The Man Who Annexed *the* Moon

By Bob Olsen

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IT is only natural that the moon, being the body closest to the earth, should be of particular interest to those writers and dreamers who believe in the possibility of interspace travel. Beyond a doubt the author of "The Man Who Annexed the Moon" is a student of higher mathematics and Einstein, but far from being pedagogic in his story, Mr. Olsen gives us a truly ingenious tale of lunar adventure and travel across the vacuum of space, presenting it all in a thoroughly plausible and easily assimilative manner.

CHAPTER I

Banning's Astounding Proposal

"BOYS! How would you like to accompany me on a voyage of exploration to the moon?" The speaker was Professor Archimedes Banning, and the "boys" to whom he addressed this nonchalant but startling proposal were Colonel Charles Berglin and myself.

Judging from the expression on his face, Berglin was surprised. Not I, however. I had known the alert, though elderly scholar too long and too well to be astonished at anything he said or did.

Professor Banning was a scientific Alexander the Great. No matter how amazing or how stupendous were the feats he accomplished, he was always looking for new worlds to conquer.

To savants throughout the world, Professor Banning was known as *the* authority on the fourth dimension and non-Euclidian geometry.

The general public, however, knew him best as the inventor of the *Spirit of Youth*—the first successful space flyer.

You will doubtless recall the intense interest and excitement which was engendered throughout the world several years ago when the *Spirit of Youth* made its epochal flight around the moon. On that occasion the space flyer, after circumnavigating the moon, had returned to the earth without stopping.

Despite the fact that no landing was made on our satellite, this unprecedented feat demonstrated beyond question the feasibility of interplanetary travel.

The event was all the more notable because the *Spirit of Youth* was piloted by no less a personage than Colonel Charles Berglin, the most famous aviator that had ever lived. Professor Banning acted in the capacity of interplanetary navigator.

It was somewhat of an accident that made it possible for me—an obscure nonentity—to accompany this famous pair on their memorable journey.

Shortly after he had resigned from his position as Professor of Mathematics at Green University in my native state of Rhode Island, Professor Banning had employed me as a sort of mechanical obstetrician for the inventions which were constantly being born in his fecund mind.

I was selected partly because I was a graduate mechanical engineer, but principally on account of the special work I had done in the more advanced and complex branches of mathematics.

Thanks to what Professor Banning was kind enough to call a rare combination of mechanical skill and the ability to grasp the complicated principles and formulas of pure mathematics, I was lucky enough to get this desirable job.

Professor Banning insisted on placing me under a contract. By its terms I received a very satisfactory salary whether or not there was any work for me to do. But the pecuniary compensation was the least of the benefits I derived from this connection. My close association with the learned scholar, besides being a source of pleasure, was a liberal education in itself.

When Professor Banning had broached to Berglin and me his intention of conducting a second expedition, this time landing on the moon and exploring its surface, Berglin's answer was characteristically brief and courageous: "O.K. with me, chief. If you feel sure it can be done and you want my help, you can count on me."

To me was left my customary rôle of critic and objector.

"Do you really think it is possible to alight on the moon?" I questioned. "How are you going to land without crashing when there's no atmosphere to support the airfoils?"

"That's easy," was the Professor's come-back. "We'll use the rocket tubes at the front and bottom of the flyer as brakes. There's absolutely no reason—either theoreti-


¶ To say that what happened next surprised me would be putting it mildly. Before I realized it, I found myself shooting away from the Amundsen at an alarming rate of speed. . . . I was probably at least a mile away from the space flyer, with the gap between us widening constantly.

cal or practical—why we shouldn't light as softly as a feather."

Perhaps I should explain, for the benefit of those who may not have given close attention to the newspaper accounts of its maiden voyage, that the *Spirit of Youth* combined the principle of an airplane with the addition of rocket tubes, which were used for navigating the airless space between the earth and the moon.

MY second question was: "How about taking off from the moon on the return trip?"

"Again we'll use the rockets. You probably know that on the moon everything is much lighter than on earth; consequently the hop-off from the moon ought to be the easiest part of the entire trip."

"But the space surrounding the moon is a perfect vacuum, isn't it?"

"Hardly a perfect vacuum, I'd say. That the moon has no atmosphere even comparable to the more rarefied air at the tops of the earth's highest mountains has been proved beyond the shadow of a doubt, but most authorities believe that the moon has a very slight amount of gaseous envelope. The nearest approach to a vacuum obtainable under the bell jar of a mechanical air pump would probably come pretty close to duplicating the atmosphere of the moon."

"If that's the case, how could we get the door of our flyer open without losing all the air from inside the cabin?"

"I'm surprised at you—supposedly a mechanical expert—asking a question as stupid as that. Haven't you ever heard of air locks? Don't you know it is a simple matter to devise a small chamber with one air-tight door communicating with the cabin and the other with the space outside? Do I need to go any further?"

"No," was my shamefaced reply. "I'll have to admit that was a dumb question, but here's one that I hope you won't think quite so stupid: 'If people have nosebleeds, hemorrhages and become violently ill, just from being in the rarefied atmosphere of high altitudes on earth, what would happen to us if our bodies were surrounded by an almost perfect vacuum? Wouldn't we just blow up and burst—just like the deep sea fishes do when they are suddenly drawn from the high pressures of the ocean's depths to the relatively low pressure of the earth's atmosphere?'"

"That's much better, my boy. I'm glad to see you have some intelligence left. It is quite possible that something like that would happen if we attempted to step forth on the moon without adequate protection. But I've already designed a species of armor or vacuum suit that will easily take care of this contingency. I'll tell you all about it later. Are there any other objections?"

The only one I could think of was: "A contraption strong enough to protect a man against the terrific forces to which he would be subjected would have to be pretty heavy, wouldn't it?"

"Not necessarily, as I shall demonstrate to you shortly. My device ought not to weigh more than two hundred pounds. But suppose it weighs half a ton, what of it?"

"How in the world could anyone but a professional strong man manipulate a weighty and cumbersome contrivance like that without help?"

"If we tried to use such a suit on earth it would indeed be difficult. But don't forget that everything weighs less on the moon. This is due to the fact that weight varies directly with the mass of the attracting body. The moon has only about one-thirteenth as much volume as the earth. On the other hand, the moon is made of lighter material. Using water as the standard, the density of the earth is five point five three and that of the moon only three point three six. From this you can easily figure out that the force of gravitation on the moon is only about one-sixth as great as on the earth.

"This means that if you, when dressed in full armor, weighed one thousand pounds on the earth, you would find it as easy to move around on the moon as if the whole outfit, including yourself, weighed only one hundred and eighty pounds.

"You weigh a hundred and fifty pounds, don't you?"

"A hundred and forty-eight."

"It wouldn't be much of a job for you to carry a load of thirty-two pounds, would it?"

"Hardly."

"But you won't even have to do that. I'm confident that we can make a suit that will do the work and will weigh less than two hundred pounds. That will make you actually weigh about sixty pounds when you start your promenades on the moon. You'll be more likely to be bothered because you'll be too light rather than too heavy, or I miss my prognostication.

"And now have I answered all your questions satisfactorily?"

"Yes, Professor. I'm satisfied."

"If that's the case there seems to be no reason on earth—or on the moon either—why such an expedition is not entirely feasible.

"And think of the glory! What we have accomplished so far is nothing compared with the honor of being the first men to set foot on the moon!"

The professor's enthusiasm was so contagious that there was no escaping the infection. The inevitable happened, of course. Both Berglin and I pledged our support to Professor Banning's enterprise and we immediately started work carrying out the details of his well thought-out plans.

CHAPTER II

The Banning Space Flyer

SINCE the *Spirit of Youth* had demonstrated its efficiency as a space flyer by completing the round trip between the earth and the moon, I naturally took it for granted that our second voyage would be made in the same conveyance.

But Professor Banning had other plans.

"The *Spirit of Youth* is a fine machine," he told me one day. "It was built for a certain purpose and it served that purpose well. But the present task is somewhat different. Our first trip through interplanetary space taught us several lessons and we'd be foolish if we didn't profit by them. I therefore propose to build a brand new space flyer, specifically designed for transportation between the earth and the moon."

Constructing a large machine of original and revolutionary design naturally required a lot of time and cost a lot of money, but neither of these items seemed to bother Professor Banning. Thanks to the royalties which for many years had accrued from the sale of his mathematics text books, augmented by the income from a number of sage investments, Professor Banning was independently wealthy.

For building those portions of the ship which were of conventional pattern, such as the fuselage and landing gear, we used the staff of the Bryan Aircraft Corporation at San Diego, which had been placed at our disposal.

Most of my time was spent in working out the mechanical details of the unique features of the flyer.

While built somewhat on the plan of a large airplane of the enclosed cabin type, our space flyer embodied several revolutionary and peculiar features. One of these was the unusually small proportions of the airfoils, which were less than one-third the ordinary size. Theoretically, we could have dispensed with wings entirely, since the rocket principle of propulsion did not require them. The reason why Professor Banning included small wings as part of his design was that by their aid our craft could be handled more easily and at a much smaller consumption of fuel during the passage through the earth's atmospheric envelope.

The most radical departure from standard airplane design was the elimination of the propeller and of the internal combustion motor. In their place were substituted a system of rocket tubes and combustion chambers which were so simple and so light that they made possible a substantial increase in the pay load.

To the selection of a suitable fuel Professor Banning devoted a great deal of study and research. After he had made hundreds of unsatisfactory tests with various types of gases, volatile liquids and other substances, the problem was solved for him in an utterly unexpected way.

Through a small item in a local newspaper he learned that Captain Frank Sims, one of the world's greatest authorities on high explosives, was living in Los Angeles. Possibly you will remember Captain Sims as the man who originated BRT, the explosive used in the depth bomb which played much havoc among German submarines during the World War.

Professor Banning visited Captain Sims in the hope of getting some suggestions regarding fuel for his space flyer.

He learned that Captain Sims had recently perfected a new explosive which was over four times as powerful as TNT, and which could be handled even carelessly with absolute safety. It was in the form of a fine powder, and was known as radatomite. At the time of Professor Banning's call, arrangements had just been completed for the manufacture of radatomite on a large scale.

When he learned of our plans to explore the moon, Captain Sims not only agreed to turn over to us the first output of his factory at cost price, but also collaborated with Professor Banning in inventing an ingenious and remarkably efficient device for exploding the powder and controlling the discharge through the rocket nozzles with safety and certainty.

SINCE this is not a treatise on mechanics, I shall omit a detailed description of the combustion chambers which Professor Banning and Captain Sims invented for regulating the discharges of radatomite through the rocket tubes. Though ingenious beyond comparison, this device was beautifully simple, and for that reason it functioned perfectly, with practically no likelihood of ever getting out of order.

According to the plans of our space flyer, most of the propulsive force was to be directed through four rocket tubes which terminated at the tail of the ship, all of them pointing dead astern. By means of an ordinary hand throttle, the stream of burning Radatomite could be controlled with marvelous exactitude, ranging from a faint fizz like the discharge of a tiny toy rocket to a continuous blast of expanding gases more powerful than the mightiest of tornadoes.

At the nose of the flyer were four more rocket tubes pointing straight ahead. A separate throttle regulated the radatomite discharges through these tubes, which served the purpose of brakes for use when it was desired to decrease or completely neutralize the forward speed of the flyer. They could even be used for flying the machine in reverse.

For steering purposes two tubes were carried to the tip of the right wing and two to the left. One of each pair pointed forward and the other toward the rear.

In the place of the propeller was a vertical beam, the lower end of which just cleared the ground when the flyer was taxiing. At each end of this beam were two more rocket tubes, one pointed ahead and the other astern.

These eight steering tubes were operated by means of a standard type of airplane joy stick. Pushing the stick to the right would produce currents of exploding radatomite through both the tubes pointing to the rear at the left tip of the wing and the one pointing forward at the right tip—thus turning the nose of the machine to the right. To steer in the opposite direction, it was only necessary to move the stick to the left.

The tubes at the extremities of the upright beam took the place of the elevator, steering the flyer upward or downward according to whether the joy stick was moved backward or forward. When the stick was in a neutral position, no gas whatever flowed through the steering tubes. The strength of the currents produced by exploding radatomite shooting through these pipes was determined by the distance which the stick was moved away from the perpendicular position.

Thus far, with the possible exception of the apparatus for controlling the rate of discharge through the rocket tubes, there was nothing original or revolutionary about the design of our flyer. In its general get-up it was quite similar to other rocket planes which had either been described or planned, or worked out in model form by scientists both in America and in Europe.

There was at least one feature of the Banning space flyer, however, which was absolutely original and unique, and that was the four dimensional steering device.

Constructing the mechanical contrivance which made it possible for the flyer actually to be steered into hyper space was the special job assigned to me.

Though I completed this astonishing task successfully, I was able to do it only because of the cooperation and close supervision which I received from Professor Banning.

I shall not attempt a detailed explanation of this complicated device since—to be perfectly frank—I'm not sure I understand it fully myself—in spite of the fact that I made every bit of it with my own hands.

Fortunately, I was present at a time when Professor Banning was explaining the four dimensional principle to Colonel Berglin, and the following transcript of this exposition is much clearer and more comprehensive than I could possibly make it.

CHAPTER III

Professor Banning Explains the Fourth Dimension

RESPONDING to a request from Colonel Berglin to explain the four dimensional steering mechanism to him, Professor Banning said:

"When you fly an airplane you have three different lines of motion to consider: one you call forward or backward, another left or right, and the third up or down.

"On our space flyer, these three lines of direction are well represented by our three systems of rocket tubes. Motion forward and backward is produced by the tubes at the bow and the stern; motion to the right or left is controlled by the tubes at the tips of the wings, and motion up or down is regulated by the tubes at the extremities of our elevating beam.

"If you imagine lines drawn to indicate these directions, they would be three in number and could be made to point in such a way that any one of them is exactly perpendicular to each of the other two.

"If we measure the extension of our flyer along each of these lines the figure we obtain will represent the three dimensions, length, width and height.

"Further than that the ordinary mind does not attempt to go. But to the trained mathematician it is easy to conceive of a *fourth* dimension, or line of direction, and to place this line in such a way that it is perpendicular to *all* of the lines representing the other three dimensions. Is that clear?"

"I think I get what you're driving at," Berglin answered. "But I don't see how it is possible to draw a line in such a way that it will be perpendicular to three other lines at the same point."

"That's because you've always been accustomed to thinking of things as having only three dimensions. I don't mean to imply that all the things with which we are familiar extend for any considerable distance in the fourth dimension, but I do know that every object in the universe has at least a small amount of four dimensional extension.

"Perhaps I can clarify this point by making comparison with objects which are commonly regarded as being two-dimensional in character—a piece of tissue paper, for instance. We all know that even the thinnest of materials must have some thickness, yet this dimension may be so small in comparison with the other two that a person accustomed only to thin, flat objects could easily assume that the paper had only two dimensions, namely length and width.

"Now suppose this Flatlander should happen to take a large number of pieces of thin paper and pile them on top of each other. Can't you see how he could thus discover the existence of a third dimension even if he had previously had knowledge of only two dimensions?"

"Yes, I can see that plainly enough," Berglin rejoined.

"Well, that's all there is to understanding the fourth dimension. Just imagine a lot of three dimensional objects grouped together in such a way that they extend in a direction that is neither east or west, north or south, nor up or down, but at the same time is at right angles to each of these directions, and you have a clear conception of the fourth dimension.

"When you want to construct a four dimensional counterpart of any particular geometrical figure, all you have to do is figure out how you would construct a corresponding three dimensional article from two dimensional units and your problem solves itself.

"For instance, if you want to build a cube you can do it by piling together a large number of squares of the same size cut out of paper until you have a pile as high as one edge of your original square. Likewise, if you wish to construct a four dimensional cube—which, by the way, is called a tesseract—you can do it by combining three-dimensional cubes.

"Take another example. To make a cylinder out of two dimensional units, all you have to do is combine a large number of pieces cut in the shape of a circle. Hence a four dimensional cylinder would be composed of the three dimensional counterparts of the circles, namely solid spheres.

"To steer our flyer into hyperspace by means of our rocket principle it is necessary to construct tubes having extension in the fourth dimension. If you were a Flatlander and wanted to make a pipe out of tinfoil, how would you do it?"

"That's easy," said Berglin. "I'd make a roll out of it."

I knew at once that this was not the answer the Professor was fishing for and I couldn't help smiling just a wee bit at the look of disapproval which Berglin's common-sense suggestion brought to Banning's face.

"That's wrong!" he shouted. "The minute you bend a roll of tinfoil you get completely out of your two dimensional environment. What I mean is, how could you build a pipe by combining a large number of articles, all of which must be absolutely flat and extremely thin?"

"Oh, I see what you mean now. They'd have to be in the form of rings or washers."

"Exactly! Now you're beginning to grasp the idea. Suppose for the sake of convenience we call your rings or washers hollow circles. Now what sort of units shall we require for building our four dimensional pipe?"

"Hollow spheres, I suppose."

"Precisely. And that's how we made our four dimensional rocket tubes. We combined a large number of hollow spheres in such a way as to make a continuous passageway, through which currents of gases resulting from the combustion of our fuel can be projected, either into or away from hyperspace.

"This sounds simple enough but in actual practice it requires a knowledge of certain principles of higher mathematics which cannot be comprehended except by a person who has spent years in studying them. The difficult thing is to know just how to group the hollow spheres together. You can readily understand that they cannot be placed one in front of the other, one beside the other or one on top of the other, since that would mean merely producing additional extension in either length, width or height. Instead, they have to be placed THROUGH each other and in such a way that the hollow spaces combine to make one continuous hole through which the gases can pass. Do you understand what I mean?"

"I guess I do, but when you talk about sticking together a lot of hollow balls in such a way that gas can pass through the hollow spaces, you're getting way ahead of me."

"That's very simple if you think of these balls as being open in the direction of the fourth dimension, just as a washer or ring is open in the third dimension.

"To a two-dimensional being it would be as impossible to put anything inside a ring as for us to do the

same thing to a hollow ball. Yet one of us can easily pick up a small article from outside and drop it inside the ring. In the same way, by moving through the fourth dimension, you could pick up a pebble and place it inside a tennis ball without making any opening in the rubber. It is also possible to combine hollow spheres in such a way as to form a gas-tight tube."

"That's mighty interesting, even though I'm afraid I don't grasp it completely," Berglin responded. "Your explanation is entirely different from the conception of the fourth dimension I had before. Somehow or other I got the idea that the fourth dimension is time. I remember reading a book called "The Time Machine." It's about a contraption which was supposed to be able to travel in the fourth dimension. With it a man could either go clear back into the days of ancient history or could travel ahead and see how the world is going to be thousands of years in the future."

To which the Professor replied, "Fantastic tales like that are not intended to be taken seriously. They make interesting yarns but couldn't possibly be true. I don't mean to deprecate the so-called scientific fiction stories as a class. Many of them, like 'Twenty Thousand Leagues Under the Sea,' which were originally written as the wildest and most impossible imaginative fiction have already been made real through modern inventions. But when you try to conceive of seeing events long before they actually happen, common sense tells us that even the most marvelous of scientific discoveries could never make such a thing possible."

HERE I took the liberty of butting in on the dialogue. "Excuse me, Professor," I ventured. "But doesn't Einstein's theory of relativity regard time as a fourth dimension?"

"In one sense, perhaps, but that's a mere matter of terminology," he continued. "The essential idea behind the principle of relativity is that every object in the universe is moving. There's no such thing as absolute rest. And since objects move at different speeds, it is impossible to obtain an accurate measure of the distance between two objects unless we know the speed with which each of the objects, as well as the observer, is traveling.

"There's where the time element enters in, and it is sometimes referred to, rather loosely, as the fourth dimension. The term 'separation interval' is a much better word in my opinion, since that suggests both time and distance.

"I don't believe that even Einstein would presume to believe that time is a dimension like length, along which one can travel either forward or backward and at varying speeds.

"On the other hand, the geometrical fourth dimension which I have just explained to you has nothing to do with time. It is a real spacial extension, of exactly the same character as length, width and thickness.

"With one of our four dimensional rocket tubes we shall be able to travel into hyperspace as far as we please, and then, by shooting discharge through the other tube we can just as easily direct our flyer back to three dimensional space.

"You already have some idea of the main purpose behind all this. My object is to use our four dimensional steering apparatus to release us quickly from the grip of gravitation when we want to escape from the earth's pull. On the other hand, we can always return to three dimensional space and to the gravitational fields of the earth or moon whenever such attractive forces will be of any use to us. Is that all clear?"

"I—I—guess so," was Berglin's hesitating response.

CHAPTER IV

The Space Flyer Is Named

IN addition to the four dimensional steering device, our space flyer had another unique and distinctive feature, namely the external lubricating system. This was simply a mechanical device for beating lubricating oil into millions of tiny bubbles and distributing them through small tubes to the exterior of the machine. By imposing rolling, oily contacts between the air and the outside surface of the flyer, this system cut down atmospheric resistance substantially and made it possible to travel through the earth's gaseous envelope at speeds which would otherwise have produced a terrific amount of friction and heat—more than sufficient to annihilate any conveyance which was not protected by this lubricating envelope.

The cabin, of course, had double walls, heavily insulated.

As our task neared completion I began to cudgel my brains for a fitting name with which to christen our mechanical baby. The only cognomens I could think of were either too trite or too commonplace—names like "The Hyphen" because it was to join the moon and the earth), "Excelsior" and "The Spirit of Luna" were discarded because they were too reminiscent of other aircraft which had won fame in bygone days.

One morning I entered the hangar to discover that the name question had been settled without any help from me. Under the direction of Professor Banning, a painter was just putting the finishing touches to the word: "AMUNDSEN."

"What do you think of it?" the Professor asked me.

"It certainly is an appropriate name. If Amundsen were alive today, he'd be just the kind of man who would endorse a trip like the one we are going to take. No one who ever lived is more worthy of the honor of having your flyer named after him."

"That's the way I feel about it. I consider your famous countryman as the greatest of explorers—the man who discovered the north magnetic pole and the northwest passage, the first man to reach the South Pole, and the only man so far who has seen one pole and has visited the other one in person. But great as these achievements were, they fade into insignificance when compared to his final voyage into the great unknown, when he sacrificed his life in an effort to save a man whom he considered an enemy.

"That's why I am proud to name my flyer after Captain Roald Amundsen!"

CHAPTER V

The Trial Flight

WHEN the *Amundsen* was almost completed, Professor Banning sent a wire to Colonel Berglin, who was then in Washington attending to his engrossing duties as head of the newly created de-

partment of aviation. Two days later Berglin arrived in his famous "air office."

It was decided first to test the *Amundsen* as a terrestrial flyer without making any attempt to leave the earth's atmosphere or gravitational field. For this reason the four dimensional tubes were not to be used and it was not considered necessary for me to go along. Naturally I was on hand at the time scheduled for the trial flight and I observed the performance from the ground.

Professor Banning and Colonel Berglin entered the cabin and a few minutes later I heard a hissing sound which told me that the rocket tubes were in operation. Evidently only a small amount of power was being used at the start. For several minutes the machine taxied around the field making a series of short low hops. Suddenly, without warning, there shot out of the rear a blast which sent up a great cloud of gravel, and the *Amundsen* leaped heavenward, at a terrific pace. In a few seconds it had reached an altitude of several thousand feet. It then began the most preposterous series of stunts that have ever been witnessed. It looped and it side-slipped; it rolled like a barrel and spun like a top. It ended up by flying upside down in a wide circle, while at the same time it fluttered like a falling leaf, losing altitude at a terrific rate.

I stood rooted to the spot in helpless horror! A terrible accident was about to occur before my eyes! So certain did this seem that I even had a momentary mental picture of the mangled bodies of my two dearest friends lying amid a nightmare vision of twisted steel.

I closed my eyes to shut out the gruesome sight. I held my breath and waited for the crash.

Nothing happened.

When I could stand the strain no longer, I opened my eyes. At first I could see nothing in the air and I concluded that in some inexplicable way the flyer had crashed without making a noise loud enough for me to hear.

But the handful of mechanics and airdrome officials who had gathered to watch the hop-off were all still looking at the sky.

With the aid of my field glasses I was able to discern the unique outlines of the *Amundsen*, sailing majestically upward and onward and apparently under perfect control.

I learned later that the erratic behavior of the *Amundsen* had been due to a slight defect in the adjustment of the mechanism for controlling the blasts through the eight steering tubes. The wild antics performed in mid-air were due to Berglin's attempts to find out what was wrong. He had finally located the trouble just in time to prevent a serious crash. By manipulating the joy stick carefully in such a way as to make allowance for the defective adjustment, he had gotten the flyer under control and thereafter had no difficulty in making it do just what he wished.

After climbing to an altitude of over 50,000 feet in about ten minutes, Berglin coasted back to earth at an abrupt angle. He could easily have gone higher, but that was hardly necessary since the performance of the *Amundsen* was sufficient to prove its fitness for its destined task.

On the downward journey the *Amundsen* approached the airdrome at a tremendous speed. It looked as if it could never land without being carried off the field by its own momentum. But when it was about five hundred feet from the ground, the forward pointing rocket tubes were brought into play. With marvelous rapidity the acceleration was diminished until the machine seemed almost to be suspended in mid air. Then it slowly floated down to earth, settling as softly and noiselessly as a dandelion seed.

CHAPTER VI

Off for the Moon

THE trouble with the *Amundsen's* steering mechanism was quickly remedied and a second trial flight demonstrated that the space flyer was thoroughly fit and ready for its crucial journey to the moon. At this time we also tried out the four dimensional steering device and it proved to be a wonderful success.

After everything had been made ready for the hop-off, Banning timed our departure so that it came when the moon was in its first quarter and was trailing the earth in its journey around the sun. While this was not an essential condition of a successful flight to the moon, it made possible a substantial increase in our speed and a saving of fuel, since it enabled us to take advantage of the motion of the moon itself.

Except for the unusual care which we took in checking over all our supplies and equipment, our take-off was uneventful. Only our assistants and most intimate friends knew about our plans. In order to avoid publicity, we embarked in the small hours of the morning.

The instant we were off the ground, Berglin pointed the nose of our flyer upward at a steep angle and so rapidly did we climb that it took us but a few minutes to reach the highly rarefied portions of the earth's atmosphere.

We were then ready to execute our famous hairpin turn, by means of which we borrowed a tremendous amount of momentum from mother earth and at the same time took advantage of the speed with which the moon was hurtling through space in its journey around the sun.

Following Professor Banning's instructions, Berglin headed the flyer in such a way that it pointed in the same direction that the earth itself was moving.

"Now give her a shot into hyper-space!" the Professor commanded, and I directed a current of exploding radatomite through one of the four dimensional rocket tubes.

Under the circumstances one might naturally expect a violent shock or jar but nothing of the sort happened. Instead we experienced a most peculiar twisting sensation like the skidding of an automobile on a slippery pavement.

For a few seconds we were projected into hyper-space, then Professor Banning said, "By this time we must be pretty well out of the gravitational field of the earth. So you may as well turn the ship about, Colonel."

Following these orders, Berglin operated the rocket tubes in such a way as to make a wide U turn, bringing the nose of the flyer around so it pointed straight toward the moon and in the opposite direction from that in which the earth was moving.

Perhaps an analogy will make the purpose of this maneuver clear.

Imagine a boy on skates being towed across a frozen lake by a horse traveling at the rate of twenty miles

per hour, and being followed at some distance by his dog who is running at exactly the same speed as the horse; that is, twenty miles per hour.

The boy lets go of the tow rope and, without making any effort to increase his speed, executes a hairpin turn so that he faces toward the dog. It is apparent that he will now be approaching the dog at a speed equal to the dog's velocity added to the original velocity of the horse, or with a total speed of forty miles per hour. Naturally he will lose some momentum in making the turn and also in coasting after the turn, but it will require only a relatively small amount of effort on his part to make up for this loss of momentum.

In our case, the earth took the part of the horse, the space flyer was the boy, and the moon was the dog. The tow rope which fastened us to the earth was the force of gravitation. When we projected ourselves into hyperspace, we virtually cut the rope. After making the hairpin turn, we found ourselves speeding toward the moon while the satellite was rushing toward us. And since, by that time, we had reached the interplanetary space where there was no atmosphere to create friction or resistance, our momentum was practically equal to that with which the earth was traveling around the sun.

"You may as well shut off the power now," Professor Banning directed. "We can easily coast most of the way. With no atmosphere to retard us, our present momentum should continue indefinitely. Suppose we make a rough estimate of our velocity. At the time we shot off into hyperspace our flyer was making a speed of about a thousand miles an hour. We were also traveling with the earth in its orbital flight at the rate of approximately 66,600 miles per hour. That makes our total speed pretty close to 67,600 miles per hour. At the same time the moon is now rushing toward us a trifle faster than 66,600 miles per hour. We are therefore approaching the moon at the rate of something like 134,000 miles per hour, so we ought to be able to cover the 238,851 miles between us and the moon in less than two hours.

"Of course we could increase our speed still more by using our rocket tubes, but I consider our present rate of progress quite satisfactory. What do you boys think about it?"

"Suits me," said Berglin.

"Me, too," I chimed in.

AS we had hopped off when it was still dark, we were in the shadow of the earth for several minutes. It wasn't long, however, before one edge of the huge spheroid behind us became visible, and a moment later the great blazing orb of the sun peeped at us from behind the earth.

The most spectacular phenomenon of the aurora borealis was insignificant compared with the marvelous play of light and colors which we witnessed as the sunlight filtered to us through the earth's atmospheric envelope. Almost in the twinkling of an eye the sun had leaped clear of the concealing globe and its corona became clearly visible. Old Sol looked as if it had suddenly increased enormously in size. Instead of appearing to be round, it was irregular in size with great jagged tongues of flame shooting out in all directions.

The stars, too, seemed much bigger, brighter, and more numerous than when observed from the surface of the earth. They shone with marvelous splendor against a jet black sky.

It wasn't long before we began to notice the effects of being relieved from the gravitational attraction of the earth. We learned that it was safer to remain seated and to avoid any sudden motion. Once, when I forgot myself and took a quick step in the direction of the water olla or cooler, I shot up into the air like a toy balloon and bumped my head against the roof of the cabin.

After assuring himself that I was not hurt, Professor Banning said, "Here, try these on."

He handed me a pair of sandals made of iron.

"Strap them on so the iron parts are under the soles of your shoes," he explained. "They are magnetized so they will stick to the steel wall of the flyer."

I strapped on the sandals and found to my astonishment that I could walk like a fly, up the walls and along the ceiling, with my head pointing downward.

All three of us noticed peculiar physiological and psychological effects which Professor Banning told us were due largely to the sudden removal of the earth's gravitation to which our bodies had always been accustomed.

A feeling of nausea, like that which a person experiences when he is in a rapidly descending elevator, was one of the most noticeable symptoms. We were also troubled with severe headaches which were no doubt due to expansion of our brains accompanying the removal of gravitational pressure.

Mentally we were all three afflicted with the most excruciating pangs of home sickness. There was something about being away out there in space, thousands of miles from any other solid substance, that made me feel desperately lonesome and melancholy, in spite of the fact that there was no one on earth for whom I cared anywhere near as much as for the two friends who were but a few feet away from me, where I could look at them and converse with them at will. But the marvelous power which the human body has to adapt itself to all sorts of unfamiliar conditions soon enabled us to overcome our disagreeable sensations and mental reactions.

It wasn't long before the half moon ahead of us loomed up with such gigantic proportions that we realized it was time to prepare for a landing.

CHAPTER VII

We Alight on the Moon

WHEN it is recalled that we were approaching the moon at the terrific speed of about 134,000 miles per hour, the difficulty of alighting without annihilating ourselves and our machine becomes apparent.

We could, of course, diminish our speed somewhat by discharging our rocket tubes in a direction opposite to that in which we were moving, but it would have been necessary to start this braking process when we were only half way to our destination, and this would have consumed a great amount of time as well as fuel.

We employed the same principle that a man uses when he boards a moving street car. Everybody knows, that if a person should run toward an approaching vehicle and attempt to hop aboard it as it rushes by, he would be certain to meet with an accident. On the other hand, if he moves as fast as he can in the same direction as the street car is traveling, he has a much better chance to board it safely.

As we dashed toward the moon, Berglin steered with the rocket devices in such a way that we made a wide horseshoe turn around the moon. We were then traveling in the same direction as the moon and at approximately the same speed. I then sent a charge through the four dimensional rocket tube, which brought us into the gravitational field of the moon. This caused an increase in our velocity.

Within a few moments we found ourselves flying swiftly at an altitude of about ten thousand feet above the surface of the moon.

It was then that we began to appreciate the marvelous beauty of the earth's fair satellite. Having gazed at the weird lunar landscapes, gorgeous and cataclysmic in their grandeur, we could easily understand why a noted scientist, whose knowledge of the moon was confined to telescopic observation, made the statement that the earth's satellite is the greatest scenic resort in the Solar System and in many ways the most fascinating object within the confines of the (telescopically) visible Universe.

Though we needed no explanations to appreciate the incomparable beauties of the panorama which quickly unfolded itself beneath us, Berglin and I felt doubly fortunate in being personally conducted by a man of Professor Banning's accurate and profound learning. There seemed to be no subject, scientific or otherwise, of which Professor Banning did not have a thorough and masterful knowledge. He certainly was well informed regarding the moon.

"Do you know, boys," he told us, "it just happens that we have approached the moon from the region nearest to its south pole. Notice that marvelous chain of mountains over there. They are the Liebnitz Mountains. Neison figured out that one of those summits has an elevation of nearly thirty-six thousand feet, which is about seven thousand feet higher than Mount Everest, the highest peak on the earth!

"When you consider that the moon itself is only one forty-ninth as large as the earth and has less than one-fourteenth of the surface area of our planet, you can appreciate how big these mountains are in proportion to the size of the sphere on which they are located. If the moon were expanded to the size of the earth, the Liebnitz Mountains would be at least seventy-nine thousand, two-hundred feet, or more than fifteen miles high!

"Now if you'll look off to the left a little you'll see one of the most interesting sights in the Universe. Those are the Doerfel Mountains. Flammarion called them and the Leibnitz Mountains "the mountains of eternal light." Notice that the Doerfel Mountains are now on the part of the moon which is not illuminated by the sun, yet the peaks are so high above the surface that they actually jut out of the shadow and into the sunlit portion of space above the moon."

With amazement and admiration approaching awe, Berglin and I silently observed these marvels which never before had been beheld at such close range by human eyes. The dazzling beauty of the brilliant, illuminated peaks, as contrasted with the Stygian darkness of the main bodies of the mountains, was accentuated by the fact that they were covered with hoar frost which sparkled and glittered like myriads of gigantic diamonds.

Finally Berglin broke the spell with, "Well, Professor, where shall we land?"

"Do you see that circular formation straight ahead and a little to the right? That is a crater or ring mountain, and is known as Clavius. The space inside the crater ought to be both level and solid; in fact it should make an ideal landing field."

Within a short time we were circling over the crater and Berglin guided the *Amundsen* so skillfully that we alighted safely without the suggestion of a jar or bump almost in the exact center of the ring.

Then an amazing thing happened. When we looked out of the windows expecting to find a ring of mountains surrounding us on all sides, we were astonished to discover that the walls had disappeared completely, and, except for a few peaks which rose from the surface of the interior and which were clearly visible, we found ourselves in what looked like a vast plain extending to the horizon in all directions.

"What in the world has happened to our ring of mountains!" I exclaimed.

"That's easily explained," Professor Banning responded. "The space inside this crater is no less than one hundred and forty miles in diameter. The wall to the west of us is seventeen thousand, three hundred feet high, and the east wall is over three miles high. That sounds as if they ought to be big enough to be seen even at a distance of seventy miles, but the fact of the matter is that, because of the curvature of the moon's surface, the peaks of our mountain walls are actually below the horizon."

"Shall we put on our suits and take a stroll around?" I suggested.

"Not yet," the Professor decided. "I believe we can see all there is to see here without getting outside the space flyer. Suppose we taxi for a few miles toward the west until we come in sight of the mountain wall."

Berglin turned on enough power through the rear rocket tubes to set us in motion and soon we were spinning along in a series of long hops at a speed of about seventy miles per hour.

In about half an hour the peaks of the crater rim hove in sight and a little while later we were able to distinguish the entire wall of hills ahead of us.

"Not much use in trying to do any exploring here," the Professor muttered. "It's just as I expected. Although these ring mountains slope very gently on the outside, their sides are rather steep on the inside. I'd estimate that those hills ahead of us have an inclination of at least forty-five degrees and that's too steep to climb in comfort, even on the moon. I guess we may as well fly out of this crater and land in some place outside where we'll have a better chance to do some real exploring."

"How about flying around to the other side of the moon—the half that is never seen from the earth!" I exclaimed eagerly.

"Plenty of time for that later. What I'd like to do first is to see if we can't solve some of the puzzles on this side of the moon—puzzles that have baffled the selenographers for the past hundred years."

CHAPTER VIII

Caught in a Lunar Trap

"ONE of the first things I'd like to settle," Professor Banning continued, "is the nature and composition of the streaks or rays which no one has yet succeeded in explaining satisfactorily. A

large number of these streaks radiate from the ring mountain Tycho, which is not far from here. Suppose we take to the air—or rather to the ether and see how these streaks look from above at close range."

Pursuant to the Professor's suggestion, Berglin "gave the gun" to our rocket tubes and, without the slightest difficulty, our flyer rose and soared over the walls of Clavius. Tycho is about one hundred and fifty miles due north of Clavius, and it took but a few minutes to cover this distance.

"Shall we set her down?" Berglin asked.

"Not yet," Banning instructed. "Let us fly around for a while and get a bird's eye view of this formation."

It was truly a remarkable sight! Tycho reminded me of a collossal hub from which radiated over a hundred of the remarkable streaks with almost as much regularity as the spokes of a gigantic wheel. There was however a considerable amount of variation in the thickness and length of the rays. The largest of them extended in a northwesterly direction in a line which was remarkably straight. The marvelous thing about it was that it seemed to disregard utterly every obstacle which lay in its path.

Not far from Tycho we saw a ring mountain of considerable size which Professor Banning told us was called Saussure. It did not deflect the large ray in the slightest degree. Up one side of the southerly wall the streak climbed—down the other side, across the interior, up to the summit of the north wall and down to the plain, along which it could be seen, stretching out to the horizon.

Continuing in a northwesterly direction, we gained altitude, so that more and more of the ray came into view. We followed its path to the place where it crossed a large depression which we learned was known as the Sea of Serenity. This so-called sea did not contain any water, of course, although the greenish, silvery luster of its surface created a remarkable illusion that suggested a lake of mercury.

Despite the brightness of the sea itself, the great ray, cutting directly through the middle of it, stood out with dazzling brilliancy.

"That ray is about ten miles wide and over 2,000 miles long," Banning informed us. "It starts at Tycho near the south pole and terminates at the Sea of Cold close to the opposite edge of the moon. The most astonishing thing is its straightness. It's just as if some superior being had laid a flexible rule along the surface of the moon and had traced the ray with ink made of diamond dust."

"It sure does!" was my banal response to my friend's beautiful flight of fancy.

"What do you suppose that streak is made of?" Colonel Berglin asked Banning.

"That's one thing I hope to find out. One of the favorite theories is that these rays started as cracks formed in the surface of the moon when it cooled from a molten state. This is supported by the fact when a glass sphere is heated and then cooled suddenly by plunging it into cold water, cracks are formed which are very similar in character to the rays on the moon."

This prompted a remark from Berglin: "But if they are just cracks, they would be like crevasses or canyons. They look to me as if they are flush with the surface."

"That's true, and the logical explanation is that the cracks were subsequently filled in with some substance which reflects the light. Suppose, for instance that at one time there were rivers and lakes on the moon, which is not only possible but very probable. Suppose that water which had passed over rocks containing soluble minerals had poured into the cracks in the surface of the moon. The water would be evaporated by the heat, leaving the mineral matter deposited in the cracks. After a while the cracks would be filled to the top with material which would be entirely different from the soil around it.

"Another possibility it that the cracks became filled with molten metal which oozed up from within the moon and subsequently cooled and solidified.

"But now that we are here, what's the use of supposing any more? Let's go down there and find out definitely."

We picked a spot in the Sea of Serenity which looked like an ideal place to land. It was as level as a baseball diamond and was covered with a fine, silvery dust. Berglin made a perfect landing, setting the flyer down gently and accurately.

Then something horrible—something totally unexpected—happened. Like a scuttled ship plunging into the depths of the ocean our flyer sank into that treacherous sea of fine dust. Quickly the light was blotted out as the dust covered our windows and engulfed us. Down, down we went until we must have been at least thirty feet beneath the surface. When we finally came to a standstill we had the feeling of being supported on a cushion rather than resting on firm ground.

I leaped to my feet and as I did so the impact of my shoes against the floor sent us down a few feet further.

"My God!" I cried in a voice which must have reverberated with terror. "We're buried alive! What a horrible death! Oh, why did we come on this trip?"

Neither Berglin nor Banning displayed any signs of fear or other emotion, which made me feel rather ashamed of myself after the first shock of fright had passed off.

"Don't get excited," Banning admonished me. "And, above everything, don't lose your head. We've all been in worse scrapes than this before and we've gotten out of them. Just make up your mind that we are going to get out of this one."

"O. K., Professor. I'll try to get a grip on myself," I assured him. "Sorry I lost control of myself. But when I felt myself sinking, sinking—it made me feel so helpless that ——"

"I understand," the Professor said in his most kindly tones. "And now suppose we plan a way to get out of this hole."

"I don't see any reason why we can't fly out," Berglin volunteered. "If this dust is so fine and so loose that it let us sink this far, it ought to be just as easy for us to get through it on the way out."

"That sounds reasonable enough," said Banning. "It won't hurt to try, anyway."

Berglin took his place at the controls and started the rocket motor. Cautiously he directed a blast through the rear tubes. At first we sank a few feet further. This was probably caused by the loosening of the dust behind and beneath us. But as Berglin increased the power, the *Amundsen* began to move forward and upward, steadily gaining momentum until it suddenly burst into the full glare of the lunar sunshine.

"Hurrah!" I yelled. "It worked! We're out of it! We're safe! And now, for the love of mud, let's steer clear out of those blankety-blank seas."

"Where do we go now?" This from Berglin.

"Turn south," was Banning's laconic order.

After we had flown in the direction indicated for a few minutes, Banning said, "See the ring mountain just ahead? That is Rhetius. I think we'll be able to land safely in that level place just to the west of it."

Following these instructions, Berglin set the flyer down and I heaved a sigh of relief as I felt the machine come to rest on solid ground.

"This is almost the center of the lunar disk which is visible from the earth," Professor Banning remarked. "It's a good place to take possession."

"Take possession?" I exclaimed. "What do you mean by that?"

"I mean that I hold a commission which authorizes me to take possession of the moon in the name of the Government of the United States of America!"

CHAPTER IX

Taking Possession of the Moon

WHEN Professor Banning announced his intention of taking possession of the moon in the name of the United States Government, I thought at first he was joking, but he soon convinced me that he was in dead earnest. To me it seemed ridiculous, a futile thing to do—for of what use could a dead, barron, uninviting world like the moon be to any nation?

Knowing Professor Banning as well as I did, however, I felt positive that there must be some strong valid reason behind his seemingly useless act, so I said nothing.

"Well, my boy," Banning said to me in a jubilant voice, "at last the time has come to try out our space suits! What do you say if we go for a little lunar hike?"

"O. K., Chief!" I replied. I tried to speak in a matter-of-fact way, but I am afraid I betrayed the fact that I was suffering a bit from "buck fever". Somehow or other, the prospect of meandering around through the weird, ghostly landscape of the moon was anything but attractive to me. There was nothing to do but go through with it, however, and I would rather have perished on the spot than to have either Banning or Berglin know that I was afraid.

For several reasons, only two space suits were included in the equipment of the *Amundsen*. One reason was that they took up considerable room, and space was naturally at a premium. Professor Banning had also decided that at no time during our trip would be advisable for all three of us to leave the *Amundsen*. Since Berglin was the official pilot of our flyer it was only natural that he should be the one chosen to stay with the ship, at least during our first trial.

The space suit invented by Professor Banning was built on the principle of a pneumatic tire—in fact, the major portion of it was constructed by a prominent manufacturer of automobile tires. The exterior of the suit corresponded to the casing of a tire. It looked for all the world like a well known trade character used in the advertising of a pneumatic tire concern—the Michelin—a man composed of tires cemented together by their sides, so as to give the appearance of a corrugated surface.

These outer walls of the suit were built with extra strength, like the heavy duty cord tires used on large motor trucks. On the inside was a lining of flexible rubber, similar to that used in making inner tubes. These linings were cemented to the collar of the suit with an airtight joint. To the shoulder plate was attached a heavy glass globe which could be screwed on like the helmet of a diver's costume.

A knapsack fastened to the back of the suit contained in very compact space a tank of oxygen, a storage battery, miniature radio sending and receiving sets, a cooling device, and an air-purifying system.

The waistline was encompassed by a wide leather belt fitted with hooks to which were attached a hammer, a drill, a small pickaxe and a large trowel. The belt also contained several pockets which were designed to receive samples of soil and rock to be collected during our exploration.

Before getting into our space suits, Professor Banning and I each donned a union suit made of wool. It had a tight-fitting hood which covered the head and lower part of face, leaving only the eyes and nose exposed. Into this hood were built the earphones and also the microphone of the radio apparatus.

The fabric of the undergarment was interwoven with fine electric wires, like an electric heating pad. Connected with the suit was a cable containing the wires for the heating device, the radio sets and also the apparatus for controlling the air supply and the cooling system. This cable was plugged into the knapsack through an outlet on the inside of the collar.

Having thus prepared ourselves we put on the space suits and Berglin screwed our glass helmets in place. When thus equipped, we each represented a complete plant for existing independently in the airless space surrounding the moon.

The radio enabled us to communicate with each other and also kept us in close touch with Berglin, who had a corresponding outfit inside the *Amundsen*. With our oxygen tanks and our air-purifying apparatus we could breathe comfortably for at least ten hours. If the temperature became uncomfortably low, we could turn on the electric heat—if we found it too hot we could keep ourselves cool by means of our refrigerating device.

For grasping tools, picking up objects, and similar acts, Banning had provided a pair of very ingenious mechanical hands which were operated by grips inside the arms of the suits.

Our airlock was just large enough for one person at a time. Professor Banning insisted on being the first one to use it. Carrying a stick wrapped in bunting, he entered the narrow chamber and closed the door. A few minutes later we heard the grating of the outer door and soon the grotesque form of the professor clad in his outlandish costume came into a position where we could see him through the window of the flyer.

With an unmistakable gesture, he beckoned me to follow him. As familiar as I was with the operation of the radio device, I was so startled that I nearly jumped out of my space suit when I heard his voice in my ear say, "Come on, my boy! It's fine out here!"

I turned the valve which allowed air from the flyer to pass into the airlock. Then I opened the door and stepped into the small closet. Fastening the door tightly, I pressed the button which operated the air pump. When the indicator pointed to zero, I unfastened the outer door and stepped awkwardly out upon the surface of the moon.

I had expected to feel a series of peculiar sensations, but except for a feeling of buoyant freedom, I felt just

about the same as I did when I was inside the *Amundsen*. But when I attempted to stride forth at my usual hiking speed, I suddenly discovered that I was in a new and different environment.

The step which would ordinarily have carried me a yard or so was more like the leap of a kangaroo. It sent me into the air in a rainbow loop which was fully ten feet high and fifteen feet long. It was so unexpected that I wasn't prepared to make a safe landing. My body pitched forward and I landed in a heap, tumbling over and over on the ground before I recovered by balance.

Banning waited until he saw me scramble to my feet. Then, after he had apparently assured himself that I was not hurt, he laughed uproariously. Thanks to the radio, I got full benefit of his hilarity.

In my earphones I heard the Professor's voice say, "Excuse me for laughing, but you looked so comical that I couldn't help it. Your tumble didn't hurt you, did it?"

"Not a bit," I assured him. "I don't blame you for laughing. Guess I did look funny. I feel almost as if I was inside a balloon."

"You'll soon get used to it. But until you do you'd better move very slowly and carefully. Don't forget that the force of gravitation here on the moon is only about one-sixth as strong as it is on the earth."

"It didn't take me long to find that out," was my reply.

With awkward, shambling steps, Banning walked to a spot where there were a number of rocks lying loose on the ground. He gathered together a score of these stones and built a small monument. Then he unwound the bunting from his staff, revealing an American flag, which he placed in such a way that the stones held the pole upright. There was not the slightest vestige of a breeze on the airless moon, of course, so the flag hung listlessly from the staff.

The sight of our national emblem amid the incongruous surroundings of the lunar landscape sent an incomparable thrill of patriotism through me and made my spine tingle. I brought my heels together and raised my mechanical hand to my forehead in a grotesque, but none the less respectful salute. When I took a quick glance over my shoulder, I could see Berglin standing at attention with his face toward the flag.

Professor Banning also saluted, as he pronounced these words in an impressive voice: "I hereby take possession of this land and all the remainder of the land on the moon in the name of the United States of America."

CHAPTER X

The Explosion

AFTER completing the formality of taking possession of the moon, Professor Banning walked westward toward the great ray, which was but a short distance from the place where we had alighted. Cautiously and awkwardly, I shuffled after him. When he arrived at the edge of the glittering streak, he detached from his belt a drill. Then he squatted down, holding the drill in an upright position.

"Take your hammer," he instructed me, "and see if you can hit the head of this drill without cracking the fingers of my mechanical hand."

Following his orders I grasped my hammer and succeeded in striking the drill squarely with the first blow. It seemed to have very little effect. The hammer felt extremely light, which was due of course to the small amount of attraction which the moon exerted on it. After what seemed like over an hour of feeble tapping, I managed to sink the drill down about ten inches.

To my great relief, Banning said, "I think that's deep enough." Fumbling in one of his voluminous pockets he drew forth a small sack. From it he poured into the hole a handful of powder, which I recognized as radatomite, the same explosive as we used for fuel in operating the *Amundsen*.

From his belt he removed a coil of wire with a small cylindrical object attached to one end. This he placed over the charge of explosive. Filling the hole with loose dirt, he tapped it down with the upper end or head of the drill.

Then he said to me, "You see that boulder over there? I mean the one that's about six feet in diameter. Go and fetch it here for me, will you please?"

"You want me to fetch that enormous rock for you?" I exclaimed. "Say, what do you think I am, Hercules, Samson, or some other professional strong man!"

"You don't need to be a Samson to lift that stone. Suppose you go over there and try."

I walked up to the boulder and managed to get a good grip on it with my mechanical fingers. Then I braced myself and gave a mighty heave. Much to my astonishment it came up so easily that it threw me off my balance and I sat down, with the great rock resting on my lap. Had an earthly stone as large as that fallen on me, I would have been seriously crushed beneath the weight of it, but the lunar rock rested on my legs as lightly as if it had been made of cork.

Scrambling to my feet again, I had no difficulty in lifting the rock and carrying it to Banning. He rolled it into a position directly over the hole containing the charge of explosive. Then he walked away, uncoiling the wire behind him.

I stepped back a few yards and stopped to watch, but the Professor continued to put more and more distance between himself and the charge. "Better come over here," he cautioned me. "That's liable to make things fly for some distance."

It was fortunate for me that I heeded his warning.

Banning exploded the charge by making an electrical connection with the storage battery which was part of his equipment.

Expecting a loud detonation, I stood with my mouth open. But not even the faintest ghost of a sound reached my waiting ears. Amid a deathly silence the ground seemed to burst open, sending a geyser of glittering lumps high into the air. The huge boulder shot into the air as if it were a toy balloon. But instead of dropping like a similar object would fall on the earth, it seemed to float down, slowly and leisurely. The fragments torn from the great ray behaved in a similar manner, of course. It was fortunate for us that they did descend with moderated velocity, for several of them came so close to us that we had to move quickly to get out of their way. It would have been rather difficult, if not impossible, to dodge missiles like that, had they dropped upon us with the speed of falling bodies on the earth.

His pedagogic training coming to the surface, Professor Banning took this occasion to point out the scientific aspects of this phenomenon.

"You see," he explained. "The effect of that explo-

sion was a great deal greater here than it would have been on earth, because there was a smaller amount of resistance to overcome. The fragments were thrown about six times as far as they would have been back home. This is due to the fact that the force of gravitation is only about one-sixth as strong here as it is on earth. For the same reason, when the pieces started to come down, they fell at a much slower speed than they would have done on our terrestrial sphere.

"The earth's gravitation makes a freely falling body drop a little over sixteen feet the first second. On the moon, the same object would fall only two feet and eight inches during the first second."

"But how come I didn't hear the explosion?" I asked.

"You ought to be able to answer that if you just use your brains. You know, of course, that sound can only travel through a solid, a liquid, or a gas. It will not penetrate a vacuum. The reason you didn't hear any sound was that there was nothing between you and the explosion which was capable of transmitting sound."

"But how about your voice coming to me over the radio?"

"That's altogether different. Radio waves don't need a material conductor. They travel through the ether and there's plenty of ether even on the moon."

"Why, of course, I know that. I just didn't use my head—that's all."

The Professor began to coil the wire.

"Suppose we gather up some of these samples we blew loose," he suggested.

Following Banning's example I picked up a few fragments of the material torn from the great ray. It was easy to recognize them by their silvery, metallic luster.

This accomplished, I asked, "Now, what do we do, Professor?"

"Do you see that ring mountain off there to your left? That is Rhetius. Now that we are here we may as well go over and take a look at it."

"O. K., Professor," I agreed, and started to walk in the direction which he had indicated.

"Hey, there!" He called after me. "Where are you going?"

"I'm going to hike over to that ring mountain."

"Hiking over there? Do you realize that it's nearly a hundred miles from here?"

"A hundred miles from here? Why, it looks as if it's only a mile or two away."

"You must remember that things look altogether different here on the moon. The reason that crater looks so close is that there is no atmosphere between us and it. On earth we judge distances by the relative size of familiar objects and also by the clearness or haziness of the images cast on our retinas. Here the distant objects are nearly as clearly visible as those that are close by. Furthermore, we can only guess at the real size of distant objects and for that reason we can not make comparisons with any degree of accuracy.

"Of course, you could walk over there if you insist. With practice you ought to be able to travel pretty fast—say twenty miles an hour—so it will take you only about five hours to get there. But, for my part, I believe I'll have Berglin taxi me over there. No use exerting myself unnecessarily."

"Count me in on the taxi party, too," I said. "Hiking a hundred miles all by myself doesn't exactly appeal to me, even if I am a much faster walker up here than I ever dreamed I could be."

CHAPTER XI

A Perilous Hike

IN turn, Professor Banning and I entered the *Amundsen* through the airlock. Since the trip was to be a short one, we did not remove our space suits. It took but a few minutes for Berglin to cover the hundred miles that separated us from our objective. Once more the two of us emerged from the space flyer and strolled across the surface of the moon.

As the Professor had anticipated, we found that the external slopes of the ring mountain were not at all steep. I estimated the grade to be approximately five per cent. On the other hand, the interior walls were quite precipitous, ranging from twenty-five to fifty per cent. in grade.

By this time we had become accustomed enough to our new environment so that we could move along at a pretty brisk pace, covering the ground in a series of long leaps. Up the gently sloping sides of Rhetius we hopped until we stood on the rim of the crater.

Here a marvelous sight met our eyes. Rhetius was by no means large compared with some of the other ring mountains. When compared with any similar formation on earth, however, it was a veritable giant.

"This crater is about twenty miles across," Professor Banning elucidated. "Just how big this is can be estimated by comparing it with the largest crater rings on the earth, of which there are only three which can boast a diameter as great as fifteen miles. They are Aso San in Japan, Lake Bourbon on the Island of Luzon in the Philippines, and a crater in northern Kamchatka. There are several large crater lakes in the United States, but not one of them is more than seven miles in diameter.

"Here on the moon there are many ring mountains that are over a hundred miles wide. The largest of all is Bailly. It measures about one hundred and eighty miles across."

As we stood on the rim of Rhetius, we could clearly distinguish the rugged and magnificent outlines of the opposite wall. In the center of the ring was a picturesque cone shaped mountain, which resembled a small volcano within a larger crater.

The colorings of the landscape were gorgeous. Never before had I seen such a riot of purple and green and magenta and orange as were splashed with reckless lavishness all over the incomparable scenery.

For some time we stood there feasting our eyes on this rare vista, then, half reluctantly, half eagerly, we retraced our steps.

Professor Banning was content with leaps of moderate length, covering approximately ten yards at each step. But I, with the characteristic willfulness of youth, must needs attempt to establish a record for a lunar broad jump.

First I tried a few standing jumps and derived a tremendous amount of enjoyment from feeling myself soar up into the air for a height of ten feet or more. I expected to get a jolt when I landed but found that I alighted slowly and gently. This also was due to the fact that my body was being pulled down with only a fraction of the gravitational attraction on the earth.

Next I attempted a hop, skip, and a jump, and found that I could leap both higher and further than from a standing start and still land without trouble. I then decided that I was ready to make a running broad jump

that would far exceed the greatest accomplishments of the world's leading athletes. In this I succeeded with a vengeance.

Because of the difficulty in judging distance in the deceptive airless space surrounding the moon, I did not realize how close I was to the rim of a titanic gorge. When I reached the highest point of my lob, I found myself headed right into the maw of this horrible chasm. I tried to emulate the figure of a cat I once saw in a movie animated cartoon, which jumped off a high cliff and, changing its mind in midflight, pulled itself through the air and back to the top of the precipice.

With me, however, this scheme didn't seem to work very well. No matter how frantically I waved my arms and kicked my legs, I continued to drop with increasing acceleration—straight into the cleft.

Sometimes I marvel at the inconsistencies of the human mind—especially with respect to such qualities as pluck, nerve, and courage. I've heard of men who have repeatedly charged deadly machines gun nests without flinching, but who whimpered like babies when threatened with the cold steel of a trench knife. There are those who have braved the perils of life aboard a submarine, who couldn't be hired to ride in an elevator.

Consider my own case, for instance. But a short time previous I had completely lost my nerve because I feared that we were to be buried alive inside our flyer. My fears turned out to be groundless. And now I was facing a far more serious danger and I wasn't scared in the least. The fact was that I actually joked about my predicament.

I was still dropping through space when I heard in my earphones the voice of Profesor Banning calling my name.

"Are you hurt? Are you hurt?" he kept repeating in anxious tones.

"Not yet!" I yelled into my microphone as I plunged downward into the abyss. "I'm O. K. so far!"

I felt a sharp jolt as the nether portion of my space suit bumped against the steeply sloping walls of the canyon, and again I called out, "All right so far."

As I bounced down, now hitting the cliff, now hurtling through space, I clutched desperately at the precipitous rocks with my mechanical hands. Once I caught hold of something, but the force of my descent jerked my grip loose. However, this served to slacken my speed sufficiently so that I was able to hang to the next projection that came in my path. Finally I brought up with a thud and managed to clamber up upon an overhanging ledge.

You can understand that this feat was all the more difficult because it was performed in Stygian darkness. The instant I had passed over the edge of the canyon the light had been blotted out as suddenly and as completely as if the sun had been totally eclipsed. Considering the fact that the plain I had just left was bathed in dazzling sunshine, it seemed inconceivable that I could be so quickly plunged into darkness so dense that I literally could not see my mechanical fist when I held it in front of my helmet.

THE explanation was simple enough. Without any air, water vapor, or dust to diffuse the light of the sun there was a total absence of illumination in the shadow of the cliff. On the moon there was no light except in those places which were exposed to the direct rays of the sun, or to light reflected from some illuminated surface.

Again I heard Professor Banning's voice calling to me, "Are you all right?"

"I'm still O. K.," I radioed to him. "Right now I'm perched on a narrow ledge of rock somewhere between the top and the bottom of this God-forsaken hole."

"Stay right where you are!" he said. "We'll see what we can do about getting you out."

"Don't worry!" was my response. "I'll stay right where I am until you rescue me. You can absolutely depend on that."

I had hardly uttered these words before the ledge on which I was standing crumbled beneath me, and again I resumed my downward journey. Fortunately I didn't fall far enough to acquire much speed before I landed on a second ledge which felt larger and more secure than the other one.

As I crouched on that narrow projection shrouded in pitchy blackness I could sympathize thoroughly with Homer's fabled Cimmerians, whom he described as living in perpetual darkness. It was lucky for me that I had the assistance of a man as ingenious and as resourceful as Professor Banning. Simple and effective as his plan of rescue proved to be, few other men would have thought of it so quickly.

By way of encouragement and instruction he gave me this explanation *via* radio: "I have my pocket flashlight fastened to an electric cable. I am now going to lower this light over the edge of the cleft somewhere near the place where I saw you disappear. Watch for the light and let me know if I have it headed in the right direction."

I gazed upward and soon saw a tiny point of moving light. "I see it!" I cried. "But you'll miss me by several feet if you keep on lowering it from where you are."

"What direction shall I move it?" he asked.

"A little to the—" I was going to name one of the four points of the compass but when I tried to figure out my relative position with respect to the light, I found myself hopelessly confused. So I foolishly shouted, "Move it over this way."

The Professor must have understood my confusion for he moved the light and then said, "Did I move it closer that time?"

"Sure!" I yelled into my radio transmitter. "But you didn't move it far enough."

"How is that?" he said after he had altered his position.

"That's too far," I told him. "Back this way about six inches. There! Now it's directly overhead. Lower away!"

Closer and closer came that blessed speck of light until I could reach out and grasp the wire in my mechanical fist.

"I have hold of the cable," I called out. "Now what shall I do?"

"Wrap it around your body and fasten it securely, but in such a way that you can slip it off quickly."

"What are you going to do? Haul me out?"

"Why, certainly."

"Do you think this wire will hold the weight of my space suit with me inside it?"

"It ought to. If it doesn't, we'll have to figure out some other way."

"Figure out some other way!" I yelled. "Don't you

realize that if you start pulling me out and this wire breaks there won't be enough of me left to do any figuring over?"

"But I'm telling you that the wire is plenty strong enough to bear your weight. Can't you take my word for that? At any rate, it's the strongest material we have on hand—so it's either the wire or nothing."

"All right," I consented. "But isn't there another danger? Suppose the rubbing of the cable against the edge of the rocks up there wears it so much that it breaks."

"I've thought of a way to avoid that," the Professor said. "I'll have Berglin pull you out with the aid of the *Amundsen*."

At the time he made this statement I couldn't see what difference it would make in the wear on the cable whether I was pulled out by a person or a machine, but when I heard Banning's instructions to Berglin, I understood what he was driving at.

"I'm going to fasten the wire to the undercarriage of the flyer," I heard Banning say. "I want you to rise as slowly as you can. There are several hundred feet of slack, but you'll have to be awfully careful so that you do not bring the wire taut with a jerk."

This sounded like a risky thing to attempt but, thanks to Berglin's superb skill in manipulating the space flyer, it was preformed without mishap. Looking upward I saw the *Amundsen* circling around, gaining altitude by inches until, with an almost imperceptible tug, I was lifted gently into space. There I dangled, like a fish on the end of a line, while the flyer continued to climb.

With a suddenness that blinded me, my head popped from the Cimmerian darkness into the dazzling glare of the sunlight. I had sense enough to close my eyes and then open them very gradually.

When I was clear of the chasm, Berglin slowly descended until my feet were only a few inches from the ground. Then he dived in a steep spiral, thus relieving the tension on the cable. In this manner he deposited me softly and safely on the sunlit plain.

A moment later I had disengaged myself from the cable. By this time my eyes had become accustomed enough to the bright light so that I was able to make out the form of the Professor in his space suit a short distance away. I also saw the *Amundsen* as Berglin set it down nearby.

Hastening to the beneficent protection of the space ship, I quickly entered the airlock and a few moments later was inside the cabin. This was rather inconsiderate of me, since it left the elderly professor the task of coiling the wire which had been used in my rescue. I divested myself of my cumbersome garment and took several deep breaths of air which seemed to taste much fresher than the atmosphere provided by the space suit.

When I glanced out of the window and saw Professor Banning laboring along with the heavy coil of wire, I felt very much ashamed and I hastened to apologize to him as soon as he appeared inside the *Amundsen*.

"Oh, that's all right," he said generously. "I understand your mental reactions perfectly. After the experience you had I could hardly expect you to lose any time in getting to a place which you consider safer."

CHAPTER XII

Our First Night On the Moon

WHEN I had sufficiently recovered from the effects of my harrowing experience, I remarked to the Professor, "That sure was some gully I got myself into. It must have taken millions of years for a cleft like that to be carved out."

"On the contrary," Banning corrected me. "It is more than likely that your little gully, as you call it, was carved out in a few seconds."

"I don't see how that could be possible."

"It wouldn't be, if it were done by water. But I think we can be absolutely certain that water had nothing to do with the making of that cleft. To be sure there might have been a considerable amount of moisture on the moon at some far distant time, but it would have been frozen solid throughout the lunar night, and would have been in the form of vapor during the periods of terrific heat when the sunlight was streaming down on this part of the moon. Under the circumstances, erosion such as takes place on the earth could hardly dig out such a tremendous gash as that.

"I'm afraid that—even after your experience in exploring the inside of yonder cleft, you have no conception of its magnitude. It is twenty miles wide and a hundred and eighty-seven miles long."

"How in the world—or rather in the moon—can you say it is exactly so long and so wide?" I asked in amazement. "I don't remember seeing you measure it or even making an estimate of its size."

"The measuring was done a long time ago by selenographers who viewed the moon from the earth through their telescopes. In some respects we know more about the geography of the moon than we do about certain portions of the earth. It is a simple problem of triangulation to measure the length and width of any object on the moon. And, thanks to the clearness of the shadows, we can also measure the height of mountains and the depth of most of the valleys with equal exactness without leaving the earth."

"But you said a moment ago that the valleys on the moon were not formed by water action, but were carved out in a few seconds. I suppose you mean that the moon must have been hit by another object."

"Precisely. Some authorities think it was caused by a comet hitting the moon a glancing blow and plowing right through the surface. Other selenographers attribute it to a similar phenomenon caused by a meteor. I am inclined to hold to the meteor theory myself."

"Well, whatever it was that caused that gorge to be formed, I've seen all of it I care to, thank you," was my closing comment.

"What's our next move, Professor?" Berglin seemed impatient to keep going.

"I think the next thing for us to do is to get some rest. Do you realize, boys, that it is over thirty hours since we left the earth and none of us has had a wink of sleep?"

It was true. What with the excitement occasioned by our incomparable adventures, combined with the brilliant sunlight and the slowness of the sun's passage across the sky, we had not realized how much time was elapsing.

The idea of taking a rest was decidedly welcome to me. Though I had not felt the least bit tired before, once the thought had been suggested to me I found myself overcome with profound weariness.

"Shall we turn in right here?" I asked.

"If you want to," the Professor replied. "But I think we will find it easier to sleep if we move over to the night section of the moon."

"What!" I cried. "Do you want us all to commit suicide?"

"What do you mean by suicide?"

"That's exactly what we would be doing if we tried to land the flyer in the dark. Believe me, I've been in the moon's darkness and I'm telling you that it's so dark down there that in comparison with it a lump of coal would look like a snowball."

"But you were in a shaded place. My idea was to land in the open but on a portion of the moon where the sun isn't shining."

"Well, if it's as dark as that in the shadow of a cliff, in the daytime, how much darker will it be at night?"

"Don't worry, we'll have plenty of light to land by. You seem to have forgotten our old friend the earth will give us earthlight."

Instinctively I gazed up at the sky. Hanging there motionless—almost exactly in the zenith—was good old Mother Earth. Though we were still exposed to the brilliant light of the sun, the sky was jet black and was studded with myriads of stars. They seemed to be far more numerous and to shine with much greater brilliancy than when viewed from the earth in their most brilliant display.

Our mother planet resembled the moon—but what a moon! Its diameter was four times as large as that of luna as seen from the earth. Our position was such that the earth was in what might be called its last quarter. Only half of it was visible and the remaining portion of its disc was like a huge semi-circular hole cut out of the star-studded background of the sable sky.

The ice caps surrounding the north and south poles were very clearly visible as they reflected the light of the sun with sparkling brilliancy. It was rather difficult to distinguish the conformation of the continents because of the mantle of clouds that hung about the orb, but between patches of the clouds I was able to make out the outlines of the British Isles and of the Scandinavian Peninsula.

Professor Banning went on with his explanation: "When we get over to the dark side of the moon we'll find the country bathed in earthlight. The earth, of course, has its phases, just like the moon. When the earth is full, it reflects to the moon about thirteen times as much light as the full moon sends to the earth. Even with only half the earth illuminated as it is now, we will find that it is about six times as light as it is on a clear night on earth when the full moon is directly overhead."

As usual, Professor Banning's predictions were fulfilled with amazing exactness. With Berglin at the controls we hopped off by daylight and within a short time we had flown into the region of lunar night.

If the scenery of the moon was magnificent in the sunlight's brilliant glare, it was incomparably beautiful in the soft, bluish light of the earth. There was an abundance of illumination and we could easily distinguish even the small objects below us.

WITHOUT the slightest difficulty, Berglin set the *Amundsen* down in the center of the ring mountain, Eratosthenes. It was not until some time later that we learned the reason why Professor Banning had selected this particular spot for our camping ground on our first night on the moon.

Before retiring, Professor Banning took a reading of the thermometer which was especially designed for registering the temperature of the space outside the *Amundsen*. It was minus 137 degrees Centigrade. Reduced to the Fahrenheit scale this represented a temperature of 215 degrees below zero.

For purposes of comparison it may be of interest to mention here that subsequent reading made on the moon ranged from 240 degrees below zero Fahrenheit just after dawn to 218 degrees Fahrenheit at the lunar noon. It will be noted that this maximum temperature is six degrees higher than the boiling point of water at sea level on the earth. In the airless space surrounding the moon, the small amount of water there would change almost instantly from ice to vapor.

In spite of the hollow walls of the *Amundsen* and the heavy insulation between them, the bitter cold of the lunar night soon began to make itself felt within the flyer and we were glad to make use of our electric heating equipment.

Without divesting ourselves of our clothing, we rolled ourselves in our blankets and lay down on our pneumatic mattresses. In a few minutes the labored breathing of my two companions told me that they had quickly fallen asleep. I, too, was physically fatigued, but my mind insisted on staying awake. This was probably due in large measure to the effects of my accident. Through a window in our portable home I could see the earth, hanging there in space like half a gigantic melon. It filled me with the most excruciating pangs of lonesomeness and home-sickness to behold my native planet away out there across that awful stretch of empty space.

It wasn't long, however, before my bodily weariness triumphed over my mental alertness. The subtle glue, of which Stevenson speaks, slipped beneath my eyelids and I fell into a sound slumber.

I awoke to gaze in open-mouthed astonishment on one of the most magnificent spectacles that a human being has ever beheld.

Sunrise on the moon!

To one who has not seen this incomparable sight with his own eyes no verbal description can convey a clear idea of the splendor of the lunar dawn.

Long before the uppermost edge of the sun's disc came into view, its advent was heralded by gorgeously colored shafts of living flame which shot up for enormous distances into the sable and diamond mystery of the star-studded sky. This wonderful phenomenon was caused by the corona of the sun which is visible to observers on earth only at rare moments during a total eclipse of the sun.

Just before the edge of the sun itself appeared, a number of smaller protuberances, fantastic in shape and brilliant pink in color, shot above the horizon.

Between us and these astonishing manifestations of cosmic illumination lay the barren plain, the distant walls of our ring mountain, and the other grotesque features of the lunar landscape, wrapped in the weird spell of the clear blue earthlight.

It was several hours before the entire circumference of the sun was visible to us, yet so wonderful and so

diversified was the show put on for our benefit that none of us seemed to tire of looking at it.

I took enough time to tear my attention away from the eastern horizon and to gaze up at the zenith, where I saw my old friend the earth in exactly the same position as I had observed her the previous evening. At first this astonished me, but a moment's reflection told me that, since the moon always keeps the same face turned toward its mother planet, there can be very little change in the position of the earth as seen from any particular spot on the moon. Such changes as do occur are very slight and caused by the libration or tilting of the satellite in its journey around the earth.

After going through the usual routine of washing, shaving, and of eating breakfast, we prepared to continue our exploration of the moon's surface.

As Banning and I were getting into our space suits, I asked, "By the way, Professor, would you mind telling us why you picked this particular spot for us to spend our first night on the moon?"

To which he replied, "I am anxious to settle as soon as possible certain questions which have been the source of a great deal of guess work and argument on the part of astronomers and selenographers. The most important one is this: Is there any vegetation or other form of life on the moon? I chose this place because the interior of the ring mountain Eratosthenes is one of the regions in which a noted astronomer claims to have detected evidence that some form of vegetable life exists."

CHAPTER XIII

Answering Puzzling Questions

WHEN a traveler is writing about a strange land—describing scenes which have never before been gazed upon by human eyes, there is perhaps a strong temptation to fabricate or at least to exaggerate. It would be easy enough—with the aid of a creative imagination—to describe the moon as covered with monstrous and preposterous vegetation and inhabited with animals—some horrible, some weird, some human-like.

But since this is nothing but a straightforward, accurate account of what we actually saw and did during our sojourn on the moon, I am compelled to chronicle that no life of such extraordinary characteristics does exist on the moon.

We learned that the changes in the color of the plain inside the ring mountain Eratosthenes, which take place as the heat of the sun warms this region, were not due to vegetation—as was erroneously deduced by one or two well known astronomers. It was caused entirely by the effect of the heat on a mineral formation which is metallic in character. Professor Banning secured samples of this mineral which were subsequently submitted to various tests. While the metal contained in them was entirely different from any substance found on earth, the transformation caused by heat in varying degrees of intensity might be compared to the changes in the color of a piece of iron when it is subjected to high temperatures. The only essential difference was that the minerals found on the moon went through these color changes at lower temperatures—ranging from 50 degrees to 218 degrees Fahrenheit.

In order to make certain that no plants or other forms of life existed in any part of the moon, Professor Banning explored and thoroughly investigated all of the places where changes that might have been caused by vegetation had previously been observed by astronomers. Among the regions which we visited during this visit for this purpose were the interior of the ring mountains Plato, Aristarchus, Grimaldi, and Alphonsus. We also flew back and forth over the Sea of Serenity, approaching close enough to the surface to observe all important details, but we did not find any evidence that either animal or vegetable life had recently existed there.

For some mysterious reason, Professor Banning seemed very much pleased when he had convinced himself indubitably that no plants or animals of any description were living on the moon.

"It's much better to begin with nothing at all than to run the risk of having to fight undesirable things," he murmured, half to himself. Just what he meant by this cryptic remark I did not know until several years later.

As time is reckoned on earth, we spent approximately ten days in exploring the half of the moon which is visible from the earth. All during this time I had been impatient to see what was on the far side of the lunar sphere. Professor Banning had grudgingly consented to our making one brief trip for a short distance beyond the western boundaries of the earthward hemisphere, while that portion of the moon was illuminated by the sun. Naturally, it was not feasible to penetrate beyond the lighted parts of the opposite side, since there we had no friendly earthshine to light our way as was the case on the portions which faced the earth.

I can only report that we discovered nothing startling or unusual. The landscape on the far side of the moon was very similar to that which is visible from the earth. The characteristic features, such as magnificent mountains, spacious craters, abysmal clefts, and glittering rays were all duplicated on the other side of the moon.

We took a large number of photographs from the air. When pieced together, these pictures constituted an aerial map of about one-fourth of the hemisphere which is turned away from the earth. Because of the fact that a considerable part of this half of the moon was in darkness, we were not able to map it completely.

The number of actual landings we made on the far side of the moon were limited—only five to be exact. The last of these stops came very near being the termination of our adventure.

Berglin had set the *Amundsen* down on a level stretch of desolate ground about 300 miles from the imaginary line, which marked the eastern boundaries of the moon's disc as seen from the earth.

We were all weary and had planned to rest for several hours. From the place which we had chosen as our camping ground we could see the sun low in the horizon, so that neither the light nor the heat was excessively intense.

In examining our surroundings before retiring, I noticed that we were close to a peculiar formation. Our flyer was just inside the angle formed by two cracks in the ground, which met at an angle of approximately 120 degrees. I estimated this from the fact that the amount of divergence seemed to be just about the same as the angle of a regular hexagon. The most remarkable thing about these cracks were that they extended as far as the eye could reach in perfectly straight lines. When I first observed them, they were only a few inches wide. Interested as I was in this unusual feature, it did not

occur to me to regard it with foreboding, or even to point it out to my companions. At that particular moment I was more interested in getting some sleep than in studying geology—or perhaps I should say "selenology."

How long I slept I do not know, but when I did awake it was with a weird feeling in my bones that something was wrong. I glanced out of the window and what I saw made me utter a yell that jolted Berglin and Banning from their slumbers with rude suddenness. Stretching away from us in almost rectilinear regularity were two ridges about three feet high. They seemed to be made of thin clay or mud which oozed forth from the bowels of the moon and piled up higher and higher as we watched.

One of the ridges extended directly under our flyer. So rapidly was it increasing in size that it had almost engulfed us before we realized what was happening.

"Quick!" cried the Professor. "Turn on the rear rocket tubes. Give it all you have—full speed ahead."

Berglin responded instantly, but the glutinous material, half fluid, half solid, already had grasped us in its tenacious embrace. Fortunately, the tail of the *Amundsen* was clear, so that we could at least make a valiant attempt to escape.

For several anxious seconds our fate hung in the balance. Starting with as much power as he dared to use, Berglin quickly accelerated until the maximum force of our powerful fuel was shooting through the rocket tubes. Under the terrific strain, the *Amundsen* shivered and groaned but held together.

Then we moved forward!

At first the movement was almost imperceptible, but nevertheless it was a motion and that was enough encouragement for us to keep trying. Inch by inch, foot by foot, we fought our way forward until, at the end of about half an hour, we cleared the ground and hopped triumphantly into space.

"Soar around for a while. I want to study this," the Professor commanded. It was then our privilege to observe a phenomenon such as mortal eyes had never before beheld—namely the birth of a crater, or ring mountain.

From our vantage point on high we were able to see that the ridge, which had threatened to engulf us, was but a part of a gigantic formation. It then became evident to me that the cracks I had seen a few hours previous had been part of an enormous hexagon. Through these fissures, semi-fluid material from below the surface had oozed out, while at the same time the section of the surface which was thus detached had sunk in.

It wasn't long before the flowing clay or mud had filled in the corners so that the wall changed from a hexagonal to a circular form.

"Well," said the Professor after a while. "That settles another important question that has puzzled selenographers for some time."

"What question is that, Professor?" I asked.

"The question as to how these so-called 'craters' were formed. You can easily see now that they are not craters at all, because volcanic action has nothing to do with it."

To which I replied, "Whatever it is that forms those rings, I'd just as soon steer clear of them from now on—especially the baby ones that are just getting 'borned'."

CHAPTER XIV

Preparing for the Homeward Journey

IN planning our itinerary, Professor Banning had set the date for our departure from the moon exactly two weeks after our arrival there. The main reason for this was that at the expiration of fourteen days the moon had moved around to the opposite side of the earth so that it was leading its mother planet in the joint march around the sun. This enabled us to make use of the momentum of the earth on our return journey, just as we had utilized the momentum of the moon on the first part of our trip.

The fourteen days referred to were, of course, *terrestrial* days which really amounted to only one of the moon's days as recorded from sunrise to sunset.

Our supplies of oxygen, water, food, fuel and other necessities had been calculated to suffice for an absence of two weeks—with liberal safety factors provided, of course.

During this period we succeeded in accomplishing, with surprising thoroughness, all the things which the Professor had mapped out for us. These tasks were two-fold in character: First, to answer the most important questions regarding the moon which had previously puzzled and baffled astronomers, and second, to learn as much as possible about the chemical and physical composition of the moon's surface.

So important is it for mankind to know the correct answers to the questions which for generations have been asked about the moon, that I think it will be pertinent to summarize them here. For convenience and clarity I am using the "catechism" or question and answer format:

Q. Has the moon any atmosphere?

A. No. Scientists have known this for some time, although there have been a few who thought they could detect evidence of the existence of a very tenuous atmosphere on the moon. Our investigations showed that the moon has no atmosphere comparable to that of the earth.

Q. Is there any water on the moon?

A. Only a very small quantity, which is in the form of vapor during the lunar day and is converted into hoar frost at night.

Q. Is there any vegetable life on the moon?

A. Since vegetable life as we know it requires both air and moisture, it is evident that no plants such as we know on earth can exist on the moon. We found not even the slightest vestige of plant life.

Q. Is there any animal life on the moon?

A. No, for the same reasons that vegetable life could not exist there.

Q. Is there *any* form of life on the moon?

A. No.

Q. How then, can the changes in coloring which take place as the temperature changes be accounted for?

A. We found this to be due to the physical effects of heat on certain mineral substances, corresponding to the color changes in a piece of iron when it is heated.

Q. Are the so-called "craters" on the moon volcanic in character?

A. No.

Q. How were these ring mountains formed?

A. By clay and similar semi-fluid material oozing up

to the surface through cracks formed when the moon cooled.

Q. How were the rays on the moon formed?

A. When the moon cooled from a molten state, crevasses were formed in the surface, similar to the cracks which would be produced if a hot sphere of glass were thrust into cold water. Later, these cracks became filled with a metallic substance, which reflects the light of the sun and makes them stand out brilliantly from the rest of the moon's surface.

Q. How were the deep valleys or gorges on the moon formed?

A. They must have been formed either by comets or meteors striking the moon glancing blows.

Q. Does the hemisphere of the moon which is not visible from the earth differ materially from the part which is visible?

A. The topographical features are quite similar on both sides of the moon.

I realize that there is nothing especially remarkable about the foregoing information. Most of it has been suspected by the keenest students of selenography for some time. But since this is not intended to be a bit of sensational fiction, but merely a faithful account of our explorations, I must chronicle the facts as they actually existed.

In order to find out as much as possible regarding the composition of the moon's surface, Professor Banning directed me to collect samples of soil and minerals from each of the various characteristic portions of luna's surface. Occasionally he helped me in this work, but most of the time I did the gathering alone, while Banning busied himself at a small bench which he had fitted up as a chemical laboratory at the rear of the *Amundsen's* cabin. Here he fussed eternally with his beakers, test tubes and crucibles. For hours on end he would work in silence, then would surprise us with an unexpected whoop of triumph or a groan of disappointment. However, he did not vouchsafe to give us any explanation of his chemical researches and neither Berglin nor myself would admit being curious enough to ask him regarding his discoveries.

On the day before the one scheduled for our departure for home, however, Professor Banning issued a singular order which could only have been predicated on something which his chemical investigation had revealed. He directed Berglin to set the flyer down close to the spot where we had previously blasted out a portion of the giant ray about a hundred miles west of ring mountain Rhetius. Again we shot off a charge of radatomite, but this time we took the precaution of piling a large number of heavy boulders over the place to be blasted, thus preventing the fragments from being thrown far from the center of the explosion.

Following the professor's instructions, I filled all the available storage space in the *Amundsen* with chunks of the material torn from the great ray.

CHAPTER XV

An Alarming Discovery

CAME the zero hour for our departure.

Momentous as this occasion was, we hopped off as nonchalantly as if we were only going on a short trip of exploration.

On our return voyage we had planned to use the same strategy which had proved successful on our trip from the earth to the moon.

Steadily and swiftly we climbed until the ground beneath us lost its concave appearance and assumed the form of a huge ball hanging in space. We directed our flight so as to carry our flyer along the same path the moon was traveling in its journey around the sun.

By operating the four dimensional steering apparatus, we severed the gravitational tie which bound us to the moon, and then made the hairpin turn which sent us hurtling back toward the approaching earth.

A few moments after this maneuver was completed, I noticed off to one side of us a peculiarly shaped object drifting in space. To see anything at all in what should have been an absolutely empty void gave me such a shock that I uttered a blood-curdling yell which made my two companions jump.

"Look!" I cried. "See that object out there! It must be a meteorite or something!"

"Hardly a meteorite," Professor Banning corrected me. "It looks to me like something from our flyer. Out there, with nothing to compare it with, it's hard to tell whether it is a large body far away or a small object close to us. Let's see how it looks with the glass."

Banning picked up a field glass and trained it on the mysterious object. "I thought so!" he cried. "It's a part of something from our ship! And if I'm not mistaken, it's a piece of a four-dimensional rocket tube!"

"Let me look!" He handed me the glass and I pointed it at the mysterious object.

"You're right!" I exclaimed. "It *is* a section of our four dimensional rocket tube. It must have been broken off the tube for steering us back out of hyperspace. How do you suppose that happened?"

"It probably became cracked or weakened while we were tearing ourselves loose after getting caught in the ooze from that newly formed ring mountain," the Professor suggested. "When you turned on the other four dimensional rocket tube a moment ago it gave the ship a jolt which must have loosened the weakened part."

"Is the loss of that part likely to cause any serious consequence?" Berglin inquired.

"Serious!" I said. "I'll say it's serious. Without that tube functioning properly it's going to be impossible for us to get back into three dimensional space. It means that we are doomed to drift around in hyperspace until our oxygen, our water, and our food give out."

Berglin seemed unwilling to accept my statement. Turning to Banning, he said, "Is that true, Professor?"

"Yes," was Banning's simple response. "It's true that we'll have to stay in hyperspace until we can get that four dimensional rocket tube repaired."

"Get it repaired?" I said in a tone which I fear was not very respectful. "You talk as if all we have to do is phone for a plumber—preferably one with a mathematical training—to fly out here and put a new four dimensional tube on our space ship."

Fortunately my sarcastic and discourteous comment did not seem to offend the Professor. He merely gave me a tolerant smile and said, "The trouble with you, my boy, is that you give up too easily. We hear a lot about the persistency of youth but after all it seems to take a man of mature years and experience to realize the fact that, no matter how hopeless a situation my be, it pays to keep on trying to get out of it."

"Do you mean that you think we still have a chance?" I said.

"Certainly. A most excellent chance. That is, providing you have enough courage and confidence in me to do what I tell you to do," said the Professor.

"After some of the things that have happened I don't feel like bragging about my courage, but as far as confidence in you is concerned, I don't think I need to tell you that I shall always be for you as I always have been. If it's just a case of taking a chance, I'd much rather be making a try at escaping rather than sitting still waiting to die."

"That's the way to talk."

"All right. What do you want me to do?" I asked.

"The first thing to do is get into your space suit."

"Would you mind telling me just what you expect of me?" I asked.

"Of course I don't mind telling you. I want you to go outside and repair that rocket tube," was his calm reply.

"But how am I going to do that? We haven't any spare tube and we haven't the material or the tools to make a new one. As for the possibility of fastening the broken parts together, I don't see how that can be done either. In the first place we can't get hold of the broken part and in the second place it wouldn't do us any good anyway, because we haven't any welding apparatus or any other way to fasten the broken parts together."

"But how about the other four dimensional rocket tube?"

"You mean the one we employed to shoot us into hyperspace with?"

"Yes. We don't need that any more, do we?"

"I suppose not. All that can do is get us further into hyperspace. What we need is something to get us away from hyperspace."

"Exactly. Except that they pointed in opposite directions, the two four-dimensional rocket tubes were identical in shape and structure, were they not?"

"Of course."

"Then all we have to do is remove the good rocket tube and bolt it on the place where the broken tube was; then we'll be able to navigate back into three dimensional space."

"The way you describe it, the job is as simple as changing a tire on an automobile," I remarked as I began getting into the space suit.

"You may find it even easier than that," was the Professor's reply.

"Oh well, I suppose somebody has to do it. So here goes."

"You won't require all those tools," said Banning, pointing to the trowel and pickaxe which hung at my belt. "You may need the hammer, though, and of course the monkey wrench will be the most useful of all. Let me suggest, though, that you fill those empty pockets with chunks of this material that we blasted from the great ray on the moon."

"What's the idea? Am I supposed to play a cosmic game of duck on the rock, or something like that?"

"Never mind the wisecracks. The lumps of rock will make you heavier and they may come in handy for another purpose." With that he opened the door of the airlock and started to screw on my helmet.

"Just a minute!" I shouted. "You're not trying to get rid of me, are you?"

"Of course not. We may need you to do some more stunts before we get back home. Why did you ask such a question?" he asked.

"How fast are we going now?"

"About 66,000 miles per hour."

"Whew! How do you expect me to hang on to the ship when it's going at such a speed? I'll be blown to smithereens the minute I stick my nose outside!" I cried.

"Nothing of the sort. Don't you realize that your body is moving with the same velocity as the flyer and in the same direction? Relatively speaking, the *Amundsen* will be standing still so far as you are concerned. You must remember that out here there is no air or other gas to offer any resistance or to form a draft."

"But suppose I should slip and fall off the flyer?"

"There's no danger of that, either. You can't fall away from the flyer unless something pushes you or pulls you. We are in hyperspace now and neither the moon, the earth, nor any other body is exerting any appreciable attraction for the flyer or for your body. On the other hand, there is a small but none the less potent gravitational attraction between your body and the space ship, so the only way you are likely to fall is toward the *Amundsen*."

Satisfied at last, I entered the airlock, sealed the inner door and turned on the valve to remove the air from the small chamber. But despite Banning's optimistic assurances, there was a feeling of trepidation in my heart when I opened the outer door.

In my earphones I heard Banning's voice say, "Can you hear me?"

"Sure!" I radioed back to him. "Your program is coming in fine. Suppose you put on the record and play 'Happy Days Are Here Again'."

"Perhaps it will be more appropriate if I play 'Get Out and Get Under the Moon!'" was his come-back.

"Well, here goes nothing!" I shouted as I eased my inflated form through the narrow opening.

Much as I depended on the correctness of Professor Banning's statements, I was astonished to discover that the flyer did seem to be floating motionless in space. With my mechanical hand I kept a tight grip on the handle of the door. There seemed to be no strain on my arm. By way of experiment I released my hold, but kept on the alert so I could make a quick grab for the handle in case I needed to. Instead of dropping or being blown away, my body swayed gently toward the flyer.

With the instinctive idea of getting on the part of the ship which we called the top, I started to pull myself up the side of the flyer. I found to my surprise that it was just as easy to stay on the bottom as on any other part of the craft. I tried crawling completely around the ship and had the peculiar sensation that I was on top all the time, while the *Amundsen* seemed to spin beneath me, as a barrel turns when a circus performer balances himself on it.

CHAPTER XVI

Man Overboard!

I WORKED my way around to the broken rocket. It took me but a few minutes to unscrew the six nuts which held the stump in place. Placing the nuts in a pocket which I had kept empty for that purpose I removed the damaged tube and let go of it. I

expected it to drop out of sight, but instead it clung to the side of the flyer.

In a similar manner I removed the good four dimensional tube, but took good care not to let go of it. The only difficulty I encountered in fastening the tube in place at the other opening was that the broken fragment which I had just removed kept bumping against my helmet.

Working as I was under a severe nervous strain, it was exasperating to have this lump of metal banging against me, but I didn't do anything about it until I had screwed the last nut home. Then I grabbed the offending object in my mechanical fist and heaved it away from me with all my might.

To say that what happened next surprised me would be putting it mildly. Before I realized it, I found myself shooting away from the *Amundsen* at an alarming rate of speed. By the time I recovered myself enough to yell for help, I was probably at least a mile away from the space flyer, with the gap between us widening constantly.

If you can imagine how it would feel to fall off an ocean liner in mid-ocean, you will have a faint idea of how I felt as I drifted out there in that awful void and watched the space ship grow smaller and smaller in the distance.

The worst of it was that neither Banning nor Berglin seemed to have noticed my departure, since I had been working near the tail of the flyer where they could not see me through the windows.

Finally, I gained command of my vocal chords and yelled, "Help! Help! Man overboard!"

Instantly, the welcome voice of the Professor came to me through the earphones: "How in the world did you get way out there?"

"Search me. It happened right after I threw away the broken rocket tube."

"You threw it way? That accounts for it. The reaction from the force of the tube as it left your hand pushed you in the opposite direction."

"I suppose you are going to tell me that I'm suffering from the effects of one of Newton's laws of motion. But right now I'm more interested in getting back to the ship. Can't you swing around here and pick me up before I get any further away?"

"That would be a dangerous thing to attempt, I'm afraid. If we should turn on any of the rocket tubes at the speed we are traveling, it is likely to alter our momentum so much that you'd never be able to hang on, even if we could come close enough for you to reach us."

"Do you mean to tell me that there is no hope for me—that I'm doomed to hang out here forever?"

"Of course there's hope for you. If you'll just keep your head and do as I say, you'll be back here in a few minutes. It would be risky for us to try to come to you, but that doesn't prevent you from coming back to us."

"What do you want me to do, swim back? When it comes to swimming in this stuff, I'm afraid my training has been sadly neglected. I'll do my best, though," and I started kicking with my legs and waving my arms.

"That won't do you any good," the Professor told me. "Better save your strength. The best way to get back here is to use the same principle that sent you out there."

"What do you mean?"

"The force of reaction. Your pockets are full of rocks. Suppose you get one of them in your mechanical hand, then take careful sight toward the flyer and throw the missile in exactly the opposite direction. This will make you move toward us."

I followed his instructions and sure enough I began to move slowly in the general direction of the *Amundsen*. To accelerate my speed, I hurled two more rocks. My aim was fair but far from perfect. I was still at least a hundred feet away from the ship as I swept past it and beyond it.

This got me excited and I started heaving my missiles with all my might in rapid succession. In this manner I succeeded in projecting myself directly at the space ship, but when I reached it, my speed was so great that I had no time to grab hold of anything. Like a huge rubber ball, my inflated space suit bumped into the side of the flyer and bounced briskly away again.

"Keep your head!" the Professor warned me. "Take time to aim carefully and try to judge your speed more accurately."

"What do you think this is," I retorted, "a cosmic golf game? If I slice my shots I get in the rough, and if I hit 'em too hard I bounce off the green. I'm afraid I'll never make par on this hole, but here goes for another try."

Perhaps I shouldn't have made this feeble attempt to be funny if I had realized that my ammunition was running short. I was still several feet away from the *Amundsen* when I discovered to my horror that my last chunk of lunar rock was gone. I was about to give up in despair when I happened to think of the six extra nuts which I had taken from the broken rocket tube.

"Thank Heaven I saved them," I said to myself.

After that there was no more fooling—no more prodigal waste of my precious missiles. With all the care of an expert playing in a championship match, I tossed the first of the nuts. It brought me closer, but a trifle to one side of my target. This I corrected by carefully throwing the second nut. I still had one of the metal objects left when I finally nudged gently against the side of the space ship and caught hold of a strut. Naturally I lost no time in getting inside the airlock and closing the door behind me.

CHAPTER XVII

Back to Earth

THE remainder of our journey was uneventful. When the proper moment arrived, Professor Banning instructed me to direct a blast through the four dimensional rocket tube. It worked perfectly, bringing us back into the influence of the earth's gravitational attraction.

In returning, we duplicated the same maneuver we had used in landing on the moon; that is we made a hairpin turn around the earth, so that we were traveling in the same direction and at about the same speed as our planet was moving in its orbit. Then, with the aid of our rocket motors, we sped through the upper regions of the earth's atmosphere until we could make out the topographical features of the land beneath us.

Under the skillful guidance of Berglin, we navigated our craft until we were hovering over our home field at San Diego. Here a most alarming sight met our gaze. As far as the eye could perceive, the roads in all

directions were jammed solid with automobiles, motorcycles, and other conveyances. Out in San Diego Harbor there was an inconceivable jumble of boats of all kinds and sizes, from canoes to battleships. So close were they packed that a person could have walked from San Diego to Coronado, on the opposite shore, merely by climbing from one boat to another.

The air was so thick with airplanes that we had difficulty in keeping out of their way. Worst of all, the field on which we were expected to land was packed full with a surging, milling mass of humanity.

It looked as if all California with additional representatives from Arizona and Old Mexico, had gathered in that one spot to greet us. To attempt a landing under such circumstances was out of the question.

"Let's go to Clover Field," Berglin suggested, and Banning agreed.

The enormous swarm of airplanes attempted to follow us, but so swiftly did our rocket motors carry us that we soon left them far behind. We found the field at Santa Monica absolutely deserted. Not an airplane, not a human being was in evidence. Apparently they had all gone to meet us at San Diego.

"In a way this is very fortunate for us," Professor Banning said. "It will give us a chance to unload our cargo without having a lot of curious reporters snooping around. There are very strong reasons why I don't want anybody to know what we brought back with us from the moon."

"Would you mind letting Berglin and me know what this stuff is?" I asked. "You know of course that you can depend on us to keep it under our hats."

"Why of course you are entitled to know. It is platinum—pure, unadulterated platinum."

"And how much is it worth?"

"About one hundred and ten dollars per ounce."

"One hundred and ten dollars per what?"

"One hundred and ten dollars per ounce. But the monetary worth of platinum is not so important as its value in science and industry. As you probably know, there are a number of cases where platinum has to be used in spite of its high cost. In some chemical operations, for instance, platinum receptacles must be used. Another illustration is in dentistry. One reason why porcelain jacketed crowns are so expensive is that they are made over a platinum shell. In many ways a dependable supply of cheap platinum would be of great advantage to humanity."

"Well, now that we have all this platinum here, what are we going to do with it?" I asked.

"That looks like an ideal hiding place," the Professor replied as he pointed to a ramshackle building just across the road from the airport. It had formerly been used as a real estate office. With the selling out of the subdivision, the building had apparently been abandoned by had been left standing. Its ruinous appearance made it only the safer for our purpose.

"We'd better hurry," Banning admonished us. "It won't be long before that flock of airplanes will arrive from San Diego."

Between the three of us, we carried the chunks of metal to the building, piling the material in such a way that it could not be seen through the windows.

"Some dark night, we'll come out here with a truck and remove the platinum," Banning observed, as he closed the door of the building.

Just then something struck my funny bone and I started to laugh.

"What's the matter with our facetious friend now?" the Professor inquired.

"I just had a mental picture of myself out there in space, heaving away lumps of platinum worth a thousand dollars apiece, as if they were mere pebbles."

"Don't worry about that," said Professor Banning. "There's plenty more where that platinum came from—thousands of tons of it!"

THE END.