight would ever be brought so completely under control as to permit of a similar display in the skies of our own world.

Merna replied that he was sure it would be quite possible some day, but it must be remembered that what we had been witnessing was the result of centuries of Martian experience in aerial navigation.

Merna then gave us an account of the progress of Martian discovery in regard to aeronautics, from which we gathered that the earlier experiences of the Martians had been somewhat similar to those of our

own people. They began with bags of various shapes inflated with gas lighter than air, similar to our balloons, then experimented with aeroplanes of various designs, also bird-like wings, on a very large scale, actuated by electric and other motors. As time went on, however, their atmosphere became thinner and thinner, until at last all such forms of apparatus became nearly, if not quite, useless as a means of artificial flight.

After this they made use of numerous vertical screws of a spiral form, which were caused to revolve with extreme rapidity by the aid of electrical machinery; and a few of the vessels thus equipped are still in use. But the discovery of natural forces emanating from the sun and from their own planet soon led to the devising of means for utilising this natural power, and this has practically superseded everything else. Now all their air-ships and many of their machines are actuated by this power, and are under the most perfect control. Air-ships are used for all purposes of passenger traffic and freight carrying. So are vessels on the canals and motor vehicles on the roads; and railways are, therefore, unnecessary.

CHAPTER XXVII

A FAREWELL BANQUET AND A PAINFUL PARTING

THE time was nigh at hand when we must think about our arrangements for returning to the earth, and, as it drew nearer and nearer, I became much troubled. I felt that it would be endangering Merna's dear life to take him to England, for our terrestrial microbes would probably prove fatal to a Martian, so it was impossible to suggest it to him; at the same time I felt that I could not again part with my newly-found son, who was now all in all to me.

Pondering over the matter, I wondered whether the Martians would allow me to stay with them and end my days on Mars with my beloved son.

Just then Soranho came to see me, and we sat awhile talking together. Presently he said, quietly, "Mr. Poynders, you would I know desire to stay here with your son, but are doubtful about mentioning the matter to me. Doubt no longer, my dear sir! We shall be proud and happy to have you with us; and I am quite sure that I am fulfilling the wishes of our people when I now cordially invite you, in their name, to make your home with us!"

Thus the Martian intuition had solved my difficulty; and, fervently thanking Soranho, I told him I gratefully accepted his kind invitation and would remain upon Mars, although parting with my two old friends would be a hard task for me.

It had been decided that we should leave on the 1st of December, that being the latest possible date, as the earth was moving so rapidly away from Mars that each day's delay would mean a longer journey. As it was, we should have about 215,000,000 miles

to travel before we could reach our destination; and, as that would require at least 108 days, we could not arrive in England before the 18th of March 1910; probably it would be a day or two later, as our course would take us so near the sun.

When John and M'Allister came in I went to the receptacle where my chart was kept and brought it out. Placing it on the table, I carefully explained what would be required, and gave them full instructions for setting and keeping their proper course, so as to head off the earth on its journey. These instructions I had also written out in readiness, so that each might know and be able to act in an emergency.

Then came the most difficult part of my task, and, in hesitating words and rather disjointed sentences, I announced to them my decision to remain on the planet. John and M'Allister were very much moved; but, as they saw the matter was really settled, they soon desisted from their attempts to dissuade me.

During the day we received from Soranho an invitation, in the name of the whole people of Mars, to attend a banquet on the day before our departure to enable them to bid us adieu.

This we, of course, accepted; and when we arrived at the place indicated we found that it was the largest hall in Sirapion, the immense building being crowded with Martians from all parts of the planet.

After the banquet Soranho rose and announced that their friends from the earth would be leaving next day, and he trusted that all who could do so

would attend at our point of departure to give us a hearty send-off.

He then dwelt upon the pleasure which our visit and company had afforded them, and said the good wishes of the whole people would go with us; adding that we might feel assured that anything which the Martian nation could do, by means of transmitted influences, to aid in the advancement of our world would be most cheerfully and willingly done.

Then he went on to make the announcement that, finding I had a strong desire to stay with them and with my newly-found son, he had invited me, in their name, to do so.

This announcement was received with tremendous enthusiasm: the whole company spontaneously rising to their feet, with repeated acclamations and expressions of satisfaction.

I then rose to express my heartfelt thanks for their kindness, saying that for many years of my life upon the earth I had loved to study their planet; and now that I had spent some time upon it and been the recipient of so much kindness and goodwill from all whom I had met, I loved both their world and their people; and in deciding to accept the invitation so cordially given in their name I trusted they would always find me a good citizen of Tetarta.

Merna translated this speech to them, and there ensued another scene of indescribable enthusiasm.

John followed with a very feeling expression of his gratitude for the welcome and kindness he had

received as a stranger from another world.

Then came M'Allister's turn, and his speech was a characteristic one.

Turning to Soranho, he said: "Mon!—no, I should say 'Chief!'—I thank you and all the people for the delightful time we have had upon Mars, and can only say I'm very sorry to leave you. But I have an old wife of my own in the world far across space over yonder, and away up in bonnie Scotland. She will be looking for my return home; so, much as I should like to stay longer with you, I cannot keep from going to her. Thank you all, and God bless you!"

I do not know how Merna managed to translate this speech, but it evidently gave the audience as much satisfaction as the others had done.

So, with many hearty handshakes and expressions of goodwill, we left the hall at the conclusion of the proceedings and returned to our home, where John and M'Allister were to sleep for the last time.

The next morning we sat discussing the final arrangements for their departure, as they would start on their return journey in two hours' time.

John and M'Allister were both much affected at my decision to stay upon Mars (or Tetarta, as it will be to me in future), for they did not like the idea of leaving me behind, and made some further attempt to induce me to change my mind on the subject. I felt, however, that they were really convinced I was doing the best thing possible in the circumstances, and had no hope that I would accede to their

request.

I told them my decision was unalterable, and that, as we all felt the poignancy of the parting, it would be better to take leave of each other now, rather than in public when they boarded the *Areonal*.

As they rose to say farewell I said, "John, my dear fellow, I have kept a record of all our doings since we left old England, thinking that, if published, it might prove of some interest to my countrymen.

"I have a few words to add to it, and also a letter to enclose for you to take to my solicitors; but Merna will hand the packet to you when you actually start. I know you will carry out my wishes and see the book through the press, although I have mentioned the tobacco and laughing-gas incident!"

John smiled and promised to do as I wished; then rising, I said, "So now, dear friends, a last and long good-bye to each other. We have been close friends for many years and have many pleasant memories of the times we have spent together; but, remember, our thoughts may still unite us, though sundered by many million miles of space, and dwelling upon different worlds!

"When I was on the earth I was living upon a star of the heavens; here, upon Tetarta, I am still upon a star of the heavens, but also along with the only living being to whom I have been united by ties of blood and loving kinship.

"It is, as Merna once said, only a change of

dwelling-places, and our kindly Martian friends are delighted to keep me here. It is hard to part from you, but do not wonder if I say—'Here I will live! here I will die!'"

Then with many, many a lingering handshake and words of mutual love and affection, we old friends bade each other an eternal adieu.

As he reached the doorway M'Allister—as truehearted a Scot as ever his country produced—turned towards me, and with upraised hand, glistening eyes, and lips quivering, exclaimed, "Mon, you are doing the right thing, but I never thought I would feel a parting with an old friend so much as I do this! God bless you, Professor!"

CHAPTER XXVIII

LAST WORDS TO MY READERS

As I have decided to stay here upon Mars, and have just taken leave of my two dear old friends, I will now address a few last words to those who may read this record of our trip to Mars, and then seal up the packet ready for John to take with him.

In the course of my conversations with Merna's tutors, I learnt much about the past history of the Martian people; and they told me that it dates back to such a remote antiquity that, as compared with

theirs, ours is only the history of an infancy!

Mars, being a much smaller globe than the earth, cooled down and became habitable æons before the earth reached that stage; and at the time when the earlier inhabitants of our world were living in woods and caves—slowly and painfully fashioning for themselves weapons and tools out of chipped flint-stones—there existed upon Mars a people who had then arrived at a full and vigorous civilisation.

What wonder then that, with all these past ages of development and the incentive which the present physical condition of the planet supplies them, the Martians of the present day are in all respects, whether physically, morally, or intellectually, far in advance of the inhabitants of our much younger, and therefore less developed, world!

The lessons to be learned from this, and from the physical conditions now prevailing on the planet, are very similar.

Mars, gradually, but inevitably, becoming a vast desert, and with the end of all things certain to arrive in a comparatively near future, pictures to us what must as inevitably be the fate of our own world ages hence, unless it come to an untimely end by some catastrophe.

As Professor Lowell has pointed out, we know we have an abundant supply of water at the present time, but we also know that, ages ago, the area of our world covered with water was immensely greater than it is now. From the very beginning of our

world's existence the process of diminution of the water area has always gone on, and it will still go on —slowly, surely, and continually.

As an inevitable result of this decrease of water, and other natural conditions, vast areas of land on both sides of our tropical zones have become deserts; and it is a scientific certainty that this process of desertism will, and must continue, until it covers the whole world.

But, I think, the end will long be delayed, for the loss by desertism will, as it seems to me, for ages be compensated by the new and habitable land arising from areas now covered by water. The old sea-beds upon Mars are now the most fertile areas upon that planet.

As the desertism increases conditions similar to those of Mars will arise; the earth will become more level, polar glaciation will cease, the atmosphere become thinner, and water vapour, instead of falling as rain, will be carried by circulatory currents to the poles, and there be deposited as snow. What the Martians have accomplished has shown us how to stave off the water difficulty, and also how a highly civilised and intelligent people can bravely and calmly face the end which they clearly foresee!

This is the lesson from the present physical condition of Mars.

On the other hand, the continual progress of civilisation upon Mars, and the very high development attained there, coupled with what we know of our own progress during the ages past, give

certainty to the hope that our own civilisation will continue to develop, slowly indeed, but surely; and also to the belief that, compared to what it will be in the future, our present stage of civilisation is merely savagery.

Development will lead to progress in everything which tends to increase the intelligence, wisdom, and happiness of the whole human race.

Our world has seen the rise and fall of many civilisations, but fresh ones have risen, phœnix-like, from the ashes of those which have departed and been forgotten. "The individual withers," but "the world is more and more." As it was in the past, so will it be in the future—ever-changing, ever-passing, but ever-renewing, until the final stage is reached.

Since the earliest dawn of our creation the watchword of humanity has been "Onward!" and it is still "Onward!" but also "Upward!!" The possibilities of the development of the human race in the ages yet to come are so vast as to be beyond our conception; for, as Sir Oliver Lodge has remarked, "Eye hath not seen, nor ear heard, nor has it entered into the mind of man to conceive what the future has in store for humanity!" Then:

> "Forward, forward, let us range,
> Let the great world spin for ever down the
> ringing grooves of change!"

This, then, is the great lesson which Martian civilisation teaches us. Surely it affords no reason for the depression and pessimism in which some upon

the earth are so prone to indulge; but rather should it stir them to a more earnest endeavour, by gradually removing the obstacles which now bar their progress, to improve the social conditions of the people; so that they in their turn may improve their intellectual conditions, and lend their aid to the general advancement of the world they live in.

Gloom, depression, and pessimism, of which we have had more than enough of late years, never yet helped any one. They have, however, proved disastrous to many.

Remember our world is young yet! so set before yourselves the great ideal of the brotherhood of humanity! Our religion teaches it; strive to help in attaining it; and in so doing each may, and will, achieve something to help forward the gradual evolution of a brighter and happier world for the generations that are to come. In that brighter and happier world I have faith, for:

> "I hold it truth with him who sings,
> To one clear harp in divers tones,
> That men may rise on stepping-stones
> Of their dead selves to higher things."

And:

> "I doubt not through the ages one
> increasing purpose runs,
> And the thoughts of men are widen'd with
> the process of the suns."

[*End of the Narrative written by Wilfrid Poynders, Esq.*]

CHAPTER XXIX

WHAT HAPPENED UPON OUR RETURN HOME —RESULTS OF THE MOST RECENT OBSERVATIONS OF MARS—PROFESSOR LOWELL'S IMPORTANT DISCOVERY

ADDENDUM

(*Written by John Yiewsley Claxton, Esq., of Norbury, in the County Borough of Croydon, Surrey*)

IN accordance with the desire of my old friend, Wilfrid Poynders, I am now about to publish the book which was handed to me by Merna on the morning of our departure from Mars.

I knew that my dear old friend's thoughts and aspirations ever soared towards the skies; but, as his last testament shows, his sympathies embraced all humanity, and I am somewhat reluctant to add anything which must necessarily bring the subject down to a lower plane.

As a narrative of his own personal experiences in connection with our trip to Mars, the Professor's work is quite complete; still I thought his readers would wish to know how it fared with his colleagues after they left Mars, and have accordingly appended a few pages furnishing this information.

I am quite convinced that, in deciding to remain behind on the planet, the Professor, as M'Allister remarked, "did the right thing"; but after the many years we have spent together in the closest and truest friendship, I miss him—ah, more than I can say.

It was really a tremendous wrench, that parting with my two old friends, the Professor and Merna, and leaving them behind on Mars, although I fully appreciated the Professor's desire to end his days with his dear son, to whom he had been so strangely reunited.

We started that morning directly after our farewell, and found a large concourse of people assembled, who had come from all parts of the planet to see us off.

Soranho and many other high officers of state whom we knew were present, and, of course, the Professor, Merna, Eleeta, and Siloni, as well as many others whom we had come to regard as personal friends; and they did not allow us to depart empty-handed.

Merna handed me the packet which the Professor had referred to. We had no formal farewell with the Professor—that was all over; but he came forward at the last moment, and we parted from him with a loving hand-clasp.

After a most affectionate leave-taking with our other friends, with whom I took good care to include Siloni, we boarded the *Areonal*. M'Allister at once took charge of the machinery, switched on the

power, and we immediately rose into the air, amidst shouts of farewell and repeated good wishes from the assembled multitude.

We rose rapidly; but, so long as we kept in view of the place, we could see the people still waving their adieus to us, and I frequently responded to their signals.

At last, when these lovable and hospitable Martians were lost to sight, I went into the *Areonal*, closing and bolting the outer door, which was never again to be opened until we reached our destination —our home in old England.

I have no doubt that, long after we lost sight of them, many of the Martians kept the *Areonal* in view with their telescopes, and followed its course far into space.

I then directed M'Allister to set our course for our own world; and when he had done so, he looked up at me and said, "Heh, mon, yon Martians are rare good folk, and I'm right sorry to leave them!"

"Yes, so am I, M'Allister," I answered. He again looked at me keenly, with a queer smile on his face; and remarked, "Mon, I'm thinking you are that, and that you have left something behind you!"

I knew he meant that I had left my heart behind me, for I was thinking the very same thing; but I turned away from him with a sigh, without answering. The matter was not one about which I cared to speak just then, for I felt very sad and heartsore.

Our journey passed off without any exciting incidents, everything on the *Areonal* working most satisfactorily. On the 4th February, 1910, we passed within forty-one million miles of the sun, and the heat at this stage of our journey was terrific, but we had a magnificent view of the sunspots, the corona, and other solar surroundings. In spite of all precautions for counteracting the tremendous pull of the sun, we were drawn considerably out of our direct course, so the journey occupied three days longer than we had anticipated. A large proportion of our time was spent in the air-chamber, in order to prepare us for breathing the atmosphere of our native world.

We passed across the orbit of Venus on two occasions, and had a near view of this splendid planet (and also of Mercury), for many days; but apart from its larger apparent size and intense brilliancy, we did not see anything more than we could from the earth with a good telescope. The dense atmosphere and its glowing light prevented us from seeing any definite details upon its surface.

Only three days late, we arrived at our home at Norbury on Monday the 21st March 1910, about an hour before daylight. We descended quite unobserved, and having stowed away our good ship *Areonal* in its shed and made all secure, we astonished Mrs. Challen by walking into the house very soon after she had risen.

She seemed truly delighted to see us back again after our long and unprecedented voyage through space, and as soon as our greetings were over she

asked, "Where is Mr. Poynders?"

I said we would tell her all the news whilst we had breakfast, so she bustled about and got the meal ready very quickly. When we sat down she listened with intense interest to our long story, expressing great astonishment when I told her about our discovery of Merna upon Mars. I had tried to keep her from asking about Mr. Poynders, but at length she questioned me so directly that I was compelled to answer, though I dreaded the effect the news would have upon her.

So, as gently as I could, I explained that Mr. Poynders, having found his son a native of Mars, could not risk bringing him to such a climate as ours, and, as he was unable to leave him, had decided to remain on Mars.

Poor Mrs. Challen was so upset upon learning this that she threw up her hands, exclaiming, "Then I shall never see my dear old master again!" and putting her handkerchief to her streaming eyes, she hastened out of the room to conceal her emotion.

I felt very sorry for her, as I knew she had a great respect and liking for Mr. Poynders, with whom she had been so many years.

During the day I called upon the Professor's solicitors, in accordance with his instructions, and handed them the letter he had entrusted to me. They read it with many exclamations of surprise, for the news it contained was enough to startle even staid lawyers out of their equanimity.

One of them rang a bell, which was answered by the managing clerk, who was requested to bring in the sealed packet of papers left by Mr. Poynders before he went away. This was quickly brought, and, when opened, found to contain documents settling an annuity of £150 per annum upon Mrs. Challen, a deed of gift of the sum of £200 to M'Allister, and another deed settling all the residue of his estate upon his old friend John Yiewsley Claxton.

There was also a will to the same effect, in case he might die before the papers were claimed; everything being properly signed and in due order.

The solicitors both shook hands with me, congratulating me on this substantial addition to my estate; but I told them I already possessed sufficient for my wants, and would greatly prefer that Mr. Poynders should be here to enjoy his own.

I gave them some particulars of our adventures, and we had quite a long chat; then, taking a cordial leave of them, I returned to Norbury.

I at once acquainted Mrs. Challen with her good fortune, but she was not to be comforted, saying she would very much rather have her old master back again; and, as this was exactly my own feeling in the matter, I expressed agreement with her.

However, she calmed down after a while, and I then asked her to consider what she would desire to do in the future. If she liked to remain in the house and look after my welfare, I should be very glad to have her as my own housekeeper; but said it was entirely for her to decide the matter, and she could

take her own time to do so.

She replied that she had neither relatives nor friends to trouble about, so there was no need to take any time over it, for she would only be too pleased to retain her old position, and would do her best to make me comfortable. I assured her that I had no doubt whatever upon that point; thus it was all settled there and then, and she has remained with me ever since.

My aunt was long since dead, but my two cousins, James and Timothy Snayleye, lived in London: so I thought I would go over to apprise them of my return home. They, however, received me so very coldly that, beyond saying I had been to Mars and back again, and giving a few details of what we had seen there, I did not tell them very much.

They asked a few questions now and then, but evinced very little interest in my affairs, though I noticed them frequently exchanging nods and winks with each other. I soon left, but after such a reception, was rather surprised when James Snayleye walked into my house the next day and asked to be allowed to call in a day or two and bring with him a couple of friends who were interested in Mars, and would like to hear anything I could tell them. I did not altogether care about discussing my adventures with entire strangers, but, as he was so very pressing, in the end I agreed to see them.

When they arrived I was greatly surprised to find that, instead of being persons of about the same age as my cousin, both were elderly men. One was

introduced to me as Mr. Josias Googery, a Justice of the Peace, and the other as Dr. Loonem.

We had no sooner sat down than the doctor started the conversation by asking, in an unctuous tone of voice, several questions about my trip —"Whether, ah, it was really true that I had, ah, travelled all the way to Mars and back again in, ah, a vessel of our own construction?"

All the time he was speaking he was performing the operation known as "washing the hands with invisible soap," a trick which always has an irritating effect upon my nerves.

In answer to his question I said, "It was quite true that I had been to Mars," and mentioned a few particulars of our trip.

Mr. Googery then put a few questions to me, and, as I replied, he interjected after almost every sentence that I spoke, "Ah! h'm, yes, just so," James Snayleye sitting by all the time with a sneering grin upon his face which I found very aggravating.

When I had told them as much as I thought necessary, they both started cross-examining me in such an impertinent and sceptical manner that at length I became extremely irritated, and declined to answer any more questions. Whereupon Dr. Loonem proceeded to wash his hands again, saying in an oily manner, as though addressing a child, "Pray, ah, don't excite yourself, my dear sir; don't, ah, excite yourself! You know, ah, it's not good for you!"

This was too much for flesh and blood to bear, so

I rose and said that as I had an important engagement to attend to, I could not spare any more time that day, at the same time ringing the bell for Mrs. Challen to show them out.

She did so, and returned in a state of indignation, saying, she did not like those people at all, they were so rude; and that as they were passing through the doorway she heard the doctor say, "It's a clear case enough; did you notice the gleam in his eyes? that alone is sufficient to settle it!" To this Mr. Googery had replied, "Ah, h'm, yes, just so!"

"Well, Mrs. Challen," I said, "please understand that if either of those people calls again, I am not at home."

"Certainly, sir," she answered with great alacrity, as she went out of the room.

It was no mere excuse, but perfectly correct, when I told those people I had an important engagement to attend to. An old friend of mine, Sir Lockesley Halley, was President of the Dedlingtonian Astronomical Society, and, after hearing my account of Mars, said he would be very glad if I could attend the meeting of his Society on the following evening and give a short address on the subject.

I was rather averse from this, as the Society was not a large one, though it had several clever men in it, and I knew that the professionals who controlled it, and also the majority of the members, prided themselves on being exponents of what they termed "sane and unsensational astronomy"; which in some cases amounted to saying that they were a long way

behind the times.

It is an interesting fact that we owe a large proportion of our knowledge of planetary detail to the work of enthusiastic amateur observers. In this Society, indeed, nearly all the best observational work was done by the non-professional class; and when, as the result of their systematic and painstaking work, they noted on their planetary drawings some lines or markings which had not previously been recorded, one would have thought their original work would have been commended. It was, however, not unusual in such cases for a professional to rise and calmly declare that the new markings were only illusions, such as he had often predicted would be claimed as discoveries.

Thus the amateurs were kept in their proper places; but the professionals did not always prove to be correct in their strictures and pronouncements.

In these circumstances, I did not expect much credence to be given to anything fresh that might be stated in my address, and therefore I rather demurred to Sir Lockesley's proposal. He, however, made such a personal matter of it that, as he was an extremely able man and a good fellow, I at last consented to do as he wished.

M'Allister accompanied me to the meeting and sat among the audience. After a few introductory remarks from Sir Lockesley, I gave my address, which lasted about half-an-hour; but it was received even more chillingly than I had anticipated, and the few comments made by the members were nearly all

indicative of scepticism of my statements and unbelief in my *bona fides*. A scientific audience is usually rather cold and unenthusiastic; but, in the present case, except for one or two isolated hand-claps, the vote of thanks was allowed to pass *sub silentio*. Sir Lockesley, of course, could not help this, and I saw that he was much annoyed at my reception.

The meeting then split up into groups, lingering here and there to discuss my statements as they moved toward the door; and M'Allister told me that, as he stood near a group, he heard one man exclaim, "It's all arrant nonsense! five minutes with my $12^{1}/_{16}$-inch reflector would convince any sane man that there are no fine lines to be seen on Mars, because none exist!" This brought a murmur of assent; then some one else said, "Well, I certainly see some of the lines with my $7^{1}/_{2}$-inch, but regard them as illusions"; and he also received some support.

Another man then spoke up, remarking, "My experience does not agree with yours, gentlemen, for when I used a 6-inch refractor I could see some of the lines, yet felt doubtful of their actuality; but since I have used a 12-inch reflector my opinion has entirely changed. The lines are visible whenever the atmospheric conditions are favourable, and are seen with so much certainty that I have long abandoned my doubts of their representing real markings!" "Hear, hear!" said several, "and in a clearer atmosphere you would see still more!"

This was the Martian controversy in a nut-shell: for so much depends upon individual eyesight,

instrumental power, and good atmospheric conditions. Even the finest instruments fail when observational conditions are unfavourable!

Many other people to whom I spoke about my trip to Mars exhibited the same incredulity as those at the meeting. I showed two persons, whom I thought would be open to conviction, some photographic views in their natural colours, which I had brought home with me. One of them looked at the pictures, then handed them to his friend, with the remark: "Clever fakes, aren't they? you can do almost anything with the camera nowadays!"

Similar opinions were either expressed or implied by others who saw them, so now I keep all such things to myself.

Two days after the meeting Sir Lockesley called to have a chat with me, and, whilst we were conversing, Mrs. Challen announced that two men insisted upon seeing me, although she told them I was engaged.

"Well," I said, "show them into the next room and I will soon dispose of them"; then asking Sir Lockesley to excuse me a few minutes, I passed through the folding doors which separated the two rooms.

The men were perfect strangers to me, and clearly not of a class with which I should care to make acquaintance.

"To what do I owe this visit?" I inquired, as I entered the room.

"Beg pardon, sir," said one of the men, "but we wished to see you on urgent business, and ask you to come with us. There is a carriage at the door!"

"But who are you, and where do you wish me to go?" I inquired.

He hummed and haa-ed, then said, "A friend desired to see me at once, and it was only a short journey!"

"Well," I replied, "I am at present engaged with a gentleman, but I must certainly decline to accompany you at all without further and definite particulars as to why you wish me to do so."

Then the other man advanced, and said, "As you won't come quietly, there's no help for it; so just look at these papers and you will see you must come!"

He showed me several documents, and, on reading them, I was astounded to find one was an order for my removal to a private lunatic asylum, the papers being signed by Josias Googery, J.P., and Dr. Loonem; and others contained statements of the evidences of my insanity, signed by my two cousins.

Of course I was furious, and refused to go with them, whereupon they rushed forward to seize hold of me. I shouted for Sir Lockesley to come to my assistance, and he at once dashed into the room. The two men, however, immediately warned him not to interfere, as they were acting in a perfectly legal manner.

This he had to admit when the matter was fully

explained to him; then he urged me to accept the situation and go quietly, and he would take immediate action to secure my release.

As it was clearly useless to resist a legalised process, I gave in, and thus was I, a perfectly sane man, incarcerated in a lunatic asylum! There I had to remain while Sir Lockesley saw my solicitors, communicated with the Commissioners in Lunacy and others, and after much correspondence and innumerable interviews, at last secured my release; but not until I had endured more than a week's confinement in that horrible place.

It was all a scheme concocted by my scapegrace cousins to have me declared insane, and thus secure control of my fortune, they being my only living relatives. But for Sir Lockesley's presence and influence their precious plot might have proved quite successful.

I do not attach much blame to the magistrate and doctor, although they might have exercised more care; but no doubt the Snayleyes had made such suggestions to them that they were prepared to find insanity in anything I did or said.

Mrs. Challen, who had been much affected and distressed at my being carried off in this fashion, was delighted when at last I returned home safe and sound after my release, and told her the trouble was all over.

M'Allister had intended going on to Glasgow during the previous week, but had remained at home at Norbury to assist in securing my release; doing

yeoman's service in seeing various people and carrying messages. When things had quite settled down again he went to Scotland and stayed with his wife for three weeks.

Upon his return we discussed our future arrangements, and agreed to become partners for the purpose of securing and working patents for various machines which we had studied upon Mars; and this has proved a lucrative business for us, besides supplying our engineers and manufacturers with greatly improved machinery.

Ever since our return home we have eagerly read all the scientific news concerning Mars that has been published, for we were anxious to learn whether there had been any verification of the Professor's forecasts as to what was likely to be seen from the earth at the opposition of Mars in 1909. The result is very gratifying to us, not only as proving the correctness of the Professor's pronouncements, but also as testifying to the keen-sightedness of some of our astronomers and their carefulness and accuracy as observers; though, of course, there are still divergences of opinion as to the meaning of what has been seen.



Drawn by T.E.R. Phillips

Plate XV

Mars, as seen through a 12-inch Telescop

The south polar snow-cap is seen at the top, and as it is early June on th dark line across it is a wide rift, the ice having commenced to break up at tl the melting snow. The circular light area near the centre is "Hellas," and the protuberance usually seen on the eastern side of Syrtis Major has this year a anywhere.

For instance, M. Antoniadi, of Juvisy Observatory, near Paris, has published a very interesting account of his own observations with the fine Meudon refractor, which has an object glass 32.7 inches in diameter; and he has also furnished several beautifully executed drawings of what he has seen. The most noticeable new features observed were two large detached pieces of the south polar snow-cap, the altered shape of the Solis Lacus and other dark areas, numerous dark rounded spots on the dark areas, much detail along the lines of the canals, and the observation of scattered markings instead of lines.

M. Antoniadi lays great stress on the advantages of large telescopes; and, whilst making frank admission that the drawings of Professor Lowell show the outlines of the Martian details more accurately than the drawings of any other observer, he dissents entirely from his views respecting the actuality of the canal lines.

With regard to M. Antoniadi's observation of dark rounded spots, it has been suggested by another writer that these are volcanoes, and, moreover, that the canal lines are really cracks in the solid ice covering frozen oceans and seas. These contentions involve the supposition that Mars is still in the stage when volcanic action is prevalent, and also that what have hitherto been supposed to be desert lands are really fields of ice. Mars has passed far beyond the stage of volcanic activity; and the theory does not account for the ochre colour of the frozen oceans, which are exactly the same colour as our deserts

appear when viewed from a great distance, for the sandstorms so frequently observed, nor for the general absence of any indications of frost over a large portion of the Martian surface. It is also very difficult to imagine the existence of a profuse growth of vegetation along cracks in solid ice; and I am afraid this theory, like many others, fails to fit in with the observed facts.

I may remind my readers that the Professor suggested that many more dark rounded spots would, under favourable conditions, be discovered on the dark areas of the planet, and he has stated what they are.

As a result of his recent observations, M. Antoniadi has boldly declared that the supposed canal lines are really separate spots and markings which, when seen with instruments of lesser power than the one he used, appear to be lines, the network of canal lines being an illusion. He contends that the markings he has seen are beyond the power of Professor Lowell's telescope to resolve, and that what he has seen forms an unanswerable objection to the canal theory and stops all discussion!

This argument has, however, been fully met in this book by anticipation; and, as will be seen later on, Professor Lowell completely refutes it and shows that M. Antoniadi is mistaken. It has also been pointed out that, if we could secure perfect seeing, the lines might really appear as separate markings, and that apparent breaks and irregularities are exactly what we might expect to find in connection with canals. I gather from a recent remark made by

Professor Lowell that he also holds this view.

Moreover, a discreet silence is observed with regard to the progress of vegetation on Mars being from the poles towards the equator, instead of from the equator towards the poles, as is the case on our earth.

This mode of progression can only be accounted for by the flow of water from the poles, and such flow extending beyond the equator involves the artificial propulsion of the water, as the flow is contrary to gravitation.

Professor Lowell's statements as to this peculiar growth of the vegetation do not depend upon the results of a few casual observations, for he has given the matter most systematic and prolonged attention, and noted upon hundreds of charts the dates when the vegetation has first appeared in various places and latitudes after the passage of the water down the canals.

This is such a hard nut for the opponents of the canal theory to crack, that I am quite prepared to learn that all these careful observations are merely illusions.

Professor Hale, of Mount Wilson Observatory, in California, has taken some photographs of Mars which do not show any canal lines; and these have been eagerly seized upon as another proof that the canals have no existence.

Unfortunately, these photographs do not show many well authenticated details which are seen with

comparative ease, nor the new details seen by M. Antoniadi. It is, therefore, no matter of wonder that they do not show the much fainter canal lines. If the absence of the canal lines from the photographs is proof that the canals do not exist, then the photographs must still more emphatically prove that these much more conspicuous details—which have been seen and drawn by M. Antoniadi and scores of other observers—are also illusions and have no objective existence. Those who seek the support of these photographs for their views must be left to extricate themselves as best they can from the dilemma in which they are now placed in regard to the observations and drawings of those highly skilled observers.

The photographs were taken with a sixty-inch telescope, and possibly this very large aperture was not stopped down sufficiently to secure on the photographic plates such very fine detail as the canal lines; on the other hand, the atmospheric conditions at the moments of exposure of the plates may have been unfavourable for good definition. However good the photographs may be, the deductions drawn from them are erroneous.

Against such purely negative evidence—which never affords good ground for argument—we must set the positive evidence of Professor Lowell's numerous photographs, which do show many of the canal lines and also confirm the drawings of observers.

Professor Schiaparelli, who has been appealed to on the subject, still maintains the objectivity of the

canal lines which he was the first to discover, and repudiates the suggestion that the new photographs supply any evidence against them. He remarks that during the last thirty years many other astronomers, using more perfect telescopes than his, have observed and drawn these canal lines, and have taken photographs which reproduce an identical disposition of the lines. He adds that a collective illusion on the part of so many astronomers is impossible, and that the photographs which do show the canals cannot be illusions.

Professor Lowell controverts M. Antoniadi's claim to have proved that the lines are non-existent, and that the only markings are small separate shadings which are illusively seen as lines. He points out that what M. Antoniadi has seen is exactly what would be seen when using a very large telescope, and that it indicates poor seeing instead of good definition. He remarks that when using such large instruments, which are so much more affected by atmospheric conditions than smaller ones, the diffraction rings round a star (which should appear as complete concentric circles) begin to waver, then break up into fragments—a sort of mosaic—and finally end in an indiscriminate assemblance of points. In certain kinds of bad seeing the parts may seem quite steady, but the fact that the mosaic exists is proof positive of poor seeing. What happens to the rings in such circumstances must also happen to fine lines! the mosaic effect seen by M. Antoniadi is therefore "the exact theoretic effect that a large aperture should produce on continuous lines, such as the canals, and always does produce in the case of the rings in the

image of a star!"

It has been stated that Professor Lowell had admitted the illusory nature of the canal lines. His reply, however, is emphatic: "I have never made any retractation as to the reality and geometricism of the canals; they are marvellous beyond conception, and are only doubted by those who never observed the planet itself sufficiently well."

Seeing an announcement that Professor Lowell had arrived in England for the purpose of lecturing on "Planetary Photography" at the Royal Institution of Great Britain, M'Allister and I made up our minds to be present at the lecture, a resolution which, I am glad to say, we carried into effect.

In the course of his lecture Professor Lowell gave an account of the methods of planetary photography initiated and carried on with such success at the Lowell Observatory; and then proceeded to give some interesting particulars of his observations of Mars at the opposition of 1909, which resulted in one of the most important discoveries ever recorded in connection with that planet.

He stated that on the 30th September, 1909, when the region of the desert to the east of Syrtis Major came into view, after its periodic six weeks' invisibility due to the unequal length of the days of the earth and Mars, some long new canals were plainly observed which had not been visible when the region was previously in view. A long and careful investigation of fifteen years' records proved absolutely that not only had these canals never been

seen before, but that they could not have existed. They are on a region which is frequently very favourably situated for observation, and could not possibly have been overlooked, for they are now the most conspicuous objects on that part of the planet. It is beyond question that they are not only new to us but new to Mars!

The two main canals run in a south-easterly direction from Syrtis Major, and with them are associated two smaller ones and at least two new oases; while, from their inter-connection, they are all clearly parts of one and the same addition to the general canal system; for they now fit in with the system as though they had always formed part of it. These new canals were not only seen and drawn, but several photographs were taken at different times.

Consider what this great discovery really means! In a region which has never been anything but a desert during the whole period over which our observational knowledge of Mars has extended, there are now strips of land many hundreds of miles in length and miles wide that have become fertile almost under our very eyes; and this result has been brought about by the passage through them of water which has artificially been carried there for the purpose of irrigation! We know this is so, for what we see is the growth of vegetation; and the systematic way in which the new canals have been fitted into the existing canal scheme proves the artificiality of the whole system.

Some sensational statements in the Press have fostered in many minds the idea that all these

hundreds of miles of new canals were constructed within the very short period of six weeks! This is altogether wrong. It is the *vegetation* that has *grown* in six weeks, in consequence of the turning on of the water to the irrigation works. We have good scientific reasons for believing that irrigation works on Mars could be accomplished much quicker than on the earth; but, as the telescope does not enable us to see the works, we do not know how long they may have taken to construct. It may have been months, or years. We only see the *results* of the works when actually in operation.

When we consider these works and their results, surely it becomes impossible to resist the evidence of intelligent design which they furnish; while if we also remember the very recent development of these canals, the existence of life upon Mars at the present time seems to be demonstrated beyond the possibility of reasonable doubt! In what physical form that life is enshrined even our science must fail to reveal. Professor Lowell, however, pointed out that the inhabitants of Mars are not necessarily human beings, but their work clearly proves that they are beings endowed with a very high degree of intelligence. A study of the canal system reveals a marvellous conception marvellously carried into effect.

Observers at Flagstaff have, therefore, practically seen the completion of a work which is the creation of intelligent beings on Mars; and in the remarkable photographs shown we were, so to speak, able to look upon the results of that work—fertility in a

region which had previously been an arid desert.

The water, as the lecturer remarked, was probably not in all cases conveyed by means of canals dug out of the soil, but we know that in some way—whether by canals, or by trunk lines of pipes and smaller subsidiary pipes, or otherwise—the land has been artificially irrigated and fertilised by water, which could not possibly have taken the course it has without being intelligently directed. Tunnelling would be easy on Mars.

Professor Lowell spoke of these matters in well-weighed and well-chosen phrases, which carried conviction of his earnestness and sincerity to the minds of his hearers; and we observed that the audience was evidently profoundly impressed by the importance of his statements. This fact seemed to us very significant, as he was addressing one of the most brilliant assemblies—representing many branches of science—ever gathered within the walls of the Royal Institution. The numerous photographs showing the Martian canal lines were projected on to the screen by a lantern, and thus their convincing evidence was clearly brought before the whole of that vast audience.

Another very interesting series of photographs showed the coming and going of the first frost of the season in the antarctic regions of Mars. This frost was first observed and photographed at Flagstaff on the 16th November, 1909, and other photographs were taken on the 22nd of that month.

In connection with these, Professor Lowell

quaintly remarked that, "To chronicle thus the very weather on our neighbour will convince any one that interplanetary communication has already commenced; and that, too, after the usual conventional manner by mundane greetings."

Referring to the photographs, it was pointed out that the human eye can see at least ten times as much as a photograph can show as regards planetary detail. This, though not generally known, is perfectly true, and it may be explained thus: We know that in terrestrial photography the camera will reveal many details which the eye is apt to overlook; and, by very long exposures, even celestial photography will give a similar result. In *planetary* photography, however, exposures must be very short, and the picture obtained is so very tiny that it cannot show all that the eye could see. Under good conditions, therefore, the eye at the telescope will always see immensely more of the finer details on a planet than any camera could show.

The great value of the photographs of Mars lies in the fact that they demonstrate beyond the possibility of doubt the existence of certain fine markings which many observers have seen and drawn, but as to the reality of which others, less skilled or less favourably situated, have been extremely sceptical. If the fine lines had no existence on the planet they could not be photographed.

In drawing attention to the details on these photographs Professor Lowell emphatically declared that, "The lines you see are '*certainties*,' not matters

admitting of the slightest question, for all their strange regularity. Not only I, but all my assistants, have seen them thousands of times the same, and sometimes with all the clearness and sharpness of etchings or steel engravings.

"An optical mistake," he then remarked, "which has latterly been hailed as showing that the lines were not lines but a series of dots, was made the other day in France. The observer saw perfectly correctly, but one with knowledge of the optics of a telescope should have known that the effect observed was the inevitable result of using an aperture which the seeing did not warrant; as he could easily have assured himself by looking at the shattered rings round the synchronous image of a star."

It may here be pointed out that these weighty and well-considered declarations—which are a complete answer to M. Antoniadi's bold claim—were made by the most experienced observer of Mars, who, as even his opponents admit, possesses the finest site in the world for his astronomical work, and is equipped with a very perfect instrument.

Besides the splendid photographs of Mars, many views of Jupiter and Saturn were shown, exhibiting clearly numerous fine details, markings, and wisps as to which much doubt had been expressed when some observers had shown them on their drawings. These beautiful and convincing results of the clever and original methods of planetary photography adopted at Flagstaff appeared to come as a complete revelation to the majority of those present, notwithstanding their scientific experience.

Probably never before had anything so wonderful as these results of skill, patience, and prolonged research been exhibited, even in that great and historic home of science. As Professor Lowell remarked in a fine peroration: "They exhibited something of the advance recently achieved in our knowledge of solar science; on the other hand, they constituted in themselves the beginning of a set of records in which the future of the planet might be confronted with its achieved past, and which should endure after those who first conceived such registry had long passed away.... They were histories of the planets written by themselves—their autobiographies penned by light; and in their grand historical portrait-gallery astronomers yet to come might see the earlier stages of the great cosmic drama which was slowly but surely working itself out!"

At the conclusion of this most interesting lecture M'Allister turned to me and said, "How I wish our old friend the Professor could have been here to-night; he would have keenly appreciated what we have heard."

"Yes, he would indeed," I answered; "but remember, he knows more now than any one we see here could tell him about Martian matters!"

Before concluding, it may be of interest to state that Professor Lowell still maintains the accuracy of the discovery made at Flagstaff that the existence of water vapour on Mars is demonstrated by the photographic spectrum of the Martian atmosphere; and he asserts that the attempt to disprove it has failed. A further discovery has since been made at

the same observatory, viz. that oxygen also is present in the atmosphere of Mars!

During the observations in 1909 several observers noted that, at times, very large areas on the surface of Mars had been so obscured by a yellowish veiling that all details were entirely blotted out. The announcement of this fact gave rise to sensational statements that a terrible catastrophe had occurred on the planet. The explanation is, however, very simple—seasonal mists arising from the canals, with the addition of clouds of sand particles in the upper air, as the result of desert sandstorms, caused a temporary obscuration of certain parts of the planet as viewed from the earth. Only this, and nothing more!

We have been interested to note that an English observer, the Rev. Theodore E.R. Phillips, has observed some new details on Mars in the region where the new canals were discovered. Mr. Phillips has in past years given considerable attention to this region, and observed several changes in the Lacus Mœris, to the east of Syrtis Major. The lake disappeared altogether for some considerable time, then reappeared. Last September he saw it again, and it was evident some further changes had occurred; and he also saw some dusky shadings on the adjacent desert of Lybia. There seems little doubt but that he actually saw, though imperfectly, the new canals which Professor Lowell's much clearer atmosphere and larger instrument enabled him to see clearly.

From what has been related in the last few pages it will be seen that many of the forecasts, as set forth

in this book by our old friend the Professor, and his statements as to the Martians being actively engaged in altering, extending, and developing their canal system, have been amply verified by the observations of our astronomers; and I am confident that his other prognostications will also be fulfilled in course of time.

Turning now from scientific matters to others affecting ourselves personally, I may say that I have heard nothing more of my cousins the Snayleyes; and, after the failure of their mean attempt upon my liberty and fortune, it is not likely that I shall again be troubled by them, for they will naturally take good care to keep out of my way.

As the days and weeks pass by I often think of those we left behind upon that far distant world: wondering how they are faring, and whether they have attempted to transmit any influences or communications to us, for up to the present we have not been conscious of any such influences.

Kenneth M'Allister is a thoroughly happy man, as he is working for his own benefit, congenially and fully occupied with matters connected with his beloved machinery. He is on the high road to making a very large fortune; indeed, we are both doing remarkably well, and are, therefore, able to give financial aid to many projects in which we are interested, having for their objects the uplifting of the people, and the improvement of social conditions generally. It was only yesterday that M'Allister remarked to me, "Heh, mon, if we continue to go ahead at the same rate as we are going now, we shall

both be millionaires before very long!"

Yes, we are doing well—there is no doubt about that; but, notwithstanding my present very satisfactory circumstances and the certainty of a brilliant future if I stay here, ideas have long and persistently been running in my mind that it would be far better for me to go back to Mars, and—by Jove! strange indeed that I never thought of it before!—perhaps those very persistent ideas are actually the outcome of Martian influences!!

The wonderful music I heard upon Mars still rings in my ears; and, at times, so thrilling and peculiar is its effect upon me, that I feel as though I were being almost irresistibly impelled to return to that planet. Well, I should very much like to see the dear old Professor and Merna again, and also my many Martian friends. Then there's Siloni, whom I can never forget, for mentally her image is ever before me. What a nice girl she was! If I were to return to Mars, I wonder whether——?

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FOOTNOTES:

[1] The exact diameters of the planets are difficult to measure owing to irradiation, and estimates of various authorities differ, especially with regard to the more distant planets.

[2] Most probably the larger planets possess satellites which have yet to be discovered.

[3] It is not yet ascertained with certainty whether Mercury and Venus rotate in about twenty-four hours, or whether the period is the same as that of their revolution round the sun. The evidence seems to point to the latter period.

[4] The "terminator" is the boundary between the lighted and the dark portion of the disc.

[5] Those who have seen the undercliff in the Isle of Wight will be able to form some idea of the terraces of the lunar ring-mountains, as they are very similar formations.

[6] This is the case as regards separate satellites; but it may be pointed out that a similar thing must occur in regard to the rings of Saturn. The rings are composed of swarms of satellites so small that they can only be termed particles, and these particles at the inner edge of the "crape ring" revolve round Saturn in 5 hours and 33 minutes, the inner edge of the ring being only about 47,000 miles

from the centre of the planet. The planet itself revolves on its axis in $10^1/_4$ hours. Thus, an immense number of these minute satellites must revolve round the planet in less time than it takes the planet to make one rotation. It is calculated that the particles in the outer edge of the next ring complete one revolution round the planet in 14 hours and 28 seconds.

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