# FOUR DIMENSIONAL TRANSIT

## *By Bob Olsen*

**Author of: "Four Dimensional Robberies," "Four Dimensional Surgery," etc.**

### CHAPTER I

### Professor Banning Returns

"MY Boy, you and I are going to produce the greatest invention ever made!" was the extravagant announcement with which Professor Banning greeted me when he stepped ashore from the Dunard Liner at Boston. Had this boast been made by anyone else, I should have dismissed it as an absurd emission of superheated atmosphere. But, coming as it did from a man of deep learning who was always meticulously conservative in all his utterances, it commanded breathless and expectant attention.

I had journeyed to Boston and had met the steamship *"Luxonia"* in response to a radiogram which Professor Banning had sent me while he was in mid-Atlantic

On the pier he explained: "The reason why I asked you to meet me here is that I want you to come with me to Parke University. My old friend Professor Stoddard has a model and a number of diagrams of a contrivance that I'd like you to study."

We were in Morcester for five days. Professor Banning and I spent most of our available time in the laboratories and libraries of Parke University. Both of us took copious notes but at the time I had but a hazy idea as to their ultimate purpose.

It was not until we were on the west bound Pullman that Professor Banning gave me the slightest inkling of his plans. As the train pulled out of the station, he cried: "Rapid transit! That's the big thing today, my boy! All other developments such as diplomacy, legislation, literature, art and science fade into insignificance compared with the importance of getting quickly from one place to another.

"Rapid transit is the world's greatest humanizing influence. It wipes out boundaries of states and nations. It breaks down racial and religious prejudices. It clears up misunderstandings and cements friendships among all the people on earth. It is the only means through which the millennium of universal peace can be attained.

"That is why I've decided to side track our work in four dimensional surgery—for a while at least—and devote all my attention to developing a means of transportation that will be safer, more economical and vastly more speedy than any mode of conveyance known today.

"With your help, my young friend, I expect to build a machine that will enable us to circumnavigate the globe in less than a day!"

I almost gasped, "That's ridiculous!" but caught myself with the words half way out of my mouth. Nothing that Professor Banning sponsored could possibly be ridiculous. No matter how preposterous it might sound, if Professor Banning made a serious statement, I could always rely on the soundness of his premises. So what I did say was: "That certainly would be a wonderful thing. Around the world in twenty-four hours seems almost impossible, but if you say it can be done—that's all there is to it. Will you give me the details of your plan?"

"You'll learn all about it in due time. Hasn't any possible solution of the problem occurred to you?"

"I haven't had much time to think about it yet. But from the studies we made at Parke University, I'd judge that you intend to make use of the rocket idea."

"That's a question. We may possibly incorporate the rocket principle in our machine, but if we do, it will be merely in the nature of a safety device, in case—but I'm getting ahead of my story.

"I've gone into the rocket idea pretty thoroughly. While I was abroad, I spent some time in Vienna conferring with Doctor Franz Knoff. I also visited the camp at Lake Constance where a group of scientists are preparing to send a registration rocket into space in the direction of the moon.

"In addition, I had an interesting interview with Max Vallier, the German astronomer, and with Ivan Vederof, who has invented a combination of airplane and rocket, by means of which he and Vallier and three others hope to fly to the moon.

"My private opinion is that the idea of placing human beings inside a huge projectile and shooting them through space far enough to escape from the gravitational pull of the earth is not practicable. To leap in a single instant from a position of rest to a speed greater than eight miles per second would hurl the bodies of the passengers against the rear wall of the rocket with such force that they would be instantly crushed to death.

"Vallier and Vederof propose to get up their initial velocity by means of an airplane, but this would alter the situation but slightly. The effect on the passengers in that case would be the same as if they were in an indestructible steel railway coach crawling along at

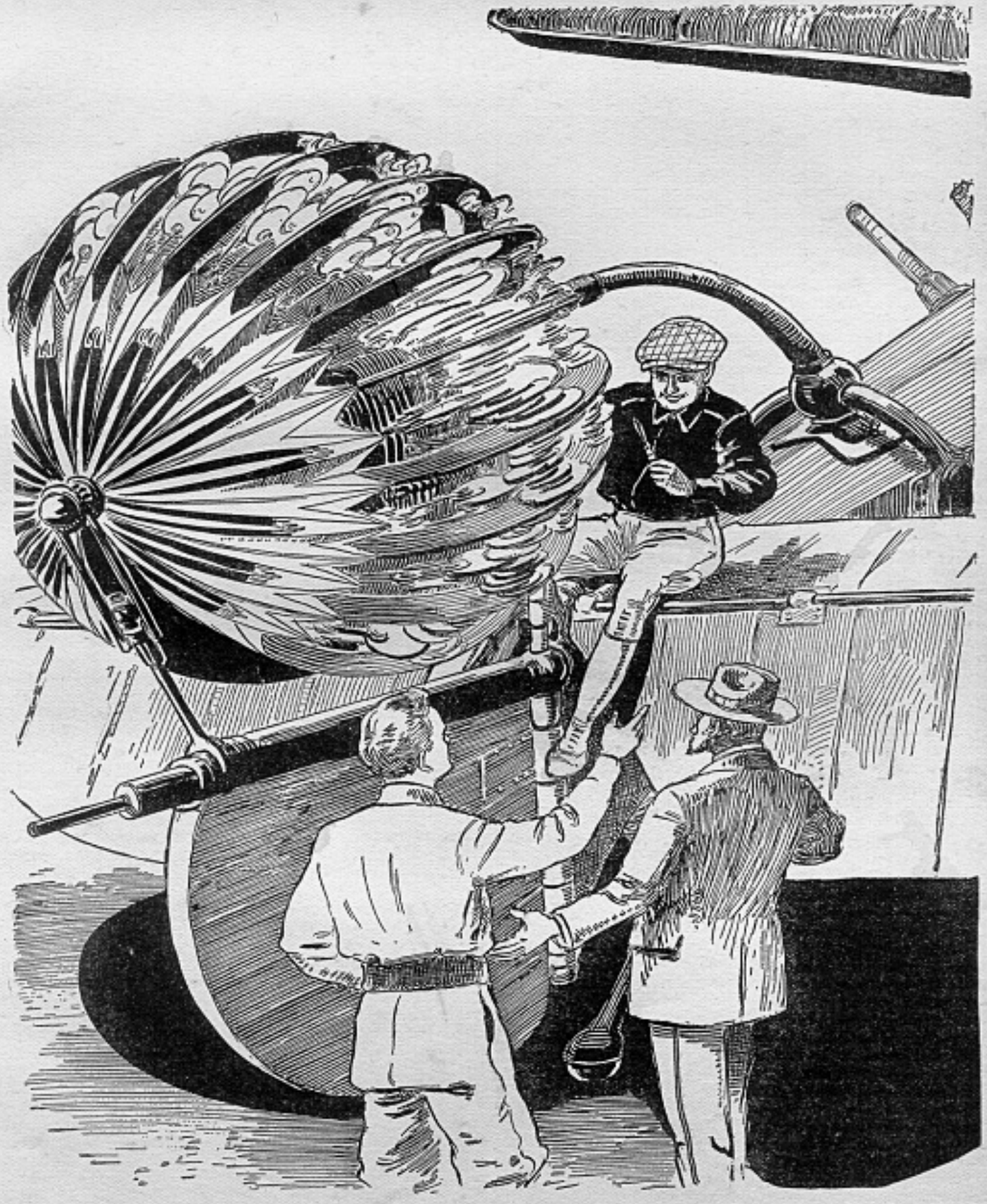
*WE have published many Four Dimensional stories both in the Quarterly and the Monthly, but we unhesitatingly state, that the present story is, without exception, the best one we have ever published along these lines.*

*This is the sort of story you will read and re-read during the months to come, and you will never get quite enough of it. And what is more, this is a story that will make you think.*

*Every high school and every physics teacher and professor will wish his class to read this story, due to the most excellent astronomical data contained in it. This story not only contains excellent astronomy, but excellent physics as well.*

*The theme is as good or even better than Jules Verne's famous classic, "Around the World in Eighty Days." Indeed, it parallels that story in cleverness and in the same sort of unusual clever ending.*

*In addition to all of this, it is an unusually good interplanetarian story, and we know that it will be joyfully received by every scientifiction fan.*



. . . but the biggest surprise of all came one day when I was sitting on the tail of the almost completed machine, attaching the rods and wires connecting the four dimensional rudders with the controls which were to operate it.

the rate of four miles an hour which was in a rear end collision with an express train traveling at the rate of sixty miles per hour. They would likewise be annihilated unless by some means they could acquire the extra velocity gradually.

"Possibly there may be some way to produce a tremendous acceleration in speed so gradually that the human beings inside the device would not be injured, but it doesn't sound feasible to me.

"You may have heard, perhaps, of the plan proposed by two French engineers, Messieurs Mas and Drouet, who think the trick can be accomplished by means of centrifugal force. Their idea is to build an enormous wheel, about six miles in diameter. With its axle resting on two lofty mountain peaks, this gigantic wheel would dip down into a deep excavation. They think that by attaching a projectile-like car to the circumference of this wheel and by increasing its speed of rotation a little at a time, the car, when released at the proper moment, could be hurled into space at a terrific pace without injury to its occupants.

"While it may not be absolutely impossible, this plan is too fantastic and too impractical to merit serious consideration. Even if it were possible to overcome the many difficulties, such as preventing a wheel as big as this from flying into a million pieces when the speed reached a certain point, the cost of such a contrivance would be so colossal as to be positively prohibitive.

"An article published some time ago in *Science and Invention* suggested a means of getting up speed which, while expensive enough, could be tried at a much smaller cost than the six mile wheel of Mas and Drouet. This is a tube or tunnel, curved in a form that is almost a circle, but with both ends straightened out. Even with an arrangement of this description, I doubt if sufficient acceleration could be developed to enable the rocket principle to be used successfully.

"You see, the real problem is to get started and stopped so gradually that the passengers will not be injured by sudden acceleration or retardation of speed. Have you thought of any possible way of doing this?"

"I've thought about it, but that's as far as I've gone," I had to admit.

"DO you know what the three greatest enemies of speed are?"

"Friction is one of them, I should say."

"That's correct. And what are the other two?"

"Would you include inertia?"

"Inertia may be either an enemy or a friend of speed. An enemy when the object is at rest—a friend after it has been set in motion. I wonder if you are not thinking of gravitation. When you travel on the ground, as for instance in an automobile, every time you pass over an elevation, or even the smallest bump in the road, you have to use up energy to lift the weight of the machine and its contents against gravity and this steals just so much from the force that is driving the car forward. There is a tremendous waste from this source, even on the smoothest, levelest roads, and it doesn't take much of a grade to convince you that gravity is a tremendous dissipator of power.

"A corresponding loss of energy is caused by the effect of gravitation on a flying machine. A large amount of the energy transmitted to the propeller of an airplane is constantly being squandered just to keep the plane in the air, against the downward pull of the earth's attraction.

"Now, can you tell me what is the third enemy of speed?"

"I'm afraid I can't."

"Then I'll tell you. It's the low efficiency of present day machinery.

"According to my analysis of the matter, the first steps toward increasing substantially the speed of human conveyances is to subjugate these three enemies: friction, gravitation and wasted power.

"To the work of cutting down the resistance of the air, aeronautical engineers have already devoted a great deal of study and research. The fleetness of the modern airplane as compared with its earlier prototypes is partly due to the application of scientific principles in designing the conformation of wings, fuselage, struts and other parts which are exposed to the air. But you, being a mechanical engineer, are of course familiar with these matters."

"I know a little bit about it," I qualified, "but aeronautics is an extensive and specialized branch of mechanics and I have to admit that I know but a smattering. Guess I'll have to brush up on the subject."

"While I was abroad," he continued, "I had an opportunity to acquire some odds and ends of information on air travel, but my knowledge of the subject is still quite superficial. As I understand it, however, the shape given to struts, airfoils and similar parts of an airplane is planned in such a way as to minimize the formation of vacuum pockets and vortex currents which tend to hold the plane back. You probably know that when a cylindrical rod with a circular cross section is moved rapidly through the air a partial vacuum is created behind it, which materially inhibits further increases in speed except at a high expenditure of additional energy. By altering the shape so that the cross section is an elongated oval, the strut is enabled to pass through the air without forming vacuum pockets, and resistance is correspondingly reduced.

"With all the work which has been done along these lines, it is singular that so little attention has been devoted to the equally important task of reducing the friction of the air against the exposed surfaces of the plane.

"Even the dumbest layman or an immature child knows that to run a piece of mechanism at a high rate of speed without lubrication is impossible. Yet nobody seems to have thought of using the same principle to reduce the *external* friction of the air against the surface of a moving object.

"I have worked out a method of lubricating an airplane on the OUTSIDE. If it works as well in practice as it seems to figure out in theory, it ought to add at least fifty per cent. to the maximum speed of any airship or other means of transportation.

"Still another method of getting away from the resistance of the air is to use a machine capable of reaching such great altitudes that it can travel through the highly rarefied strata of the atmosphere.

"This is one of the means by which a German inventor hopes to attain a speed of 800 miles per hour. I suppose you've heard of Arno Boerner?"

"I believe I have. Didn't he invent the three chamber motor cylinder?"

"Yes. And let me tell you that Boerner's motor is going to revolutionize the gasoline engine design. I visited Boerner at Dresden while I was in Europe and he was good enough to supply me with blueprints and even a duplicate set of patterns for making his motor. They are now on this train—in the baggage car ahead. I also have Boerner's written consent to make

use of his motor in the machine which we are going to construct.

"Boerner estimates that a speed of from 750 to 800 miles per hour can be achieved by using an extra large propeller made possible by the superior driving power of his engine. I have gone over the calculations on which Boerner bases his expectations and have checked them with exacting care. If anything, I believe he has underestimated the capability of his motor. His figures are based on using gasoline as fuel. But I'm going to try out a new synthetic fuel. It's called "Larsene," in honor of the inventor, Ole Larsen, who, I believe, is a countryman of yours.

"Already it is being manufactured in commercial quantities. I have ordered several thousand gallons. It was loaded on a fast steamship before I left Europe and is now on its way to San Diego. I have also arranged for adequate supplies of Larsene to be stored for our use in other parts of the world.

"Freight included, a gallon of Larsene costs about seven cents. Its latent energy is at least double that of an equal quantity of gasoline and it weighs about thirty per cent. less. This will help build up additional speed in two ways: first by delivering more power to the pistons and second by materially lightening the weight of fuel needed for a given cruising radius.

"With the aid of this efficient fuel and several other revolutionary improvements, I confidently believe that we can at least double the speed that Boerner predicted. In fact, we ought to be able to travel at least 1,500 miles per hour!"

"But you also said something about overcoming gravitation," I interposed. "You haven't told me about that yet."

"There's where you come in, my boy! To get away from the restrictions of gravitation, I propose to project our machine into hyper space. And this *you* are to make possible by constructing a *four dimensional rudder!*

## CHAPTER II

### The Four Dimensional Rudder

UNDER ordinary circumstances, I would have been flabbergasted by such a statement. But Professor Banning pronounced it so glibly, with such a matter-of-fact, that's-all-there-is-to-it air, that it did not occur to me how preposterous his plans might sound to some people.

I pressed him for further particulars, but he merely answered, "Let's wait until we get to San Diego. I'll have to explain all the details to Bryan and I may as well kill two bulls with one bullet by giving it to both of you together."

That was my first inkling as to our ultimate destination. I discovered that Professor Banning had already made telegraphic arrangements with Milton Bryan, the famous manufacturer of airplanes, to make use of his mechanical staff and plant at San Diego, California.

As soon as we had deposited our baggage at the hotel in San Diego, we immediately went to the Bryan factory. Making himself known to Bryan, Professor Banning at once launched into an explanation of his ideas for building a super airplane. He exhibited the blueprints of Boerner's motor, supplementing them with verbal explanations, of which the following is a condensation:

"Briefly, the Boerner device converts a single cylinder into three cylinders, each with an inlet, exhaust and spark plug. By this means, a greater proportion of the latent energy contained in the gas is utilized and the amount of power is enormously increased."

He also explained his idea for reducing air friction by lubricating the external surfaces of the plane:

"The progress of man has depended, to a certain extent, on his ability to overcome, or rather reduce friction. In the conquest of friction, the first battle was won by the inventer of the sledge. Men discovered that by placing a pair of smooth runners under the carcass of a large animal or other heavy weight, it could be dragged along the ground much more easily.

"But the greatest genius was the man who devised the wheel, and thereby originated the cardinal idea of replacing sliding friction with rolling friction. Greasing the axle of the wheel to make it run smoother was the next step. Then there was a long stretch of time before some one thought of utilizing the rolling principle for reducing the friction between the wheel and its axle, and ball bearings and roller bearings were invented.

"That was many years ago, and since then very little progress has been made in combatting friction. Every engineer knows that a terrific amount of energy is squandered in overcoming friction between the air and the exterior surfaces of automobiles, airplanes, ships and other conveyances. Yet, except for the slight improvements in the shape of wings, struts and other exposed parts of airplanes, practically nothing has been done to reduce this force-consuming condition.

"I have a plan that will accomplish this reduction in two ways: First, by forming an oily film over the entire surface of the flying machine and second, by using the well established principle of substituting rolling friction for sliding friction."

"My system is to cover the exterior of the airship with a special kind of oil which has previously been whipped into millions of tiny bubbles. I have already conducted successful experiments with a small, inexpensive device, by means of which I can convert a quart of oil into over a thousand gallons of small bubbles—enough to lubricate the outside of an airplane for at least seven hundred miles. These bubbles are forced to the surface through small openings distributed at various points on the machine to be lubricated. The force of the air currents will distribute these bubbles evenly over the exposed portions.

"Each tiny bubble is like a well oiled ball bearing, which doesn't *slide* but ROLLS over the cushions of air. What do you think about that idea, Mr. Bryan?"

"Rather startling and revolutionary, but I see no reason why it wouldn't work," replied the manufacturer.

"You'll probably think that my other innovation is still more astounding," the Professor resumed. "I propose to overcome, or at least materially reduce the force of gravitation by equipping our airplane with a four dimensional rudder. By this means, we ought to be able to steer the machine in and out of hyper space at will. I presume you are familiar with four dimensional theory, are you not?"

"I'm afraid this four dimensional business is a little beyond me," Bryan apologized. "But perhaps if you feed it to me slow and easy, I may be able to digest it."

"ONCE you grasp the fundamental idea, it's really quite simple," the Professor encouraged him. "Four dimensional mathematics has the same relation to solid geometry that solid geometry bears to plane geometry. In plane geometry all the figures have only two dimensions, length and width, while solid geometry merely adds another dimension, which we call height.

"If you move a square having a side one inch long for a distance of one inch at right angles to both its length and width, you generate a three dimensional solid or cube. All you have to do is move the cube for a distance of one inch at right angles to each of its three dimensions and you have a hyper-cube or tesseract. We know exactly what such a figure looks like and can tell you precisely how many lines, surfaces and corners it has.

"Getting at it from another point of view, we can generate a four dimensional object by rotation. Rotate a line about its central point and you form a circle. Rotate this circle about one of its diameters and you have a sphere. If you go one step further and rotate the sphere about a plane passing through its center, you have a hyper-sphere.

"By moving through four dimensional space, some remarkable feats can be accomplished. If a man turns a somersault through the fourth dimension, he would vanish for a moment and when he became visible again everything about him would be reversed in position. His heart would be on his right side and his appendix on his left side. To his friends he would look exactly like his image in a mirror—with everything bilaterally inverted.

"Ordinary walls and other confining boundaries mean little or nothing to the denizen of hyper-space. He can step out of a locked prison cell without even touching the walls, ceiling, floor, door or windows. He can eat an egg without cracking or puncturing the shell and can turn a football inside out without tearing or injuring it.

"Possibly you have heard about the Hyper-Forceps, which our young friend here made with my co-operation. It has actually been used for removing foreign substances from the stomach of a goat without cutting its skin. With it we have also removed gall stones and other objects from the abdomens of human beings, without the slightest shock or injury and withuot making even the smallest incision."

"I have heard of that," Bryan asserted, "but, to tell the truth I thought it was just a lot of bunk. From what I've heard about this speculation concerning the fourth dimension, I've always thought it was purely theoretical—something like the arguments the old philosophers used to have over how many million angels could stand at the same time on the point of a needle. Of course I don't doubt you for a second, but you'll have to pardon me for being a bit skeptical about the practical use of the fourth dimension. Is there any other real proof that such a thing as the fourth dimension actually exists?"

To which Professor Banning responded, "There's fully as much proof of the existence of the fourth dimension as there was of the law of gravitation at the time when the historic apple bumped Isaac Newton on the head. Proof of a new theory is largely a matter of consistency. It usually originates in the form of a hypothesis, which, in the mind of at least one man, seems to offer a logical explanation of phenomena otherwise inexplicable. So long as this hypothesis is reasonable and consistent and so long as it is not contradicted by any single conflicting fact or circumstance, it may be considered as an acceptable theory. But the instant some incongruity or inconsistency is found between the hypothesis and a scientifically recorded fact, the theory immediately becomes untenable.

"So far, I have never been able to find any inconsistencies in the theory of four dimensional mathematics. Nor have I ever heard of any fact or circumstance that proves the existence of a fourth dimension impossible. On the contrary, the theory is surprisingly consistent and is the only means I know whereby certain mystifying phenomena can be explained.

"Take electricity, for instance. After many years of exhaustive research and practical application by some of the greatest scientists in the world, we don't even know what electricity is or how it is transmitted. Yet, if you are willing to grant the possibility of a fourth dimension, some of the most mystifying of electrical phenomena can easily be explained. I can't take time now to give you all the details, but you can take my word for it that several prominent physicists have seriously advanced the theory that certain electrical manifestations are due to vibrations, or other motions, in the fourth dimension.

"Another scientific mystery that can very readily be explained by four dimensional mathematics is the behaviour of polarized light. There are two varieties of tartaric acid, absolutely identical in their properties except that one turns the plane of polarization to the right and the other to the left. The crystals of one variety are shaped exactly as the others would be, if they were inverted through the fourth dimension, and that's the only way such an inversion could take place.

"A similar example is that of dextrose and levelose. Both of these carbohydrates are found in honey and they are similar in their properties, except that dextrose, as its name indicates, turns the plane of polarization to the right, and levelose to the left. If we can conceive of atoms moving in four dimensions, this phenomenon is easily accounted for.

"There is also a species of snail of which there are two varieties—one with the spiral twisted in clockwise rotation from the center outward and the other in counter clock-wise rotation—just as it would be if turned through a fourth dimension. When the juices of these snails are examined by polarized light the fluids from one variety turn the plane of polarized light to the left and those of the other variety to the right.

"To take a more familiar example, let's consider the right and left symmetry of a solid object, such as an apple. We are accustomed to explaining the symmetry of a leaf—which, though it is a three dimensional solid, may be considered as almost two dimensional because one dimensional is so small—by folding it through the third dimension, so that the two halves will fit one on top of the other. If we could fold an apple through the fourth dimension, we could make the two halves fit over one another just as the parts of a folded leaf do.

"My own private opinion is that every object in the universe has some extension in the fourth dimension. Compared with the other three dimensions, this fourth dimension is extremely small—but is still appreciable in size and is variable in different kinds of substance.

"This may be likened to the thickness of a sheet of tissue paper or of the finest gold leaf, 1/250,000 inch, which is so small a quantity, that it is almost equal to zero. For purposes of comparison, we may consider that a sheet of gold leaf is but two dimensions. Yet we know that if we pile enough square sheets of gold leaf one on top of the other, we can build up a solid cube with a thickness equal to its length or width. In the same manner, by joining together three dimensional solid cubes, we can build up an extension in the fourth dimension, until we have constructed a hyper cube or tesseract. By combining spheres, we can construct a hyper-cylinder. In a similar manner we can construct a variety of other four dimensional objects, such as the hecatonicosahedron, which has one

hundred sides and the hexacosahedron which has six hundred sides.

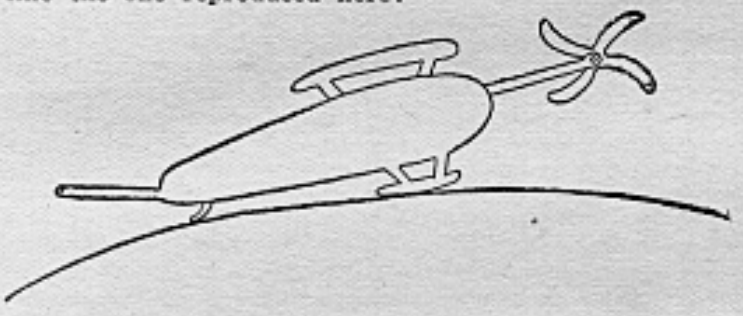
"On two separate occasions, our young friend here has actually succeeded in constructing four dimensional objects—first, when he built the Four Dimensional Roller Press for William James Sidelburg and second, when he constructed the Hyper-Forceps for me.

"With my aid, he is going to attempt to make an airplane rudder having appreciable extension into the fourth dimension. With such a rudder as part of the equipment of a flying machine, I believe it will be possible to pass in and out of hyper-space at will and thus produce a variation or even a complete nullification of the force of gravity acting on the machine. Do you comprehend the idea?"

"I'm afraid I don't understand completely," Bryan admitted, "though I'm beginning to get the drift. Would you mind explaining this thing to me a little more fully?"

"Perhaps an analogy will help clarify the matter," the Professor suggested. "Let us imagine a perfectly flat airplane having only two dimensions, flying over an earth which is a flat, circular disk, instead of a spheroid. Since every portion of this Flatland airship must be in the same plane, the propeller would have to move like the paddle-wheel of a Mississippi steamship. Something like this:"

He picked up a pencil and made a sketch somewhat like the one reproduced here:



"Such an airplane could move only in one plane. Hopping off, it would fly away from the circumference of the disk, and in landing would return to the circle; but it couldn't travel in any direction that would take it outside that one plane.

"Now, suppose we attach to this two-dimensional airplane a rudder having three dimensions and capable of being extended at various angles away from the original plane. With the help of the momentum already created by its motion in the single plane, the airship could be lifted away from the earth-disk. Assuming that this disk has a gravitational pull, tending to draw every article in its own plane towards its center of mass, it is clear that as soon as the object is lifted out of the plane, the attraction, acting at an angle and over a greater distance will be reduced considerably. If the object is moved far enough away from the plane of the earth-disk, the gravitational attraction may be diminished to the point where it is practically equal to zero.

"In a similar manner, by equipping a three dimensional airplane with a four dimensional rudder, I expect to reduce materially the force of the earth's attraction for the machine, or even to remove it completely from the gravitational pull. In this way I hope to attain a much greater speed than is possible with a machine that has to waste a tremendous amount of power in overcoming gravity. Does that make it any clearer?"

"A little bit. The way you explain it, this four dimensional business sounds as simple as A. B. C. But I'm afraid if I tried to work these ideas out myself, I'd go nutty. So I guess you two had better look after the four dimensional rudder and I'll see that the rest of the airplane is made according to specifications."

"That's all we expect you to do, and you may depend on it that the four dimensional features will be taken care of properly."

"Fine!" said Bryan. "And now, if you'll pardon me, I'd like to ask an important question. You understand that, while I am intensely interested in your invention, I am also a business man. All these things you have enumerated are going to cost a pile of money. Has that part of the proposition been satisfactorily attended to?"

"You need not worry about finances. I'm glad you brought that up, though, because it's only natural that you should expect a teacher of mathematics to be as impecunious as a mouse in a Scotch church. If I had depended exclusively on my salary, I should indeed be indigent. However, it so happens that when I was still a young man, I wrote a series of text books on the various branches of mathematics. I've been rather fortunate and my modest works have been endorsed by school boards and colleges all over the United States and have enjoyed a steady, substantial sale.

"Practically all my income from this source has been saved. Until a few months ago, I haven't had to dip into it at all. About half of it went into conservative bonds. With the other half I've taken a few flyers in real estate. Some of them proved remunerative to a very gratifying degree. So you may rest assured that whatever money is needed will be forthcoming. Just let me know how much cash you will require from time to time and I'll see to it that you are paid in advance. Will that be satisfactory?"

"You just bet it will!" Bryan almost shouted.

## CHAPTER III

### Building the Super Airplane

SINCE the work which I had been delegated to perform required meticulous care and intense concentration, a corner of Bryan's factory was partitioned off for my exclusive use. Professor Banning spent about half of his working hours with me, preparing the complicated formulas, diagrams and models, without which I was powerless to carry out the mechanical details of the four dimensional rudder. The remainder of his time he devoted to the work of supervising the building of the airplane itself.

Constructing a machine of this sort, which departed radically from airplane designs as commonly used, naturally took a lot of time. It was several months before the task was completed.

In outward appearance, the Banning invention looked very much like a standard type of all-metal airplane. However, there were a number of details of its internal make-up which were entirely unique. The Boerner motor, with its triple unit cylinders, was perhaps the most notable of these outstanding features. The entire fuselage was constructed with double walls —like a thermos bottle. The hollow space between the walls was filled with a special insulating material, the nature of which the Professor did not reveal until later.

There were several heavy plate glass windows, also double. They were arranged in such a way as to give the passengers an unobstructed view in every direction—up, down, forward, rear, right and left. The walls were penetrated by ten tubes, one terminating at the center of the machine's nose, one at the tip

of the tail, one at the extremity of each wing and six others distributed at various angles along the sides. These tubes protruded for short distances beyond the exterior of the plane and were flexible. By means of an ingenious mechanism, they could be turned to point in any desired direction. All the tubes were connected with an apparatus which produced a steady spray of burning Larsene through any one tube or combination of tubes.

Professor Banning explained that the rocket device did not constitute a major feature of the machine. They were incorporated in the plans as a possible auxiliary source of power and also as a safety device to be used in case of unexpected contingencies. As you shall learn later, it was eventually the means of saving us from a horrible fate—which no one—with the possible exception of Professor Banning, had anticipated.

The other unusual feature, which gave the Banning airplane an odd and distinctive appearance, was the four dimensional rudder. This was fastened to a rod extending about eighteen inches from the extreme tip of the tail. It is rather difficult for me to describe this peculiar device without using the terminology of hyper-space, which would be unintelligible except to a student of higher mathematics. Perhaps you can get a faint idea of its conformation, if I compare it to to one of those collapsible tissue paper decorations that are used at Christmas time. Some are shaped like bells, others like spherical balls. When purchased, they are usually flat and may be opened out to form the decorative ornament.

The four dimensional rudder was somewhat similar in form to one of these familiar articles. When fully extended, it was like a sphere made out of a large number of small sections. By means of a delicately adjusted control in the cabin, the parts of the rudder could be pressed together or spread apart.

This was the device, by means of which, we hoped to steer the machine in and out of hyper-space and thus regulate the amount of gravitational force on the plane at any given time.

## CHAPTER IV

### The Arrival of Colonel Berghlin

MY association with Banning had constantly been pregnant with unexpected eventualities, but the biggest surprise of all came one day when I was sitting astride the tail of the almost completed machine, attaching the rods and wires connecting the four dimensional rudder with the controls which were to operate it.

I could hardly believe my eyes when I saw the slim young man who accompanied Professor Banning, as he entered the airdrome.

"Of course you know who this is," was Banning's informal way of presenting him.

Who wouldn't know him—a man whose likeness is probably familiar to more people in all parts of the world than anyone who ever lived—Colonel Charles Berghlin!

I nearly fell off my perch when I recognized him, but I had sense enough to take the hand he reached up to me and to stammer, "Of course! Everybody knows Colonel Berghlin."

I'm sure you will be glad to learn that Colonel Berghlin has consented to be the pilot of our machine," Banning announced.

No news could have been more welcome to me. Truth to tell, the question as to who was to handle the controls of our wonder plane on its trial flight had given me considerable concern for some time. The most carefully constructed creation on earth would be foredoomed to failure unless it was properly manned. As soon as I learned that Berghlin was to be the nurse of our mechanical baby, my mind was completely set at rest.

While our machine was basically an airplane and included all the fundamental features of the standard Bryan type of flyer, there were enough radical differences and additions to make it necessary for our prospective aviator to spend several days in studying the unique portions of its mechanism.

When the time came for Professor Banning to explain the four dimensional rudder to him, Berghlin merely threw up his hands.

"Excuse me," he said, "but I'd rather not meddle with something I don't understand. As far as operating the regular controls of the airplane and navigating in the ordinary way are concerned, I can handle the whole business; but when it comes to working a rudder that is going to steer us into the fourth dimension, I'm afraid I'll want help from either or both of you."

Professor Banning looked straight at me and said, "It's up to you, then, my boy!"

"Me go along on the first trip?" I gasped. "I should say not! Nothing doing!"

I hate to give the impression that I was afraid to go. It wasn't so much lack of courage, as it was an innate, common sense caution that prompted me to refuse so emphatically. Ever since I was twelve years old, I have been compelled to rely largely on my own efforts. The hard bumps I have received have taught me to look after Number One and to follow the well known aphorism, "Discretion is the better part of valor."

But between the two of them, they talked me into it, of course.

It was Professor Banning who hammered home the clinching argument, when he said: "Did you ever stop to think, boys, that when this task is accomplished it will mean a great deal more than the enormous speeding up of the world's transportation, which we expect to achieve? In addition, it will place two glorious feathers in the cap of youth! It will set up two brilliant examples to act as beacon lights for the guidance of all the young men and women of our land.

"Berghlin has already accomplished unbelievable wonders in turning the minds of thousands of young people away from jazz and petting and the mad pursuit of exciting pleasures, and in directing these fine, youthful minds toward serious thinking and useful attainments. This splendid work is certain to be multiplied many, many times after you two young men—the one with his mechanical skill and the other with his grit and his skill as a pilot—have succeeded in accomplishing a feat that will go down into history as the dawn of a new era."

"I'm afraid you're spreading it on a little thick," I told him and I'm sure I don't belong in the class with Colonel Berghlin, but if you and he both think I ought to go along on the trial trip, I suppose I'll have to. I can operate the four dimensional rudder O. K., but how will I know which way to steer when we get to rambling through hyper-space? Navigation is Greek to me and I don't know the difference between Pi and Phi. It looks to me like we'll need you, too, Professor."

Our pilot promptly agreed: "I think so too, Professor Banning. I don't know of anyone else on earth that is as well qualified as you are to navigate the

machine through the fourth dimension. You've simply got to go along, too."

Much to my surprise, Professor Banning was as tickled as a kid, who has been invited to accompany his dad on a fishing trip.

"I'll be mighty happy to be with you, boys, he rejoined. "To tell the truth, I was afraid that you wouldn't want an old codger like me along. I know Berghlin usually likes to fly alone, but if he thinks we can help—Lord love him—we'll give him every ounce of support he needs!"

Whereupon the three of us grabbed each other's hands as if we were about to play "Ring Around the Rosie." But there was nothing but the most serious thoughts in our minds as we silently and solemnly pledged ourselves to unified, loyal effort toward the accomplishment of our great purpose.

Professor Banning broke the silence: "I just thought of a name for our baby. How do you like this name—the *Spirit of Youth?*"

I assented and Berghlin cried, "Great! And don't forget for an instant, Professor, that of the four that make up 'WE' this time, you are by far the youngest."

## CHAPTER V

### The Trial Flight

WE had tried to keep our plans a close secret; but Berghlin carried with him an ever present brilliance that could not be hidden under a bushel. It wasn't long before the reporters ferreted him out and insisted on getting an account of his activities.

He merely told them that we were working on a new type of improved airplane, by means of which we expected to surpass all previous records for speed.

Came at last the day of days. The last nut had been screwed into place, the last coat of lacquer had been blown on, every piece of mechanism had been tuned up with the most exacting care, the tanks had been filled with Larsene and the *Sprit of Youth* was ready for her maiden flight.

We started in the early hours of an April morning, just as the first faint heralds of the coming dawn began to thrust their wan fingers into the murky sky behind the eastern hills. The exact time of our hop-off we had successfully kept under cover, and only Bryan and two of his most trusted assistants were there to see us off.

No eagle has ever taken wing more gracefully than did the *Spirit of Youth*, as with her oversized propeller beating the air at a furious speed, she shot down the runway like an arrow from a bow. It seemed as if she were off the ground almost the same instant that her restraining bonds were released. Within a few seconds, San Diego and the Pacific had vanished out of sight.

For the first hundred miles or so, we were content to run the machine as an ordinary airplane, without bringing into play either the external lubricating system or the four dimensional rudder. We climbed rapidly to an altitude of approximately twenty-five thousand feet, where our extra large propeller was able to develop a substantially accelerated speed in the rarefied atmosphere.

We found it necessary to start our compressor, which drew air from outside and condensed it so that the atmospheric pressure inside the cabin was automatically maintained at what would correspond to normal barometer pressure. A thermometer, specially designed for recording the temperature outside the machine, registered thirty-four degrees below zero, but we were kept quite comfortable—partly through the exceptional insulating properties of our walls and partly through the aid of a small electric heater operated from storage batteries.

Our super speedometer—which had been invented by Professor Banning for the particular purpose of measuring extremely high velocities—indicated the astounding speed of eight hundred and forty-one miles per hour. This, remember, was accomplished without making use of the two revolutionary features on which we depended more than anything else for extra acceleration.

When our chronometer showed that we had been in the air for about twenty minutes, Professor Banning announced that we ought to be somewhere in the vicinity of Phoenix, Arizona. To verify this, Berghlin turned the nose of the plane downward at a steep angle and we dropped to an altitude of about fifteen hundred feet. We were just in time to catch a fleeting glimpse of Roosevelt Dam and to see the buildings of Phoenix fading into the vague outlines behind us.

Up to this time, we had been flying almost due east. We now veered to the northeast and again climbed to the twenty-five thousand foot level.

Then, for the first time, Professor Banning turned on the external lubricating device. There was an unmistakable quickening. It was like coasting down a steep grade with a car in low gear and then suddenly throwing out the clutch. A glance at our speedometer revealed that we were traveling at the amazing rate of nine hundred and seventy-two miles per hour!

But while our initial trial of the external lubricating system proved that it was a glorious success, it also brought out a small fault which might have had serious consequences. No sooner had the fine jets of oil bubbles been released outside the airplane than every one of our windows became clouded with oil, so that it was impossible to see through them.

We were reasonably safe in flying blindly so long as we kept at this high altitude, but the possibility of something unexpected happening—made even more likely by our tremendous speed—prompted Professor Banning to shut off the external lubrication. Within a few moments the film obscuring the windows had completely cleared.

Professor Banning then announced that we were ready to try out the four dimensional rudder. You may well imagine what the coming out of our debutant device meant to Professor Banning and me. We could well appreciate the feelings of a composer who has spent years of labor and has poured his very soul into a symphony and then waits with thumping heart to hear how the critics receive his creation.

Following Professor Banning's orders, I took my place at the delicately calibrated wheel which controlled the four dimensional rudder.

"Take it easy!" he shouted in my ear. "Turn it just a fraction of a degree and let's see what happens."

I followed directions. There was no result, except my disappointment.

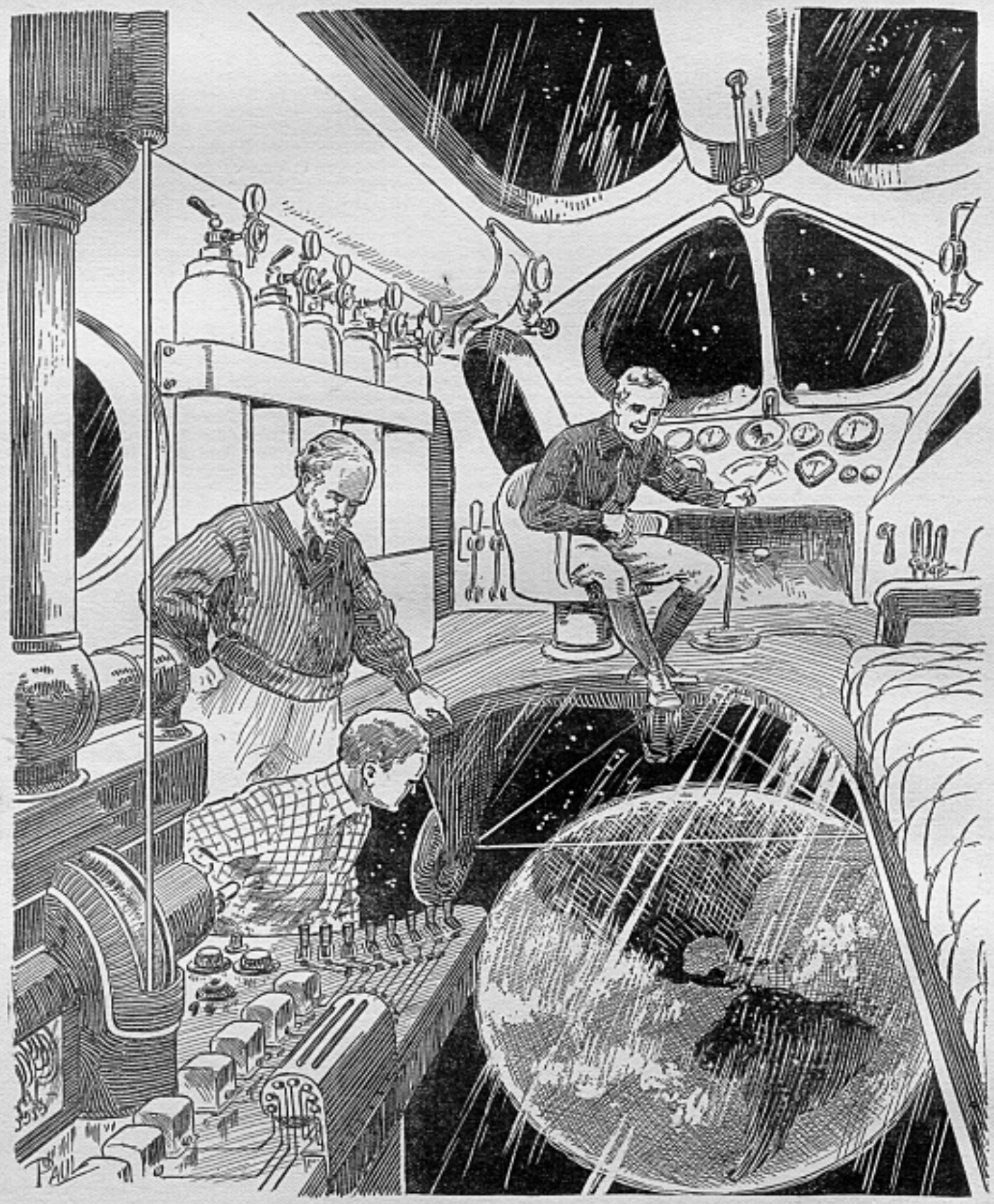
"Give it a bit more," ordered Banning.

Still no effect was noticeable.

"This time move it about five degrees."

I did so. Then something did happen. The plane gave a sudden lurch and I felt that sinking, helpless feeling that I once experienced when a small car I was driving skidded on a wet pavement and spun around through a semi-circle.

For a second or two, the *Spirit of Youth* slid sidewise through the air, but Berghlin, with masterful skill, got it under control and headed back to the course we had been following.



Instead of a wide stretch of earth, which from an airplane ordinarily looks either flat or else concave like the inside of a saucer, the earth beneath us was a well defined ball.

WE all kept our eyes fixed on the speedometer. It registered eight hundred and thirty-nine miles per hour—exactly the same speed as we had been holding when the four dimensional rudder was first put into play. Then, to our surprise and dismay, the needle indicating our speed began to slip backward, until it finally steadied at eight hundred and fifteen miles per hour.

"What do you know about that!" I yelled. "Instead of speeding us up, the fool thing makes us go slower. All that work for nothing, ding bust it!"

"Don't be so sure that your efforts have been wasted," Banning tried to reassure me. "I'm not a bit surprised myself. In fact, it's just what I expected."

"Just what you expected? Then why in the world ——"

"Don't you get the point? Can't you understand that it makes a lot of difference whether we are moving from west to east or from east to west? Just now we are traveling in the same direction as the earth. As long as we are tied to the earth by gravitation, our movements with respect to any point on its surface are the same as if the earth were standing still. But as soon as we cut off some of the gravitational force, our plane becomes a separate body, competing in speed with the earth itself. The ground just beneath us is moving forward at the rate of approximately one thousand miles per hour, and since our speed is only about eight hundred and forty miles per hour, it is but natural that we should lag behind a bit."

"Then what good is the four dimensional rudder?" I asked anxiously.

"Haven't you figured it out yet? When we move in the opposite direction, conditions are reversed. Then we will be traveling from east to west and the earth will be spinning in the opposite direction—which will have the effect of increasing our velocity by that amount, besides the extra speed we will gain by saving the power otherwise needed to keep us in the air against gravitation. I'm getting tired of yelling. I'll write the rest of my explanation."

He picked up a pad and pencil and rapidly wrote the following:

"Imagine yourself on an enormous steamship. Assume that this hypothetical craft is one hundred miles long and is capable of developing a speed of one hundred miles per hour. You are in an airplane which can travel at the rate of one hundred miles per hour while taxying and at exactly the same rate while in the air. If your plane taxies along the deck of the boat, it will take just one hour to travel from stem to stern. The time required to make this trip will be precisely the same, whether the ship is stationary or is moving ahead at top speed.

"But suppose you hop off into the air while the ship is steaming ahead at the rate of one hundred miles per hour. A moment after the take-off, the initial speed of your plane would be two hundred miles per hour, one hundred of which would be developed by the airplane motor and one hundred by the momentum borrowed from the forward motion of the ship.

"The speed created by the motor would continue at the rate of one hundred miles per hour, but the extra momentum due to the speed of the ship would gradually decrease. In this case, it would take considerably longer to fly from stern to stem than to taxi the same distance. And if the extra momentum happens to become exhausted before the airplane has finished the trip, the airplane would never be able to reach the prow but would remain directly above the same point on the ship's deck, since it would be flying at exactly the same speed as the ship is traveling."

He tore a sheet off the pad and handed it to me. While I was reading it, he wrote the following:

"This accounts for our decrease in speed after we detached ourselves *partially* from the gravitational attraction of the earth. While our motor was pushing us ahead at the rate of eight hundred and forty miles per hour, we were also being carried along with the atmosphere of the earth at an additional velocity of approximately one thousand miles per hour. As long as we remained completely within the gravitational influence of the earth, we continued to acquire this extra speed. But the instant the four dimensional rudder placed us in a position where we were influenced by only a portion of the earth's gravitational field, we began to lose some of the momentum given us by the earth's rotation.

"When we start traveling from east to west, it will be a different story. To return to the analogy of the airplane on the giant ship, it will be like flying from stem to stern instead of from stern to stem.

"If the plane taxies from stem to stern, it will take it exactly the same amount of time as to make the trip in the opposite direction, regardless of how fast or how slow the ship may be moving. But when the airplane rises into the air and flies from stem to stern at 100 miles per hour, while the ship is traveling ahead at the same speed, the velocity of the plane with respect to any point on the ship will be the sum of its own speed plus the speed of the ship—or 200 miles per hour. In that case it would cover the 100 miles between the stem and the stern in half the time, or 30 minutes."

I nodded to show that I understood this explanation.

"SHALL I point the four dimensional rudder in the other direction before we lose any more momentum?" I shouted.

Professor Banning signified assent. I carefully turned the control until the indicator pointed to zero. Nothing happened except that our velocity continued to diminish. Banning waited for me to do the thing which to him was apparently quite obvious—then he yelled:

"I thought you said you were going to steer in the *opposite* direction. You'll never get back with the rudder in a neutral position."

That sure made me feel dumb. Rather sheepishly, I adjusted the rudder so that it was turned about five degrees in the opposite direction. For a few seconds nothing happened. Then there was another sickening, skidding jolt and our machine began to spin in a plane parallel to the surface of the earth. The peculiar movement reminded me of a plate which a vaudeville juggler sends spinning through the air in such a way that it comes back to his hand.

Once again the masterful skill of our pilot saved us before the airplane got completely out of control.

Immediately we began to pick up speed until we had settled down to a gait of approximately eight hundred and fifty miles per hour, while flying at an altitude of over twenty thousand feet. This velocity was reduced by nearly one hundred miles per hour when, following Professor Banning's instructions, we dropped to the four thousand foot level.

Within a few minutes we had shot completely over and beyond a large city as quickly as an express train dashes through a tank settlement.

"That was Denver," Berghlin shouted.

"Might as well turn here and head back to San Diego," Professor Banning ordered.

Berghlin brought the plane around in a wide circle and a few seconds later we were over Denver again. Banning then yelled these instructions:

"I want to try a little experiment. Let's just circle over the city for a while. Fly low enough so we can see the details of the buildings. That's fine!" Then he commanded me, "Now for the four dimensional rudder. Give her just enough to steer her to the edge of hyper-space."

With the plane still circling about the city, I carefully manipulated the control. This time Berghlin was ready for the skidding spin and in a jiffy had the airship under perfect control. Then a most preposterous series of phenomena burst on our consciousness.

During our previous trial of the four dimensional rudder, we had been flying over uninhabited territory and at an altitude so great that the earth was nearly out of sight. For that reason we had noticed nothing especially unusual about the appearance of visible objects. But in flying over the metropolitan city, we had plenty of things to look at and an excellent opportunity to study four dimensional perspective.

The insides of all buildings were visible to us. They looked like doll houses that are open at the tops or fronts, so that all the furniture and other objects inside the rooms are plainly visible. The most peculiar thing was that the roofs and the nearest walls did not look transparent or totally absent as they should logically have been in order to expose the interiors to our gaze. On the contrary, they seemed to be as solid and substantial as the rest of the buildings.

Another amazing thing was that we seemed to be able to view the objects beneath us from all directions at once. For instance, I caught a fleeting glimpse of a red-faced corpulent human biped dressed in his B.V.D.'s and manipulating his body into ridiculous postures. I swear that at one and the same time I could see the top of his head, the soles of his feet, his right and left sides, his chest and his back.

Without intending to peep, we found ourselves witnessing some intimate and funny scenes as we whizzed by hotels and apartment houses.

"I'm afraid we are committing a reprehensible solecism by spying on the privacy of our fellow humans in this way," Professor Banning yelled," so let's be on our way."

As soon as we were headed westward, it became instantly apparent that the four dimensional rudder had more than fulfilled our expectations. Although we were just on the border line of hyper-space and were only partially outside the gravitational field of the earth, the effect of having the globe spinning in the opposite direction beneath us became apparent.

We were also anxious to try out the external lubricating system, so I rigged up a crude device by means of which we could from time to time wipe off a clear place on the oil covered windows. Then we turned on the oil globules and at last were shooting through space at what we thought was the maximum limit of our speed.

From the time we left Denver until we landed at San Diego, we were in the air for approximately forty minutes—which indicated the astounding speed of about 1,500 miles per hour.

Our trial spin had proved the *Spirit of Youth* to be a wonderful success. The only flaw we had been able to discover in the entire mechanism was the clouding of our windows by the oil-mist, and this was trivial. All we had to do was to install automatic windshield wipers on each pane of glass and our mechanism was ready for its trip around the world.

## CHAPTER VI

### Pontius Bragg Butts In

HAVING demonstrated that the Boerner motor, the external lubrication system and the four dimensional rudder were all practical and having satisfied himself that the *Spirit of Youth* would do all that he had expected, Professor Banning consented to furnish the newspapers and magazines with a description of his invention and his plans for circumnavigating the globe in less than eighteen hours.

You probably recall the interest and excitement that were stimulated when this astonishing announcement was first made public. Perhaps it was only natural that most of the newspaper writers treated the story as a joke. Some were even bold enough to hint that Professor Banning's brain had become slightly addled through too much ratiocination over tesseracts, hecatonicosiahedragons and other four dimensional nonsense.

It was gratifying to note, however, that the newspapers of the better class gave the matter serious consideration and attention. Even the yellowest of the publications that were inclined to ridicule us made no attempt to explain the definite account of what took place on our trial trip, which was released in the form of an official statement signed by Professor Banning, Colonel Berghlin and me. Of course they gave no particular weight to my corroboration and many were inclined to discount Professor Banning's assertions, but to ninety-nine and forty one hundreths per cent of the inhabitants of these United States the word of Berghlin was as good as the word of George Washington.

The controversy was at its zenith when Pontius Bragg butted into the argument.

Everybody has heard of Pontius Bragg—the most colossal bluff, four-flusher and egoist that ever tried to get his name in the papers.

Bragg, you will remember, first came into prominence several years ago when, after having led an exploring party into central Asia, he returned with the announcement that he and a single companion named Story had succeeded in scaling the highest peak of Mount Everest.

The world in general accepted his claim without question and, for about a week, Bragg was on the front page of nearly every newspaper throughout the world. Wherever he went he was the center of hero-worshipping and adulatory mobs. He was fêted and decorated by the governmental and scientific leaders of several great nations.

It was not until a committee of eminent scientists appointed by the National Geographical Society, interviewed Bragg and Story in a sincere effort to elicit valuable contributions to the world's knowledge, that the real truth transpired. The utter inability of Bragg and Story to furnish a plausible and consistent explanation of how they were able to survive the terrific blizzards that are incessantly raging on the slopes of Mount Everest, and how they were able to conserve enough physical energy to struggle through the extremely rarefied atmosphere at the tremendous altitude of 29,002 feet, was the first thing to excite their suspicion.

The committee, organized to glorify Bragg's supposed achievement, ended by making a gruelling investigation. They unearthed some startling information. Story, the sole corroborator of Bragg's claim, turned out to be a notorious swindler, liar and ex-convict. As for Bragg, the committee became firmly convinced that he had not been within one hundred miles of Mount

Everest. They issued a formal statement, denouncing Bragg and Story as imposters and branding their claim to have scaled Mount Everest as a gigantic hoax.

For some time after that Bragg disappeared from public view, only to pop up again a year or two later as the promotor of a questionable gold mining scheme. From these mining and stock selling operations, Bragg is reputed to have cleaned up over a million dollars, most of which came out of the pockets of people who could ill afford to lose their meager savings.

The next effort which Bragg had made to grab the spotlight had occurred just about the time we started work on the *Spirit of Youth*. He had then announced his intention to fly in an airplane across the South Pole and Aukland to Capetown. He even went so far as to make the journey to Aukland, taking with him a specially built airplane and a crew consisting of three mechanics and two pilots.

After several delays and false starts, he finally hopped off, only to return in a few hours with the report that he had run into a terrific storm. This performance was repeated no less than four times, until the public got so sick of Bragg, that practically all of the newspapers ignored him and consigned to the waste basket the reams of publicity, which were prepared and planted by Bragg's paid press agents.

Then Bragg returned to the United States and succeeded in getting a few newspapers to print the announcement that he had postponed his flight across the South Pole until the following fall when he expected weather conditions would be more favorable.

Bragg's most recent opportunity to break into print came after Professor Banning released his startling announcement regarding the *Spirit of Youth* and our plans to circumnavigate the globe in less than eighteen hours.

AN open letter, signed by Bragg, was published simultaneously in several of the more sensational newspapers throughout the United States. It started out by affirming that Professor Banning's theories were ridiculous and absolutely impracticable. In support of his statement, Bragg offered to wager $10,000 against an equal amount to be posted by Banning that the *Spirit of Youth* would not succeed in its initial trip in circumnavigating the globe in less than eighteen hours.

Following the publication of this challenge, a flock of reporters called on us. Professor Banning made a dignified reply to Bragg's letter. He stated that he did not approve of betting or any other form of gambling for gain. But in order to justify his faith in the *Spirit of Youth* and to prevent Bragg from getting away with what looked like an egregious bluff, Professor Banning made the following counter proposal.

Instead of $10,000, Banning offered to post $20,000 providing Bragg would put up a like sum. In case the *Spirit of Youth* succeeded in circumnavigating the globe in less than eighteen hours, making one or more stops on the way around, all of the $40,000 was to be used to endow a fellowship, the income from which would make it possible for some young man of unusual promise to devote his life to the advancement of aviation. If the *Spirit of Youth* did not get completely around the earth on its first attempt or if the feat of circumnavigation was accomplished in more than eighteen hours, the $40,000 was to be devoted to any charitable or educational purpose which Bragg chose to name.

Bragg's rejoinder was a typical reflection of the man's character. He consented to raising the ante from $10,000 to $20,000, but when it came to the clause regarding "any charitable or educational purpose," he stated:

"I believe that both education and charity begin at home. The only charity I am interested in is the future welfare of Pontius Bragg and his immediate family. The only education I care anything about is the education of the Bragg offspring." By this he could have referred only to Pontius Bragg, Jr., his only child, who had already been expelled from two Eastern colleges and had acquired considerable notoriety through his mad pranks in the night clubs of New York.

You can well imagine that this statement did not mitigate Bragg's unpopularity with the public and the press.

Much as he detested Bragg's principles and Bragg's attitude, Professor Banning accepted his final stipulation. He insisted, however, that the $20,000 be put up in cash by each party and placed on escrow at a bank in order to guarantee the fulfillment of the agreement.

This was done.

## CHAPTER VII

### Across the Pacific

WHILE the controversy was going on between Messrs. Banning and Bragg, we had been busily engaged in grooming the *Spirit of Youth* for her crucial flight. Mechanically there were only a few additions and changes needed. The most essential of these was the installation of the automatic window wipers already mentioned.

Although the machine was capable of carrying enough Larsene to propel it 25,000 miles, or completely around the earth, and although we had every reason to believe that we could easily circumnavigate the globe and return to our home port without stopping, Professor Banning very wisely decided *not* to make it a non-stop flight.

"This is not to be a mere stunt; it is to be a practical demonstration," he stated. "There is no practical value in flying completely around the world and ending up at the starting point without making any stops on the way. That's why we intend to make at least one stop—possibly two or more. The first will be at Shanghai. If we decide to alight a second time, it will probably be at Paris."

Over a month previous to our departure Professor Banning had arranged to have a supply of Larsene shipped to each of the two cities just mentioned. Although this was not exactly necessary, it was done as a measure of precaution, in order to make sure that we would have a large reserve of fuel to draw on if needed.

As is usually the case on long flights, our store of fuel constituted the major portion of our cargo. A few sandwiches and three large thermos bottles full of hot malted milk was all the food we expected to consume during the journey. We also had a five gallon keg of fresh water and enough concentrated, liquid food to last us a month in case we should be forced to land in some remote place.

In addition to the regulation equipment, the *Spirit of Youth* was provided with a specially constructed telescope which had a camera attachment. The telescope was operated somewhat on the principle of a submarine's periscope, except that when in use, it protruded from the bottom of the airplane instead of the top. With this device, it was possible to turn the ob-

jective of the telescope in any direction. It could even be extended at right angles, far enough to one side to clear the body of the plane and in this position afforded an unobscured view directly overhead.

There was but one opening to the cabin and the door had double walls like the rest of the body. When closed, it was absolutely air-tight. Since we expected to do most of our flying at an altitude of over 30,000 feet in order to take advantage of the low resistance of the more rarefied air, our equipment also included a small compressor, which I have referred to previously. This operated automatically, drawing air from outside and compressing it until it was just the right density for comfortable breathing. For use in case of emergencies, an adequate supply of oxygen was provided. We also were supplied with a chemical apparatus for absorbing carbon dioxide from the air after we had breathed it.

After all these devices and supplies had been carefully inspected and checked over, the *Spirit of Youth* was wheeled out on the runway and we were ready to start. It was in the middle of June—the fifteenth to be exact—close enough to the summer solstice to assure us of having the maximum amount of daylight for our trip. For certain reasons, Professor Banning had set the hour of 12 noon as the starting time.

At about nine in the morning we started getting the *Spirit of Youth* ready for the great adventure. The tanks were filled with fuel and a plentiful supply of oil—both for internal and external lubrication—was put into the storage compartment.

Everything was carefully inspected by all three of us, and each of us was also held individually responsible for a complete and painstaking checking of all details, which came within our own particular jurisdiction. For instance, Berghlin went over every cap, lever and bolt of the motor and the control mechanism; Professor Banning saw to it that the equipment of instruments, accessories and supplies was complete, and I inspected, with meticulous care, the four dimensional rudder and everything connected with it.

This work was all completed by ten forty-five and we had an hour and a quarter of idleness before the time set for our take-off. That brief period of waiting seemed like months. It was the hardest, most nerve racking part of the entire adventure.

At last the zero hour arrived!

Though we had done all we could to keep the exact date of our departure a secret, the news had leaked out and there was a goodly coterie of newspaper men, photographers and motion picture camera men—as well as several hundred other spectators present to see us off.

PROFESSOR BANNING and Berghlin stepped into the cabin as nonchalantly as if they were going on a short jaunt to Los Angeles. As for me, I made no bones over the fact that I was both scared and nervous. I felt a great deal as I did the first time I ever dove from a spring board twenty-five feet above the water. I hated to take the jump, and at the same time I didn't want the people who were watching me to see me hesitate too long.

And so, with a sinking heart and with shimmying knees, I scrambled through the narrow opening and Berghlin clamped the air proof door shut.

A moment later we heard the barrage of the motor and we were darting down the runway. With his consummate skill, our pilot maneuvered the heavily laden machine off the ground and headed her nose westward. For several minutes we climbed upward until we had reached an altitude of several thousand feet. Professor Banning then turned on both the external lubricating system and the mechanism for keeping the air inside the cabin at a comfortable breathing pressure.

Then Professor Banning signalled for me to deflect the four dimensional rudder. I gradually turned the wheel until we felt the peculiar skidding motion which told us that we were being steered into hyper-space. Berghlin soon had the airplane under perfect control and we all settled down for a monotonous, steady grind.

At about one forty-five, Banning scribbled a note and held it up where both the pilot and I could read: "We ought to be pretty close to the Hawaiian Islands now."

Sure enough, a few moments later, after we had descended to an altitude of about 3,000 feet, we were able to make out the distinctive outlines of the island of Hawaii, with two small specks which we knew to be Hilo and Maui lying to the west of it.

In a few minutes we had left the "Paradise of the Pacific" far in the rear and were flying high above the vast expanse of ocean. Everything went smoothly and that part of the journey was uneventful.

Shortly after five o'clock, we again dropped down to the lower levels and all three of us kept a sharp lookout for land.

It was Berghlin's keen vision which first caught the dim outlines of the Chinese coast. I don't believe any member of Christopher Columbus' crew was more delighted to see land than I was.

Berghlin justified his reputation as a genius for locating his objectives by finding Shanghai and making a perfect landing on an airport which he had never seen before.

An unwieldly mob of hysterical people had collected on the field and the police were powerless to keep them in check.

With only one-third of our journey completed and with none too much time left in which to finish the trip according to schedule, we were hardly in the mood for hero worship. But, despite our protests and desperate struggles, the crowd dragged us out of the cabin and carried us about the field, while the air was made hideous by the raucous honking of auto horns and the shricking of human voices.

By the time we had persuaded our well meaning, but none the less troublesome admirers to permit us to return to the *Spirit of Youth* and to get it refueled and into the air again, we had lost over an hour out of our precious eighteen.

## CHAPTER VIII

### Far Into Hyper-Space

WHEN we finally found ourselves once more off the ground we all three heaved sighs of relief. It was then that Professor Banning did an astonishing thing. He scribbled a note and handed it to Berghlin. Looking over his shoulder, I read, "Head due east."

I could hardly believe my eyes and Berghlin seemed equally puzzled. At first I thought that the excitement at Shanghai had brought on a brain storm, but he hardly looked or acted like an insane person. Anticipating our objections, he hastily wrote the following: "Please do as I ask. I'll explain later."

That was enough for Berghlin. While he was bringing the plane about, Professor Banning was busily engaged in scribbling another note. This he handed to me. It said, "Turn the F.D.R. until I signal you to stop."

With infinite care I slowly turned the wheel. At about five degrees there was the usual skidding sensation. I stopped, but Professor Banning motioned for me to continue turning it in the same direction. I obeyed. When the dial pointed to twenty-seven degrees, the plane gave a terrific lurch, and the Professor signalled: "Stop!"

With another note, Banning then directed the pilot to make a wide semi-circle which would gradually bring the airplane around until it pointed west again. This maneuver completed, the Professor scribbled off his promised explanation. It read like this:

"To make up for the time we've lost, we must do something to increase our speed. I figured out a way to do this. When we were traveling from west to east at the rate of 800 miles per hour we also were riding along with the earth's atmosphere which is moving from west to east at the rate of approximately 1,000 miles per hour. (For convenience I am using only round numbers.) This made our total, absolute speed about 1,800 miles per hour.

"By steering with the F.D.R. for a considerable distance into hyper-space, we have been able to detach ourselves almost entirely from the gravitational attraction of the earth—while still maintaining our speed of 1,800 miles per hour.

"Now that we are headed east again, the surface of the earth is moving beneath us in the opposite direction with a speed of 1,000 miles per hour, while we ought still to be making nearly 1,800 miles per hour. Suppose we assume that in making the turn and getting headed west again we lost some of our velocity—say 300 miles per hour. We would still have left a rate of 1,500 miles per hour, which added to the speed of the earth's rotation would make our velocity with respect to any point on the earth's surface, approximately 2,500 miles per hour."

I shook my head to indicate that I did not comprehend fully. Professor Banning amplified his explanation as follows:

"Let's go back to the analogy of the airplane on the deck of the imaginary steamship 100 miles long and traveling at a speed of 100 miles per hour. If the plane taxies toward the bow at the rate of 100 miles per hour and then flies off, its initial velocity will be 200 miles per hour.

"Now, suppose it makes a hairpin turn so that it moves in the opposite direction from that in which the ship is sailing. If it is able to maintain its original rate of 200 miles per hour, its velocity with respect to any point on the boat will be 300 miles per hour, enabling it to travel the 100 miles from stem to stern in one-third of an hour or twenty minutes.

"In actuality, of course, it would quickly lose its original speed, due to the resistance of the air.

"Up here, however, the atmosphere is very rarefied and also because of our special devices for reducing both friction and gravitational attraction, our loss should be very slight. If it were possible to reduce this loss to zero, here's how our present speed would work out:

| | |
|---|---|
| "Speed due to motor.. | 800 M.P.H. (Approx.) |
| Extra amount due to earth's rotation... | 1,000 M.P.H. (Approx.) |
| Total speed during brief period while we were traveling from west to east. | 1,800 M.P.H. (Approx.) |
| Speed of earth's rotation, which since we are now traveling from east to west, is in the opposite direction... | 1,000 M.P.H. (Approx.) |
| Total speed with respect to any portion of the earth below us..... | 2,800 M.P.H. (Approx.) |

"As I indicated before, I do not think we are actually traveling quite that fast, since we must have lost some velocity while we were making our right-about-face maneuver, but I wouldn't be surprised if we are traveling at the rate of at least 2,500 miles per hour right now."

WE had no way to measure our speed since our specially designed speedometer could register no higher than 2,000 miles per hour. To estimate our velocity from the movement of objects beneath us was also impossible, due to a large cloud bank which completely hid the earth from view.

One thing that was quite noticeable, however, was the rapid acceleration of the motor. It began racing at an alarming speed, and it had to be throttled down. Finally the flow of fuel was reduced to the amount required for idling while on the ground. Still the propeller whirred faster and faster. When it sounded as if the motor would fly apart, the power was turned off completely.

Just then we reached the edge of the clouds and I was able to secure an unobscured view downward.

What I saw made my eyes bulge and brought to my scalp that tingling, prickly feeling that we always associate with intense and sudden fear.

Instead of a wide stretch of earth, which from an airplane ordinarily looks either flat or else concave like the inside of a saucer, the earth beneath us was a well defined ball. To be sure it was an enormously large ball which completely filled the space beneath us, but it was rapidly becoming smaller before our very eyes.

I must have uttered some fearful cry, for both Berghlin and Banning looked at me with startled concern. I tried to say something, but the words caught in my throat and nothing but an incoherent gurgle issued from my numb lips. I finally pointed through the window and, following my gesture, they looked downward.

I saw a look of amazement come to Berghlin's features and his lips formed an exclamation which must have been:

"My God! What's happened?"

Only Professor Banning preserved his usual calm equanimity. He even had the nerve to smile!

Berghlin frantically manipulated the controls in an attempt to coast to a lower altitude but all his efforts were fruitless. Instead of descending, we seemed to be falling rapidly *away* from the earth.

My own attempts to reverse the direction of our machine by working the four dimensional rudder were equally futile.

With the motor shut off, we could now converse easily without shouting or resorting to notes. Professor Banning was the first to speak calmly:

"I was afraid this might happen. But don't worry. I have prepared for it."

"Prepared for what? Afraid what might happen?" I gasped.

I knew the answer before he gave it.

"Don't you see what we've done? The four dimensional rudder kept steering us further and further into hyper-space until we have been projected CLEAR

BEYOND THE GRAVITATIONAL FIELD OF THE EARTH! The *Spirit of Youth* is now like a meteor or small comet. WE ARE FLYING THROUGH SPACE ABSOLUTELY INDEPENDENT OF ANY DIRECT CONNECTION WITH THE EARTH OR ANY OTHER BODY!

## CHAPTER IX

### Banning Makes An Astounding Proposal

"DO you mean to say that we have risen to such a high altitude, or have gotten so far into hyper-space as you call it, that the earth no longer exerts any attraction for us?" Berghlin asked Professor Banning.

I woke with a start, to find myself floating in mid-air and bumping against the ceiling of the cabin. The Professor grasped my leg and pulled me back to the floor.

"Not at all," was the answer. That would be impossible, no matter how far away we go. You've studied physics, of course, and you will recall the law of

gravitation, which may be expressed something like this:

> "'Every body in the universe attracts every other body with a force that varies directly as the product of their masses and inversely as the square of the distance between them.'

"That means exactly what it says. It means that the *Spirit of Youth*—or for that matter even this tiny match which I now hold in my hand—is being attracted in some measure by the sun, by the earth and all the other planets from Mercury to Neptune, and by every other object in the universe, including the smallest asteroids and the remotest stars.

"The force with which we are being attracted by any individual body depends on two things, its mass and its distance away from us. When we were flying within a mile or two of the earth, its gravitational attraction for us was, of course, infinitely greater than that of any other body in the universe. This was due partly to the enormous mass of the earth, but principally to our closeness to it.

"If the mass of the earth were doubled, the weight of every object on the earth or close to it would be doubled. That is providing the weighing is done with a *spring balance*. You can readily see that if things are weighed with scales depending on balancing standards of known weight, a change in the mass of the earth would have no effect on the weight registered, since the standard weights themselves would be altered in exactly the same proportion as the objects weighed.

"Let me call your special attention to the fact that the distance between two objects has a much greater effect on the amount of the gravitational force than their joint masses. If this distance is doubled, the attractive force becomes one-fourth as great; if it is trebled, the attraction is only one-ninth as great; and if the distance is multiplied one thousand times, the gravitational force is diminished to one one-millionth of its original magnitude. That is what we mean when we say the force varies *inversely* as the *square* of the distance.

"You can easily see, therefore, that we don't need to get so very far away from the earth, before its attraction for us becomes extremely small. And since out here there is practically nothing else to offer any resistance to our progress or to reduce our speed, our

tendency will be to keep on moving with uniform velocity in a straight line until some other large body gets close enough to us to deflect us away from our course."

It took several minutes before the full significance of these startling statements registered clearly on my brain. When they finally did sink in, I was surprised to find that I could take the shock quite calmly. A person would reasonably be expected to get a bit excited when he was told that he was flying through interstellar space with no particular course or destination. It didn't take me long, however, to conclude that there wasn't much we could do under the circumstances and hence we might as well make the best of it.

Berghlin also was as calm as well water and equally cool. That was natural enough in view of the many chances he had taken in the past which had undoubtedly steeled him to look danger in the eye without flinching.

Of the three of us, the Professor was the most excited. Not that he showed any indication of fear or regret. On the contrary, he seemed to be elated to the point of exultation.

"Just think of it, boys!" he exclaimed. "We are the first human beings who have ever traveled beyond the earth's atmospheric envelope! What a wonderful contribution we are making to science!"

"A lot of good our contribution to science will do with us doomed to go crashing through space until we hit something or run out of the things we need to keep us alive," I cried bitterly. "We'll soon be slowly starving to death if we don't smother first, or freeze or burn up or meet some other horrible fate—and then what good will our contribution to science be?"

"Don't be so pessimistic, my young friend," was the Professor's mild reproof. "Who said we are going to smother, or starve or freeze? Not if I can help it. As I told you a moment ago, I foresaw that this might happen and I have tried to make adequate provision for every eventuality."

"Do you mean to say that you deliberately planned to have us shot off into space like this on a—on a—(I hesitated for a suitable phrase) on a wild comet's chase?"

Though he must have known that I was tragically serious, the Professor chuckled. "I didn't exactly plan it, but the possibility that it might happen did enter into my calculations when I designed the *Spirit of Youth*."

"Then why in Sam Hill didn't you tell me all this before I consented to go along on this fool expedition?"

It was then for the first time that Berghlin interposed a remark. He merely said quietly, "What's the use of all this argument? We're in it now, so let's see it through like men."

THAT was all I needed to put me straight again. "You're right, and I ought to be kicked," I admitted. Then turning to the Professor, "I'm sorry and I apologize. Guess my Scandinavian temper got the best of me."

"That's all right, my boy. Glad you got it out of your system. And now, if you'll just trust me as you used to, I feel sure that we'll come out of this unharmed."

That "trust me as you used to" made me feel like a pimple on a microbe's proboscis—if a microbe has such a thing as a proboscis. Like the boy who was caught in the melon patch, I had nothing to say.

Berghlin picked up the conversation.

"Do you mean, Professor, that you actually think there is a chance for us to get back to earth again without being annihilated?"

"Just as good a chance as you had of reaching Paris when you were flying alone through the Atlantic fogs. But it seems to be getting a bit stuffy in here. I'll turn on the air purifier." He pressed a button and a small machine at the rear of the cabin began to give off a whirring sound.

"This is a new invention I haven't told you about before. It was designed for use on submarines, but will serve our purpose equally well. Mechanically, it is as simple as a vacuum cleaner. Nothing but a small motor and a fan, operated from storage batteries. It keeps the air inside the cabin in constant circulation. The important principle of the device is a chemical one. It absorbs the surplus carbon dioxide and other waste matter which we put into the air when we breathe. An automatic apparatus also keeps supplying just the right quantity of additional oxygen to compensate for what is used up. It will take care of our breathing needs for at least two months—which is considerably longer than I expect to use it. We also have plenty of food aboard, so don't worry about that."

"But how are we going to keep from freezing to death?" was my query. "According to our physics text books, the temperature of interstellar space is absolute zero, which, as I remember, is the same as minus 273 degrees on the Centigrade scale or about 459 degrees below zero on the Farenheit scale. What about that?"

"Nothing to worry about. Whether or not the writer of your physics text book is correct in his assumption is one thing we shall probably find out. Undoubtedly it is true that space itself is not heated by the rays of sunlight which pass through it. But when these same rays impinge on a solid object, such as the earth or the surface of this airplane, we know that they are capable of producing immense quantities of heat.

"Bear in mind that out here we have no atmosphere, no fog, no clouds and no night time to reduce or tone down the strength of the sun's rays. As long as we are in the open, it will always be day time on the side of the machine nearest the sun and night time on the shaded side. And since the rays must hit at least part of our surface at right angles, I expect a climate to be more like that of the Sahara Desert than that of the Arctic regions.

"Instead of being in danger of freezing, I think, if anything, we'll find it uncomfortably hot. However, I'm relying on the insulating material between the walls, combined with the neutralizing effect of the shaded portion of the plane, which ought to absorb enough heat from the sunny side to keep us comfortable. And if the worst comes to the worst, we have both an electric heater and a refrigerating plant aboard, so we're prepared for anything that is likely to happen. Is there anything else that's worrying you?"

"Yes. What about the cosmic ray? I've read that, even after penetrating several miles of the earth's atmosphere it is strong enough to affect the indicator of an electroscope several hundred feet below the surface of a lake. Isn't it likely to have some injurious effect either on us or on our machinery as soon as we get completely outside the earth's atmospheric protection?"

"If anything like that was going to happen, it would have been all over before this. And I don't for a minute doubt that serious consequences might have

taken place if I hadn't thought of that, too, and guarded against it.

"I don't know whether you noticed it or not, but the material which we used for filling the space between the two walls of our airplane is a vitreous, jelly-like substance known as *Cosmotite*. It is not only a remarkable insulator against heat; it is also an insulator against the cosmic ray. Experiments have proved that one inch of *Cosmotite* offers as much resistance to the passage of cosmic rays as eight miles of atmosphere at normal barometer pressure. The thickness of the insulation inside our hollow walls is enough to give us approximately the same protection as is afforded by the earth's atmosphere. Fortunately this insulating material is transparent to ordinary sunlight, so I have been able to use it between the double windows as well."

"One more question, if you don't mind," I said. "How are we going to get back to earth? Even if we could make our motor run slowly enough to operate the propeller without racking it to pieces, it wouldn't do any good because the propeller can't move the plane except by creating a current of air in the opposite direction, and since there is no air up here, the propeller has nothing to take hold of."

"That's quite correct. And here is where our rocket tubes come in. Remember, when you and I were discussing this part of the design before we started building the *Spirit of Youth*, I told you that I installed the rocket tubes as a safety precaution in case of emergency? Well, the emergency is here, and we are prepared to meet it."

"I'll have to hand it to you, Professor," I eulogized. "You sure thought of everything, didn't you?"

"I hope so. I've tried my best to anticipate and provide for anything that might happen. I may have overlooked something, but I trust that I haven't."

"When you tackle a job like this, you don't usually overlook anything—so I guess we are safe."

"I'm glad to hear you say that. Thank you very much."

"That's all right. Now, is there anything I can do?"

"Yes, there is. I want you and Charley to help me make a very momentous decision. Shall we turn back to the earth right now or shall we go on?"

"Go on?" I gasped. "What in the universe do you mean?"

"Just this: We already have a good start on a trip that may develop into the greatest adventure that any human beings have ever undertaken outside of a book of imaginative and sensational fiction."

"You mean . . ."

"A trip around the moon and back to the earth!"

## CHAPTER X

### We Try the Rocket Tubes

"YOU mean you think it will really be possible for us to land on the moon?" I asked Professor Banning.

"I didn't say anything about *landing* on the moon. While I believe it could be done, I wasn't thinking of attempting *that* on *this* trip. My suggestion is that we fly within a thousand feet or so of the moon, make a hairpin turn around it and return to the earth without stopping. In this way we could make close observations and perhaps get some good, close-up photographs of the moon's surface.

"As you know, the moon rotates in such a way that it always turns the same face toward the earth. For that reason, nothing whatever is known about the opposite side of the moon. I propose to find out what this hidden face of the moon looks like."

"What good will that do?" I asked.

"No practical good, perhaps, any more than the expeditions of Amundsen and Byrd and Wilkins across the polar regions had any practical value. But I think that they were justified because they added to the store of human knowledge. Just think what it will mean to contribute a new page to the world's book of knowledge! Isn't that worth striving for? Isn't it worth taking risks for?"

"If you want my honest opinion," I grumbled. "I'm for hitting it back to good old mother earth while the hitting is good."

When I saw the pained look of disappointment on Professor Banning's face, it made me feel ashamed.

He appealed to Berghlin: "What do you say, Charlie?"

"It looks to me to be worth trying. If you think there is a good chance for us to make it to the moon and to get safely back to earth, I'm for going on."

I knew there was no use holding out any longer after that, so I said, "If both of you feel that way about it, far be it from me to throw sand in the gear box. So let's make it unanimous!"

"Thanks, boys!" said the Professor, as he grasped my hand warmly with one hand and patted Berghlin on the shoulder with the other.

During the time we were holding this conference, the *Spirit of Youth* was hurtling through space without a guiding hand. Our pilot, to be sure, had stuck to the joy stick, but he might just as well have left the machine entirely to its own devices, for the controls no longer exerted the slightest influence in our course.

From the moment he had found it necessary to shut off the motor, he had given practically no attention to navigating or controlling the plane's flight. Now, he turned his attention to this important matter.

"What I'd like to know is how we are going to navigate now that none of the controls will work," he remarked. "And if we do succeed in figuring out some way to steer, how are we going to know what direction we are supposed to go?"

"Steering is easily accomplished by means of our rocket tubes," the Professor responded. "The reason why your motor races and your controls won't work is that there is virtually no air or other fluid out here on which your propeller or your rudders can take hold. For the same reason, there is practically no resistance being offered to our progress, so we are shooting merrily along at about the same speed we were going when we shut off the motor. This is in accordance with Newton's law of motion:

> 'A body in motion tends to continue moving with uniform velocity in a straight line, unless acted on by some external force.'

"Under the circumstances, the only way we can change either the speed or direction of our flight is to apply Newton's third law of motion, which is:

> 'For every action there is an equal reaction exerted in the opposite direction.'

"To produce the requisite reaction, all we need to do is project something out of the plane through one of our rocket tubes. This may either be a single shot like a bullet from a gun or a steady stream of sparks or burning gases like the tail of a rocket. Like the kick of a gun, this produces a reaction which will push the plane in the opposite direction.

"Since there are ten tubes—all capable of being

pointed in different directions—we can easily steer toward any given point, merely by turning one or more of the tubes in the direction opposite from that in which we desire to go, and shooting a charge of explosive gas through the tubes.

"But how shall we know whether to steer north, south, east or west?" Berghlin asked.

"My dear boy, there are no such words as north or east—or even up or down in the universe. Even on earth, these terms are very ambiguous. For example, when Amundsen flew across the north pole in the Norge, he traveled due north until he passed over the Pole; then he immediately began to travel southward, or in exactly the opposite direction, although he didn't change his course a particle and continued to move in the same direction he was going when he was headed north.

"Likewise, when an aviator flies around the earth from east to west, his direction, while he is flying over China is exactly opposite to what it is when he is over Pennsylvania, and yet in both cases he is traveling toward the west.

"The terms up and down are also inexact. What they really mean is 'away from the center of the earth' and 'toward the center of the earth.' At twelve o'clock, noon, the steeple of a church points in exactly the opposite direction from what it does at 12 o'clock midnight. At six o'clock it points at right angles to the original direction, yet we say the steeple always points 'up.'

"When you get away from the earth, such terms as up or down, north or south, east or west, have absolutely no significance. That is, unless we adopt some system of definition and arbitrarily assign meanings to them. For instance, we can draw an imaginary line from the North Star to the center of the sun and continue it for an indefinite distance beyond the sun. This we can call our North and South Line. Through the center of the sun, we can then pass a plane of unlimited area meeting the North and South Line at right angles. Some prominent star which happens to fall within this plane may now be selected and named the 'East Star.' A line drawn from this star through and beyond the center of the sun will give us our East and West Line. If we wish to include hyper-space in our chart, it will be necessary to draw a fourth line through the center of the sun at right angles to each of the other three lines. This line will extend into the fourth dimension. To it we can give any name we wish—as for instance the 'In and Out Line.'

"With these four co-ordinates we can easily locate, with definite exactness, any object in the Solar System, or for that matter in the entire universe. A complete science of navigation for space flyers could be built up, using this conception as a basis."

"And do we have to figure all this out in order to find our way to the moon and back?" asked Berghlin.

"Oh no, indeed. Our problem is quite simple—as simple, in fact, as it would be for a pilot to steer a straight course toward a brilliantly visible lighthouse.

"Our beacon light is the moon itself, which will always be conspicuously present in the heavens. All we have to do is fly straight toward it. When we get fairly close, we'll have to do a little navigating to steer around the moon and to escape from its gravitational clutch. After that it will be plain sailing, with the great ball of the earth as our goal."

"Isn't it about time we got our bearings and set our course?" Berghlin suggested.

"I think you'll find we are traveling in approximately the right direction right now," the Professor assured him.

Our pilot looked through the front window and said, "I can't see the moon at all."

"Come here and take a look through this window," said the Professor.

BOTH Berghlin and I looked in the direction indicated and there, sure enough, was the moon—but such a moon as human eyes had never before seen. It looked as big as a medicine ball. Half of it was illuminated with a dazzling brilliancy that almost rivalled that of the sun. The outlines of the other half, though dark, could be very plainly distinguished.

"But it's behind us and to the starboard side of us instead of straight ahead!" cried Berghlin. "We must be flying away from the moon instead of toward it."

"If we were moving in the direction that our nose is pointing that would be true; but I think, if you watch the moon for a while, you will see that it is gradually growing larger, indicating that we are traveling toward it, even though our machine itself is moving backward and sideways.

"Since there is no atmospheric pressure or other resistance up here, it really doesn't matter how our machine is headed so long as the whole plane itself travels in the right direction.

"To make sure, I'll take an observation. All I need to do is to point our telescope toward the center of the moon, take a reading of the scale and then point it toward the center of the earth. If we are traveling in a straight line between the earth and the moon, the angle between these two lines of direction will be exactly one hundred and eighty degrees."

He adjusted the telescope and, pointing it first at the moon and then at the earth, took a reading of the scale.

"Hm! One hundred and seventy-three degrees and forty-two minutes. We are six degrees and eighteen minutes off our course. Let's see if we can correct this. And while we are about it, we'll also try to turn the nose of our plane toward the moon."

He jotted some figures on a scrap of paper, figured rapidly for a few seconds, and then said, "Seven units in number three and sixteen in number eight ought to do the trick. Then the Professor made some adjustments on a special keyboard, which operated the mechanism of the rocket tubes and we heard a hissing sound exactly like that of two big sky-rockets being fired off at once. We felt a slight jar, which was followed by a change in the direction of the airplane. In a moment it had swung around until the moon was visible through the front windows, a few degrees to the port side of our normal line of flight.

"That isn't perfect, but I think it will be close enough for now. My mechanism for controlling the rocket tubes is very crude and imperfect. When I get time, I expect to work it out in such a way that the rockets can be operated automatically by means of the joy stick—just like ordinary flying. For the time being, however, our present method will serve the purpose, I think."

"Can't we use the rocket tubes to increase our speed?" inquired Berghlin.

"Certainly. But I don't think we had better waste any of our fuel now. We are speeding along at a pretty satisfactory gait as it is and we may need all the power we can develop to get us around the moon and back to earth again, so I believe we had better conserve our resources."

"How long do you think it will take us to complete the trip?" (This was my question.)

"That's hard to say. Since we have no way to measure our velocity with any degree of accuracy, we'll have to estimate it. My guess is that we are traveling about 1,500 miles per hour. I obtain this figure by adding the approximate speed which our motor was developing, or about 800 miles per hour, to the velocity of the earth's rotation, which in round numbers is 1,000 miles per hour, and then making a reasonable deduction for loss of motion while passing through the upper, more rarefied strata of the earth's atmosphere.

"The distance from the earth to the moon is 238,851 miles. If we maintain a uniform speed of 1,500 miles per hour, it will take us about sixty-three days to reach the moon and another sixty-three to get back, making a total of over four months for the round trip."

"Phew!" I ejaculated.

"But," continued the Professor. "I don't expect to consume anywhere near that amount of time. There are two ways in which we can accelerate our speed. One is by making use of the gravitational attraction, first of the moon and then of the earth. And, as a last recourse, we can always boost our velocity by means of the rocket tubes. With these aids, we ought to be able to make the complete journey and be back on earth inside of thirty days."

"That's plenty long enough for me!" I exclaimed. "But so long as we get back safe, I should worry about how long it takes us." By the way, I wonder what time it is."

Simultaneously, we all looked at our wrist watches.

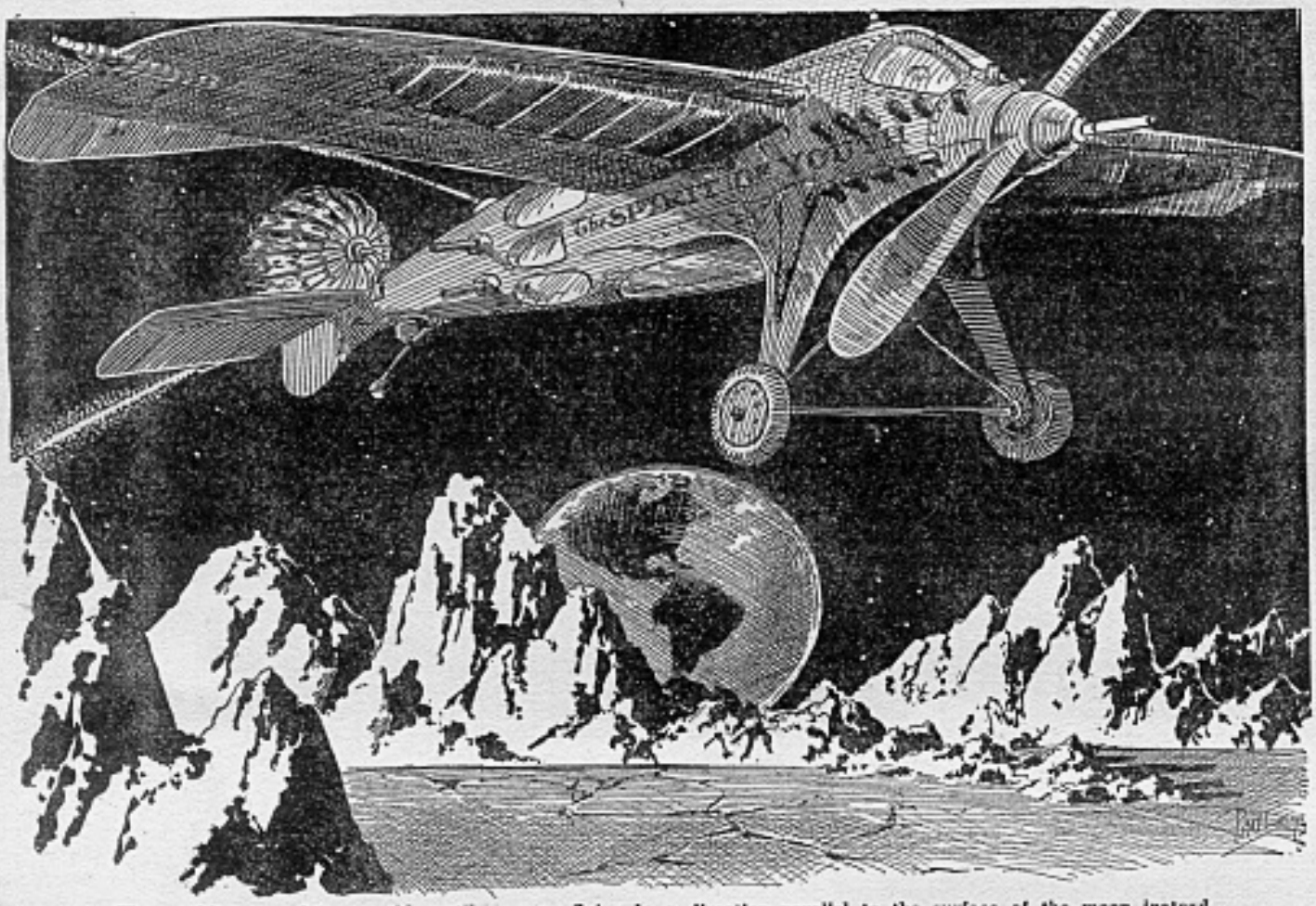
"Mine says seven forty-eight," Berghlin announced, as he held his watch up to his ear. "That can't be right. Must have stopped just after we left Shanghai."

"My watch is also stopped," the professor declared.

"Mine too," I chimed in.

The chronometer on the dashboard also was stopped, with the hands pointing to seven forty-eight. We all tried to get our time pieces going again, but neither of them could be made to work.

"It must have been the jolt when we took that sudden dive into hyper-space just after leaving Shanghai that put our chronometer and watches out of commission," Professor Banning explained. "That's too bad. Now we have no means whatever for measuring time. We can't even count the days that pass,




The machine veered to one side until we were flying in a direction parallel to the surface of the moon instead of pointing directly toward it.

since the sun doesn't rise or set here. There is nothing to do about it, though, so far as I can see."

## CHAPTER XI

### We Lose Track of Time

UNTIL I found myself absolutely bereft of any basis for recording or even estimating time, I never realized how much we human beings depend on the clock in regulating our activities. To be lost in time was to me far more serious than to be lost in space—and lost in time we certainly were.

It is the weirdest feeling I have ever experienced—the utter inability to distinguish between weeks and days and nights, or even between hours and seconds. The ability to estimate the time of day within a half

hour or so—which almost anyone can ordinarily accomplish with ease—was completely lost to us here.

Of course we had no way of knowing how many days were passing by. On one side of the plane the sun shone continuously. The other side was in dense shadow.

I told Professor Banning that my conceptions of time were completely disrupted and asked him if he was affected in the same way. His answer was, "Certainly not. I feel sure I can estimate the time that elapses just as well as if we were on earth. I guess it's my mathematical training that makes this possible."

"If that's the case, you'd better be our time-piece. I can't answer for Berghlin, but as for me, I'm completely at sea—or rather at space—so you'll have to tell me when it's time to eat and sleep.

"That reminds me," the Professor remarked. "We've been a long time without food. Let's eat right now."

We made a meal out of the rest of the sandwiches, which we had taken along thinking that they would be ample for the entire journey. Since Banning had assured us that we had an ample supply of concentrated food, we all ate heartily, making no attempt to conserve our rations.

When it seemed to me but a few minutes after we had finished eating, Banning said, "Well, boys, it's past midnight now. Aren't you going to bed?"

"I'm not a bit sleepy," I assured him. "You two go ahead and sleep. I'll stand watch."

"So will I," our pilot volunteered. "I'm too nervous to sleep."

"Well, if you boys don't mind, I believe I will take a nap. If anything unusual happens, be sure and wake me." With this, the Professor stretched himself out on the floor of the cabin, drew up a blanket, and almost instantly began to snore contentedly.

With Professor Banning asleep, Berghlin and I were at loss for something to occupy our minds. Since we had not expected to have any time to kill on our rapid trip around the earth, we had brought with us neither books, cards nor other means of passing away the time. While Banning was awake, we were content to ask him questions and listen to his interesting explanations, but since neither of us two knew anything about interplanetary navigation, we soon had to give up trying to figure out what the result of our amazing voyage would be.

There was nothing to do but stare out of the window and we soon found the vista quite monotonous—astonishing and spectacular as it was at first sight.

Were it not for the brilliant sunlight streaming through the windows that faced old Sol, we might have thought we were flying through stygian darkness. The sky was as black as a windowless cellar full of coal. The Milky Way, the Great Dipper and all the other stars and constellations were all shining with a brightness never perceived from the earth.

Three great glowing orbs hung in space against the sable sky. The largest of these was the earth, now far behind us and looking like a gigantic push-ball floating in space. We could make out the form of the entire globe and could even distinguish the familiar outlines of the eastern hemisphere. About half of the globe was brightly illuminated and the other half but faintly visible.

Much the same "half lit up" appearance characterized the moon, which had grown until it looked as large as a medicine ball. Little change had taken place in the apparent proportions of the sun—but it was a far different sun—a sun the like of which human eyes had never before beheld. The corona was constantly visible. It shot out gigantic tongues of dazzling flame in all directions.

MY contemplation of the heavens was interrupted by a cheery, "Good morning, boys," from the Professor who had just awakened.

"Good morning?" I questioned. "Aren't you a bit too soon? It can't be much after midnight. You've been asleep for an hour or so."

"Pardon me, my boy, but there you are sadly mistaken. I am positive that I have slept at least eight hours. Otherwise, I should certainly not feel as refreshed as I do at present."

"I hate to contradict you, Professor, but here's once I can prove you are wrong. Until just a few minutes ago, I kept my eye on the earth almost constantly, and I know it hasn't moved much. Take a look yourself and you'll see that we are still over the center of Asia. If we had been away as long as eight hours, the earth would have made one-third of a rotation—which would have made the entire Atlantic Ocean visible to us. Now will you admit, for once, that you are wrong?"

It was a disrespectful thing for me to say, but I couldn't resist the chance to gloat over the Professor, who had so many times shown me up as an ignoramus. But, as usaul, he had a come-back, and as usual, I was quite properly and deservedly squelched.

He glanced through one of the rear windows and said, "It's impossible to tell what portion of the earth's surface is turned toward us now, but it's just as likely as not to be the Atlantic Ocean, since it's completely obscured by clouds and fogs."

I looked and what he said was true.

"My gosh!" I wailed. "Even the elements are conspiring to make a simp out of me. But I'll leave it to Charley whether you slept eight hours or less than one hour."

"I'd guess about five hours; but it might have been eight," he repudiated me.

"What's the use?" I gave in. "You win! I'll have to quit!"

"That being the case, suppose we eat breakfast."

The Professor handed us each a stick of chocolate and a small bottle of reddish brown liquid which he said contained concentrated nourishment sufficient to sustain the human body at maximum efficiency for at least twenty-four hours.

We ate and drank in silence, after which Banning said, "I think you two youngsters had better lie down and get some sleep. There's nothing to do and the more we sleep, the less food we'll need."

This sounded sensible, so I lay down and had no sooner closed my eyes than the mysterious glue, of which Stevenson speaks, slipped in between the lids and I drifted off into the sea of sleep.

The most ridiculous and preposterous dream popped into my head. I was in an open birch bark canoe, paddling for dear life in the interstellar space. After an interminable length of time, I finally reached the planet Mars, which I found entirely deserted and uninhabited. I pitched a tent and spent a restless night on Mars. After exploring this planet for about a week, I again embarked in my space flying canoe and paddled millions of miles until I reached Venus. In this way I journeyed from one heavenly body to another, spending several days on some and months on others. I finally turned the prow of my craft toward the earth, but on the way I ran afoul of the moon and found to my dismay that I could neither get *to* the moon nor *away* from it. No matter how furiously I paddled and steered, my canoe continued to

circle the moon. At last I realized with horror that my boat had become a satellite of the moon, doomed to continue whirling around it through eternity.

I woke with a start, to find myself floating in mid-air and bumping against the ceiling of the cabin. The Professor grasped my leg and pulled me back to the floor.

"How long do you think you've been asleep?" he asked.

"At least two years," I answered.

He thought I was trying to be smart and to ridicule him, until I told him about my dream. Then he laughed: "You've been sleeping less than five minutes. This I know positively because I started counting my pulse the moment you lay down. When I reached 296, which would make it a trifle over four minutes, you began to wave your arms around and to kick until you managed to get up in the air about something. I woke you immediately, so you see it couldn't have taken very long. However, this is an excellent illustration of how indefinite and unreliable our conceptions of time are unless we have some standard or form by which to measure it."

"But how in the world did I get to floating up there by the ceiling?"

"That is because, now that you are away from the earth's gravitational field, your body has practically no weight. About the only gravity that is acting on us now is the attraction of the airplane itself for our bodies. I have tried to put as much weight as possible under the floor of the cabin, but it isn't enough to exert a very stong attraction, especially when our bodies are moved even a short distance away from the floor. As long as we don't take long steps or make any sudden motions, we ought not to have any difficulty, however.

"But, now that you've gotten that dream out of your system, suppose you go back to sleep."

I followed the Professor's suggestion.

## CHAPTER XII

### The Turning Point

THERE was little or no variety in the events which happened during the long period immediately following our first night in the really great open spaces.

Berghlin and I slept and ate when Professor Banning told us to. Sometimes the days seemed surprisingly short to me and at other times they seemed interminably long; but I had learned my lesson and no more did I offer any protests or suggestions regarding Professor Banning's methods of estimating time.

Meanwhile, the moon continued to grow larger and the earth smaller. At last we came so close to our satellite that it nearly filled the entire expanse of sky ahead of us.

"Isn't there a danger that we'll fall right into the moon?" I asked the Professor one day.

"There might be if we didn't do something to prevent a catastrophe like that. It all depends on our velocity and on the direction in which we approach his Lunar Highness. To be on the safe side, I believe I'll give the rocket tubes another shot or two."

He made the adjustments and a moment later we heard the fizzing sound which told us that the burning gases were being projected through one of the tubes.

The machine veered to one side until we were flying in a direction parallel to the surface of the moon instead of pointing directly toward it.

"I'm going to steer in such a way that we'll pass around the moon in the opposite direction from its motion around the earth," the Professor explained. "That will make our speed with respect to the surface of the moon greater than if we traveled in the same direction the moon is moving."

It wasn't long before we were close enough to the moon's surface to observe all details of its configuration quite plainly and to distinguish objects even as small as a few feet in height.

If I were writing a piece of extravagant fiction, and had the creative imagination of a Jules Verne or an Edgar Allan Poe to help me, I could undoubtedly make a fascinating and amazing chapter out of what we were supposed to see on the moon.

I could clothe it with grotesque vegetation and people it with preposterously queer beings. I could describe the peculiar buildings and fantastic monuments of a departed race of former inhabitants. Gigantic insects and abortive monsters could be made to prowl amid lakes of blood and mountains of glittering jewels. Had there been any such freaks on the moon, we could easily have distinguished them clearly—even without the aid of our telescope.

But what's the use of idle speculation? My job is that of a historian rather than a fabricator of colorful yarns—so I'll have to stick to the truth. Much as I regret to report them, the facts concerning what we saw on the moon were exceedingly drab and uninteresting.

True, we did get excellent vistas of the portion of the moon on the side away from the earth—which never before had been seen by human eyes—but these views were quite commonplace. Any astronomer—merely from logical deduction—could easily infer with reasonable accuracy what the other side of the moon looks like.

Except for the natural differences in the size and locations of the craters and "ring mountains," the surface of the far side of the moon had practically the same characteristics as the portion that is constantly facing the earth—which has been repeatedly photographed and charted.

Our observations verified conclusively the belief of scientists who have become convinced that the moon is absolutely devoid of both moisture and atmosphere. There is no life of any sort—vegetable or animal—on the moon. To live on the moon, a man would have to bring air, water and food with him.

This ought to settle definitely the question sometimes brought up by some pseudo-scientific people as to whether or not the moon is inhabited or capable of sustaining life.

It took but a short time for us to complete the semi-circular journey around the moon, after which the Professor fired a couple of shots from the rocket tubes and thus changed our direction until we were headed straight toward the earth.

Only a few minutes had elapsed—though the moon was already becoming perceptibly smaller—when Berghlin suddenly exclaimed: "How about the photographs?"

"My God! What a dumb-bell I am!" Professor Banning yelled. (It was the first time he had ever used either profanity or slang in my presence.) "To think of coming clear out here with a first class camera all ready for use, and then start back without taking a single picture! We've got to go back—that's all there is to it."

And before either the pilot or I could say another word, he had fired three more shots and our machine was speeding back toward the moon. This time we approached even closer than before and completely

circumnavigated the satellite. Following the Professor's instructions, I focussed the camera and clicked the shutter as fast as I could wind up the film, while Banning in the meantime was busy steering the plane by means of the rocket tubes.

The task completed, we again took leave of the moon and started on our homeward journey. During the return journey, Professor Banning made frequent use of the rocket tubes—not only for changing our direction but also for accelerating our speed.

When we were about half way home, a distressing realization suddenly dawned on me, which I voiced to the Professor:

"It looks like we're going to make it after all—but there's one ugly fly in the ointment."

"What do you mean?"

"Bragg. You've lost your $20,000 bet to him."

"Oh, let's not worry about that. What's $20,000 to a man who has been around the moon?"

"But I hate to think of that old blatherskite getting any enjoyment out of spending your money."

"Let him enjoy it for all I care. It will be nothing compared to the pleasure I'll get from knowing how he will feel when he learns that we are back safe and sound with a number of irrefutable photographs to prove that we've actually made the trip around the moon."

As we sped closer and closer toward the earth, we were like a trio of school boys who had just completed the last stiff examination and were journeying toward home and vacation time.

"Just think what a sensation we'll make when we get back," I said on one occasion. "They must have given us up for dead long ago. Of course, nobody would miss me, but I'll bet there has been a heap of mourning for you two—especially Charley. And when we land on earth again and tell what we've done—the folks who see and hear us, just won't believe their senses!"

## CHAPTER XIII

### Homeward Bound

NOTHING of special consequence happened until we were quite close to the earth. It seemed to increase in size much more rapidly than it had diminished on the outward journey, indicating that our speed was considerably greater. This could easily be accounted for by the extra impetus imparted by frequent discharges through the rocket tubes.

As the earth loomed up until it obscured nearly all of the sky ahead, we could catch an occasional glimpse of a patch of water or land through rifts in the banks of cloud that enveloped the globe, but we could not get a clear enough view to identify any portion of the earth with certainty. Once I felt sure that I recognized the outlines of Spain and the Straits of Gibraltar, and Professor Banning altered our course slightly toward the direction of North America. At the same time he turned on the external lubricating system and fired several shots through the tubes in the forward end of the machine. He explained his reasons for doing this as follows:

"It won't be long now before we shall enter the more rarefied portions of the earth's atmosphere. Just how fast we are going now is pretty hard to estimate, but it is quite possible that if we continued at our present velocity—even with our external lubrication in operation—the friction caused by our passage through the earth's atmosphere would generate a terrific amount of heat—just as it does in the case of a meteor, or falling star.

To be on the safe side, I think we'd better slow down considerably. The discharges through the rocket tubes pointing straight ahead should have a powerful braking effect, reducing our speed to safe degrees."

It was a good thing he thought of this when he did, because he had hardly spoken before it began to become uncomfortably warm inside the cabin, indicating that the heat of friction was even intense enough to penetrate the special insulation.

With the sweat streaming from his forehead, Professor Banning directed a continuous stream of burning gases through the forward tubes. Finally the temperature began to fall again, showing that the crisis had passed and that disaster had been averted through the resourcefulness and quick thinking of our learned commander.

By this time, Berghlin had taken his place at the controls.

"Turn on the motor and let's see what happens," Banning directed.

An instant later we heard the welcome hum of the engine. As if the entire performance were part of a great, preordained, comic play, the clouds beneath us parted and we found ourselves flying over a landscape that looked like Paradise to us.

"The Gulf of Mexico!" Berghlin yelled. "I know where I am now, by ginger! Leave it to me to find my way home."

Down, down we slid at a dizzy angle until we reached an altitude of approximately thirty thousand feet, after which we straightened out and headed in a bee line for the west.

It seemed but an hour or so before we saw the familiar glint of the Pacific in the distance. To slacken speed somewhat and to prepare for a landing, the Professor instructed me to adjust the four dimensional rudder in such a way as to bring the plane back into three dimensional space.

The skid, which accompanied this maneuver, was considerably more severe than on any previous occasion, but though we spun like a windmill for several seconds, our pilot finally righted the plane.

"There's one good thing!" he shouted. "This time we won't be bothered by a crowd, because they can't possibly be expecting us now."

In this however, Berghlin was wrong.

For some unaccountable reason, there were three airplanes hovering over the landing field as we sped toward San Diego. They must have sighted us and recognized the *Spirit of Youth*, because two of them flew toward us, while the other descended, apparently to carry the news of our arrival to the officials on the ground.

The escorts sent to greet us circled and attempted to accompany us, but we were miles beyond them before they had time to turn.

When we came within sight of the airport, we were astonished to discern thousands of jostling, milling human beings tightly packed around the edges of the field. A space had been roped off and a number of men in uniform were trying to keep the crowd in check. Just as we were on the point of landing, the mob broke through the ropes and quickly swarmed over most of the field.

With his usual skill and resourcefulness, Berghlin checked his downward plunge just in time and zoomed up to a safer altitude. After circling the field several times, vainly hoping that the crowd would have sense enough to clear a space large enough for him to land, he finally spied a small patch of open ground in one corner, shut off from the rest of the field by a line of parked automobiles.

Barely grazing the tops of the cars, he made a beautiful landing, bringing the *Spirit of Youth* to rest with the propeller but a few inches from a barbed wire fence.

In an instant the crowd was around us, and our ears were almost deafened by the most raucous conglomeration of cheers, yells, laughter—and even weeping.

Berghlin was the first to step out of the cabin. With characteristic *sang froid* he said, "Sorry, we're late, folks. You see, we got a little bit off our course and took a trip around the moon before we found our way back again."

THE few persons who heard this remark were probably too excited to pay much attention to his amazing announcement. Even if they heard and understood, they undoubtedly took it as a joke.

Before either of us could utter another word, we found ourselves being carried around the field on the shoulders of hysterical men and women. Finally the police came to our rescue and escorted us into the office of the airport, where Berghlin went through the customary routine of signing in. As he was filling out his report, he asked one of the officials, "What time is it? My watch is stopped."

"Exactly five forty-seven."

"And what's the date?"

"June sixteenth, of course."

"June sixteenth?" Berghlin ejaculated. "Are you trying to kid me?"

"Certainly not! That's the right date. If you don't believe me, there's the calendar." He indicated a huge figure sixteen printed on a card which hung on the wall.

"You mean to say we've only been away for a day?"

"Less than a day. Seventeen hours and forty-three minutes, to be exact."

"If you say so, I suppose you know what you're talking about. I can't begin to understand it—but if what you say is true then Professor Banning has won his bet with Bragg."

"Why of course you've won! What do you think all the celebrating is about?"

"Well, I'll be hornswaggled!"

Just then Banning leaned over and whispered something in Berghlin's ear. He also gripped my arm, before I had time to say anything and in a low quiet tone he admonished me, "Let's not tell them anything about the trip around the moon yet. Without the proper preparation, I'm afraid the true story will only bring us ridicule."

That's why you haven't read anything in the newspapers about the extra journey we took around the earth's satellite.

On the suggestion of Professor Banning and with the consent of Colonel Berghlin, I was appointed the historian of our expedition.

Fearing that the narration of adventures as extraordinary as ours, might seem impossible and ludicrous to the rank and file of newspaper subscribers, we decided not to give it to the daily press.

Instead, we agreed to submit this official account to a publication which appeals only to readers of more than average intelligence—readers who are progressive and open minded and are accustomed to judging the verisimilitude of amazing stories.

So to you, who are now reading these lines, is granted the first privilege of learning the true facts regarding the *Spirit of Youth* and her remarkable journey.

## CHAPTER XIV

### Professor Banning Explains

AS soon as we had completed the customary formalities at the San Diego Airport, Bryan said to us, "You fellows must be pretty well fagged. Better let me drive you to your hotel."

Neither of us had the nerve to tell him that we actually thought we had been away for over a month and that each of us—in imagination at least—had enjoyed more than thirty full nights of slumber. We did want to be alone, however, for there was much to talk about.

When at last everybody had left, and the three of us were closeted in Banning's room, I broke out:

"Well, Professor, so far you've been able to account for everything that has happened in a satisfactory way, but *now* you sure have a lot of tall explaining to do."

"Just let me have a pencil, a scrap of paper and about five minutes, and I think I can explain everything in such a way that it will be as clear as the road to the moon.

In the first place, let me remind you that when we shot off into hyper-space after leaving Shanghai, we had for the moment turned the nose of our plane toward the east. That gave us the benefit of the motion due to the rotation of the earth. I've already explained this to you, but what I didn't mention before is, that during the few seconds prior to our extended projection into the fourth dimension, we were also traveling in a direction which gave us the added momentum due to the *revolution of the earth about the sun.*

"You will also recall that after detaching ourselves from three dimensional space, we made a hair-pin turn, which brought us around so we were moving in the opposite direction. Do you happen to know how fast the earth moves around the sun?"

"Not off-hand," I admitted, "but I think I can figure it out—approximately at least. I know that the distance between the earth and the sun is about ninety-three million miles, and that the orbit of the earth, though elliptical, is near enough to a circle, so that if we multiply the radius by two pi or six point twenty-eight, we'll get the approximate circumference of the earth's orbit. Without multiplying it out, I'd guess that this will give us something under six hundred million miles. All we have to do is divide this by the number of hours in a year and the result will be the speed with which the earth revolves around the sun!"

"Very good," the Professor commended. "And to save you the time it would take to do all that calculating, I'll tell you right now that the earth and the moon together travel around the sun at the rate of eighteen and one-half miles per second or sixty-three thousand miles per hour."

"Another thing that helped us was that the moon at that particular time was on the side of the earth *away* from the direction of rotation. When we left the earth, we were traveling at the rate of about sixty-three thousand miles per hour in the opposite direction from that in which the earth was moving, while the moon was shooting toward us—also with a speed of about sixty-three thousand miles per hour.

"If we had continued at the same speed without any loss of momentum, we would have approached the moon at the terrific speed of one hundred and twenty-six thousand miles per hour.

"Since the moon is only 238,851 miles from the earth, it would have taken us less than two hours to

reach the moon at that rate. In actuality, it took us a trifle more than two hours, since we lost some of our speed in making the turn and in getting away from the earth's gravitational pull.

"When we circled the moon, we still retained almost all of our original momentum of somewhat over sixty thousand miles per hour, which I nearly doubled by means of charges shot through the rocket tubes. Though the trip back seemed to be faster, it really took us about twice as long, or over four hours, because then we were moving in the same direction as the earth and had to consume a lot of our speed in our efforts to overtake the earth. Does that make everything clear?"

"I guess so," I hesitated. "That seems to account for the possibility of our making the trip in such a remarkably short time—but how about the time we *thought* it took. I can easily understand how we could make a mistake of an hour or so—or even two or three days—in estimating the time that was elapsing But to be convinced that over a month was passing when it really was only about six hours—I don't see how the Dickens that could possibly happen."

"If you'll stop to think a minute," the Professor rejoined, "I believe you will be able to explain that yourself. Remember the dream you told me about in which you took a trip through the universe which you thought must have consumed several years? It seemed real to you while you were dreaming, didn't it? Yet the entire dream lasted but a few minutes.

"I suppose I may as well confess now and tell you that—in the interests of psychological research—I played a little trick on you and Berghlin.

"During the excitement just before we left Shanghai, I managed to doctor up the timepieces we had with us, so they wouldn't run. I did this by the simple expedient of passing a strong magnet a few times across the faces of your watches and our chronometer. This magnetized the mainspring and all steel parts and put them out of commission.

"Unknown to you, however, I kept tabs on the time by means of my old time-piece, with which I didn't tamper, of course. I had this watch in my vest pocket all the time and consulted it repeatedly, while you and Berghlin were looking out of the window. Then, by the power of suggestion, I made both of you think that several weeks were passing.

"What happened proves pretty conclusively, I think, the hypothesis that, once we are removed from the physical means for measuring or estimating time, our conceptions of the duration of given intervals are absolutely inaccurate and undependable. Under such circumstances, a second may seem like a year and a year may seem like a second!"

"Just a minute!" Berghlin interposed. "Let me get this thing straight. Do you mean to say that you put our timepieces out of commission purposely!"

The Professor nodded.

"And then you kidded us into eating our meals only five minutes apart and taking our night's sleep at intervals of half an hour or so, in such a way that we were following our ordinary daily routine?"

Another nod.

"I might be willing to grant the possibility of the sleeping part of it—but how in the world could our digestive systems take care of so much food?"

"You will remember that most of the so-called food I gave you was in liquid form. I told you it was a very concentrated form of nourishment. As a matter of fact, it was nothing more than water with a little coloring matter and a dash or two of epsom salts mixed with it."

"Then you mean to say that the trip which we thought was taking over a month really consumed only a few hours?"

"That's precisely what happened," the Professor admitted. "But remember, boys, I did all that in the interests of psychological research."

All Berghlin could say to that was:

*"Well, I'll be hornswaggled!"*

THE END.