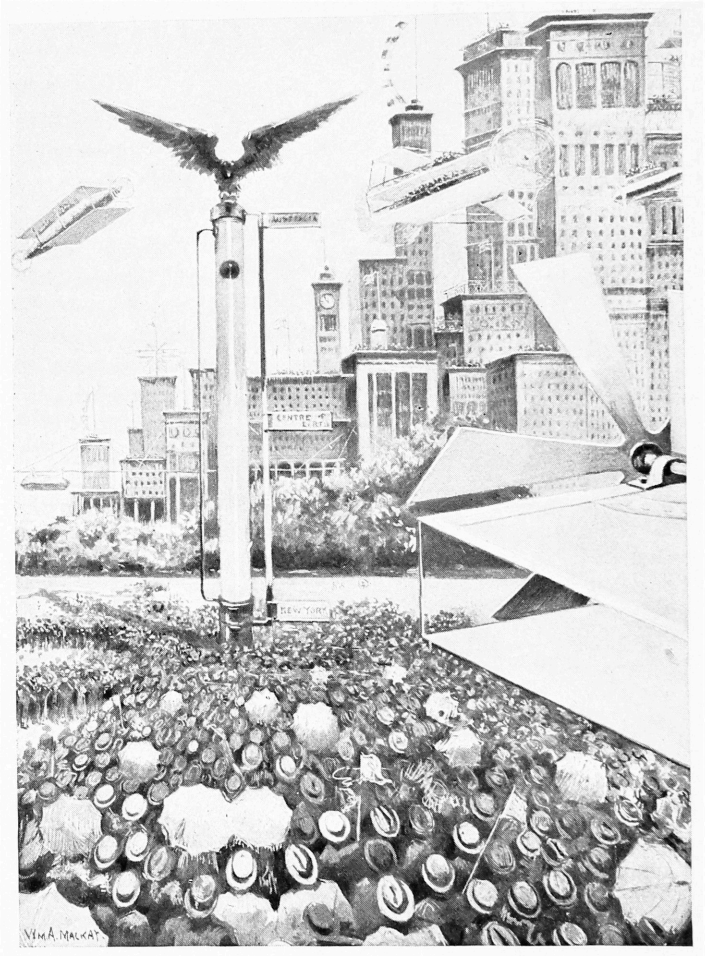
Through the Earth

by Clement Fezandié

THROUGH THE EARTH



"SPECIAL APPLIANCES HAD BEEN ERECTED FOR RENDERING VISIBLE THE COURSE OF THE CAR."

THROUGH THE EARTH

BY

CLEMENT FEZANDIÉ

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TO

MY NIECE DORETTE

THIS BOOK

IS AFFECTIONATELY

INSCRIBED

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THROUGH THE EARTH

THROUGH THE EARTH!

CHAPTER I

A NOVEL SCHEME

"  HAT do I think of it? Why, doctor, the whole scheme is impossible from beginning to end, and I am surprised that a scientist of your standing should entertain it for a single moment."

"But, James, you surely cannot understand my plan fully, or you would see that, so far from being impossible, it is most feasible if I can only secure the necessary capital."

"Either I must be dreaming, doctor, or else I do not altogether understand you. From what you tell me, I gather that your idea is to open a rapid-transit line between Australia and the United States. You propose to bore a hole

through the center of the earth, this hole to terminate at the city of New York. Am I right thus far?"

"Perfectly."

"Into this hole you intend to drop merchandise, baggage, and what not, and let them fall through to the antipodes. This, at least, is the way I understand the matter."

"Yes," said Dr. Giles, tranquilly, "that is my idea in a nutshell. Now tell me what objections you find to it."

"What objections? Only one, namely, that the entire plan is utterly impossible," replied James, conclusively.

"My dear friend," said the doctor, "do you know what the word 'impossible' means? It means simply something that has not yet been done. Everything is impossible until some one does it, and then it becomes, on the contrary, astonishingly easy. If we take any other definition for this word, we must admit that there is only one thing that is impossible."

"And that is?"

"And that is, to know that anything is impossible. But tell me, James, what it is you find difficult in my plan."

"Certainly, if you wish it. In the first place, perhaps you will be kind enough to tell me how you are going to make your tunnel through the earth. It strikes me that the man who undertakes that job will have a pretty big contract on his hands. Possibly, however, you may not yet have thought about this matter."

Dr. Giles laughed. "If you can find any feature of the whole scheme that I have n't studied over for months," he said, "you will deserve a gold medal. And as, of course, the most important part of the undertaking consists precisely in the boring of the hole through the earth, it is this subject which has received my most careful consideration."

"Then you actually mean to say that you think it will be possible to dig a tunnel through the center of the earth?"

"Most certainly I do."

"But how will you set about it?"

"Just as I should set about digging a well," replied the doctor. "But, to expedite matters, I shall be obliged to devise special machinery that will do the work of hundreds of picks and shovels."

"I should think you would indeed need special

machinery," returned James Curtis, the first speaker. "But machinery is n't everything. Of course I won't deny that you could dig a well a few thousand feet deep; but all efforts to go much beyond this depth would be unavailing, since the walls would continually cave in, burying your workmen under an enormous mass of earth and stones."

"And so you suppose that I would stand by with folded arms, and allow the walls to cave in, do you?"

"I don't see how you could help yourself."

"Nothing will be easier. As fast as I dig, I shall have a stout metal tube cast, of the size of my well, and let it down to support the walls. In that way all danger of caving in will be avoided."

"Well, admitting, for the sake of argument, that you can make machinery powerful enough to dig through miles of solid rock, and allowing that you could prevent the walls from caving in, even so, I hardly see that you would be very much more advanced than you were before."

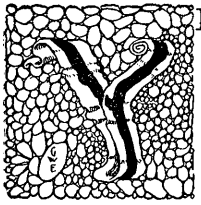
"And why not, pray?"

"Because you seem to forget that the earth, at the center, is one mass of liquid fire. So that, even if you succeeded in boring down through

the solid portions of the external crust, you would be brought to a complete standstill as soon as you reached the red-hot fluid portions in the center. All your machinery, including your metal tube, would melt like wax, while your workmen could not live a single instant in the stifling, scorching heat!"

CHAPTER II

THE CENTRAL HEAT



ES," repeated Mr. Curtis, bringing down his fist with a bang, "that 's where the real difficulty lies; that 's where the impossibility arises. The other obstacles might perhaps be overcome if sufficient time and money were devoted to the work. But the great question is, How will you manage when you reach the center of the earth, where the materials are one mass of liquid fire? Answer me that!"

"How do you know the earth is a mass of liquid fire at the center?" inquired the doctor, coolly.

"How do I know it? Why, all the best authorities concede the fact."

"Indeed, I was not aware of it. On the contrary, I thought that our most profound thinkers all rejected this theory."

"You mean to say that the center of the earth is not a mass of molten matter at a white heat?"

"We have every reason to believe that this is not the case."

"Then how do you explain that, in mines, the temperature becomes warmer the deeper down you go? You will at least admit this fact, will you not?"

"Certainly," said Dr. Giles; "that fact is well established. But you must remember that our deepest mines barely extend a couple of miles into the earth."

"Still, in those two miles the increase in heat is considerable, the bottom of the mine being always hotter than the top."

"True; but this increase varies considerably in different parts of the earth, being much less in some mines than in others."

"Yes; but the average increase, as I understand it, has been found to be about 1° F. for every sixty feet, so that, if we accept this as the normal rate, the heat at the depth of a very few miles would be sufficient to melt the hardest rocks we know of."

"That would be true enough," said the doctor, "if the heat continued increasing at the same

rate. But this scarcely appears possible. You might as well claim that, because the temperature becomes colder the higher we ascend on a mountain, if we were to continue forever in a vertical line the temperature would keep on decreasing at the same rate."

"Well, would n't it?"

"Most certainly not. We, of course, know very little about the matter, but this we do know, that there is a point of absolute cold, which is supposed to be at 459° F. below zero. A body at this temperature would have absolutely no heat left in it. Our scientists may very well be mistaken as to the exact figure, but, at any rate, we know that there is some point beyond which the cold cannot continue to increase as we ascend in the air. Hence those who argue that because the cold becomes greater when we climb a mountain, it would continue increasing at the same rate if we ascended into the heavens, would be altogether mistaken. Similarly, those who claim that because the temperature becomes higher as we descend in mines, the heat must be inconceivable after we have gone a few miles, have no logical basis for their statement."

"But does not the existence of volcanoes prove

that there is a central fire in the interior of the earth?"

"It proves that there are certain incandescent masses in the interior, but not that the whole center of the earth is in a molten condition. In fact, if the earth were liquid at the center, the incandescent matter, or sea of fire, would have tides just as our oceans of water have. Consequently every active volcano would have each day two high and two low tides, whereas nothing of the sort happens. Indeed, all the manifestations with which we are familiar accord more closely with the theory of a solid earth than of one containing a sea of molten matter."

"But how about earthquakes? Do not earthquakes occur continually in every portion of the globe? And are not these earthquakes caused by internal heat?"

"True; but the earthquakes only lend support to what I have said. It is an undeniable fact that the land in almost every country on the face of the earth is slowly but continually either rising or falling. These elevations and depressions are, however, so gradual that most persons do not even notice them; in fact, very delicate instruments are required to ascertain their occurrence. It is only

when they are very sudden and very violent that the general public hears of them as the earthquakes which destroy houses, devastate forests, or engulf whole villages."

"Well," said Mr. Curtis, triumphantly, "it seems to me that these facts support what I have just said. Whether the earthquake be great or slight, it must be produced by the same causes; and since these earthquakes occur continually in all parts of the world, it must be because the interior of the earth is in a liquid state."

"Excuse me," said Dr. Giles; "but I was about to add that the subject of earthquakes has been very carefully studied by seismologists, and the best authorities have calculated that the origin of the disturbance is usually not very deep in the interior of the earth — probably not over thirty miles below the surface in the most violent earthquakes, and certainly at a much slighter depth than this in many cases. Now, if the whole interior of the earth were in a liquid state, it would be natural to expect that the origin of our earthquakes would be at a much greater depth."

"So far as you are concerned," remarked Mr. Curtis, "I don't see that it makes very much difference whether the whole interior of the earth

is incandescent, or whether there are only small seas of liquid fire scattered around within thirty miles of the surface. In either case you must count on having to battle with the internal heat of the earth."

"Oh, certainly," said Dr. Giles; "I have arranged to do so."

"What!" exclaimed Mr. Curtis, astonished, "you mean to say that you could dig your tunnel through these seething lakes of fire?"

"That is precisely what I do mean," returned Dr. Giles, "and it will not seem so strange to you when I explain the precautions I intend to take against the internal heat."

CHAPTER III

A COLD SUBJECT

R. CURTIS let his hands drop helplessly by his side.

"So you actually think," said he, "that you can construct machinery that can work unharmed through lakes of molten matter?"

"Yes," answered Dr. Giles, "I am convinced that I can."

"And that you will be able to find, for workmen, human salamanders who can flit about in the fire unharmed by the scorching heat?"

Dr. Giles broke into a hearty laugh. "No," said he, shaking his head emphatically; "I claim no such power as that. I am convinced that I shall be able to construct fire-proof machinery, and that will be all I shall require. Of what use would it be to secure fire-proof workmen? If I were obliged to send my men down into the tube, I

should, of course, need some protection for them, but I shall arrange my machinery so that it can be worked from above the earth."

"Even so, do you mean to tell me that machinery can be constructed that will pass unharmed through a sea of fire?"

"I think I would better explain the whole scheme to you in detail," observed Dr. Giles, "as otherwise there would be no end to your objections. To begin with, as I have already told you, I intend to have a metal tube cast and let down as the digging progresses; this tube will, of course, prevent any molten matter from entering my well from the sides."

"Yes, unless the tube itself melts."

"Precisely; and as this is what I wish to avoid, I shall, in casting the tube, provide it with internal passages such that refrigerating agents of the greatest power may be continually pumped through to keep the tube from melting."

"And you believe that you can obtain refrigerating agents of sufficient power to counteract the intense heat of the interior of the earth?"

"I am certain of it. For several years past I have been devoting considerable attention to the subject of accumulating cold, and I have at last

succeeded in finding what I sought. I am now able to produce a temperature of about 425° F. below zero, and you will readily admit that a cold of this intensity can be made to offset any heat that I may meet with in my undertaking."

"But how do you manage to secure so great a degree of cold?" asked Mr. Curtis, somewhat skeptically.

"The details of the operation," said Dr. Giles, "would naturally be too complex to explain offhand, but the general principle on which I work is quite simple. To begin with, I suppose you are aware that, properly speaking, there is no such thing as cold. We say that ice is cold because it has considerably less heat than the human body. But ice nevertheless does possess heat, and quite a goodly amount of it, too. The only bodies which possess no heat whatever are those which are at a temperature of about 459° F. below zero. This is, to the best of our knowledge, the point of absolute cold, that is to say, the point at which a body will retain absolutely no heat at all. By no process that we know of can such absolute cold be produced,—although, as I have said, I have succeeded in coming very near to it."

"But how do you manage to obtain such a low temperature?" persisted Mr. Curtis.

"It was a hard problem," remarked Dr. Giles, "and my method is not easy to explain, but I shall do my best to make the matter clear to you. As you are aware, in order to cool a body, it is necessary to make it impart some of its heat to other bodies, and this is precisely what I have succeeded in doing. I put in my machine a gallon of specially prepared non-freezable liquid, and then pass a current of water at 50° F. through the apparatus. Every gallon of water that passes through becomes heated to 51° F. in its passage; in other words, it absorbs one degree of heat from the original liquid, so that the temperature of this liquid after ten gallons of water have passed through will be ten degrees lower than it was at first. By continuing the flow of water through the apparatus, this absorption of heat keeps on, at a slightly decreasing rate, until the temperature of the original liquid is lowered to 425° F. below zero. Beyond this point I have not yet succeeded in going, but 425° F. below zero is a temperature so inconceivably low that it will amply suffice for any practical application of cold."

"Well, doctor, you seem to have an answer for everything, although I must confess that I am only half convinced by your arguments. Still, even granting that you could bore your hole

through the center of the earth, your scheme would yet seem impossible."

"How so?" asked Dr. Giles.

"Why, in this way. Let us suppose that you drop something into the hole; the object would merely fall to the center of the earth and stop there. It would then, of course, be half the way to New York, but to haul it up the last four thousand miles would require such expensive apparatus, and would be such a slow and laborious operation, that you would lose much more than you would gain."

CHAPTER IV

FLORA CURTIS ASKS A QUESTION

"SO," said Dr. Giles, smiling, "you think that if I succeeded in boring a hole through the earth, and dropped a stone into it, the stone would fall down to the center of the earth and stay there?"

"Why, undoubtedly. The attraction of the earth may be considered as coming from the center, may it not?"

"Certainly it may — at least in the present case."

"Well, then," said Mr. Curtis, triumphantly, "it seems to me that if the attraction comes from the center of the earth, the stone would only be pulled down to the center, and would stop there, because there would be nothing to pull it any farther."

"Your idea is to a certain extent correct," replied the doctor; "after the stone reached the

center of the earth there would indeed be no attraction to cause it to fall any farther; but you forget that it would then be traveling at considerable speed, and so would not stop."

"Yes, I understand that," said Mr. Curtis; "but as soon as the stone passed the center of the earth, the attraction would begin to pull it from behind, and so would draw it back to the center."

"To be sure, it would pull from behind," laughed Dr. Giles; "but the trouble is, it would n't pull hard enough. If you harnessed a dog to the front of a carriage and a horse at the back, and made them both pull with all their strength, you would certainly not expect the carriage to go forward. No matter how hard the dog might pull, the horse would easily drag him backward."

"I must say that I don't see the connection," observed Mr. Curtis.

"No? Well, then I 'll explain. You probably know that a body falling to the earth falls sixteen feet the first second, forty-eight feet the next second, and eighty feet the third."

"Yes, I know that. The speed of a falling body constantly increases, and the increase is about thirty-two feet per second."

"The increase is thirty-two feet per second *at*

the start," corrected the doctor. "As the body neared the center of the earth the increase would become less and less each second, until at the very center of the earth there would be no increase whatever. But, without going into the figures in detail, you will readily see that if the speed of the falling body increased, say, an average of sixteen feet per second, by the time it reached the center of the earth it would be going at such a frightful velocity that it could not stop, but would be carried on right past the center and far up the tube toward the New York end.

"In vain the attraction of the earth would try to hold it back; it would be like the dog pulling against the horse, for the body, carried onward by its acquired velocity, would continue on its mad career, though at a continually decreasing rate, until it came to a stop almost at the very surface of the earth at the New York end of the tube. In fact, if there were no air in the tube, the laws of physics teach us that the body, dropped into the hole here in Australia, would go completely through to the United States!"

"Yes, that 's true enough; but when the body reached the United States, it would simply fall back again, and keep on falling backward and

forward in the tube. Moreover, as the air would create a certain resistance to the passage of the body, it would make a shorter journey each time, until finally it came to a complete rest at the center of the earth."

"So it would, if we allowed it to fall back; but you must remember that before it can fall back it must come to a complete stop; and what prevents us from having suitable catches in the tube to hold the body fast and prevent its return? If it stopped short of its destination, as it probably would, it could be hauled up the last part of its journey by any convenient device — say, for example, an electrically actuated cable."

Mr. Curtis was silenced. One by one the objections which had seemed to him so vital vanished into thin air before the doctor's ready answers. He did not for an instant admit the possibility of the scheme, but he was silenced for a moment, and during that moment a third actor appeared upon the scene. This third personage was no other than Mr. Curtis's daughter Flora, a pretty girl of ten, who, curiously enough, far from inheriting her father's pessimism, possessed, on the contrary, the happy faculty of always looking at the bright side of things.

At the beginning of the dialogue above recorded she had been reading unnoticed in a corner of the room; but, little by little, she had become interested in the conversation, and had gradually approached the two speakers. And now, while her father paused, she profited by the interruption to put a question on her own account:

"Dr. Giles," said she, "when you get your hole dug through the earth, will you send only baggage and things like that through it? Won't you send people through as well?"

Mr. Curtis laughed. "I guess nobody would care to go on such a trip as that, Flora," he said.

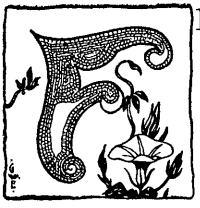
"I 'm not so sure of that," returned Dr. Giles, drawing the young girl to him, and looking at her kindly. "In fact, I have seriously been thinking of sending passengers through my tunnel."

"What," exclaimed Mr. Curtis, in utter amazement, "you mean to say that you actually think of dropping a living man down a bottomless pit eight thousand miles deep!"

"Yes," said Dr. Giles, "I most assuredly do!"

CHAPTER V

PROS AND CONS



LORA clapped her hands with delight. "Oh, what fun it will be," she exclaimed, "to drop right down through the earth like that, and come out thousands of miles away in the United States!"

"Don't excite yourself, Flora," said Mr. Curtis. "There may be found some men foolhardy enough to risk such a trip, the result of which would be almost certain death, but neither you nor I would ever consent to undertake such a journey."

Dr. Giles smiled contemptuously. "That 's always the way with anything new," he observed; "the dangers of any undertaking the least bit out of the usual run are always magnified to extraordinary proportions, whereas much greater dangers with which we are familiar dwindle down to almost nothing."

"But, doctor, you are surely joking when you speak of dropping passengers through the tunnel?"

"I was never more serious in all my life."

"Still, you must admit that a man could not possibly breathe while he was falling at this frightful speed; and by the time he had fallen his eight thousand miles, and reached the opposite side of the earth, he would find himself — dead, so to speak."

"Not at all. You forget that every man upon this earth is continually moving at the rate of about sixty thousand miles an hour, this being the speed at which the earth revolves about the sun, and yet we find means to breathe comfortably."

"Yes, because our air travels with us."

"So it would with my passengers, for I should put them in a closed car, with plenty of air stored up for the trip."

"Even so, there is another point which I think you have not sufficiently considered. We have just spoken of the resistance of the air in the tube. At the velocity which your car would attain, the resistance of this air would be something enormous, and would suffice to stop the car long before it reached its destination."

"That 's true enough."

"Besides, not only would the air in the tube retard your car, but the resistance would be so great that the friction would produce enough heat to melt up both the car and the passengers."

"Certainly it would, if I were foolish enough to leave the air in the tube; but I should, of course, first take the precaution of removing the air from my tunnel before I attempted to send my cars through."

"But —"

"My dear friend," interposed the doctor, calmly, "you must remember that I have been studying this problem for the last ten years; you must remember that I have carefully considered every detail of the operation, and that there is not a single difficulty which I do not feel confident I can overcome. You must consequently admit that the scheme is not altogether so impossible as it would seem at first sight."

"Well, doctor, let me say just one last word. Do you realize the incalculable sum of money that will be required to carry out such an undertaking as you have in view?"

"It will not cost so much as you think, James," returned Dr. Giles. "I have estimated that the

expense ought not to exceed one hundred million dollars."

"One hundred million dollars!" replied Mr. Curtis, contemptuously; "that 's altogether too low an estimate for such a gigantic undertaking. But even taking your own figures, where in the world are you going to obtain a hundred million dollars? Where will you find men sufficiently foolish to pay their money for the mere anticipation of the pleasure of being dropped down a hole eight thousand miles deep?"

"I have little fear of failing to secure the necessary capital," replied Dr. Giles. "The advantages to be gained are so great, even from a financial point of view, that I am convinced the shares of the company will sell like hot cakes."

"The advantages of the scheme!" echoed Mr. Curtis. "I must say I cannot see what advantages you find in it."

"Perhaps not. But do you know how long it now takes for merchandise to go from Australia to New York?"

"It takes several weeks in our steamers."

"Yes, and several months in our sailing-vessels. Perishable goods cannot be shipped at all, or at least not without resorting to expensive methods

of refrigeration, which are almost invariably injurious to the articles shipped. Now, do you know how long it would take for merchandise from here to reach New York through my tunnel?"

"No, but I suppose only a day or two."

"Less than one hour! Consequently the most perishable goods could be shipped without deterioration, and even for other articles of merchandise the great saving in time effected would be of the highest value. A dealer need order goods only at the moment he wants them, instead of having to estimate, weeks ahead of time, what products he will require, and loading himself up with stock that he may afterward be unable to dispose of."

"Well, that certainly would be a slight advantage," admitted Mr. Curtis.

"It would be an inestimable advantage," retorted Dr. Giles. "Moreover, do you realize what the expense is of shipping goods by steamer—of the thousands upon thousands of tons of coal burned, of the salaries of the men employed, the high cost of the vessels, etc.? With my tunnel, almost all this expense would be done away with. The goods would merely have to be dropped into the hole in Australia, and carried away when they reached the New York side. There would be almost

no limit to the quantity sent, because one car-load after another could be dropped through as fast as they could be taken out on the other side. There would be no danger of collisions, as no car could ever possibly catch up with the car in front of it; there would be no delays, and there would be almost no expense, the earth itself furnishing the motive power, and an inexhaustible one at that."

"It does make a pretty picture," said Mr. Curtis, half convinced by his friend's earnest manner.

"Yes, sir," continued Dr. Giles, warming up to his subject, "the advantages of the scheme are so great that I hope to live to see the whole earth honeycombed by such tunnels, destined to facilitate the communication of the different nations. It seems a pity to think that man, although traveling a million and a half miles in space every day, cannot travel even two or three thousand miles on the earth itself in the same time. Why, our fastest locomotives travel only a couple of hundred miles an hour, while with my tunnel through the earth we shall be able to travel some ten thousand miles in the same time without noise or jolting.

"Surely you must admit that the scheme has advantages, and great ones, too, and that the men

who furnish the funds will have a fair prospect of reaping a rich reward. No, sir, there is no lack of free capital in the world, and our business men are sufficiently enterprising to risk it gladly in a work of this sort."

"Well, I suppose you know your own affairs best," observed Mr. Curtis, unconvinced.

"I ought to," said Dr. Giles; "and that reminds me that if I wish to carry this undertaking through successfully, I shall have to lose no time, but set about it at once. Consequently I shall be obliged to leave you both for the present."

"Dr. Giles," said Flora, coming closer to her friend, "how long do you think it will take you to make your tunnel through the earth?"

"It will probably take several years, under the most favorable circumstances," replied the doctor, smiling. "It will be very slow work at the best, and there are many difficulties to be overcome. Perhaps I may even find the undertaking beyond my powers and be obliged to give it up in despair."

"Oh, no," said Flora, looking up at him brightly; "I feel sure that, if you once start in, you will keep straight on, and not give up until you have your tunnel finished. I never knew you yet to fail when you set out to do anything."

Dr. Giles was touched. "Thank you for that, dear," he said, stooping down and kissing the young girl tenderly. "You do not know what a great comfort and assistance it is to receive such sympathy as yours when one is about to undertake some new enterprise. A word of encouragement and sympathy spoken at the proper time is often enough to cheer up a man and give him strength to carry on his plans to a glorious fulfilment, where words of doubt and discouragement might lead him to throw up the whole undertaking in despair."

CHAPTER VI

IN WHICH JAMES CURTIS IS SURPRISED

HE morning following the conversation above recorded, the whole civilized world was startled by the announcement that its foremost scientist, Dr. Joshua Giles, was planning to construct a tunnel through the center of the earth, for the transportation of merchandise to and from the antipodes, and that he required a hundred million dollars for the undertaking.

To the surprise of everybody, the project was received with general favor, and the capital came pouring in, so that in an incredibly short space of time the immense sum required for this strange enterprise was more than subscribed.

Of course a large number of the capitalists looked upon their money as entirely lost, and gave merely in the interests of science, but there were many who gave with the confident hope that

the enterprise would prove a profitable investment.

As for the doctor, he rubbed his hands gleefully at the thought that before long the products of the United States would reach Australia on the very day of their manufacture, and *vice versa.* Surely this would be the grandest achievement science had yet witnessed!

The great, and in fact the only, difficulty toward putting the plan in operation was the boring of the hole. Imagine digging a well eight thousand miles deep! It was no easy task under any circumstances, and was rendered doubly difficult when the internal heat of the earth had to be taken into consideration.

But, perplexing as the problem was, Dr. Giles was the man to solve it, though it had required all his ingenuity to devise a machine that would do the work expeditiously and well. He had carefully prepared his plans and patterns beforehand; and as soon as the capital began to come in, he set about having the necessary machinery constructed.

The first question to be considered was, of course, the selection of a site for the tunnel. Dr. Giles, although living in Australia, was a native Ameri-

can, and accordingly wished one end of the tunnel to terminate at or near the city of New York. The opposite end of the tunnel would thus, curiously enough, come within the Australian dominions.

It was while the doctor was considering this problem of a site for the tunnel that he had another conversation with Mr. Curtis, a conversation which ended in a fresh surprise for the latter gentleman.

"Well, doctor," said Mr. Curtis, bursting into our friend's study one afternoon, "how is your tunnel getting along?"

"Famously," replied Dr. Giles. "I 've got the most important part finished."

"Indeed! and, pray, what may that be?"

"The securing of the capital," said the doctor, with a merry twinkle in his eye. "Not only has all the stock been sold, but the shares of the company are already seventeen per cent. above par. I could at this moment, if I wished, sell out all the shares I have received for my services, and be a rich man, although the whole scheme exists only on paper as yet."

"Then how is it you don't do it?" asked Mr. Curtis.

"Simply because I hardly think it would be

right," answered Dr. Giles. "Besides, if, as I am fully convinced, the operation succeeds, I shall make far more profit by keeping the shares than by selling them. Moreover, you must remember that I did not start on this undertaking with any idea of making money out of it, although I shall, of course, gladly accept any profit that may fall to my share. But it was principally in the interests of science and humanity that I took up this work, and I shall feel amply repaid if I succeed in carrying it through successfully, even though I do not make a single cent out of the operation."

"Well, doctor," said Mr. Curtis, heartily, "I am glad for your sake that the financial part of the enterprise has succeeded so well, because, the more I think over the scheme, the more I am convinced that it will prove a complete fiasco in practice. And that reminds me that there is one question which I wish to ask you."

"Ask away," said Dr. Giles, resignedly.

"I am curious to know what you are going to do with all the earth you take out of the tunnel."

"What I am going to do with it?" repeated Dr. Giles, surprised; "why, dump it anywhere where it will be out of the way."

"H'm!" said Mr. Curtis, "that does sound like

an easy way of getting rid of it. But have you calculated what an enormous amount of earth you will have to remove from this tunnel,— thousands upon thousands of cubic miles,— a regular mountain of matter, some of it perhaps in a red-hot condition?"

Dr. Giles could not repress a hearty laugh at this vivid picture. "Why, James, where in the world did you get your figures?" he asked. "The tube will be only thirty feet in diameter, internally."

"Yes; but it will be eight thousand miles long."

"True; and do you know how much matter a hole eight thousand miles deep and thirty feet in diameter will contain? It is a very simple calculation; with a pencil and a scrap of paper you can figure out the result for yourself in a few minutes."

"I suppose, then, that you have calculated this amount exactly?"

"Certainly; and the total quantity of materials we shall have to remove in digging our tunnel will not be much more than about one fifth of a cubic mile."

"Only one fifth of a cubic mile!" echoed Mr. Curtis.

"That's all, and it's plenty, let me assure you.

It represents a pile of earth one mile square and one fifth of a mile deep—quite a neat little heap, as you will admit. Of course half of this earth will be taken out on the New York side; here in Australia we shall have only one tenth of a cubic mile of materials to dispose of."

"Bless my heart!" exclaimed Mr. Curtis, "I should never have imagined it possible that so long a tunnel would contain such a comparatively small amount of matter. Nevertheless, it will be no small job to get rid of all this waste matter."

"I shall not have the slightest trouble on that score," said Dr. Giles, cheerfully, "because, both on the New York and the Australian side of the tube, I shall begin digging my hole at the bottom of the ocean."

"Dig your hole at the bottom of the ocean!" cried Mr. Curtis, in amazement.

"Yes," said Dr. Giles, calmly, "it is my intention to begin my tunnel under water."

CHAPTER VII

A SUBMARINE TRIP

"  HY, doctor, surely my ears deceive me! You don't actually mean to say that you are thinking of beginning operations at the bottom of the ocean?"

"Most assuredly I am."

"But what reasons have you for such a foolish step? Why do you wish to allow the ocean to run into your tunnel?"

"I think I shall have no difficulty in keeping the ocean out," said Dr. Giles, smiling.

"Well, but what advantage do you see in beginning work under water?"

"To begin with," said Dr. Giles, "there is the advantage you mentioned of having a convenient dumping-place for all the materials excavated."

"And I suppose, too, you will save a few miles

of digging by beginning at a deep spot in the ocean instead of beginning on land?"

"That consideration," said Dr. Giles, laughing, "would not influence me in the least, for the difficulties of working under water would retard us far more than we should be helped by the mile or two we should gain. No; my main reason for commencing the work under water is a most imperative one, and one that I do not wish to talk about just yet. You may, however, rest assured that I have excellent reasons for beginning work in the ocean itself."

What those reasons were was seen only later.

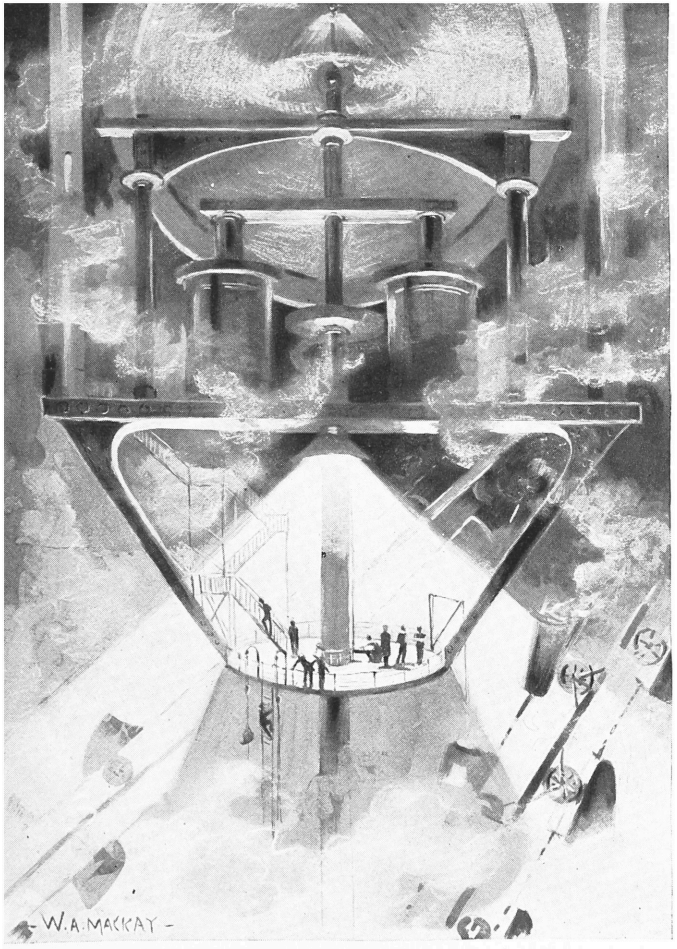
Dr. Giles lost no time in putting his plans into practical operation. As we have already hinted, he began operations simultaneously in Australia and New York, so that the digging might proceed in both directions at once. In this way the work would occupy but one half of the time it would require were the start made only from one side.

The point selected for the operation in the eastern hemisphere was at about 40° south latitude and 110° east of Greenwich, near the southwestern coast of the Australian continent, about two hundred miles from shore; while on the

American side the point selected was at about 40° north latitude and 70° longitude west of Greenwich—in other words, not far from the city of New York.

The work was begun in an immense chamber constructed under water; and to prevent the caving in of the walls of the tunnel as the digging progressed, a tube of considerable thickness and wonderful strength, made of the new metal, carbonite, was used. This metal, discovered—or, more properly speaking, invented—by the doctor, possessed all the qualities necessary for the purpose; for, while obtainable in large quantities, and easy to work, it had a strength compared with which the strength of the best steel was virtually nothing.

As it would have been out of the question to cast an eight-thousand-mile tube in a single piece, or, even if cast, to insert it afterward into the hole, some other plan had to be devised for accomplishing the desired result. But Dr. Giles had carefully studied out this part of the work, and by an admirable contrivance he had arranged to cast the tube little by little, immediately over the hole, and let it down as the boring progressed. In this way the top of the tube was always in a state of fusion, although the bottom was perfectly cold.



"THE GIGANTIC MACHINE DEVISED FOR BORING THROUGH THE EARTH WAS A VERITABLE MASTERPIECE OF INVENTION."

The tube could thus be made of any desired length in a single piece.

As regards the gigantic machine devised for boring through the earth, it was a veritable masterpiece of invention, but so complicated in operation that it is impossible to give more than a general idea of its effects. The device used for excavating the first few hundred miles was somewhat in the style of an immense auger, which, by its rapid revolutions, loosened the earth and transported it automatically to the surface, where, after being carefully scrutinized by a geologist for its mineral wealth, it was dumped into the ocean to form a new island. To the great joy of the capitalists who had invested in the enterprise, it was found that the returns obtained from the sale of the mineral wealth brought up were considerable, while much valuable knowledge was gained as to the internal structure of the earth.

Whenever a stratum of solid rock was met with in the downward progress of the boring auger, this rock was first brought to a state of fusion by directing upon it jets of flame of exceedingly high temperature. The molten rock was then easily scooped up by special devices protected from the effects of the heat by refrigerating agents of great

power, which were kept in rapid circulation through internal passages in the machinery.

The boring auger itself was so constructed that it continually descended as the hole deepened, and it was soon working far below the surface of the earth, the power that caused it to revolve being transmitted from above by means of electrical conductors.

Fastened near the bottom of the carbonite tube, along the interior, was an endless chain of fireproof buckets, which received the loose material thrown up by the auger, and emptied it into a second chain of buckets fastened somewhat higher up in the tube; and these emptied into a third chain, and so on until the loose material finally reached the surface of the earth. A new chain of buckets was added at the top each time the length of the tube was increased.

The work of excavation progressed at an astonishing speed, for the machinery was kept in splendid running order, and was so cunningly devised that any part which broke could at once be replaced by a new one, without its being necessary to stop the machine even for an instant.

The power required for the work had been furnished by the ocean itself, whose tides were

"harnessed up" and pressed into service. This was the cheapest motive power that could be obtained, and it was withal efficient, easy to handle, and ample to perform many tasks like the one set it. As before mentioned, this power was converted into electricity and then carried down into the tube, along wires, to the points where it was required.

As the work advanced the difficulties increased. The greatest obstacle seemed to come from the internal heat of the earth; for in spite of what the doctor had said, the temperature rose with every mile's progress.

Mr. Curtis, who was always taking flying trips to the tube to see how matters were progressing and to give the doctor much unsought advice, was delighted when he noticed this steady increase of temperature.

"What did I tell you?" he cried, his eyes beaming with pleasure at the fulfilment of his prophecy. "I guess you 'll soon have to set your refrigerating liquids circulating through the tube if you want to keep it from melting."

"I have given up that idea of pumping cold liquids through the tube," replied the doctor. "The experiments I made in that line have con-

vinced me that such a device would not be practicable on a tube of the great length this one will have. I have, however, found a plan, on much the same principle, that promises to give far better results than the other."

"I thought it was only pretty women who were allowed to change their minds," said Mr. Curtis, smiling.

"Pretty women and intelligent men," retorted Dr. Giles. "A man who has n't sense enough to change his mind when he has a good reason for doing so, is little better than a fool. A truly scientific man is always ready to give up one idea for a better one."

"Well, then, tell me your new idea, I beg, that I may see if it is in keeping with the rest of your absurd plan."

"I have n't time to go into much detail," said the doctor, "but I can briefly explain it to you in outline."

"Please do, and make your explanation as simple as you can. I always like explanations that are clear and easy to understand."

"All right. Now, in the present case, the problem is simply this: The heat has been steadily increasing the farther down we get into the in-

terior of the earth, and it threatens to continue increasing in the same manner for some time to come. As this heat might injure the tube, I shall be forced to remove it in some way."

"Remove the heat?" said Mr. Curtis, inquiringly.

"Of course; the only way to get rid of heat is to remove it."

"But in your first plan of pumping cold liquids through the tube, you did n't remove any heat."

"If that plan had been adopted it would most certainly have resulted in removing the heat, and that is precisely where its weak point lies. The heat would have passed into the cold liquids, and these would soon have become so hot that the pumping operations would have had to be on a gigantic scale to keep the tube at the proper temperature."

"Ah! and what is your new plan?"

"My new plan is simply to transform the internal heat into electricity, and then carry off this electricity from the tube by means of special conductors."

"What!" exclaimed Mr. Curtis, "you think you will be able to change the heat into electricity?"

"Certainly," said Dr. Giles. "Did you not know that heat, force, light, and electricity are

really all the same thing under different forms, and that one can be readily converted into the other? Every day we change heat into force, light, or electricity, and *vice versa*, so that what I propose to do here is merely what the world has been doing for many years."

"Well, go on," said Mr. Curtis.

"There is nothing further to say, but simply this, that, in casting the tube, I have so prepared both the outer and the inner surface that any heat above 70° F. will at once be changed into electricity by a secret process of my own devising. This electricity instantaneously passes to my office along the conductors mentioned. As you are aware, electrical energy travels so fast that it can go eight times around the earth in a single second; you will therefore see that, so long as I can use up this energy as fast as it reaches me, the tube cannot acquire a temperature much above 70° F. As soon as the heat becomes greater than this, the excess is at once converted into electrical energy and instantaneously passes to my office."

"But how do you get rid of all this electricity that accumulates in your office?" queried Mr. Curtis.

"I sell it."

"You sell it?"

"Yes; I have had special wires laid to the Australian shore; and what electrical energy I do not myself use for my boring operations, I transmit to Australia and sell to different parties there to run the machinery of their factories, draw their cars, light their houses, cook their dinners, and perform innumerable other operations. I have contracts at very remunerative figures for all the electrical power I can possibly furnish."

Mr. Curtis was nonplussed. "Well, that does beat everything!" he exclaimed. "It is beyond my comprehension how practical business men can be such fools as to pin their faith on an enterprise of this kind, and make contracts for electricity dug up from the center of the earth."

Dr. Giles laughed. "You 'll be more astonished yet," he said, "before I finish this job I have undertaken. But that reminds me that, if you want to see something interesting, you 'd better come along with me, and take a look at my submarine houses. I think that Flora, too, would like to see them."

"Oh, yes, indeed," said the young girl, who had been intently listening to the conversation. "I find everything so interesting down here, and you make matters so plain to me."

"Well, come along, then," said the doctor; and he led the way into an adjoining room which could be hermetically shut off from the other parts of the caisson.

"There is our boat," he remarked, pointing to a large submarine vessel resting on its keel in the middle of the room.

A hatchway at the top of the boat was wide open, and through this Flora could see that the interior was upholstered in the most gorgeous style, and was provided with every modern improvement.

"Oh, what a pretty place!" she exclaimed, delighted. "Those colored electric lights make it seem like fairy-land, and it is furnished like a king's palace!"

"Yes," said Dr. Giles; "I had this boat built expressly for receiving state guests who come to visit the works. It has already carried several royal personages, but although good enough for kings and queens, it is none too good for you, Flora." And Dr. Giles pinched her cheek mischievously.

After the party had taken their places, the hatchway was closed, water was admitted to the outer chamber, and communication opened with the ocean. The pressure of a button set the

machinery in operation, and the boat, propelled by a powerful dynamo, was soon speeding along beneath the surface of the sea.

Glass windows formed the sides and top of the vessel, and powerful search-lights illuminated the surrounding ocean, so that to Flora it was a veritable trip in fairy-land to pass through these wonderful regions inhabited by fish and other marine animals of the most curious shapes.

All too soon they reached the spot where the submarine houses were being erected, some already completed, others just begun. It was truly weird to see the workmen in their diving-suits engaged in the construction of these habitations, and Flora did not tire of watching them. Mr. Curtis, too, was interested, but he was puzzled as well.

"I must say, doctor," said he, in a tone of perplexity, "that I don't at all understand what you need these submarine houses for. Where do your workmen lodge at present?"

"Most of them return to Australia after their day's work is done," replied Dr. Giles, "but a number of them sleep in the caisson where the digging operations are carried on."

"Then, why is it they cannot continue to sleep

there, instead of your being obliged to go to the expense of constructing these extra habitations?"

"For the simple reason," said Dr. Giles, "that if I failed to take this very elementary precaution, my workmen might pay the penalty with their lives."

CHAPTER VIII

IN WHICH MATTERS TAKE A SERIOUS TURN

O say that Mr. Curtis was astonished would be to put the matter mildly.

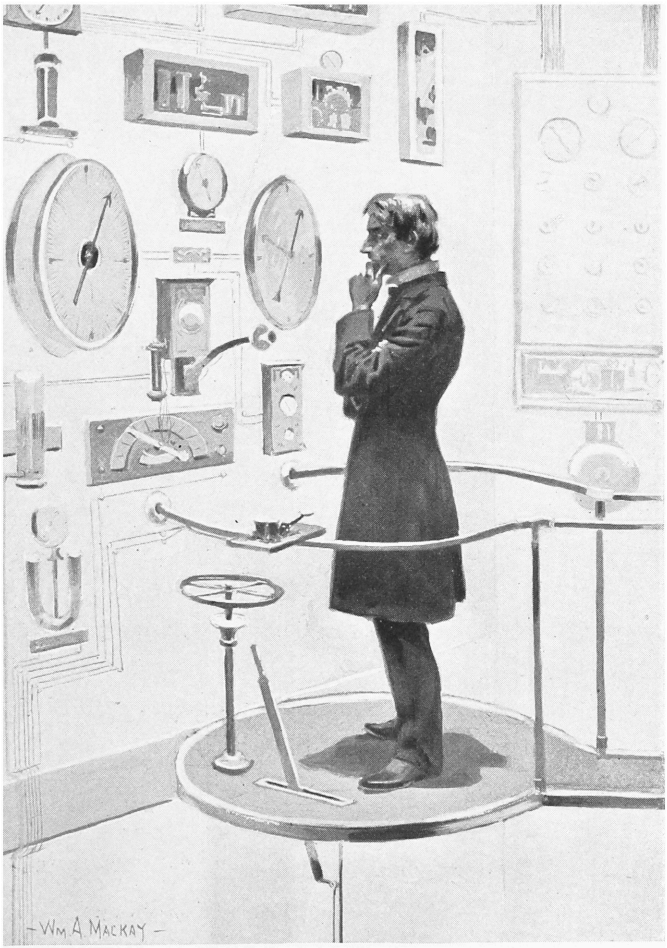
"Well, doctor," said he, "perhaps you understand what you are about, but nobody else does. This whole matter has been a continual surprise to me from the very beginning; and as soon as I get used to one aspect of it, there immediately crops up something new. The very idea of piercing a hole through the earth first took my breath away; then a fresh surprise came when you decided to start the work under water. It seemed strange to commence operations under water instead of beginning on the land itself; still, I became accustomed even to this portion of the scheme, and accepted it. But just as I have reached this point, here you come with a new idea of building submarine boats and

houses for your workmen. There does not seem the slightest reason for incurring this extra expense, and yet you claim that these constructions are absolutely necessary, and that without them the lives of the workmen would be imperiled. Really, I am all at sea. I cannot in the least understand what your object is."

"You will understand soon enough," said Dr. Giles, grimly—"in fact, all too soon, for, unless I am much mistaken, these submarine houses will be required within less than a month from to-day."

After taking rapid note of the progress of the work, Dr. Giles bade adieu to his guests and returned to his private office. He never left this long under any circumstances, for here it was that he kept himself informed of the progress of the work of boring the tunnel. Instruments of the greatest delicacy indicated just how the work was progressing and what were the conditions at the bottom of the hole, the fluctuations in the currents of electricity showing as plainly as articulate speech the changes that occurred every minute.

By means of these instruments the doctor knew to within a fraction of an inch the exact depth that had been reached, the temperature at that depth, the pressure on the walls of the tube, and



"DR. GILES TOOK UP HIS POST WHERE HE COULD KEEP SHARP WATCH ON THE FLUCTUATIONS OF THE INSTRUMENTS."

a host of other details, including the speed at which the boring implements were working. Nay, more; by means of a special telephone he could hear what was going on in these lower regions; and by an ingenious modification of the telautograph, continuous photographs taken at the bottom of the tube were transmitted to his office, so that he could actually see for himself what was taking place at the bottom of the tube. In other words, he could follow every detail of the work as well as if he himself had descended into the bowels of the earth.

It is needless to state that Dr. Giles studied these records with the greatest attention and anxiety; and as the well increased in depth, the furrow in the doctor's brow deepened also, and he took up his post where, night and day, he could keep sharp watch on the fluctuations of the instruments.

He felt that he was now reaching a critical period in his experiment, and he proceeded to take certain precautions which to his assistants seemed uncalled for, but which he knew were absolutely necessary. Among other things, he issued an order that no workman should remain in the caisson unless his presence there was absolutely indispensable. At the same time he had

his instruments transferred to one of the submarine habitations, where he now made his office. This office communicated with a carbonite observatory above water, from which the top of the tube could be plainly seen.

As time went on the doctor became more and more taciturn, and more severe in his discipline, until finally he issued an order forbidding any of the workmen to enter either the tube or the caisson.

Nor were these precautions superfluous; for on January 17, 1988, at three o'clock in the afternoon, a large volume of smoke and gases of all kinds was ejected from the tube, and this was accompanied by a rumbling and trembling in the earth that was felt for miles around.

For several hours these gases escaped; but finally the pocket that contained them was so far exhausted that the pressure was no longer sufficient to hold back the greater forces underneath, and, with a report like thunder, these gave themselves a vent, and the boring-screw, carried upward by a furious column of lava, was thrown high into the air, whence it fell back into the ocean, a considerable distance from the mouth of the tube, accompanied by a seething and hissing of the water most wonderful to behold.

The workmen, warned beforehand, had barely time to take refuge in the submarine houses before the flood of liquid fire was upon them.

"Well, Dr. Giles, what can we do now?" inquired the chief engineer, astonished beyond measure at the turn affairs were taking.

"We can wait, out of harm's way, until the eruption is over," replied the doctor, quietly.

"Indeed! And how long will that be, pray?"

"I know no more than you do," answered the doctor. "I have tried to figure out the probabilities; but there are so many conditions of which we are totally ignorant that such a calculation is beyond our powers. If the molten mass is in pockets, and the pocket we have struck is a small one, the eruption will be over in short order—perhaps in a few weeks. If, however, we have been unfortunate, it may be years before the eruption ceases. Many volcanoes have had an uninterrupted flow since prehistoric times, and what we have here is simply a new volcano. All we can do is to keep the tube from melting, by seeing to it that the apparatus for converting the heat into electricity is in perfect working order; and the rest we must leave to time!"

CHAPTER IX

THE ERUPTION

AY and night the stream of noxious vapors and molten matter poured forth from the newly created volcano; and a most magnificent spectacle it formed. But, interesting as it was to watch these brilliant fireworks, there was not one of our friends who did not ardently desire the display to stop, that the work of digging the tunnel might be resumed.

Even Flora Curtis was as impatient as the rest, though she took great delight in climbing up into the doctor's observatory to watch the immense sheaf of flame rise into the sky, and then drop down, a great distance away, in graceful curves of fire. Fortunately, the observatory itself was protected from the heat by means analogous to those used to keep the tube from melting.

The submarine boats were in continual demand,

not only for the use of the workmen, but also for the transportation of visitors, thousands of whom flocked to see the new volcano.

As for Dr. Giles himself, he seldom left his office, except for the purpose of ascending into the observatory to watch the eruption, endeavoring to discern whether or not there were any indications of a diminution in the volcanic flow.

His constant supervision was necessary for the important task of securing a free outlet for the electricity produced in the tube; for if, through any inadvertence, this electrical energy was not disposed of as fast as it was created, it would do one of two things: it would either find a vent for itself, at the risk of causing considerable damage, or, if pent up, it would check the further conversion of heat into electricity, and the carbonite tube would then melt at once under the influence of the excessive heat.

Fortunately, as we have said, there was a ready market in Australia for more electricity than the doctor could produce; so that, although his supply was now many times greater than it had been before the eruption,—the whole interior surface of the tube being at present engaged in the work of transforming heat into electrical energy,—the

doctor was unable to fill all the orders he received. Nevertheless, the coffers of the company were filled to overflowing with the receipts from the sale of this electrical power. In fact, the vexatious delay caused by the eruption was destined to prove of the greatest financial benefit to the stock-holders.

The important task of keeping the apparatus in perfect running order the doctor would confide to no one except to his chief engineer during the intervals of time when he himself was obliged to sleep; and even then it was only with strict orders that he should be awakened at the least sign of irregularity in the working of the current on either side—for special wires kept him in constant communication with the New York end of the tube.

To be obliged to wait thus with folded arms until the volcanic activities had quieted down was exceedingly discouraging, and the only hopeful sign the doctor saw was that there was a large proportion of vapor mingled with the molten matter hurled forth by the volcano. This led him to believe that only a pocket had been struck. Such, indeed, seemed to be the case; for after four months of weary waiting the eruption gradually subsided.

"DAY AND NIGHT THE STREAM OF NOXIOUS VAPORS POURED FORTH."

Dr. Giles, who had been fast losing hope, was greatly relieved at this turn of affairs, not only because he could go on with his work, but also because he feared that if the eruption continued, local earthquakes might be looked for when the crust of the earth settled into place.

Fortunately, the amount of matter ejected was relatively small, and nothing of the kind occurred. Work was therefore resumed, and pushed to completion with the utmost rapidity.

It was somewhat discouraging to be obliged to begin over again what had already been done, but there was no help for it; so the tube was cleared of the molten matter that had gathered there, and the work of digging was then continued, with instruments of still greater complexity than before, to meet the new conditions in the tube.

Day and night did the work continue, there being six relays of workmen, each serving for four hours at a time, assisted by dynamos of undreamed-of power; and as fast as the hole was deepened the tube was lengthened and lowered. Every possible precaution was taken, and less than five years after the first eruption the two tubes were within a single mile of each other.

During the entire previous portion of the work

Dr. Giles had managed to maintain his calm outward appearance; but now, as the tunnel approached completion, he could no longer conceal his agitation, but paced to and fro like a caged animal.

"Why, whatever is the matter with you, doctor?" asked James Curtis, who had dropped in, as usual, with his daughter Flora, who was now a charming girl of fifteen, and as brimful of sympathy as ever.

"The matter is, James, that to-day I am to learn whether or not the tube is finished, or whether it will require five more years of hard work to complete it."

"Why, what in the world do you mean? Are n't your two tubes now within a mile of each other, and won't they touch to-night?"

"I sincerely hope so," said the doctor; "but it is quite possible that they will never meet."

"How so?" inquired Mr. Curtis, quickly.

"Well, the thing is this. Even in constructing a tunnel a few miles long, our engineers, if they begin work at both ends at once, find the greatest difficulty in making the two holes meet. Moreover, in their tunnels a small error is of no material consequence. Now in my case I am digging

a tunnel eight thousand miles long, and have begun work at both ends. Besides, I have only been able to allow a margin for error of three feet at the point of meeting. A margin of three feet on eight thousand miles is, as you can readily calculate for yourself, only a margin of *one two hundredth* of an inch on each mile! In other words, if, in digging my tunnel, I have made an error of one two hundredth part of an inch on each mile, or, at least, if these errors do not compensate, my tubes will not meet, and half the work will have to be done over again!"

"Whew!" whistled Mr. Curtis. "And you knew this when you started to build the tube?"

"Perfectly," said Dr. Giles; "and I was accordingly obliged to devise instruments of almost impossible delicacy of operation to use in aiming my tubes. The next twenty-four hours will show me whether or not my aim has been true, or whether we shall have five years more of weary working and waiting. Do you wonder now that I seem agitated, and that I cannot stay quietly in place, but pace up and down like a caged animal?"

CHAPTER X

SOME CURIOUS SPECULATIONS

ITH bated breath our three friends watched the instruments in the doctor's office during the last mile of the digging. Car-load after car-load of matter was removed; and as the two boring-screws approached each other the sounds made by the New York screw could be distinctly heard through the telephone on the Australian side of the tube.

Finally the two tubes came so close together that the doctor stopped the New York instrument, and continued the work on the Australian side only. The speed of revolution was also gradually slackened, until it seemed to the excited watchers as though the auger were not moving at all; but when it did finally scoop up the last bucketful of matter, and the Australian tube touched the New York tube with a shock that set them both

vibrating, the enthusiasm of the spectators was intense.

The doctor had succeeded! He had successfully carried out a piece of engineering work such as had never been dreamed of before, and whose difficulties can be realized only by those who have made a lifelong study of mechanics. This last triumph of making the two tubes meet together in the center of the earth, with a discrepancy well within the margin of error allowed for by the doctor, in itself entitled him to a high rank as a civil engineer.

Of course there had been many minor accidents in the course of his stupendous task; but now that victory had crowned the efforts of the intrepid doctor, he felt amply repaid for all the sleepless nights he had passed. Even James Curtis, skeptical as he was, was forced to acknowledge that the word "impossible" was one which deserved to be stricken from the dictionaries of the twentieth century. As for his daughter Flora, she danced about with delight at the success of the undertaking.

"WELL, doctor, when does the first car start?" asked Mr. Curtis, hardly five minutes after the tubes had met in the center of the earth.

"Not for many days yet," laughed the doctor. "The worst of the job is over, I 'll admit, but there 's still plenty to do. It will be over a week before the last car-loads of matter reach the surface here, and in the mean time I must set about welding the two tubes together in the center."

"H'm!" commented Mr. Curtis, "that will indeed be a delicate job. I suppose you will have to send a gang of workmen down into the tube to attend to that."

"Not on any account," returned Dr. Giles, quickly. "Up to the present moment, as you know, I have not been obliged to send workmen down to any distance below the surface of the earth, and even now this will not be necessary. I purposely prepared the bottoms of the tubes so that I can, when I so desire, weld them together electrically, without any one being obliged to go down into the tube. By merely pressing certain buttons here in my office the proper connections will be made."

"I am glad of that, for the sake of the workmen," said Mr. Curtis; "but in some ways it is a pity that no one will go down into the tube, for it would be quite a novel sensation to be down at the center of the earth, where there is no attrac-

tion, and where consequently bodies have no weight."

"Why, father, what do you mean?" asked Flora. "Would n't bodies weigh anything at all at the center of the earth?"

"Not an ounce," replied her father. "If you were down there, Flora, you would float around like a feather; is n't that so, doctor?"

"Yes," assented Dr. Giles; "there is not the slightest doubt about it."

"Oh, then, doctor, you 'll let me go down in the first car, won't you?" cried the young girl, eagerly.

"My cars won't stop at the center of the earth, Flora," replied Dr. Giles. "As I told you, they will go right through to New York."

"Still," said Mr. Curtis, surprised, "I hardly see how that can make any difference. When the car reaches the center of the earth, even if it does n't stop there, the passengers will have no weight, will they?"

"I am not so sure about that," replied Dr. Giles, thoughtfully. "On the contrary, I feel inclined to think that at the center of the earth my passengers will have weight, though not their normal weight, by any means. Instead of being able to float about like a feather, Miss Flora would probably

find it nearly as hard to run about, and would hurt herself almost as much if she tumbled down, as she does here."

"Well, I declare! That passes my comprehension!" exclaimed Mr. Curtis. "Time and again have I heard it said that at the center of the earth there would be no attraction of gravitation whatever. Consequently I can scarcely credit what you say."

"Understand me," said Dr. Giles. "What I say is that if a body were standing still at the center of the earth it would indeed weigh nothing. But the objects that will be in my car will, I am convinced, have a certain amount of weight at the moment when they reach the center of the earth."

"Ah, I see; you mean to say that the car will be moving so fast that the bodies will not remain a single second at the very center of the earth, and consequently the passengers will not have time to feel the effects of the loss of weight."

"No," said Dr. Giles, "that is not where the trouble lies. The difficulty is that I shall not be able to produce a perfect vacuum in the tube. Even with all the appliances I have devised for removing the air, there will still be a small amount left—enough to keep the car from coming

to within about a mile of the surface at the New York end of the tube. It is this air which will make all the trouble."

"What in the world has the air in the tube to do with the weight of the passengers in the car?" asked Mr. Curtis, astonished.

"It has everything to do with it," said Dr. Giles. "But that 's a subject I do not wish to speak of yet. I myself have no clear idea of how nearly perfect a vacuum I shall be able to produce, and hence my calculations are only the roughest kind of approximations at present."

"Well," said Mr. Curtis, "it will be a great pity if the passengers do not lose their weight. Just imagine, Flora, how you would feel floating around at the center of the earth, like a feather. If you had a tennis-ball in your hand, you could n't throw it anywhere, because the ball would have no weight; and if you brought down your fist with all your might on the most delicate glass vase, you could n't possibly break it, because your hand would have no weight and so would just bounce back."

Dr. Giles laughed heartily. "That 's news to me," said he, "I must confess; but then, you know, we all of us learn something new every

day. I 've studied physics all my life, but it 's to-day for the first time that I learn that a body which has no weight cannot be thrown around, or that it cannot break a glass vase if thrown with sufficient force."

Mr. Curtis looked a little sheepish at this burst of sarcasm, but he felt so sure of his position that he replied:

"Why, doctor, the same thing happens here on earth with bodies that have little or no weight. Give a feather to the strongest man alive, and, because it has little or no weight, he will only be able to throw it a few inches, even though he exerts his utmost strength, whereas he could throw a heavy base-ball quite a distance."

"That 's true enough," said the doctor.

"Well, now let the same man take that feather and throw it down with all his might against the most delicate glass vase, and yet he won't be able to harm the vase in the least."

"That is also true," said Dr. Giles; "but the reason is not, as you seem to think, because the feather has little or no *weight*."

"What is it, then?"

"It is because the feather has almost no *mass*."

"Why, I always thought that mass and weight were the same thing."

"Not a bit of it," said the doctor. "*Mass* is the amount of matter a body contains. I weigh a hundred and fifty pounds. Put me at the center of the earth, and I would weigh nothing at all; and yet my body would still contain the same amount of matter. My mass would remain unchanged, though my weight would disappear. Consequently, if Miss Flora were at the center of the earth, she would have no trouble in throwing a ball; in fact, she could throw it much farther than she can here. And if she brought her fist down with all her strength on a glass vase, delicate as her fist is, it would shatter that vase into a thousand pieces."

"What a pity it is," said Mr. Curtis, "that your passengers will not be able to stop at the center of the earth. There would be so many curious experiences for them to undergo."

"Their experiences," said Dr. Giles, smiling, "would not be one whit more interesting if they stopped at the center of the earth than they will be as it is. You would be astonished if you knew what curious phenomena are in store for the first

man who drops through my tunnel. I have calculated a large number of them, but every day I think of something new. I can tell you this much, though: that from the very moment of the start to the instant when the car arrives in New York, there will be a continuous succession of surprises for my passengers!"

CHAPTER XI

DR. GILES STRIKES A SNAG

TO weld the two tubes together at the center of the earth was a most delicate operation; but the work was performed with the greatest care, and the doctor was highly gratified to find his labors crowned with success.

Then the boring-screws and other instruments were withdrawn, and specially constructed pumps were set in operation to exhaust the tube of air. This work was supplemented by the use of ingenious chemical processes to absorb the greater part of the rarefied air which the pumps and other apparatus were unable to remove.

This precaution was absolutely necessary, for, as already stated, air presents an enormous resistance to objects which are traveling at a great velocity. Air in the tube would not only have retarded the car considerably in its passage, and

prevented it from reaching the opposite side of the earth, but would, by its friction, have also produced an amount of heat sufficient to damage the vehicle seriously.

Along with the boring of the hole, the construction of the car had occupied the doctor's attention. Fortunately, there was nothing very difficult in this part of the work, for any closed vessel whatever would have answered the purpose. Nevertheless, there were certain points that required to be taken into consideration. For example, as, in spite of the efforts made by the doctor to obtain a perfect vacuum, there would always remain a small amount of air in the tube, it would be well to construct the car of such a shape as to offer the least possible resistance in its passage.

Dr. Giles hesitated some little time as to the best shape for his vehicle, but ended by making the body of the car cylindrical, tapering to a point at both top and bottom. The height of the car was about twenty feet, and its width about fifteen; consequently, as the hole was thirty feet in diameter, there seemed little fear of the vehicle striking the sides, even though it should turn around during its journey.

As to the furnishing of the interior of the car, it is needless to say that the doctor had omitted nothing that would conduce either to the comfort or convenience of the passengers.

Mr. Curtis and his daughter happened to be in the doctor's office when the finishing touches were put to the work, and Dr. Giles rubbed his hands gleefully as he exclaimed:

"Well, James, what do you say now to my project?"

The doctor was justified in feeling elated, for the tube was at last complete, a veritable triumph of human skill, bringing Australia and New York into direct communication for the first time in the history of the world.

"What do I think now of your project?" repeated Mr. Curtis, with a sardonic smile. "I think that you have succeeded in this part of the work far better than anybody ever expected, and you deserve great credit for what you have done."

Dr. Giles noticed his friend's lurking smile, and understood it at once. "So, James," he said, "you 're not satisfied yet as to the practicability of my enterprise?"

"No," replied Mr. Curtis, his smile broadening to a grin. "The fact is, I have been studying up

the matter on my own account, and I find there is one very important point that you have entirely overlooked, and which yet will be sufficient to prevent the car from ever going through to New York."

"Out with it, James! Don't keep me in suspense like this!" said the doctor, with mock gravity; for he was accustomed to his friend's objections, and knew that they were generally of the utmost insignificance.

"Yes, doctor," said Mr. Curtis, with ill-concealed triumph, "there is one very important factor you have failed to take into consideration."

"Well, what is it?" asked the doctor, still smiling.

"The centrifugal force of the earth!" said Mr. Curtis, impressively.

Flora Curtis was a passive spectator in this scene, which she only imperfectly understood. But as her father uttered these last words she saw the doctor's face become ashy pale, and he sank back in his arm-chair almost without consciousness.

"James, you are right!" he articulated hoarsely. "I 'm the greatest idiot alive! I had completely forgotten the centrifugal force of the earth; and

this one little oversight will thwart all my plans! I shall now never be able to send cars through my tunnel! All the work we 've done is absolutely useless; all the money we 've spent is simply thrown away! All my planning has gone for nothing; my whole scheme is utterly wrecked, and all through one seemingly insignificant little oversight!"

And Dr. Giles hid his face in his hands.

CHAPTER XII

FLORA CURTIS COMES TO THE RESCUE

HE triumphant smile faded out of Mr. Curtis's face as he noted the effect of his words on the worthy doctor, and, half ashamed of himself, he turned on his heel and marched out of the room, leaving Flora and the doctor together.

As for Flora, she saw only one thing,—that Dr. Giles was in trouble,—and with a woman's intuition she seized upon the best possible mode of comforting him. She seemed to feel instinctively that Dr. Giles was one of those persons who, when afflicted with any trouble, instead of giving it free vent, keep it tightly locked in their bosoms, letting it do all the internal ravage it pleases. She therefore thought it would be the very best thing for the doctor to make him ease his mind by talking of his trouble, and she accordingly seated herself

on the sofa by his side, and began questioning him.

"I know I am dreadfully stupid," she said, "but I don't at all understand what has happened. Won't you please explain the matter to me?"

Dr. Giles felt the young girl's sympathy keenly, and it comforted him more than he was willing to confess.

"The long and the short of the matter, Flora," said he, "is that I am a fool! By overlooking one little point I have rendered my whole scheme impossible, and, after all my work, I shall never be able to send either freight or passengers through my tube!" And Dr. Giles clenched his fist viciously.

Flora was puzzled. "I don't see why it is you won't be able to send your car through," she said. "The tube 's all ready, and the car 's all ready. Everything has been prepared just as you wished, and everything seemed successful, so I don't see what will prevent you from sending a car through, as you had planned!"

"Ah, Flora, neither did I until your father spoke just now. I had n't stopped to reflect on what would happen when I dropped the car into the tunnel."

"Why, it would just fall through to the New York side, would n't it?" asked Flora.

"That 's what I thought, too, and what anybody would think. But I was mistaken. I had completely forgotten the centrifugal force of the earth!"

"What 's that?" asked Flora, "and how would that hinder the fall of the car?"

"You know, of course, Flora, that the earth turns around on its axis once in every twenty-four hours."

"Yes, I know that; that 's what makes day and night."

"True. Now, if it were not for this motion, anything dropped into my tunnel would fall straight through to New York; but this movement of the earth is going to spoil everything."

"How so?" inquired Flora.

"Why, in this way. As the earth is twenty-five thousand miles in circumference, and turns around on its axis once in every twenty-four hours, it follows that every person on the equator is continually traveling in a circle, at the rate of more than a thousand miles an hour."

"Yes, I understand that," said Flora.

"Well, here in Australia we are twenty degrees

below the equator, and are consequently not traveling quite so fast; but for convenience I shall suppose that we are turning at the rate of one thousand miles an hour. In other words, every object in Australia, including you, myself, the car, and, in short, every object around us, is continually traveling toward the east at the rapid rate of one thousand miles an hour!"

"I understand," said Flora, noticing that her companion paused.

"Well, suppose the earth were to suddenly stop spinning; do you know what would happen to you?"

"I suppose I should keep on turning in a circle," said Flora.

"Not a bit of it," said Dr. Giles; "you would fly off in a straight line toward the east, at the rate of one thousand miles per hour! And the same thing will happen with the car. In a word, the car, in its fall through the earth, will retain this initial velocity, and during its entire passage through the tube will be flying toward the east at the frightful speed of one thousand miles an hour."

"Yes," said Flora, "I understand that; but the tunnel, too, will be traveling just as fast. The tube will be moving toward the east at the rate of

one thousand miles per hour just as well as the car; so it seems to me the car ought to stay right in the middle of the hole during the entire trip."

"You forget," said Dr. Giles, "that it is only at the surface of the earth that the hole will be traveling at the rate of one thousand miles an hour. The lower portions of the hole, making much smaller daily circles, naturally travel at a much lower speed, whereas at the very center of the earth the hole, instead of moving toward the east at the rate of one thousand miles an hour, will only move a few feet in a whole day!"

"Well, then, what will happen to the car?" inquired Flora, anxiously.

"What will happen to it? Why, even though I took the precaution to drop the car down into the very middle of the tube, as the vehicle will retain its rapid rate toward the east during its entire passage, it will continually scrape against the eastern side of the tube. This friction will be so great that it will certainly prevent the car from going much beyond the center of the earth, and it will in all probability be sufficient to destroy both the car and the tube!"

Flora was silent, and the doctor continued:

"Do you wonder now that I feel so badly?

Just as I was on the very verge of success, to find all my plans knocked on the head, all my work rendered useless! In fact, my whole scheme is impracticable, unless I dig a tunnel through from the north pole to the south pole. Here, indeed, I should have no centrifugal force to deal with, as the axis of the hole would be relatively stationary; but a tunnel in such a location would be of no use whatever. At any other spot on the earth I should be obliged to make due allowance for the centrifugal force, and dig a curved tunnel instead of a straight one. Here in Australia, my tube, instead of going straight through the earth, would have to make something like a parabolic curve, and terminate nearly two thousand miles away from its present location."

"How do you make *two* thousand miles?" asked Flora. "I thought you said the trip would not take more than an hour, and that the car would move eastward only at the rate of one thousand miles an hour."

"Yes," said Dr. Giles; "but you must remember that while the car is falling the New York end of the tube will also be moving eastward at the rate of about a thousand miles an hour. In other words, the car will move one thousand miles east-

ward, and the New York station another thousand miles; therefore, both of these motions taken together would make a difference of nearly two thousand miles. That is to say, the New York end of my tube would have to be about two thousand miles farther west than it is at present."

"You mean farther *east*, don't you?" corrected Flora.

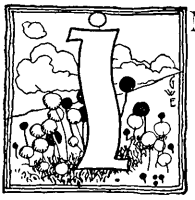
"No, farther *west*. What is the east side of the tube for us is, of course, the west side for people at the other end. But of what use is it to say any more about this matter? To build a curved tunnel such as would be necessary would, at the present day, be a mechanical impossibility, so it 's just a waste of time to speculate about it."

"But, doctor," said Flora, "could n't you do anything to prevent the car from striking the walls as it went down?"

"No," said Dr. Giles, reflectively; "I see no way of doing that unless—eureka! I have it!" he suddenly shouted. "Flora, you 're an angel!" he cried, springing up triumphantly from his seat. "Do you know that you have shown me the way to overcome this difficulty, and to-morrow my first car will make its journey through the earth, or my name is n't Joshua Giles!"

CHAPTER XIII

THE QUESTION OF A PASSENGER



N a few words Dr. Giles explained to Flora how he would counteract the effects of the centrifugal force of the earth.

"Without you, Flora," said he, warmly, "I should have given up the whole affair in disgust. It 's what you said about finding some way of preventing the car from striking the tube that put me on the track, because really nothing is simpler."

"How will you manage it?" asked Flora, overjoyed at having been of some assistance to her kind friend.

"Why, in this way. Before I drop the car down on its journey to New York I shall charge it highly with negative electricity."

"Won't that be bad for the passengers?" inquired Flora.

"They will not even perceive its presence," replied the doctor. "The eastern side of the tube I shall also strongly charge negatively. Fortunately, the conductors we have along the inside of the tube will enable me to distribute this charge to whichever parts of the surface I desire."

"What good will this electricity do?" asked Flora.

"Why, this. As two electricities of the same kind repel each other, the car will be thus prevented from striking against the side of the tube. In fact, by increasing or diminishing the charge according to circumstances, I shall be able to keep the car always well in the center of the tube."

"Oh, I 'm so glad!" exclaimed Flora.

"Not half so glad as I am," responded the doctor, heartily. "But I have n't a moment to lose. The start of the first car has been announced all over the world as taking place tomorrow at eleven o'clock in the morning, and I have all these electrical arrangements to prepare. It 's fortunate your father discovered my oversight so opportunely, and that you showed me the way to remedy it. I hardly know to which of you I owe the greatest gratitude. Although we instinctively dislike the faultfinder, he often proves as service-

able to us as the man who aids us with his sympathy and encouragement. As the good old Chinese proverb says, 'The things which we least like to hear are those which it is most to our advantage to know.'"

FLORA and the doctor did not meet again until eight o'clock the following morning, Dr. Giles having been so busy putting the finishing touches to his work that he could not spare a moment for any other purpose. But eight o'clock found the doctor back in his office again, with the last detail attended to, and everything in readiness for the departure of the first car, scheduled to start at eleven o'clock.

Yet, though the enterprise was thus brought to a point where success seemed assured, Dr. Giles was not wholly satisfied; and the reason was that he had been unable to find a passenger to embark on this first trip. He had, with some misgivings, offered a reward of one hundred pounds to any one who would consent to make this journey through the earth. His fear was that this inducement, small as it was, would nevertheless bring him an endless number of applicants desirious of making the trip; but, to his great surprise as well as disappointment, not a single person presented himself

in answer to the advertisement. There was something appalling in the thought of dropping eight thousand miles, and not a man could be found willing to undertake the strange voyage.

"What a pack of cowards they are!" the doctor exclaimed angrily. "If I could only trust these machines with some one else, I should n't hesitate an instant to go myself! But so much depends upon the proper working of the electrical currents that I could not possibly delegate so difficult a task to even my most competent assistant. The mere work of regulating the charge of repellent electricity in the tube to counteract the centrifugal force of the earth will, in itself, demand the closest attention. The least inadvertence or error on the part of the operator would jeopardize the success of the whole undertaking."

"Have you been able to get this part of the apparatus in good working order at such short notice?" asked Mr. Curtis, to whom these remarks were addressed.

"Oh, yes; there was no trouble about that," replied the doctor. "I have, as you know, a large corps of workmen, and the task was really a simple one. But although everything is in perfect condition, the proper control of the cur-

rents will be a most delicate operation. I have arranged these so as to be automatically controlled, as much as possible, by the very position of the car in the tube; but my presence is absolutely necessary here, in case the slightest thing should go wrong."

"Well," said Mr. Curtis, "I must confess that, for my part, I am not at all surprised that no one should be willing to run the risk of taking this plunge through the earth. Not only is there, as you say, the danger of being killed by striking against the side of the tube, but the very rapidity of the passenger's fall would, as I have already said, prevent him from breathing; so that, even if he were not smashed into fragments or burned to a cinder, he would still be suffocated before he reached even the center of the earth!"

"Nonsense!" replied the doctor. "As I have already told you, we are all of us traveling at a much greater speed than this car will acquire, and there will consequently not be the slightest danger. A child could undertake the trip. And now that we are discussing the subject, I am surprised, James, that you do not yourself go."

"Oh, thank you, doctor; but although, as you say, I might go without danger, I am enough of a

child to prefer my life to the pleasure of falling down a bottomless pit."

"I 'd be willing to go, if father would let me," said Flora Curtis, who had been closely following the conversation, and who now broke in with the above startling words.

Both gentlemen turned and looked at her with astonishment. Was it possible that this young girl was willing to risk a danger that so many older persons were afraid to face? But there was no mistake about the seriousness of her proposition, for her manner was most earnest; and her father hastened to nip her project in the bud.

"Never in the world would I consent to have you go, Flora," he declared emphatically. "You may well suppose that under no circumstances could I allow you to face any danger which I myself was unwilling to meet."

Dr. Giles heartily seconded his friend. "You are a brave girl, Flora," he said, "but I could not think of letting you take this trip, as emergencies may arise which a man will be more fit to cope with than a woman, especially a young lady like yourself. I am, of course, sorry to be obliged to submit to the humiliating necessity of sending the car through without any passengers, but there seems no alternative. I regret this all the more

as there will be many interesting physical experiences for my passengers to undergo during the trip, and I should very much like to have an account of them.

"There is one more chance left. I told my agents to wait in Australia until the last moment, and not to leave the continent without doing everything possible to secure a passenger. That is my last hope. So far they have telephoned me that they have been unsuccessful; but they have still five minutes left, and—who knows?—perhaps even now something may turn up."

The minutes passed slowly by until the last one had sped. Dr. Giles put up his watch, and turned disconsolately to his friends.

"It 's no use," said he; "the car will have to go through without any passengers, after all."

At this moment the telephone in the doctor's office began to ring. With a bound the worthy man was at the instrument, listening to the message. It was most laconic:

"Boy of sixteen wants to go as passenger. Shall we bring him?"

Dr. Giles hesitated a few seconds, and then his reply was borne back over the wires:

"Bring him anyway."

Only three words, but they meant volumes!

CHAPTER XIV

IN WHICH OUR HERO COMES UPON THE STAGE

T half-past ten o'clock there was a knock at the door of the doctor's private office.

"Come in," said Dr. Giles, and there was a tremor in his voice as he uttered these two familiar words.

A boy entered—a young lad with a pleasant face, but evidently belonging to the poorer classes; for while there were no holes in his clothing, it was full of patches of different colors. But, in spite of this, he had an indescribable air of neatness about his person. Evidently he had seen better days.

A shade of disappointment passed over the doctor's face as he gazed searchingly upon the lad.

Mr. Curtis and Flora, at a sign from Dr. Giles, had discreetly retired to an adjoining room, from which, however, they could hear all that passed.

It was the boy who first broke the silence, and it was easy to see, from his brisk, businesslike manner, that he thoroughly knew how to take care of himself.

"Do I understand, sir," he said, going at once to the subject in his mind,—"do I understand that a reward of one hundred pounds is offered to whoever will take passage in the car that is about to be dropped through the earth?"

"Yes, my boy, that *is* the offer; but you appear somewhat young to try an experiment which so many older heads are afraid to risk."

"I beg of you to let me go, sir," said the boy, earnestly; "for that hundred pounds means life or death to my poor mother."

"What is your name, my boy?" the doctor asked kindly.

"William Swindon, sir."

"Well, William, do you not see what a responsibility I should be taking if I were to allow you, a minor, to go on this trip? Suppose anything should happen to you; could I ever forgive myself for letting you go?"

"I will gladly take the risks," exclaimed William, eagerly. "And pray do not believe that because I am only sixteen I do not know how to

take care of myself. On the contrary, I have had more practical experience than many young men of twenty-one."

"You have not always been poor, William. I can see that by your speech and manners."

"No sir; only two years ago we had everything we wanted. In fact, I was destined to become a mechanical engineer, and was studying with that end in view when my father died. Somehow, his partner, in settling up the business, managed to keep everything for himself, and left nothing for us."

"Could n't you sue him?"

"That, unfortunately, is what my mother did; and she spent what little money we had in trying to get the rest back. But the result was, she lost all. Then I was taken from college and sent to work in a shop at very low wages, while mother tried to give private lessons and do sewing at home. Our friends helped us a little at first, but soon became tired of doing so. And then mother fell ill, and we gradually ran into debt.

"The crisis came yesterday. When I went to work in the morning I found my employer had failed, and that thenceforward I was without a position. When our landlord, to whom we owe

about ten pounds, heard this, and saw that even the small income we had was thus cut off, he declared he could keep us no longer, and yesterday noon turned us out into the street, although poor mother is yet far from well.

"I should not like to pass through yesterday's experiences again! All the afternoon we tramped about in the hot sun, asking for work, or for lodging on credit; but nothing could we find. Finally, as evening came on, we went to one of the public parks, and passed the night on a bench there. Poor mother! it was the first time in her life she had not a roof to rest under; and although she tried to bear up bravely for my sake, I could hear her sobs as we sat there waiting for the daylight. Ah, thank Heaven, yesterday can never dawn again! I should go wild if it did!"

"Who knows?" said the doctor, smiling inwardly, though his eyes were moist. "Perhaps if yesterday did dawn again, it might be ten times happier than the happiest day you have ever known so far. Besides, how do you know that to-morrow may not be many times worse?"

"Ah, sir, if you would only let me go on this journey, I feel sure that we should never want again. The hundred pounds offered would enable

us to pay all our debts, and would, with what I could earn, keep us alive for at least a year. During that time I am certain I could find some good position—one that would enable me to support my mother."

Dr. Giles felt the tears coming to his eyes at this simple tale, and coughed to hide his emotion. Yet still he was hesitating, when Flora, who had been listening to the conversation from the next room with the most intense interest, burst into the doctor's study.

"Oh, doctor," she cried impulsively, "please let him go. I feel sure that if you let him make the trip you will never be sorry for it!"

CHAPTER XV

DR. GILES STARTLES HIS HEARERS

TILL Dr. Giles hesitated; but when Flora laid a caressing hand on his shoulder, and looked up at him with imploring eyes, the last vestiges of his opposition vanished.

"Well, William," said he, "since you are determined upon going, I don't see but that I shall be obliged to let you make the trip. If there were any real danger, I could not, of course, think of such a thing; but, as a matter of fact, you ran more risks in coming here on the ship than you will in going through the earth. This voyage, being something out of the ordinary run, naturally frightens people more than a greater danger with which they are familiar. Novelty breeds fear, just as familiarity breeds contempt."

Flora beamed with delight as the doctor thus practically gave his consent, while William re-

turned profuse thanks. Visions immediately floated through his mind of a speedy and successful trip, and he pictured his arrival in New York, where, of course, he would be received in triumph, and fêted like a hero. He would not have been a mortal boy had he not been dazzled by the glory that seemed in store for him.

Had he realized then the dangers and difficulties to be passed, he might well have paused and turned back. But, with youthful optimism, he saw none of these, and he faced the ordeal with a brave and cheerful heart.

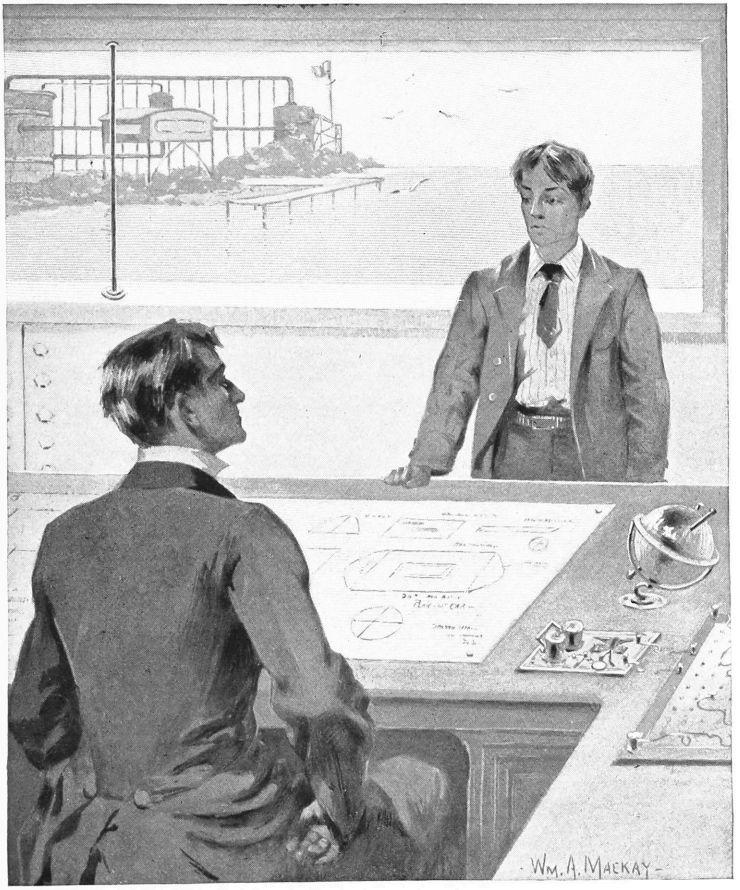
Our hero was brought back from his reflections by the doctor's next remark:

"We now come to the question of money, William. I hardly suppose you will wish to take the hundred pounds with you on your trip?"

"No, sir," said William; "I should like mother to get them as soon as possible."

"Very well; then I 'll despatch a messenger at once with the money, and will myself add a second hundred pounds to the amount. But where can we find your mother?"

"I left her in the park early this morning, sir, while I went out to look for work; and I told her I should be back by noon, if possible, or, if I



"'WELL, WILLIAM,' SAID HE, 'SINCE YOU ARE DETERMINED UPON GOING, I DON'T SEE BUT THAT I SHALL BE OBLIGED TO LET YOU MAKE THE TRIP.'"

found something to do, at seven o'clock to-night. I shall write her a line to inclose with the money. And believe me, sir, I am truly grateful to you for your kindness."

"Not at all," replied Dr. Giles. "But now that I come to think of it, my boy, you have not yet asked any questions about the trip you are going to undertake, but seem willing to go into it blindfolded."

"I thought all I should have to do would be to get into the car," said William. "I supposed you would press the button and do all the rest."

"Even so, I should think you 'd want to know something of the dangers that you will have to run."

"I 'd much rather not," replied William. "What 's the use of knowing about a danger when you can't help yourself? While I am falling through the earth I 'll be as helpless as a baby; so what 's the good of frightening me by telling me of the danger? You would only make me nervous and want to back out."

"I guess there 's not much danger of your backing out," said Dr. Giles, after a careful survey of the manly face before him. "Besides, you will not be so wholly helpless as you seem to think."

At this juncture Mr. Curtis, who had entered the room, thought it necessary to put in an oar.

"I think, with the doctor, William, that you won't be absolutely helpless while you 're falling. I remember, when I was a youngster like you, I used to go swimming with a number of other boys. There was a very high dock from which we used to dive, and one day a comrade, in a spirit of mischief, pushed me overboard when I was n't looking. I was badly frightened, I can tell you, when I felt myself falling; but I knew that if I fell flat I should be badly hurt, so I kicked and squirmed as I went down, and succeeded in turning myself around, so that I reached the water head first, and was n't hurt a bit."

"Yes," said William, "the same thing has often happened to me. Besides, I know that cats, when they fall, always manage to land on their feet. Some years ago, my mother one day heard her pet canary fluttering about in its cage, and knowing that something was wrong, she rushed to the window, and spied a large black cat, that had climbed up the wistaria-vine and was trying to get at the cage.

"Mother was so angry and excited that she caught the cat by the back of the neck and threw

it out into the middle of the street. She was, of course, sorry the moment she had done it, for this was the fifth-story window, and there was a stone pavement below. She looked out in agony, expecting to see the poor beast crushed to death by his fall; but—would you believe it?—that cat coolly turned around in the air, fell right side up on his four paws, and disappeared like a streak of lightning, without being hurt in the least!

"Now, that cat was a great deal worse off than I shall be, because he had nothing to hold on to, while I can cling to the car. I suppose that Dr. Giles has got a mattress fastened to the floor, and by holding on to this I shall be all right."

Dr. Giles had been listening to this entire dialogue with an amused face, but he now thought it time to interfere.

"I think that neither of you has the faintest idea of the conditions that will prevail during the trip," he observed pleasantly. "If you imagine that your fall through the earth is going to be like the fall of a cat through the air, you are very much mistaken, and it will therefore perhaps be well for me to give you some idea of what will really take place. To begin with, I want

to ask you a few questions, William, on a point that Mr. Curtis and I have been discussing. I understand that you studied physics at school?"

"Only the very elements," answered William, hastily, fearing that his imperfect knowledge was about to be put to the test.

"Well, that ought to be sufficient, for all the problems you will meet with in your trip are elementary ones. But tell me first what you know about the force of attraction at the center of the earth."

"Why, there is no attraction of gravitation at the center of the earth—or rather, the attraction is the same on all sides, so it is neutralized. A body placed at the very center of the earth would weigh absolutely nothing; if I were there at this moment I should weigh nothing at all, not even one tenth of an ounce."

"Your answer is perfectly correct so far, William, and we all agree with you. Now tell us, please, what you think your weight will be during your trip in the car."

"Why, at the beginning I shall weigh just as much as I do now, that is to say, one hundred pounds. But as I go down my weight will be less, because, instead of being attracted downward

by the entire mass of the earth, that part which I have passed, being above me, will attract me upward. Thus my weight will become lighter and lighter until, when the car reaches the center of the earth, I shall weigh absolutely nothing; then, as the car progresses, and I pass the center and go up toward New York, my weight will gradually return again; and when I finally do reach New York I shall weigh one hundred pounds, as before."

"That 's just exactly what I said!" exclaimed Mr. Curtis, glancing at our hero approvingly.

"I think so, too," observed Flora, timidly.

"Well," said Dr. Giles, "your reasons are good, and would be true of bodies at rest; but it will not be true of William in the car. A body at rest at the center of the earth would weigh absolutely nothing; a body at rest half-way to the center would only have about half its normal weight; while a body near the surface would have its complete normal weight. But in William's case it will be altogether different."

"How so?"

"Why, unless I am very much mistaken, at the very moment his car starts he will at once lose all his weight and float up in the air like a feather!"

CHAPTER XVI

A STRANGE EXPLANATION

"  HAT?" exclaimed Mr. Curtis, in amazement. "You really think that William will lose his weight at the very instant that the car begins to fall?"

"Not only do I think so, but I am absolutely sure of it."

"Why, what grounds have you for such a belief?"

"I understand your astonishment, James, for I confess I long shared your idea that the passengers in the car would retain their weight until they reached the center of the earth. The problem is a most curious one, and is very puzzling at first; but once the conditions are well understood, the explanation is quite natural."

"Well, I 'm afraid that, for my part, I don't know enough about physics to understand your

explanations; for none of the physical laws with which I am familiar explains how a man can lose his weight at the very surface of the earth. I suppose, though, that you have found some obscure little law, known only to scientists, which will account for your strange assumption."

"Not a bit of it, James. The law I refer to is one of which you see examples every day, and which is quite a familiar one. Have you ever seen a man riding on a street-car?"

"Well, rather! I see hundreds of them every day," replied Mr. Curtis. "But what connection is there between a man on a street-car and a man falling through the earth?"

"There is a closer connection than you would be ready to believe. Now, let us suppose that the street-car is traveling at the rate of ten miles per hour; do you know how fast the passenger himself is traveling?"

"Why, he must be traveling at the same rate—ten miles per hour, also."

"Quite true. So long as the man does n't walk toward the front or rear of the car he is necessarily traveling at the same rate as the car. Well, now, if, as you say, the man is traveling at just the same speed as the car, no matter how long he

travels, will he find himself any farther front in the car?"

"No."

"He 'd find himself pushed forward when the car stopped," interposed Flora. "I 've noticed that whenever a car stops suddenly I 'm always thrown forward."

"Yes; but that 's because you 're no longer traveling at the same speed as the car. When the car stops, its speed becomes less, while yours remains the same as before. Consequently you are really traveling faster than the car for the time being, and so you tend to get ahead of it."

"Well, I understand all that," growled Mr. Curtis; "but what has this got to do with the entirely different kind of car that we are going to drop through the earth?"

"It has everything to do with the matter. At what speed do you suppose the car will be going during the first second of its fall?"

"It will fall sixteen feet during the first second, being pulled downward by the attraction of the earth."

"Correct; and how fast will the boy be falling?"

"He will be falling sixteen feet per second, too,

because gravitation will pull him down just as rapidly as it does the car."

"Also correct. Well, if the boy falls sixteen feet in one second, and the car falls sixteen feet too, how much nearer will the boy be to the bottom of the car at the end of that second than he was before?"

"You don't mean to say that he would n't be any nearer to it than he was before?"

"Most certainly I do. If two people are running a race, and one goes just as fast as the other, neither of them can get ahead."

"Of course not."

"Well, it 's the same thing here. The car will travel just as fast as the boy. Consequently if, at the start, the boy is five feet away from the bottom of the car, he will remain five feet away. He is falling just as fast as the bottom of the car, and so cannot get any nearer to it. If he starts in the air he will remain in the air."

"You mean to say that he will remain floating in the air?"

"Precisely."

"But the air cannot support him. Air can only hold up very light bodies."

"Understand me. It is not the air that will sup-

port the boy. Even though there were no air whatever in the car, if the boy were half-way between the floor and ceiling when the car began to fall, he would still remain suspended in space."

"But why is it he would n't fall?" asked Flora, not altogether able to understand the matter.

"He *would* fall," said the doctor; "that is to say, he would fall toward the center of the earth. But the car would be falling, too, so he would remain suspended half-way between the floor and ceiling of the car."

"I must be awfully stupid, but I don't quite understand it yet."

"Well, listen, Flora. Suppose I were to drop a stone down through my tunnel, and were immediately afterward to let another stone fall after it. Would the second stone ever catch up with the first?"

"No, of course not. The first one would be falling just as fast as the second one, and as it started before the other, the second one could never catch up with it."

"Exactly," said Dr. Giles, triumphantly. "Now, suppose I let the bottom of the car fall through the earth first, and then a second later drop William through; could he ever catch up with it?"

"No, he could n't."

"Well, that 's just the way it will be. I shall arrange matters so that William will start say five feet behind the bottom of the car, and he will accordingly remain five feet behind it during the entire journey. Starting after the floor, he cannot catch up with it; and the ceiling starting behind him, it cannot catch up with him; so he will remain half-way between the floor and ceiling."

"Then you mean to say," said Mr. Curtis, "that William will have absolutely no weight at all during his whole trip through the earth. Yet not long ago you told me, on the contrary, that you expected he would have weight when he arrived near the center of the earth."

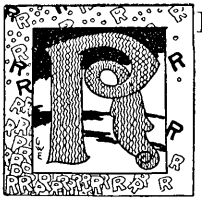
"True, and I say so again."

"What!" exclaimed William, "you really believe that while I shall have no weight at the start, I shall yet have a certain amount of weight when I get near the center?"

"I most certainly do," replied the doctor.

CHAPTER XVII

THE LAST MOMENTS

"  EALLY, doctor," said Mr. Curtis, "I don't see how you can reconcile this last statement with what you 've already told us. You said just now that as the boy will start a small fraction of a second after the bottom of the car, he cannot catch up with it, and will consequently remain floating in the air."

"In other words," said Dr. Giles, "he will have no weight. If he weighed himself on the spring balance I have placed in the car, he would find that it did not mark a single ounce."

"That I understand. If he floats in the air, it must, of course, be because he has no weight. But now you tell us that near the center of the earth he will have weight. How can you make this tally with what you said before?"

"Remember, James," said Dr. Giles, "that what I

said was this: that so long as both William and the car were traveling at the same rate of speed William would have no weight, and consequently he would remain floating in the middle of the car. But if at any time William were to travel faster than the car, then he would regain a certain amount of weight."

"But did n't you just remark that the earth would always attract William just as much as it does the car, and so would cause him to fall at the same speed?"

"Yes."

"Then how could he travel faster than the car?"

"Listen. I have already told you that, in spite of my efforts to produce a perfect vacuum in the tube, I was unable to get rid of all the air. Now, air, as you know, presents a high resistance to objects traveling at a great velocity. This air, although highly rarefied, will, when William is traveling at his greatest speed, retard the car considerably."

"Yes; but it will retard William, too."

"Not in the least. It is the outside of the car that will strike against this air and be checked. William, snug inside his car, will not feel the great wind thus produced. The car will fall more

slowly, but William will fall almost as fast as before; and so, instead of remaining suspended in mid-air, he will now catch up with the bottom of the car and soon reach it. In a word, he will have regained a certain amount of weight."

"Well, doctor, since you say so, I suppose I must believe you; but I only wish we had an X-ray apparatus here that would enable us to see William during his strange trip. It promises to be more astonishing than I had imagined, and I should be willing to give a great deal to be able to see what happens to him."

Our hero, although he had listened to these long explanations with interest, was now becoming impatient; for he saw that the time of departure was approaching, and he wished to ask the doctor a few practical questions which had occurred to him.

"What is it, my boy?" asked the doctor, noticing his uneasiness.

"I 'm sorry to interrupt you," said William, "but I should like to have some advice in regard to my trip. For example, I suppose you 've arranged some special apparatus so that I shall be able to breathe during my fall."

Dr. Giles shook his head with a smile. "No, William," said he; "you will need nothing of the

sort. You will not find the slightest difficulty in breathing. I understand your being afraid of traveling at so high a speed; but you will not feel the slightest jolt, or be inconvenienced by the noise of machinery, as you would in all other methods of transportation. You will have no more difficulty in breathing than you have now; for our earth is traveling many times faster than the greatest speed you will acquire. You may become slightly dizzy, but not enough to hurt you; and besides, the whole trip will be over in less than an hour."

"All right, then," said William. "If you 've no further advice to give me, I 'll just write a word to mother, and after that I shall be ready to start."

"That 's a good idea, my boy," said Dr. Giles; "and I 'm glad you called me back to present matters, for I was forgetting how time is flying. But before you go, let me tell you, William, that you are a plucky lad, and that you are displaying a courage to-day of which a man might well be proud. I regret that you have to leave us so soon; but the car is scheduled to start at eleven o'clock sharp, and the inhabitants of the whole world are now gathering to see the start. Of course, they cannot witness the real descent, but

by means of electrical devices they will see it indirectly."

William hastily scribbled a few lines to his mother, and then took leave of his newly made friends. Each had a good word for him, and Flora beamed on him with undisguised admiration as she warmly shook hands with him and expressed the most sympathetic wishes for his trip, while our hero was so confused at the young girl's kindness that he could only blush and stammer out his thanks. He felt convinced that without her intercession the doctor would never have allowed him to make the trip, and the picture he carried away of the beautiful young girl gave him fresh courage for the trying ordeal that was in store for him.

"Everything is now ready for the start, William," said the doctor, kindly, as he led the boy to the door of the car. "Be of good courage, and remember that the dangers of the trip are more imaginary than real. There is, in fact, almost no actual danger. You will find that I have attended to everything necessary for the comfort and safety of passengers. I have also placed full instructions how to act on signs hung around the interior of the car. Follow the instructions *to the letter*, and I will guarantee that you make a safe and speedy trip. But however strange the directions

may seem to you, it is absolutely essential that you should *follow them exactly.*

"Remember, too, that while there will be no possibility of communicating with us during the journey, we shall yet know just where you are, and whether all is well or not; for I have here instruments of the greatest delicacy, which will inform me of your exact position, and the conditions of heat, cold, and so on, that you are experiencing. During the entire journey I shall not take my eyes from the instruments for a moment; and in case of any emergency you can count upon us to aid you by all the means in our power. And now good-by, my boy, and mark my words: you will never regret the step you have taken, and I promise you that you will be back here, safe and sound, before nightfall!"

The doctor spoke too confidently. Little did he dream, as he made this promise, that it was destined to be weeks before our hero set foot on his native land again!

A moment later William passed into a closed chamber at the top of the tube, made his way into the car, and carefully locked himself in. Then the suction-pumps were set to work, this upper chamber was exhausted of air, and the car was ready to start on its strange journey.

CHAPTER XVIII

AN UNEXPECTED TURN OF AFFAIRS

EANWHILE Dr. Giles had returned to his office, where he found Mr. Curtis and Flora eagerly awaiting his arrival.

"Well, doctor," inquired Mr. Curtis, "how did our young friend bear up at the last moment? Was he beginning to feel shaky when you left him?"

"Not a bit of it," answered Dr. Giles. "William is a brave lad, and, aside from a slight nervousness which is perfectly natural under the circumstances, he does not display the slightest signs of fear. In fact, I am convinced he is better fitted to make the trip than many a man would be."

"Oh, Dr. Giles," exclaimed Flora, "you really don't think anything will happen to him, do you?"

"Nonsense!" replied the doctor, with more show of conviction than he really felt. "What *could* happen to him? The advantage of this railroad over all others is that the trains cannot get off the track, and that collisions are impossible. So, you see, the danger is very slight."

"There 's one thing I forgot to ask about, doctor," said Mr. Curtis. "How is William going to renew his supply of air when it gives out?"

"There will not be any need of renewing it," replied the doctor. "The trip will take only one hour, and as the car is as large as a good-sized room, William will have enough air to last him a whole day, at a pinch. As an extra precaution, however, I have put in a tank of liquefied air, which he can turn on in case he needs it."

"Why, in what case could he need more than a day's supply of air?"

"Well, for instance, if the resistance of the air during his fall is so great as to prevent the car from reaching the catches I have placed on the New York end of the tube."

"And what would happen in that case?"

"Why, it would stop short of its destination and then fall back."

"I see; and as it would n't fall back far enough

to reach the catches on this side of the tube, it would continue falling backward and forward until it came to a rest in the center."

"Yes; and as the retardation would be only gradual, several days would probably elapse before it came to a complete stop."

"Ah! And then, of course, William would need the extra air?"

"Certainly; for the simple reason that we could not send him any assistance until he came to a complete rest. But, understand me, while I thought it best to take these precautions, I have not the slightest fear of anything of the kind happening. I have catches arranged on the New York side as far as twenty miles below the surface of the earth, and I am certain that it will be impossible for the car to fail to reach these. On the contrary, it will pass these first catches with such speed that I have been obliged to devise means of moving the catches out of the way instantaneously, if necessary, so as to afford free passageway. I am fully convinced that William will not come to a stop until he is within two miles of the surface on the New York side."

The conversation was here interrupted by an exclamation from Flora.

"Oh, Dr. Giles, look at that ship!" she cried.

Dr. Giles turned to the window and looked out. To his surprise, he saw a large vessel at anchor. During the events of the last half-hour he had been so engrossed with other matters that he had not noticed its approach; but now he looked at it with some anxiety; and his anxiety was but too well founded.

"Why, that 's an Australian revenue cutter!" exclaimed Mr. Curtis. "What in the world can it want here? I suppose it 's going to establish a custom-house on the islet to collect duties from the American passengers who come through the tunnel. When William returns, his baggage will all have to be inspected and chalked before he will be allowed to land."

"I sincerely hope it is only that," said Dr. Giles, somewhat relieved.

At this moment there was a knock at the door, and a government official entered, bearing a large missive.

"Is this Dr. Giles?" he inquired.

"Yes, sir; that 's my name," said the doctor, with an anxious glance at the document which his visitor held.

"Well, I represent the Australian government,

and this is an injunction forbidding you to let your car go through the earth."

"What!" exclaimed Dr. Giles, bounding to his feet.

"Yes, sir; the Australian government positively forbids your letting the car start. And, furthermore, it commands you to have the tunnel filled up with earth again immediately. In case of failure to obey, I have orders to arrest you at once!"

CHAPTER XIX

THE START

DR. GILES was so stupefied at this totally unexpected turn of affairs that for a moment he was unable to utter a syllable. But in that moment his thoughts were not idle.

Full well he knew that among the Australian politicians there were quite a large number of "Jingoes," and he knew also that there had been considerable discussion as to the dangers which menaced Australia from the construction of the tunnel.

One of the sensational papers was particularly bitter in denouncing the scheme, as the following extract will show:

Up to the present time Australia and the United States have been on a most friendly footing, owing to their remoteness from each other. With nations, as with individuals, it is among near

neighbors that quarrels are most apt to arise. To-day the greatest harmony reigns between us because our countries are situated on opposite points of the globe; but once this tunnel is constructed through the earth, so that passengers can arrive here with a single hour of travel, all these conditions will be changed. Australia will then become America's nearest neighbor, and quarrels will be continually arising. And in case of war between the two nations, what an inestimable advantage the United States will possess in being able to drop troops, firearms, and provisions through this tunnel, certain that they will reach this side in good condition less than one hour after they leave New York!

As to the statement made by certain persons that it would be an easy matter for the Australians to gain possession of this end of the tube, and block up the tunnel by allowing the ocean to run into it, it is made by parties who have no idea of the true condition of things. With proper fortifications on the islet, and an American fleet to defend it, the United States could hold it against any nation. The garrison could not be starved out, since they would receive constant food-supplies from the other side of the earth; and they could not be conquered, for as fast as the defenders were killed off, new ones would take their place. The American ships would receive constant munitions and provisions of coal, while the Australians, having none of these facilities, would be under a great disadvantage.

No; unless the government speedily acts in the matter, the United States will soon gain a foothold here from which they can never be dislodged. Under these circumstances, it behooves our government to at once issue an injunction prohibiting the passage of any cars through the tunnel, and ordering the latter to be immediately filled up with earth again.

The Australian government had weakly allowed itself to be swayed by arguments of this nature, and the issuing of the injunction restraining the passage of the car bearing our hero followed as a matter of course.

The injunction once signed, the fleetest revenue cutter was despatched with it, and had arrived at the very moment we have mentioned, when William was already snugly ensconced in his car.

ALL this flashed through the doctor's mind in an instant, and at the same time a wave of disappointment came over him at the idea that his fifteen years of hard toil were to go for naught. After conducting his enterprise to a satisfactory termination in spite of all the obstacles of nature, he was now to be stopped and turned back through the foolishness of men! It was a hard blow, but there was no help for it. The doctor was not the man to oppose the decree of the government under which he lived.

With a heavy heart he turned to his speaking-tube.

"Petrie," he called out to his chief engineer, "we shall not be able to send the car through; please have it held back."

"Too late, doctor," returned the engineer. "The

car is just starting, and to try to stop it now would be useless!"

Dr. Giles, with a cry of joy, looked up at the clock. It was indeed too late, for the hour hand was just pointing to eleven.

Turning to the government official with great politeness, Dr. Giles explained the state of affairs.

"You come just five minutes too late," he said. "Had you arrived but a few moments sooner, I might have been able to prevent the car from starting; but it is now beyond mortal power to stop it. It has started on its trip through the earth, and cannot possibly be stopped until it reaches the other side."

And with great courtesy he bowed his unwelcome visitor out of the room.

While these events were transpiring, immense crowds had gathered, in every city of the world, around special appliances that had been erected for rendering visible the course of the car during its passage through the earth. The news had already spread that at the last moment a passenger had been found to undertake the journey, and hence public interest was excited to the highest pitch.

At one and the same moment an electric bell in each of these places sounded a warning ring for a few seconds, and then suddenly ceased, while at the instant of cessation a ball placed in a tall glass tube began to fall slowly downward. This ball was in electric communication with the carbonite tube itself, and by an ingenious arrangement it measured and made manifest to the spectators the exact speed and position of the car at every stage of its rapid fall through the earth.

The die was cast! Our hero had started on his novel journey. And novel it was destined to be beyond anything he had ever imagined!

CHAPTER XX

DOWNWARD HO!

HILE the whole civilized world was watching, as it were, the fall of the car, let us see how William was faring in his singular vehicle.

His first sensation on entering it had been a most curious one, for the internal arrangements were quite striking. To use our hero's expression, he seemed to be inside a large Dutch cheese. The fact is that the room, if such it may be called, was nearly cylindrical in shape, and the walls were lined throughout with thick, soft cushions of a reddish color. Even the door by which he entered, and which he now carefully closed and locked behind him, was padded with similar cushions.

"Evidently," thought William, "the doctor does n't want me to get hurt in case my car

strikes against something on the way. It was very thoughtful of him to arrange matters so comfortably, and I 'll have to profit by his kindness to have some good gymnastic exercises on the journey."

He little suspected the variety of gymnastics that was in store for him!

The car was illuminated by a diffused light, fully equal to that of a bright day, and all objects were, therefore, in plain view. But what especially amazed our hero was the furniture. Fastened to the floor at one side of the room were a lounge, a chair, and a table with a few books secured to it.

There was nothing extraordinary in this; but on casting up his eyes, what was William's astonishment to see, fastened upside down to the ceiling, duplicates of these pieces of furniture. Two strong handles were affixed to each article, thus adding not a little to their singularity.

"What in the name of the seven wonders can that furniture be doing up there on the ceiling?" said William to himself, greatly puzzled by this sight. "The lounge that is hanging there would be comfortable enough, I suppose, if I could only be glued to it; but as it is, I don't really see of

what use it can be—unless," he added, a light striking him, "it may be useful after I pass the center of the earth, when the attraction of gravitation will pull in the opposite direction; or perhaps it is only intended for the use of those passengers who come from the New York side."

Both of these surmises seemed plausible, but neither was completely correct.

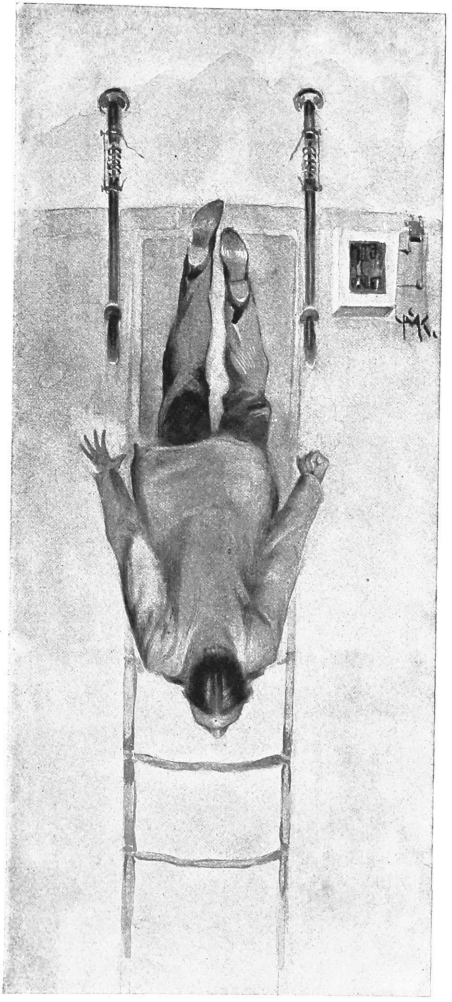
William's first surprise being over, he gazed around at the various instruments on the wall, the uses of which he readily understood from the printed notices below each. But what specially interested our hero was a number of curious inscriptions printed in large letters upon the cushions of the car. These notices were so extraordinary that it may not be amiss to give the reader a few specimens:

STAND ON YOUR HEAD AS MUCH AS POSSIBLE DURING THE ENTIRE TRIP!

DO NOT TOUCH THE SIDES OF THE CAR UNLESS ABSOLUTELY NECESSARY!

BE CAREFUL NOT TO SPIN AROUND TOO QUICKLY!

ALWAYS STRIKE THE CAR WITH YOUR FEET RATHER THAN WITH YOUR HEAD!



"HE TURNED HEAD DOWNWARD, AND LET HIMSELF DROP."

DO NOT LOOK OUT OF THE WINDOWS OF THE CAR UNLESS UNAVOIDABLE!

DO NOT SWIM TOO NEAR THE INSTRUMENTS!

IN CASE OF DANGER TURN ON THE COLD!

"Well, I never!" exclaimed William, hugely astonished. "So, I must stand on my head, eh? And I must n't spin around too quickly? Rather superfluous advice, I should think, for I have n't the least desire to take a spin, and I could n't very easily, even if I would. Moreover, why does the doctor tell me to strike the car with my feet rather than with my head? Does he think I am such a ninny as to want to strike it at all? And why in the world does he speak of swimming, when there 's not enough water in the car for a cat to swim in? I declare, I am almost ready to believe that the doctor is crazy, and this whole scheme of his a humbug. Nor does that furniture dangling from the ceiling tend to change this opinion."

As he said these words he came to another sign, which read:

TO START THE CAR, CLIMB BY THE STRAPS TO THE CEILING, AND THEN LET YOURSELF DROP, HEAD DOWNWARD!

"Good gracious!" exclaimed our hero, looking upward in astonishment, "that 's a drop of about fifteen feet! In spite of the cushions, I 'd have a pretty rough fall if I tried that kind of diving. On the other hand, the doctor told me to be sure to follow exactly the directions given; and he did n't look as though he wanted to kill me. Perhaps, after all, I 'd better follow his advice."

And, lightly climbing up by some straps which he noticed on the side of the car, William seized two handles that were swinging from the ceiling. At this moment he heard the clock strike eleven.

"Time 's up," said he. "Well, good-by, Australia. Take good care of yourself while I 'm away." And with these words he swung out into mid-air, turned head downward, and let himself drop.

A whole minute passed, and still there was no change in the conditions; nor did William feel in the least uncomfortable in his awkward position, although he was completely at a loss for an explanation of this curious phenomenon.

Wishing for some definite information, he screwed his head around until he could see the telemeter on the side of the car—an instrument designed to indicate the speed and position of the vehicle at every stage of its journey. To William's surprise, the needle of the instrument was descending rapidly from the top to the bottom of the first glass tube.

"Sure enough," said William, "we have started. And we 're going pretty rapidly, too, if that instrument is correct, though, to look at the car, I should n't for a moment imagine that it was moving."

Then the truth flashed over him. "I see it all!" he exclaimed. "I understand now how it is I don't get any nearer the bottom of the car, but float up here in the air like a balloon; for, as Dr. Giles said, although I am falling at a good speed, the car is falling just as fast as I am. Consequently I can never reach the bottom, and unless something happens, I shall remain up here,

floating about in mid-air, until I reach New York! Well, I 'm sure I can't complain, for this cushion of air is about as soft as any feather-bed I ever lay on; but I feel sort of queer at thus continually falling without ever getting anywhere."

He was interrupted in his scientific meditations by a fly, which had, in some manner, found its way into the car, and now came and alighted upon his nose. William slapped it violently away with his hand; and as he did so he noticed that the motion had thrown his body somewhat out of the perpendicular. But if our hero was surprised at this, his astonishment may be imagined when he perceived that his body was slowly revolving, so that he soon found himself lying horizontally in the air; and a little later he was standing upright —if any one can be said to stand when resting on nothing but air.

"Good gracious!" he exclaimed, "I 'm turning around in a circle!"

He was right; and as he had studied mechanics at school, it did not take him long to see the cause of this curious fact. He knew that no action could take place without a corresponding reaction, and that the force used in moving his hand to brush away the fly, working against the resistance

offered by the rest of his body, had been sufficient, now that his movements were unimpeded by the attraction of gravitation, to set him turning around as if on a pivot, the resistance of the air being insufficient to stop him. In fact, he found it necessary to throw up his other arm in order to stop himself.

William amused himself for a time by thus making his body revolve like a wheel, first in one direction and then in another, and found it a most novel experience. He enjoyed it immensely, but after a while the sport became monotonous; in fact, worse than that, our hero began to feel the first symptoms of seasickness, and wished he could reach the bottom of the car.

"I don't know how it is," he said, "but my head feels queer, as though this spinning had sent all the blood into it." He did not reflect that, besides this, there was the fact that his blood was no longer attracted downward into his legs by gravitation, and that consequently an undue flow was sent to his head.

The novelty of the situation having passed away, our hero began to feel a trifle blue.

"It is curious," said he, "but although I am perfectly free in all my motions, and am not tied

in any way, yet I am held here an absolute prisoner in the center of the car, held more securely than if my hands and feet were tied, and I were inclosed in a strong iron cage. I can spin around in all directions, but I cannot get an inch nearer the top or bottom of the car, or approach either side.

"In order to move my whole body in any direction I must be able to change the position of my center of gravity, and this I cannot do unless I have something to push against. If I had a long pole here I could push against the side of the car, and so move my body in the opposite direction; but as it is, I have absolutely no point of resistance against which to work, and I must therefore remain here, suspended in space, like Mohammed's coffin.

"No matter what happens, here I must stay, dangling about in mid-air! Truly no one was ever before placed in such a fix as this!"

CHAPTER XXII

THE NEW MOHAMMED

HE situation was indeed a strange one. Here was our hero, in full possession of all his powers, suspended in mid-air, and seemingly absolutely powerless to budge a single inch in any direction; for it is one of the first laws in physics that a body cannot be set in motion without the action of some force, and no force is possible without some point of resistance against which to act.

"Well, here 's a pretty state of things!" exclaimed William, dolefully. "Dr. Giles must have overlooked the fact that I 'm to be kept prisoner up here. It 's no earthly use my trying to reach the bottom of the car, because I have no means whatever of moving from this spot. If there were

only somebody else in the car, he could throw a chair or something at me, and so knock me close enough to the wall to enable me to catch hold of one of the straps; but there being nobody with me, there seems no possible means of my reaching the floor."

It was indeed an awkward predicament, and the more William puzzled over the problem, the more difficult did it appear, until finally an idea struck him.

"If I only had a heavy weight here with me," said he, "I could reach the side of the car fast enough; for by throwing the weight with all my force toward one side of the car, the reaction would be sufficient to push me in the opposite direction. Unfortunately, the heaviest thing I have in my pockets is my jack-knife, and that is much too light for the purpose. I could, of course, cut off one of my arms and use that for a weight. By throwing it in any direction my body would certainly be pushed back in the opposite direction until I reached the walls of the car; and once I could get hold of the straps, I should be all right. This method would be sure to succeed, but it 's one I should wish to be excused from trying."

William's theory, singular though it may

appear, was nevertheless perfectly correct. The mere act of throwing a heavy body in any direction would have sufficed to set his own body traveling in the opposite direction. Of course the speed at which he would move would depend upon the weight of the body thrown, or rather upon its mass, since bodies in the car no longer possessed weight.

In other words, supposing some emergency to arise which would render it absolutely necessary for our hero to reach the side of the car, he could do this by resorting to the heroic expedient of cutting off his own arm and hurling it away from him with all his strength. A singular expedient, truly, but a most effective one; for, assuming his arm to be one tenth as heavy as the rest of his body, he would move in one direction with one tenth of the speed at which his arm was thrown in the opposite direction.

"It 's some comfort," thought William, as he meditated over this curious plan, "to know that I could, if I wanted, reach the side of the car; but at present I hardly think it worth while to sacrifice one of my arms for no real advantage. If ever I get out of this fix alive, I want both my arms to come out with me. If only my jack-knife

were a little heavier I could make that answer, but I 'm afraid it 's much too light."

The idea of utilizing the knife in this way seemed, however, to haunt him, and at last he exclaimed:

"I don't see why the knife won't answer almost as well as my arm. Being so light, the reaction will, of course, be much less, and it will consequently take me a great deal longer to reach the side of the car.

"Let me see; the calculation is an easy one to make. My knife weighs about one ounce, and my body weighs over one hundred pounds. Consequently, if I throw the knife with sufficient force to make it reach one side of the car in a single second, the reaction will force my body to the other side of the car in sixteen hundred seconds, that is to say, about twenty-six minutes. In other words, I shall not be obliged to remain suspended here more than half an hour, at the most. That 's bad enough, I must confess, but it might have been worse."

Just as William was about to throw the knife, a new thought stayed his hand. "I forgot the resistance of the air!" he exclaimed. "The knife will pass through the air all right, because it is

small; but my body is so large that the air will stop me before I get half-way to the side of the car!"

Our hero's face fell; but the idea of the resistance of the air suggested a new train of thought.

"Hurrah!" he cried. "I see now how I shall be able to reach the side of the car! All that I have been saying about being obliged to stay here would be true only if there were no air in the car. If there were no air I should indeed have no point of resistance against which to work. But there is air in the car, and this will prove my salvation. The air in the car will furnish me with the point of resistance I have been seeking. In five minutes I shall reach the floor, for I will *swim* down through the air! It will be harder work to swim here than through water, but it will be far better than to remain suspended in mid-air like this!"

CHAPTER XXIII

IN WHICH OUR HERO INVENTS A NEW KIND OF SWIMMING

ILLIAM was right in his surmise. The presence of air in the car afforded him a point of resistance against which he could act, and he would therefore be able to reach the side of the car without resorting to any heroic measures such as he had been considering. Had there been no air in the car, however, the only possible way for him to have reached the floor, ceiling, or walls would have been some method similar to that suggested.

Our hero's first idea was naturally to reach the floor. He accordingly turned himself head downward, and proceeded literally to swim toward the bottom of the car. But William had failed to consider, in his calculations, how slight the resis-

tance offered by the air really is; and after making a dozen lusty strokes without appreciably advancing, he was ready to give up the undertaking in despair.

"Whew!" said he, panting, "if I can't get on any faster than this, with all my exertions, I sha'n't reach the floor in a year. Why, in swimming through water I 'd go ten times as fast! It seems to me that it ought to be just the contrary, and that, as air offers a much slighter resistance to my progress than water would, I ought to go faster here."

In speaking thus our hero did not take into account the fact that, although the resistance to his progress was much less, the force of impulse was correspondingly decreased. Consequently, since his advance was due to the difference between the propelling force and the resistance to his progress, the denser the medium in which he traveled, the quicker he would go, so long as the medium remained mobile. Hence he could swim through water very much faster than through air.

Another very peculiar fact which our hero noticed was that, in making these swimming motions, the speed of all his movements was

greatly increased. The same fact had struck him on attempting to hit the fly. For example, even when he tried to raise his hand very slowly, it would be shot violently upward, while when he moved it normally it would travel with lightning speed. So, in his swimming movements, although he meant his strokes to be very slow and deliberate, yet his arms fairly flew through the air.

Our hero was very much puzzled at first for an explanation of this singular phenomenon; but at last it struck him that the reason his motions were so much more violent than on the earth was that, while his muscular force remained unchanged, this force produced greater effects, since his limbs now possessed no weight.

When he moved his limbs on the earth a great portion of his muscular force was consumed in overcoming the attraction of gravitation, while here no force whatever was wasted in this way; hence the same exertion would produce very much more rapid movements.

"I understand it now," said William, after considering the matter a little. "We learned at school that a force sufficient to give a weight of one pound an acceleration of one foot per second

would, if the same body were placed where it would have no weight, suffice to impart to it an acceleration of thirty-two feet per second. In other words, all motions which I would make on the earth in direct opposition to the attraction of gravitation will, now that I have no weight, be made thirty-two times as fast. Of course all my motions are not of this character, but, on the whole, the average speed of my movements is considerably increased."

So far, so good. But interested though William was in explaining this curious mechanical effect, his present desire was to get to the bottom of the car as soon as possible; and his efforts, in spite of the violence of his movements, carried him but slowly forward.

"I guess I 'll have to give it up!" he exclaimed, at length. "This is too slow work."

So saying, he stopped his exertions for a breathing-spell. But, to his surprise, he saw that, although he had stopped swimming, he was still slowly progressing.

"Sure enough!" he exclaimed joyfully. "I was forgetting that, now that the attraction of gravitation no longer has to be taken into account, any motion I make will continue indefinitely, or

at least until it is stopped by the resistance of the air in the car. Consequently, now that I have a start, I need merely fold my arms, and I shall slowly but surely keep on advancing. Moreover, if I want to set to work and swim a little more, each stroke I take will increase my speed, so that by keeping on I could finally get up a speed of over a mile a minute."

It is safe to say that William could never have succeeded in obtaining so great a rapidity as this, since the resistance of the air would increase as the square of his velocity. Still, he could have obtained a high rate of speed had he had sufficient space to swim in. As it was, however, he was fast approaching the bottom of the car.

It was most amusing to find that when he stopped his exertions he still continued progressing at the same rate, while whenever he took a few strokes his speed increased and continued at the new rate. Finally he reached the lower part of the car, and catching hold of one of the handles on the lounge, he pulled himself down.

"This is hot work," said he, as he let go of the handle and remained lying about ten inches above the sofa. "It 's hot work, but it 's glorious fun! I wonder if I 'll be able to swim up again.

Of course, in going up, I shall have to work my way against the attraction of gravitation, and that will make it much harder for me to swim up than it was to swim down. I am really like a fish in a basket that is floating down a river. So long as the fish remains perfectly still he won't get any nearer the ends of the basket; but if he wants to swim, he will find it easier to swim down with the current to the lower end of the basket than to swim against the current to the upper end."

William's simile of the fish in the basket was perfectly correct, but there was a serious flaw in his conclusions as to what would happen in the given case, and this error was the cause of his meeting with a new experience, which might have turned out rather unpleasantly.

"It can't make very much difference, anyway," thought William; "for even if I find it too hard to swim up, I can turn around and swim down again. I shall, however, give myself a good start by jumping up from the floor with all my might, and will thus have less distance to swim."

With these words, our hero, bracing himself by the handles at the bottom of the car in order to get a good start, put down his feet against the floor, and gave himself a strong upward push.

The result of this simple action was a positive and very disagreeable surprise. Never in the world would he have imagined that such an every-day act as jumping could produce such wonderful results as it did here in the car!

CHAPTER XXIV

THE DANGERS OF JUMPING

HE effect of William's attempt to jump upward was, as we have said, a positive surprise to him. He had fully expected that the act of jumping upward would bring the attraction of gravitation into play again, or, more properly speaking, that to rise in the car he would be obliged to overcome the earth's attractive force. He consequently calculated to be able to jump no farther in the car than he would have been able to spring from the surface of the earth; that is to say, he expected to rise two or three feet, and to be then obliged to swim up the rest of the way to the top of the car.

But he was mistaken in believing that his upward progress would be checked by the attraction of gravitation. As the bodies in the car were

falling with exactly the same speed as the car itself, they no longer possessed any weight, and it was consequently just as easy to move a body upward as downward, or to one side of the car. The result of William's jump was accordingly to carry him up toward the ceiling with great rapidity; but, owing to his bent position at the start, instead of going straight up, he found himself turning a series of somersaults as he rose in the air.

In vain he tried to stop himself. The impetus he had acquired was too great, and up he went, spinning like a top. Fortunately, the trip was not long, and he soon reached the ceiling. But, to his surprise, instead of stopping there, he struck against the cushions, and then bounced back toward the floor again, still spinning quite rapidly.

Poor William was highly alarmed at this completely unexpected turn of affairs.

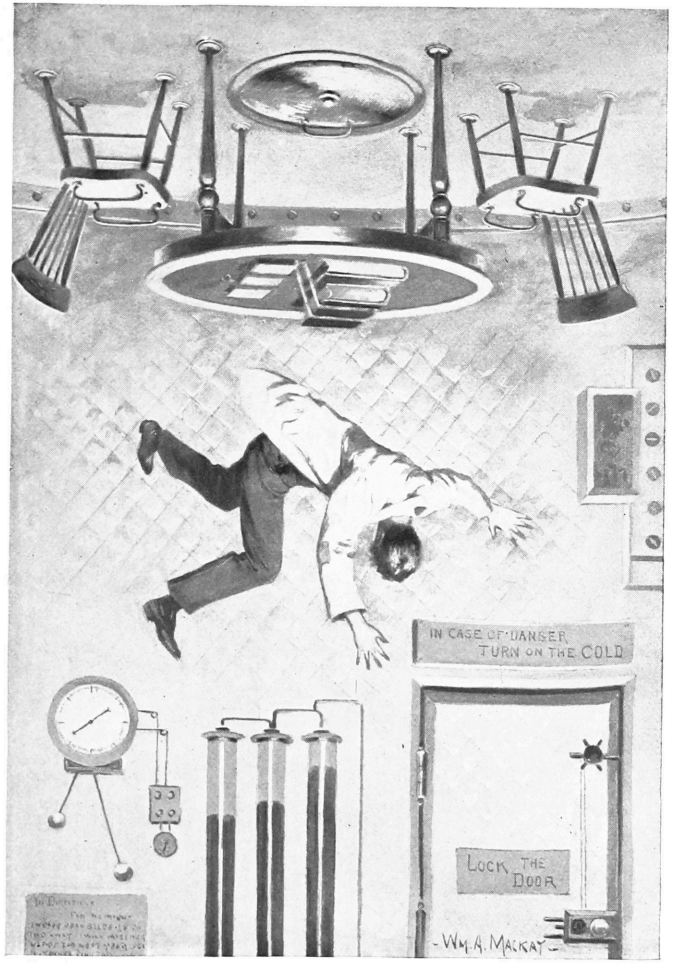
"Good heavens!" he exclaimed; "it looks as if I was going to keep on bouncing up and down, and spinning round and round, until I am stopped by the resistance of the air and the elasticity of the cushions! This will never do, because I already begin to feel terribly dizzy."

How matters would have ended it is impossible to say, had not our hero made one supreme effort, and managed to grasp the back of the lounge, thus stopping himself, though with no little difficulty.

"Gracious!" said he, as he pressed his hand to his throbbing temples; "it 's lucky I managed to catch hold of that lounge, or I should surely have had an apoplectic stroke, with all that blood running to my head as I spun round."

The blood had, in fact, been unduly forced to his head by centrifugal force as he whirled around, and the problem now arose, how to get this blood down into his feet again. Surely there must be some way in which this could be effected, and yet William was obliged to puzzle over the problem some little time before a solution occurred to him.

"I have it!" he exclaimed, at last. "The only way I see to get back the blood into my feet is to stand on my head! It does seem a curious remedy; but everything is so different here from what it is on the earth that in order to get the blood down into my feet I shall now be obliged to stand head downward, whereas, on the earth, to stand in this position would have just the opposite effect."



"UP HE WENT, SPINNING LIKE A TOP."

William's explanation of his reasons was a most plausible one.

"The thing is this," said he. "As I am falling faster and faster every second, there is every instant a slight shock which tends to throw my blood upward."

He was, of course, referring to the well-known sensation that a man going down on a very rapid elevator experiences when the elevator starts, a peculiar disturbance in the pit of the stomach—the well-known sensation of falling. The reason is that the body of the man falls a small fraction of a second before his internal organs, and these consequently seem to rise up in his abdomen.

"Here in the car," continued our hero, "as my velocity increases every instant, I must feel the same kind of a shock continuously when I am upright in the air; but when, on the contrary, I turn head downward, the shocks will be in the direction of my feet, and will therefore tend to send the blood slowly away from my head. Besides, Dr. Giles recommended an upside-down position; and the farther I go, the more I see that he knew what he was about when he put up those signs on the walls."

It seemed as though William had hit upon the

true solution; but unfortunately, things are not always what they seem, especially not in our hero's case, and William's explanation, plausible though it was, was incorrect. This he soon discovered; for although he turned himself head downward for a short time, he found that this position did not relieve him in the least.

The real explanation of the matter was probably that William's internal organs were under the same conditions in his body as he himself was in the car; in other words, they tended to remain stationary at whatever point they might be. Hence whether he stood upright or head downward made no difference; even his blood would have no tendency to run more in one direction than in another. No matter how he placed himself, the flow of blood to his head would be somewhat more than normal, because gravitation no longer pulled it down into his feet as it did on the earth. In a word, his head received as much blood now as it would ordinarily upon the earth if he were lying perfectly flat.

William's surprise at not feeling in any way the increase in his velocity would have disappeared had he remembered that the earth, in its course

around the sun, travels very much faster during the winter than during the summer. Yet although this increase of speed occurs every year at about the same date, no one feels any unpleasant effects from it, or even notices it.

After vainly trying to solve this puzzle, William was obliged to give it up; but it reminded him that Mr. Curtis had asked him to try two experiments during his trip.

"He told me," said William, "that as soon as bodies in the car lost their weight he would like me to try to throw something from one side of the car to the other. He claimed that I should n't be able to throw an object a single inch.

"He said that up on the earth a very light object, such as a feather, cannot be thrown far, even by a very strong man; and the lighter the body, the less distance it can be thrown. Consequently, if a body had no weight at all, he claimed, it could n't be thrown any distance. He told me that if I tried to throw a ball or any other object, no matter how hard I tried, the ball would stick to my hand as if it were glued there, and that I should n't be able to get rid of it.

"I noticed that Dr. Giles laughed, but he too

told me that I ought to try the experiment; so, as I 've got my jack-knife in my pocket, I 'll have a try with that."

Our hero accordingly took his knife from his pocket, and, steadying himself by the handle of the lounge, he threw his cherished four-blader with all his force toward the top of the car.

CHAPTER XXV

SOME SINGULAR EXPERIMENTS

F Mr. Curtis had been in the car at that moment, especially if he had been in the direct path of the knife, he would have freely acknowledged the fallacy of his theory; for the knife, far from clinging to William's hand, as predicted, sped off like a shot to the ceiling, its velocity being much greater than it would have been if thrown from the surface of the earth with the same force. Bounding back from the cushions, it returned to our hero, who dexterously caught it and put it back in his pocket.

William laughed heartily at this result. "I guess there must be something wrong with Mr. Curtis's reasoning," he said, "though I hardly see where his mistake is. I know that on the earth a ball stuffed with wadding could be thrown only

a short distance, while a good heavy base-ball could be thrown out of sight. The same thing ought to be true here in the car, because here all objects are stuffed with wadding instead of with weight, so to speak; yet my knife flies around here better than it would up there. I can't understand it at all!"

After a moment's pause, our hero continued:

"If the knife had even a small amount of weight, I could understand why it is possible to throw it around; but I know that objects in the car have no weight at all, because I can stay up in mid-air if I want to, and this would be impossible if I had weight. Besides, among the instruments on the wall there is a spring balance with a pound weight in the pan. At the present moment the needle in the balance points to zero. This shows that the pound weight does n't pull on the spring at all, or, in other words, the same piece of iron which on the earth would weigh a pound has no longer any weight. Just for the fun of it, I weighed myself on the balance, too, but even *I* did n't weigh a single ounce. Consequently it 's certain that bodies in the car have now no weight, and that makes it hard to understand why that knife flew around so nicely."

At this juncture William remembered that there was a second experiment which Mr. Curtis had asked him to try.

"He said that as soon as I lost my weight I should no longer be able to smash anything. He said that even if I had the most delicate glass vase in the car, I could hit it with my fist, or stamp on it with all my force, and yet I could n't break it, because, of course, neither my hand nor foot would have any weight.

"I thought he was joking at first; but he explained that, on the earth, if we took a body without weight, or even a very light body like a feather, and threw it down with might and main on top of a delicate glass vase, the feather could not possibly break it. So he claimed that when bodies in the car lost their weight they would be lighter than the lightest feather, and said I could take a heavy piece of iron and throw it down with all my force on the most brittle vase, and yet I could n't smash it.

"I promised to try; but the only thing I see to experiment on is the tumbler that is hanging up by the water reservoir, and I don't want to run the risk of breaking that. Besides, I should n't like to have any broken glass flying around loose

in the car. Perhaps I may find something in the drawer of the table."

Acting on this idea, our hero opened the drawer; but the only object he found in it was a light wooden box containing various odds and ends. William decided that this box would answer his purpose, and ruthlessly dumped out the contents into the drawer. Then he placed the box beside him in the air, about a foot from the ground, and, supporting himself by one of the handles on the lounge, he drew back his foot and brought it forward with all his strength, giving the box a violent kick that shivered it into fragments and sent the pieces flying in all directions.

"Gracious!" exclaimed William, as he gazed at the flying fragments. "It 's mighty lucky I used the wooden box instead of the glass tumbler. Otherwise the car would now be full of flying pieces of broken glass that would n't make very pleasant traveling companions. I guess there 's something wrong about Mr. Curtis's mechanics, and I 'm glad there are no more of his experiments to try. They don't seem to turn out as expected."

William's studies in physics helped him to understand the reason for the two occurrences which had just puzzled him.

"I understand the whole thing now," he said, a light dawning on him. "I have been confusing *weight* with *mass.* The *weight* of bodies has nothing whatever to do with the question as to how far you can throw them, or the amount of damage they will do when thrown; it is their *mass* that decides this.

"Mass is the amount of matter a body contains, while weight is the force with which it is attracted to the earth. My mass here is just the same as it was on the earth, although my weight has entirely disappeared, and hence I can do as much damage with my hands and feet here as I could in my native land. The reason we can't throw a feather far on the earth, or smash a glass vase by throwing a feather at it, is not because the feather has little *weight,* but because it has almost no *mass;* that is to say, it contains very little matter."

These two experiments being satisfactorily terminated and explained, our hero now turned his attention to a third one which occurred to him, and that promised to afford no end of entertainment.

CHAPTER XXVI

A CURIOUS PROBLEM IN ATTRACTION

"AS the earth has no longer any attraction for bodies in the car," thought William, "or rather, as it can produce no change in their position in the car, it must follow that if there were any loose objects here they would be attracted toward me and follow me around wherever I went. The car itself would n't attract them, because, the car being almost spherical, the attraction would be the same on all sides, and so neutralize itself. The attraction of each side of the car is balanced by that of the opposite side, and the attraction of the floor balances that of the ceiling. It is true that the furniture on the floor would pull bodies downward, but the furniture on the ceiling would pull them upward to the same extent.

"Consequently, if there were a loose stone in the

center of the car, I should be the heaviest body to attract it, and it would accordingly fall to me, whether I were above it or below it, and it would follow me around wherever I went. If there were a whole cart-load of loose pebbles in the car, they would all come clustering about me like a hive of bees. There would be no possible way to escape them, for, wherever I went, they would be obliged to follow. What a glorious time I should have swimming about the car with such a procession after me!"

Our hero was perfectly correct in saying that, now that the earth's attraction no longer influenced the position of objects in the car, they would be free to follow the attraction of other bodies. He was also correct in saying that the attraction of the car itself would be neutralized, since it was practically the same on all sides. Sir Isaac Newton himself demonstrated that if the earth were a hollow shell it would exercise no attraction whatever on bodies in the interior. Hence if people lived inside of it, gravity would no longer exist for them, and they could fly about at will from one point to another.

These facts being admitted, the necessary consequence was that all loose objects in the interior

of the car would be attracted toward William. On this point there could be no dispute. But there was one little fact which he overlooked, and that oversight was enough to doom him to disappointment.

William had no pebbles in the car with which to try the experiment, but he had the jack-knife which has already been mentioned, and this would, of course, answer the purpose just as well.

Taking the knife from his pocket, he placed it in the air beside him, and then started to swim for the top of the car. When he reached the top, and turned around to look at the knife, he was overjoyed to find that it had disappeared.

"It is evidently following me," said he. But in this he was mistaken; for, looking more closely, he perceived the knife flying about through the air, but, far from coming toward him, it was going in almost the opposite direction.

"Gracious!" exclaimed our hero, after gazing at it for a few moments in open-mouthed astonishment. "What in the world can be the matter with that knife?"

Then the explanation slowly dawned on him. "I see," said he, laughing. "The wind I make in swimming blows the knife about as though it were a feather. It seems funny to think of blowing a

knife about through the air, but that 's certainly what I 've been doing. I 'll have to wait till the wind stops before I can expect my body to act as a magnet and attract the knife toward me."

William was right. It was indeed the wind made by his movements that blew the knife irregularly through the air; for after he had waited a few minutes, and the air became calm again, the knife slowly ceased its movements and came to a rest in mid-air.

"Now it 's going to fall toward me," muttered our hero, under his breath, remaining perfectly still to avoid causing new currents. But, to his surprise, although he waited quite a little while after the air had become still again, the knife remained in the identical spot where it had come to rest, about six feet away from him.

"I can't understand this at all," said William, considerably puzzled. "I 'm positively certain that, by the laws of physics, that knife ought to fall toward me. And yet it does n't. Of course I know that it won't fall toward me as fast as a knife usually falls to the ground, but it ought to fall toward me at some speed. The rule they taught us at school was that "the attraction of bodies is directly in proportion to their masses." That is to

say, if one body weighs twice as much as another (or, more properly speaking, if it contains twice as much matter as another) it will have twice the power of attraction.

"Now I weigh a great deal less than the earth does, and consequently the knife will fall toward me a great deal more slowly than it falls toward the earth. Ah, 'now goes me a light up!' as our German professor used to say. The earth must weigh over a trillion times as much as I do, and consequently, since it would take a second for the knife to fall sixteen feet on the earth, it would take—a trillion seconds for it to fall to me. Now a trillion seconds represent many thousands of years, so that if I want to wait until the knife is attracted to me, I shall have to stay in the same spot here for thousands upon thousands of years, and I 'm afraid I have n't the time to spare just at present."

William had hit the nail on the head this time, but he had greatly underestimated the time that would be required. The density of the earth is five and one half times that of water, and our planet, therefore, weighs five and one half times as much as a globe of water of the same size. The diameter of the earth being about eight thousand

miles, the weight, or rather the mass, of the earth is no less than thirteen octillion pounds!

13,000,000,000,000,000,000,000,000,000 pounds!

It is difficult to form any conception of this stupendous figure, but some idea of it will be obtained when we state that the earth weighed so much more than our hero that, since it would take a second for the knife to fall sixteen feet on the earth, it would take *billions* upon *billions* of years for it to fall even *one ten thousandth part of an inch* nearer to William!

To say that our hero was amazed at the result even of his inaccurate calculations would be to put the matter mildly. Like every other person who has had a smattering of physics, he was familiar with the fact that the attraction of bodies is proportional to their masses; but few persons stop to reflect how infinitesimal the attraction of a man really is in comparison to the attraction of the earth itself.

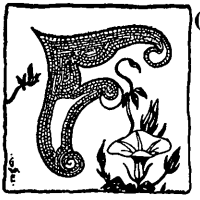
William, it must be confessed, was highly disappointed at this turn of affairs, for it would have been most amusing to swim around the car, with all the loose objects in it, solids as well as liquids, following around after him as a nail follows a magnet.

This being out of the question, he turned his thoughts to another matter. He had already noticed a reservoir of water fastened to the side of the car, and as his varied exercises had made him somewhat thirsty, he decided to climb up and help himself to a drink.

On the earth it would have been the simplest matter in the world to climb up to the reservoir by means of the straps, and draw off and drink a glass of water. But here in the car, where bodies had no weight, it was by no means so simple a matter as it seemed, and our hero was destined to a fresh series of experiences, more wonderful than any he had yet met with.

CHAPTER XXVII

A SUCCESSION OF SURPRISES



ORGETTING the doctor's admonition not to touch the side of the car, our hero started himself on his upward journey by giving a strong jerk on the strap by the side of the car—one of the same straps, in fact, by means of which he had climbed to the ceiling before the start.

But a strange surprise was in store for him; for, while by his pull upon the strap he sent himself traveling upward, the reaction pushed the car in the opposite direction, and it began slowly spinning around while our hero rose in the air.

William did not at first realize the true state of affairs. The idea that the car was turning did not at once occur to him, and he consequently imagined that the car was stationary, and that it was he himself who was spinning around. It was a

natural illusion, and it was only dispelled when he noticed, in passing one of the instruments that denoted the position of the car in the tube, that the cylinder which represented the car was now placed obliquely in the glass tube, and was slowly turning. Then the truth of the matter flashed upon him.

"Well, here 's something new," he remarked gleefully. "Not only can I spin myself around as I please, but I can also spin the car around, and make it revolve in any direction I wish."

As he said these words he reached the wall of the car, and the mere act of grasping the straps brought both him and the car to a stop.

"This does beat everything!" he exclaimed, highly pleased at the novel experience. "If I was like a fish in a basket before, I 'm now more like a squirrel in a rotary cage, and could keep the car spinning around all day by climbing around the inside! At present, however, I 'm not much in the humor for anything of the sort, especially as the car will present a slightly greater resistance to the air in the tube unless the point is kept perpendicularly downward. Besides, I 'm still thirsty, and I want to get that drink."

So saying, William, little dreaming what was in

store for him, quietly swam for the reservoir, and turned on the faucet; but, to his surprise, no water came out.

"H'm! this is pleasant," he said. "Dr. Giles must have forgotten to fill the reservoir."

Wishing to "make assurance doubly sure," he lifted off the cover, but in doing this left the faucet open, and also neglected to keep hold of the strap on the side of the car; and to these omissions he owed a new and rather disagreeable experience, for in his effort to lift off the lid he was obliged to use the side of the car as a point of resistance.

The consequence was that, when the cover did come off, the force of his exertions sent him flying through the air, still clutching the cover; and, as usual in his flights, he began spinning around, this time varying the monotony by turning his somersaults backward.

But this was not the worst of the matter, for, the faucet having been left open, the cover acted as a sort of piston, and sucked up all the water in the reservoir after it; and this water, accordingly, followed our hero in his strange flight, so that the poor boy was soaked through and through, while the water, by his violent movements, was scattered to all sides of the room as spray, and was either

absorbed by the cushions, or rebounded from the instruments and came flying back, some portions of the liquid remaining suspended in glittering drops in mid-air, as though supported by invisible spider-webs.

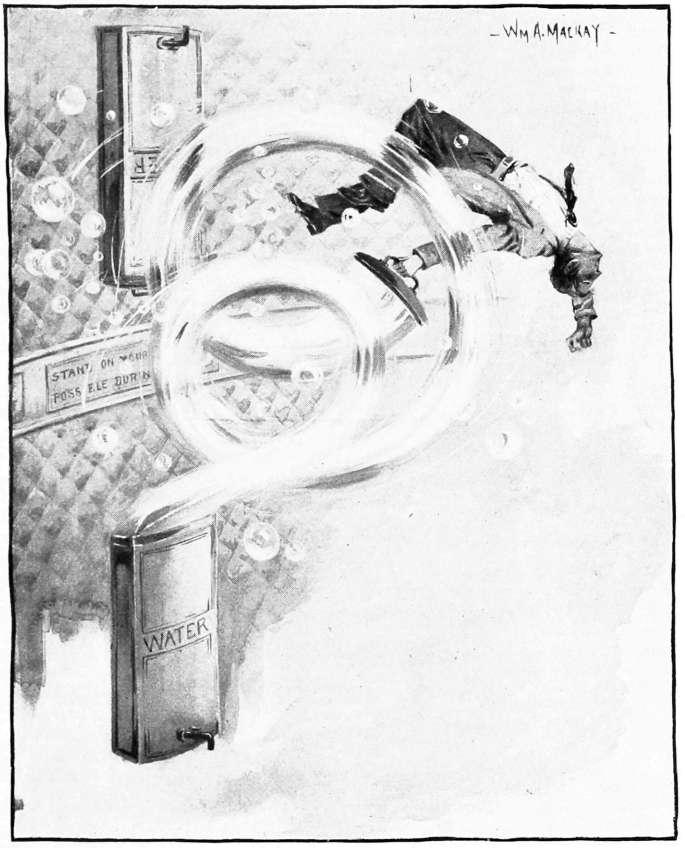
But this was not all. Blinded and spluttering from his unexpected shower-bath, William did not notice just where he was going, and went crashing against one of the delicate instruments on the side of the car, breaking it into fragments.

This last incident brought him to his senses, and hastily grasping one of the straps, he brought himself to a stop, and tried to regain his composure.

"I wish Mr. Curtis was here now," he said to himself, grimly. "If he could look at that broken instrument, I guess he 'd be satisfied that it does n't require weight to smash a glass globe.

"I see, too, what a fool I was when I set about getting that drink of water. I understand perfectly why it was the water did not run out of the faucet. The water, having no weight, could not, of course, be expected to run out. The law applies to liquids as well as to solids, that a body without weight will have no tendency to fall.

"I understand, also, how it was the water followed the cover of the reservoir and deluged me so



"THE FORCE OF HIS EXERTIONS SENT HIM FLYING THROUGH THE AIR."

completely. I left the faucet open, and there was accordingly a pressure on the water, from below, of fifteen pounds to the square inch. Consequently when I lifted up the cover a partial vacuum was formed, and the pressure from below pushed up the water after the cover in much the same manner that it would in a suction-pump. And as the vacuum continued as the cover moved along, the water would naturally tend to follow, having no weight to overcome, and its own inertia helping it."

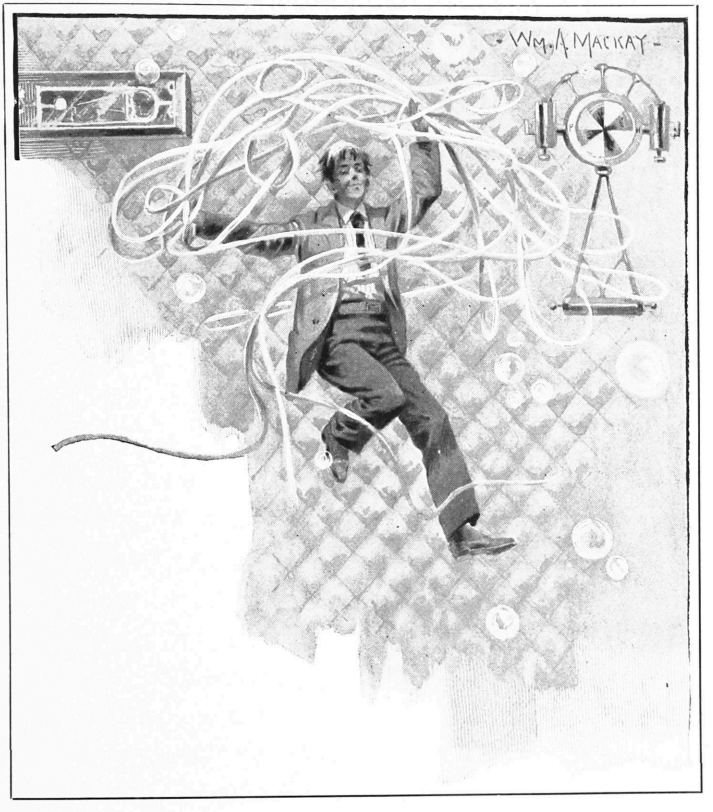
This explanation was all very satisfactory, but it did not tend to quench our hero's thirst. There was, of course, enough loose water suspended in the car to enable him to get a good drink, if he were willing to swim after it, and swallow a few drops here and a few drops there, frog-fashion; but he was not much tempted to try this experiment. He had noticed a second reservoir of water, fastened upside down in the car for the convenience of passengers traveling from the New York side, and he therefore set to work to obtain a drink from this. He had, however, learned a lesson by experience, and reflected carefully before acting.

"Even if I could fill a tumbler with water," said he, "I should n't be able to drink it, as the water

would n't run into my mouth. In fact, I 'm not sure that, even after I get it into my mouth, I shall be able to make it run down my throat. If that 's the case, then I 'll be truly in the position of the ancient mariner, with plenty of water all around, yet never a drop to drink. Even if that is not the case, I shall have no easy task in getting the water into my mouth; in fact, the only possible way to accomplish this, that I see, is to suck it from the faucet."

This was, in reality, the easiest method at his command, and he had soon refreshed himself, for he found not the slightest difficulty in making the water pass down his throat. The feat was, in fact, the same as is frequently performed by jugglers, who quaff a tumbler of water while standing on their heads.

But William's passion for experimenting had not left him, and after he had drunk his fill, he swam slowly back from the faucet, without turning off the flow of water. As he had previously opened a vent in the cover, the pressure of the air from above forced the water out through the faucet into the vacuum formed, and the liquid accordingly followed our hero slowly, in the form of a long rope dangling from his mouth.



"WILLIAM WAS ABLE, BY BEING VERY DELIBERATE AND CAREFUL IN HIS MOVEMENTS, TO TIE IT UP INTO VARIOUS KINDS OF KNOTS."

William was highly delighted to see this rope of water lying in mid-air; and he was able, by being very deliberate and careful in his movements, to tie it up into various kinds of knots, and to mold it into different shapes, his sculptural skill, however, being somewhat hindered by the fact that the water adhered considerably to his hands; but, on the whole, it was quite a novel experience.

Finally, when our hero tired of the sport, he wondered what to do with this water. By striking it in all directions it would, of course, be absorbed by the cushions, like the first lot; but he did not care to wet them any more than necessary, so he gathered up the mass of water in his hands, and slowly swam with it to the empty reservoir, and with considerable difficulty succeeded in putting it in and closing the cover again before it could escape.

It was really curious to be thus enabled to treat water almost as though it were a solid substance, the absence of weight rendering it so much easier for the mobile molecules to keep together!

Our hero's experiences with the water had proved so diverting that he now turned his attention to another experiment, which also promised to yield very amusing results.

CHAPTER XXVIII

THE MODERN SAMSON

N casting his eyes around the interior of the car, the sight of the furniture had suggested to our hero the idea that, now that bodies no longer possessed weight, he ought to be able to lift up a very heavy weight with no appreciable exertion.

"It seems to me," said he, "that I ought to be able to lift thousands upon thousands of pounds with my little finger. As bodies have no weight, it ought to require no force to lift them. I have already noticed that the furniture is all arranged so that it can be easily unfastened, and I think I shall experiment on that."

Acting on this idea, William accordingly unfastened all the furniture that was in the car, and, piling the articles one on top of the other, he tried to lift the entire pile with his little finger, being

careful, however, to first slip his foot under a strap at the bottom of the car—a necessary precaution to prevent him from rising with his load.

But the furniture would not budge.

"I guess I 'll have to use my whole hand," he said, somewhat discomfited. But even with his hand he was unable to move the pile.

This was a positive surprise to William. "I thought," said he, "that, now that bodies have no weight, I ought to be able to lift the heaviest objects without any exertion whatever."

Then he recollected what the doctor had told him about *mass*. "Ah," said he, "I think I see what the trouble is. If the furniture were up in the air I should indeed require no force to hold it there, since it has no weight—that is to say, no tendency to fall. But in order to raise it, it will be necessary to use a certain amount of force to overcome its inertia. A very little force will suffice, if I am willing to wait long enough, and I could, if I wished, raise all the furniture with my little finger; but it would take too long, so I shall use both hands."

Here, again, our hero's reasoning was perfectly correct, but it was based on the assumption that objects in the car possessed no weight at all, and

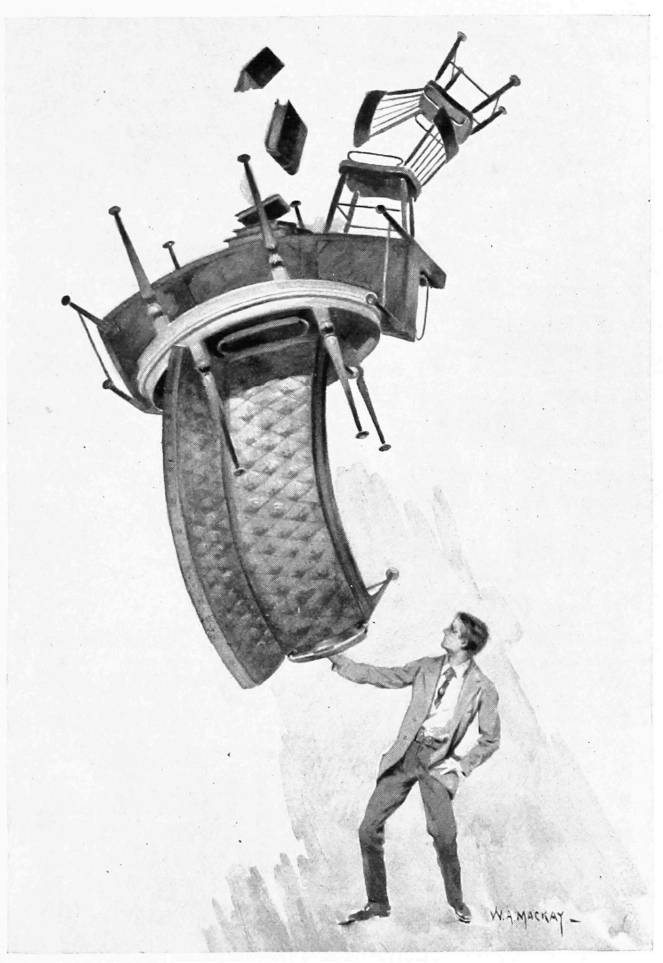
this assumption, as he was soon to learn, was erroneous; for, even with his two hands, William found it quite a task to raise the furniture. He, however, finally succeeded, and triumphantly held out this weight of several hundred pounds at arm's length.

"Here you are, ladies and gentlemen!" he cried. "Walk right up and view the modern Samson. I can lift anything you give me, and not half try! Walk right up! Admission, only five cents, or half a dime! Only a nickel, ladies and gentlemen! Walk right up!"

It was really quite amusing; but, to our hero's surprise, the objects, instead of being devoid of weight, exerted a very perceptible pressure on his hand.

Astonished at this, he gave the articles a strong upward push, and up they all went, pell-mell; but, curious to relate, instead of ascending to the ceiling, as William had confidently expected, the objects began to slowly fall again before they reached the top of the car.

"Well, I declare!" exclaimed our hero, hugely astonished. "If I had been obliged to figure out beforehand what was going to happen on this trip, I should never have been able to come anywhere



"HE HELD OUT THIS WEIGHT AT ARM'S LENGTH."

near the truth. The things that you feel sure are going to occur are those that don't take place, while the ones you don't think about are precisely those that do happen. And as soon as something does happen, and you think everything else is going to occur in the same way, then it changes and takes place in a different manner. All the laws of nature seem turned topsy-turvy in this car!"

Whatever the explanation, there was no doubt about the fact that bodies in the car now possessed a slight weight. William would not believe it until he had made several experiments. He began by placing his penknife beside him, and slowly, very slowly, it fell to the bottom of the car and stayed there. The furniture, too, did likewise. He lifted each article a slight distance from the floor, and yet it slowly but surely fell to the bottom again. To "make assurance double sure," he now did what he should have done at first, namely, he looked at the spring balance suspended in the car. The needle showed that the pound weight now weighed about half an ounce. As a final test, our hero suspended himself to the balance, and found he weighed about six pounds.

"There 's no longer the slightest doubt about

it," muttered William. "Everything in the car is now regaining its weight."

Then the doctor's words recurred to him, together with his explanation about the resistance of the air retarding the car, though not checking his own speed.

"I guess the doctor was right, as usual," said our hero; "but, whatever the reason, if bodies are going to get their weight again, the sooner I bring this furniture back to the top of the car, the better it will be. If I delay long it may become too heavy for me to carry up, and I don't want to have it loose in the car when we come to a stop on the New York side."

Accordingly, William, now no longer fearing to jump, bounded up to the ceiling with one of the lounges, and fastened it in place there. Then he let himself slowly fall to the floor, and jumped up again with one of the chairs, which he fastened securely in place. The table with the books came next; and then he occupied himself with restoring the remaining articles of furniture to their proper places at the bottom of the car.

These matters having been attended to, our hero gave a casual glance at the clock. It may be well to state here that this clock was not worked by a

pendulum, as a pendulum could not swing if deprived of its weight. In order to have a clock that would correctly keep the time in the novel conditions in which it was to be placed, the doctor had it arranged to be worked by a spiral spring, his clock being, in reality, nothing but a huge watch, the parts finished with the highest accuracy in order to insure its perfect working. When our hero looked up, the hands pointed to ten minutes past eleven.

"Ten minutes past eleven!" exclaimed William. "Is it possible that it is only ten minutes since I started? Why, I 've passed through so many curious experiences that the minutes seem like hours. Nevertheless, I ought very soon to be at the center of the earth. They taught us at school that a body falls sixteen feet the first second, forty-eight feet the next, eighty feet the third, and so on, falling thirty-two feet more each second. The distance to the center of the earth is about four thousand miles; so, as I have a pencil in my pocket, I can easily make the calculation. Let me see; why, it will only take me a little over nineteen minutes to finish the first half of my journey. In nine minutes more I ought to be at the very center of the earth."

He looked again at the telemeter; but, to his dismay, the needle was still far from the spot that would indicate the center.

A sudden fear came over our hero. "Something must be wrong!" he exclaimed in anguish. "I must calculate at once how far I ought to have fallen already, and compare it with the indications of the telemeter."

With feverish haste he jotted down the figures and performed the operations; but when he looked up again at the instrument a cry escaped him.

"I am lost!" he exclaimed in despair. "I am already one whole minute behind time! There must have been more air in the tube than the doctor calculated. One minute seems like a very small delay, and yet it is sufficient to keep me from arriving within six hundred miles of my destination. I shall never come anywhere near New York, but shall keep falling backward and forward in the tube until I finally come to a stop in the center; and there I may have to remain several days before the doctor can find some means of fishing me out—dead or alive!"

CHAPTER XXIX

A WEIGHTY SUBJECT

HERE was but one hope left, and this was that the telemeter might be wrong. But of this there was very little chance, as Dr. Giles had taken the greatest precautions to secure instruments that would be perfectly accurate. In fact, as it turned out in the sequel, the telemeter was correct to within a very small fraction of an inch.

But William did not know this at the time, and, in his anxiety to learn the truth at all costs, he glanced around at the different instruments in the car, and his attention was attracted to the spring balance already mentioned. To his surprise, the pound weight now exerted such a pull that the needle pointed to two ounces.

"What!" exclaimed William, in great astonishment. "Is it possible that objects in the car are

really regaining their weight? At the start the needle of this balance pointed to zero; the last time I looked at it, it pointed to only half an ounce; while now it shows two ounces. If this balance is correct, and one pound weighs two ounces, then every object in the car must have regained one eighth of its full weight, and I myself must now weigh twelve and one half pounds."

A careful watch on the instrument showed William that his surmise was correct; for the needle of the balance gradually turned more and more, showing that the heaviness of objects in the car was increasing every second.

Our hero was at first unable to account for this strange fact. The whole journey had been a perpetual succession of surprises, but here was one that seemed to promise more interest than anything which had yet transpired.

His astonishment will be readily understood. He was sufficiently well versed in physics to know that a body at rest near the center of the earth would have little or no weight. Consequently, even if the car were standing still, at the point which he had reached the objects it contained should have almost no weight. On the other hand, since the car was falling in obedience to the attrac-

tion of gravitation, as all the objects in the car were falling with precisely the same speed, they ought to weigh absolutely nothing during any part of the journey!

But it was now plainly manifest that bodies in the car did have weight, a weight equal to one eighth of what they possessed upon the earth, and this weight was steadily increasing every minute!

Here was indeed a puzzle. William that morning was firmly convinced that during his fall through the earth all bodies in the car would at the start have their normal weight, but that at the center of the earth none of them would weigh anything at all.

Yet, in practice, what had occurred? The very reverse of what he had imagined. At the start, none of the bodies in the car possessed any weight, while here, as he approached the center of the earth, they were in some mysterious manner rapidly regaining their heaviness.

Then he remembered the doctor's words, and the explanation came back to him like a flash. Evidently this resumption of weight was due to the presence of air in the tunnel. The doctor had not been able to remove all the air from the tube, and what little was left sufficed to retard the car

somewhat; and the greater the speed of the car, the more was it retarded by the resistance of the air.

"Ah, now I begin to understand," said William, thoughtfully. "The reason I had no weight before was because I fell just as fast as the car did, and so could never catch up with the bottom. But now that the speed of the car is checked by the resistance of the air in the tube, the bottom of the car is held back three or four feet every second; and as I am, of course, not held back at all, save by the trifling resistance of the air in the car, I am each second forced three or four feet nearer the bottom. And the faster we go, the more will the car be retarded, and the more I shall, consequently, weigh. As soon as the resistance is sufficient to retard the car thirty-two feet each second, I shall weigh just as much as I did upon the earth, namely, one hundred pounds. If the resistance becomes still greater, I shall weigh even more. When I reach the center of the earth, it is quite possible, as the resistance increases with the square of the velocity, that I may be falling at a sufficient speed for the car to be retarded one hundred and twenty-eight feet each second, in which case I should weigh *four hundred pounds!*

"Four hundred pounds! Just to think of it! I should be such a heavy, lead-like mass I could not stand upright, and would have the greatest difficulty even to drag myself around. I could scarcely move my hands or feet. Truly, I am in a veritable fairyland, and everything turns out just the opposite of what I expect. I would have sworn, this morning, that when the car started I should have my usual weight, and when it reached the center of the earth I should float around like a feather, without any weight. How has it turned out? Just the reverse! At the start I floated around like a feather, while at the center, far from floating around, I shall be an inert, lead-like lump, so heavy I can hardly move myself about! Surely, wonders will never cease!"

CHAPTER XXX

"DANGER!"

T really seemed as if William was correct in his surmise, for the weight of bodies in the car kept steadily increasing, and he could now jump from the floor to the ceiling without fear of rising too quickly. In fact, if the increase in weight continued at the same rate, it was evident that bodies in the car would have several times their normal weight before the center of the earth was reached.

Our hero was so fascinated by the idea that he was soon to weigh some four hundred pounds or so that he could not take his glance away from the spring balance for an instant, but watched it with feverish interest. Imagine his dismay, therefore, when, shortly after indicating a weight of four ounces, the needle on the dial began to move backward.

"Why, whatever can this mean?" exclaimed William, in fresh surprise. "Nothing here ever seems to happen the way I expect. Just as I had made up my mind to be the champion heavy-weight of the world, bodies begin to grow light again, and with no apparent cause. It is impossible that we can have already passed the center of the earth."

A glance at the telemeter confirmed this impression, for it showed that the car was still quite a distance from the center. What, then, could cause this diminution in the weight of bodies? Only one thing, namely, a decrease in the velocity of the car. But the speed of the car, instead of diminishing, ought to have been increasing every second.

"H'm!" exclaimed William, "here 's a fresh puzzle. Objects in the car now seem to be getting lighter and lighter, although I have n't yet passed the center of the earth. It would be a pity if four ounces to the pound were to be the greatest weight I shall have. I was beginning to think that my weight would keep on increasing until I weighed four or five hundred pounds and could n't drag myself about any longer."

There was only one small flaw in our hero's rea-

soning. He was right in believing that his weight would be greatest when he was traveling fastest, as the resistance of the air in the tube would then be greatest. He was also right in believing that, if there was no air in the tube, his speed would be greatest when he reached the center of the earth. What he overlooked was the fact that, while the increase in the speed of the car each second was now very small, the resistance offered by the air was considerable. In a word, although he had not yet passed the center, his speed was checked by the air more than it was increased by gravity, so that the car was gradually slowing up. He had passed the point at which objects would have their greatest weight, and from now on all bodies in the car would continue growing lighter and lighter.

"Ah, yes," said William, as he slowly realized the true state of affairs; "I begin to see now where I made my mistake. Under no circumstances could I have weighed more than I generally do on the earth, because, if the resistance in any one second had kept back the car more than thirty-two feet, my speed the next second would of course be less than before, since gravity, even when greatest, only increases my velocity thirty-two feet each second. And my speed being less, the resis-

"A WARNING SIGN APPEARED, BEARING IN LARGE BLACK LETTERS THE WORD 'DANGER!'"

tance of the air would be less also. There is no conceivable way in which I could obtain a weight of four or five hundred pounds, and I was a dunce to imagine such a thing possible!"

It seemed a pity to be deprived of the novel experience he had anticipated; but William soon consoled himself, and looked at the telemeter to see what progress he was making. The instrument indicated that the car was now only two hundred miles from the center of the earth, and was falling with the frightful velocity of six miles per second, its speed, however, decreasing every instant.

At this moment our hero was startled by the violent ringing of an electric bell fastened to one of the instruments, while at the same time a warning sign appeared, bearing in large black letters the word:

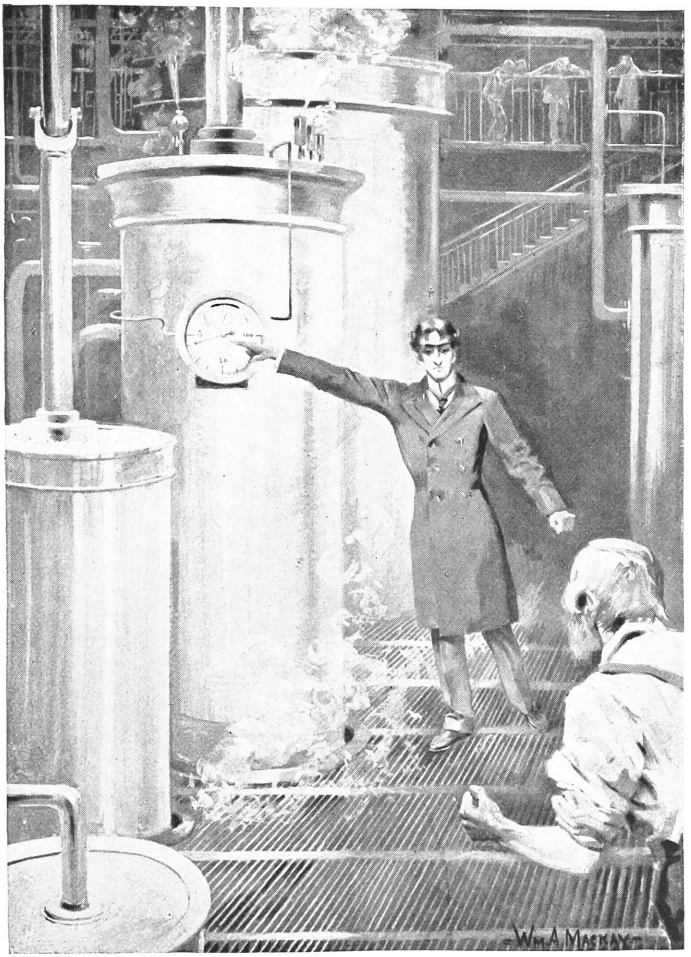
DANGER!

CHAPTER XXXI

IN WHICH DR. GILES RECEIVES A SHOCK

T the very moment when the warning of danger appeared to William in his car, a similar sign appeared in Dr. Giles's office, where that gentleman was closeted with Mr. Curtis and Flora. For some little time past the doctor had noticed with growing anxiety an abnormal fluctuation in the electrical current from the tube. Evidently something was the matter, but what could it be? In vain the doctor tried every conceivable remedy; the trouble increased, and finally the danger-signal itself appeared, warning him that matters had reached a crisis, since this signal was only set for a high amount of disturbance in the current.

The effect of this signal on the three spectators may be readily imagined; but on Flora Curtis it was especially potent. The poor girl buried her face in her hands, and burst out sobbing.



"FOR SOME LITTLE TIME PAST, THE DOCTOR HAD NOTICED WITH GROWING ANXIETY AN ABNORMAL FLUCTUATION."

"It 's all my fault!" she cried in anguish, the natural spirit of self-condemnation of her sex rising to the surface. "If it had n't been for me, you would never have let William go; so if he is killed, all the blame will rest upon me!"

"Nonsense," said the doctor, kindly. "You had nothing whatever to do with the matter, Flora. I had fully made up my mind to let William go before you spoke a word. Besides, matters are not so bad as they seem. If the danger can only be warded off for half an hour more, William will be in safety on the other side. Every instant we gain now is so much toward his salvation. Come, dry your eyes; for I shall need you to help me watch the instruments, and on the promptness of our actions everything may now depend.

Thus admonished, Flora quickly brushed away her tears, for in the hope of being of use to our hero she would have risked anything and dared anything. But as she turned to the instruments, a cry of alarm from the doctor caused her to look up.

At the same moment an ominous rumbling was borne to her ears, and closely following it came a more pronounced irregularity in the working of the electric conductors which served to keep the tube from melting.

Dr. Giles heard this rumbling too, and the whole truth flashed upon him in an instant. Something must have happened to the tube! The devices for converting the heat into electricity must in some way have become injured, and now refused to work properly.

The doctor's face blanched as he realized the full meaning of these signs.

Evidently, if the apparatus was out of order, the internal heat of the earth, having no longer a free outlet, would rapidly accumulate, producing such a temperature that the tube would melt; and what would then become of the brave boy who had dared this unknown danger for the sake of his mother?

With set faces, our three friends watched the instruments, when suddenly they were startled by a loud report like distant thunder, accompanied by a shock that set the whole office vibrating. Dr. Giles cast one agonized look at the instruments, and then fell back in his chair.

"William is lost!" he cried in anguish. "The carbonite tube has given way. The poor boy's death is certain; for I am absolutely powerless here, and can only stand idly by and let matters take their course!"

CHAPTER XXXII

THE CENTER OF THE EARTH

ET us now return to William and see how he is faring. At the same moment that the danger-signal appeared in the car, a microphone fastened to the wall began to work, and William, highly puzzled, rapidly made his way to the instrument. This microphone was so arranged that it received the sounds from outside, and transmitted them, greatly magnified, to the interior of the car.

Had there been a perfect vacuum in the tube, the instrument would, of course, have been useless, as sound cannot travel through empty space. But, fortunately, there was, as we have said, a certain amount of air left in the tunnel, so that sounds could be received from the metal walls of the carbonite tube. These sounds were, it is true, considerably weakened in intensity, but by means of

the microphone they were afterward increased to their normal volume.

Accordingly, when our hero put his ear to the instrument he could plainly hear all that was passing around him. He listened with an anxiety that may be readily conceived, and his face paled a little when through the instrument was borne to his ears an ominous rumbling and grumbling like the muttering of distant thunder. There was no mistaking the significance of that sound: it meant that some mighty internal commotion was taking place at the center of the earth, and that it portended danger to him. And as he listened the sound became louder and louder, until he seemed to be in the very midst of a battle, with heavy pieces of artillery thundering on all sides.

To depict our hero's feelings as he listened to these ominous sounds would not be easy. A hundred conflicting thoughts rushed through his mind; but he felt the need of prompt decision, and resolved above all things that he must reach the walls of the car in order to be ready for action when the time came.

"If I only had Dr. Giles here to advise me what to do," he exclaimed, "there might be some hope left; but thrown as I am entirely upon my own

resources, and not even knowing just what the danger is that threatens me, I 'm a goner, sure!"

As he said these words his eyes happened to fall on the telemeter, and to his surprise he found that he was now only twelve miles from the center of the earth—that spot so long a mystery to the human race; and the instrument showed him, moreover, that in two seconds more he would be at the exact center.

The clock pointed to twenty-one minutes past eleven. It had taken him only twenty-one minutes to fall to the center of the earth!

"Tick-tack, tick-tack," went the chronometer; and as the two seconds sped, the needle of the telemeter descended until it pointed exactly to the center of the earth. But at this instant our hero felt a terrific shock, and was hurled violently upward against the top of the car!

CHAPTER XXXIII

WHAT WILLIAM SAW FROM THE WINDOW

HAT in the world could have happened? William had reached the stage now where he was ready to accept anything as a matter of course. He had just passed through so many strange experiences, each more wonderful than the last, that he would hardly have been surprised if Aladdin's genie had appeared to him and asked his commands.

His natural good sense, however, soon reacted against these impressions, for he knew that all the astonishing manifestations which he had met with must be due to natural causes. But what natural cause could explain the danger-signal which had reached him, or the violent shock which he had just experienced?

He saw only two ways in which a shock might reach him in the car; the first was the necessary

jolt when his car stopped at New York, and the second a possible shock if the car struck the side of the carbonite tube.

But the telemeter plainly indicated that the car was at the center of the earth, or four thousand miles away from New York, while other instruments showed that the car occupied a central position in the tube, being no nearer one side than another. Hence neither of the two hypotheses seemed tenable.

These thoughts flashed through William's mind in an instant, as he clung to the straps at the top of the car, which he had managed to clutch after being thrown to the ceiling. Determined to ascertain the truth at all costs, he rapidly made his way to the window at the top of the car, and threw open the metal shutter that guarded the glass pane, his action serving at the same time to automatically turn on a search-light designed to illuminate the tube.

What a sight met his eyes! There, directly above him,—or, more properly speaking, below him, since he had now passed the center of the earth,—he beheld a most startling sight. The carbonite tube was red-hot, and was evidently yielding to a pressure from without! Even as he gazed it

gave way with a crash, and a column of molten matter issued forth into the tube!

But William's surprises were not at an end, for, closing his eyes with a shudder to escape the sight of the dreadful death impending, what was his astonishment, on opening them again, to see that the stream of fire, instead of approaching him, seemed to be going in the opposite direction, and was now farther away from him than it had been a moment before.

He was not long in realizing the true state of affairs.

"It 's no wonder," said he, "the molten matter seems to be going the other way, for I am falling so fast now—nearly six miles every second—that nothing can catch up with me. But, unfortunately, my speed is continually slacking up, as I have passed the center of attraction, while the liquid mass of fire will probably keep on just as fast as it is going at present; so it will sooner or later catch up with me, especially when the car comes to a stop six hundred miles from the surface of the earth, and begins to fall back again.

"I 'm a gone coon, whatever happens! However, I 'll fight for my life as long as possible; and that reminds me that the signs mentioned some-

"IT GAVE WAY WITH A CRASH, AND A COLUMN OF MOLTEN MATTER ISSUED FORTH INTO THE TUBE!"

thing about what to do in case of danger. I guess I 'd better go down and see what they said."

But as he swam down toward the floor his mind was busy in trying to account for the strange shock he had received at the center of the earth.

"The only possible explanation I can see," said William, "is that there must have been something in the tube in front of the car, because the shock threw me upward toward the ceiling. And now that I come to think of it, I see that the trouble must have been caused by some large stone that fell into the tube and remained at the center of the earth. It must have been a pretty big one, though, to give me such a shock as that!"

Our hero did not stop to reflect that he was traveling at such a frightful speed that, had it really been a stone that he had struck, the shock would have smashed the car to atoms.

What is known in physics as the *living force* of a body is equal to its mass times the square of its velocity. Consequently, if the car had struck even a small stone, the stone would in all probability have passed through it like a bullet. Hence in the present case the chances were that the shock experienced was due to the presence of some very light particles of matter that had accumulated at

the center of the earth—some dust remaining in the tube. With all the doctor's ingenuity and care, he could not avoid leaving some particles of matter in the tube, and it was evidently these particles which caused the whole trouble.

While seeking to discover the cause of the shock William's attention was somewhat diverted from his perilous situation; but having, as he thought, found the true solution, he dismissed the matter from his mind, and prepared to cope with the difficulties which he felt were in store for him. With a renewed sense of his danger, he anxiously looked at the telemeter.

One glance was sufficient to show him that the speed of the car was decreasing rapidly, and it at once flashed upon him that the molten matter must be gaining upon him. To satisfy himself on this point, he again opened the shutter at the top of the car, and looked out; but, to his intense relief, the molten matter that was following him in the tube had now dwindled down to a mere speck of light.

For a few moments he remained at the window, absorbed in his own thoughts. It was comforting to know that there was no immediate danger, for while there 's life there 's always hope, and so long as the car was gaining on the molten matter

he could well afford to forget the precariousness of his position.

His fears somewhat allayed in regard to his present danger, our hero swam to a window at the side of the car to see if the tube there showed any signs of giving way. He did not stop to reflect on the doctor's admonition, but threw open the shutter and looked out at the tube.

He gave but a single glance, and then, with a cry of pain, he clapped his hand over his eyes; for he was now falling with such frightful rapidity that the light of the car, reflected from the walls of the tube, almost blinded him.

He hastily closed the shutter again, and after waiting a few minutes to compose himself, he swam again to the top of the car, and gazed up the tube. But what was his consternation to notice that the speck of fire was gradually growing larger! The molten matter was evidently gaining on him!

CHAPTER XXXIV

A RACE FOR LIFE

UR hero glanced hurriedly at the telemeter and then at the clock. The latter indicated twenty-five minutes to twelve.

"Good gracious!" he exclaimed, "I must have made a mistake somewhere in my calculations. Let me see!" And he hurriedly went over his figures. But now a light dawned on him.

"I am saved!" he shouted. "I forgot that it was only *above* the earth that the velocity of a falling body increases thirty-two feet every second. As it approaches the center of the earth the increase gradually diminishes until it finally becomes nothing at all.

"Consequently, when I calculated that it would take me only thirty-nine minutes to go through the earth I was wrong. It would really take a

trifle longer than this. I am saved! Hurrah! Instead of stopping six hundred miles short of my destination, and falling back to be roasted alive, I may yet reach the New York side safely, if I can only keep ahead of this liquid fire for a few minutes more!"

Curiously enough, now that the danger had diminished the anxiety of our hero had increased. The reason was that, before, hope seemed altogether out of the question, while now there was a small chance of escape.

It was a race for life or death, and our hero did not leave the window for an instant. To his dismay, the liquid mass of fire came every minute nearer, while the telemeter, on the contrary, showed that the car's speed was decreasing every second.

Six minutes of dread suspense had passed in this manner when a phonographic alarm fastened to the side of the car began to speak in loud metallic tones.

"In one minute more," it said, "you will arrive in port. Lie down on the sofa that is fastened to the ceiling, and grasp the handles tightly. You will thus avoid all shock when the car comes to a stop."

But William had other things to think of just then than the means of preventing the slight shock that would occur on his arrival at the New York

end of the tube; for the words on the cushion had recurred to him: "In case of danger, turn on the cold!"

These words, at which he had previously scoffed, now proved an inspiration. If the molten matter caught up with him, he could hope to save his life only by producing a very low temperature in the metallic shell of the car.

He accordingly swam down to a tank containing the refrigerating agents, and pressed the releasing device. An intense cold was distributed over the outside surface of the car, a cold so intense that our hero, in spite of the protection afforded by the non-conducting walls of the car, was chilled to the marrow, and hastily turned on the artificial heat inside.

Then he started to swim for the sofa; but he was too late, for a sudden click showed him that he had arrived in port, while at the same moment he was thrown down to what had formerly been the bottom of the car, and then fell heavily to the top (now really the bottom, since it was the end nearest the center of the earth), bruising himself somewhat in his fall, notwithstanding the elasticity of the cushions.

He had not yet, however, reached the surface of

the earth, for the telemeter showed him that he was still two miles underground.

"This is just as I expected!" exclaimed William; "for although Dr. Giles did his best to get all the air out of the tube, he was not able to make a perfect vacuum, and what little air was left has sufficed to retard the car somewhat, and so prevent it from going the whole distance. In fact, it is surprising that the vacuum was even so perfect as it has been. I did not expect to come within twenty miles of the surface on the New York side.

"It is true that my greatest loss of speed was only eight feet per second, since objects in the car, even when heaviest, weighed only four ounces to the pound, so I could easily have calculated that my total retardation would be about two miles. At any rate, I have beaten the record for rapid traveling, for I have gone eight thousand miles in a little over forty-two minutes, and that is a figure that will not be beaten in a hurry!"

Scarcely were these words well out of his mouth when he felt another shock, and perceived that the car was in motion again.

A sudden fear arose in his mind. "That must be the shock of the molten matter!" he cried. "It must have caught up with me!"

Instinctively he tried to swim up through the air to get as far away from this matter as possible; but he was not able to lift himself an inch. Then he tried to jump up to what was now the top of the car, but was not more successful in this, for he rose only a couple of feet, and then fell back again.

"What a dunce I am!" he exclaimed. "Of course I can't jump or swim around any more, now that I am no longer falling. I have reached *terra firma* again, and have regained my entire weight, so I must return to primitive methods, and climb up by the straps. No fear now of setting the car spinning!"

This was true, for the car was being rapidly drawn up the last part of its journey by means of an electrically actuated cable.

A few minutes later our hero felt another shock, and the door of the car was hurriedly thrown open, when he found himself face to face with a workman.

It was not, however, at the workman that William looked, but at the sky. To his surprise, it was night-time, and the stars were shining brightly in the heavens. Our hero rubbed his eyes in bewilderment; but rub as he might, the stars

continued twinkling, and the bright moon looked down at him as if laughing at his stupefaction.

But if our hero was astonished to find it was night-time, his feelings may be imagined when, on emerging from the car, he found that the islet was covered with several inches of snow, which sparkled in the moonlight as though it, too, participated in the enjoyment at our hero's surprise.

And well might William rub his eyes, and well might he feel bewildered and imagine that some elf was playing its tricks upon him. He had left Australia at eleven o'clock in the morning, and his trip seemed to have lasted but fifty minutes; yet it was night-time when he reached the United States! He had left Australia on a sultry midsummer's day, with the thermometer at 100° in the shade; yet he arrived in the United States in midwinter, the ground being covered with several inches of snow!

Truly our hero might well be forgiven for believing himself suddenly transported back into the days of the fairies.

CHAPTER XXXV

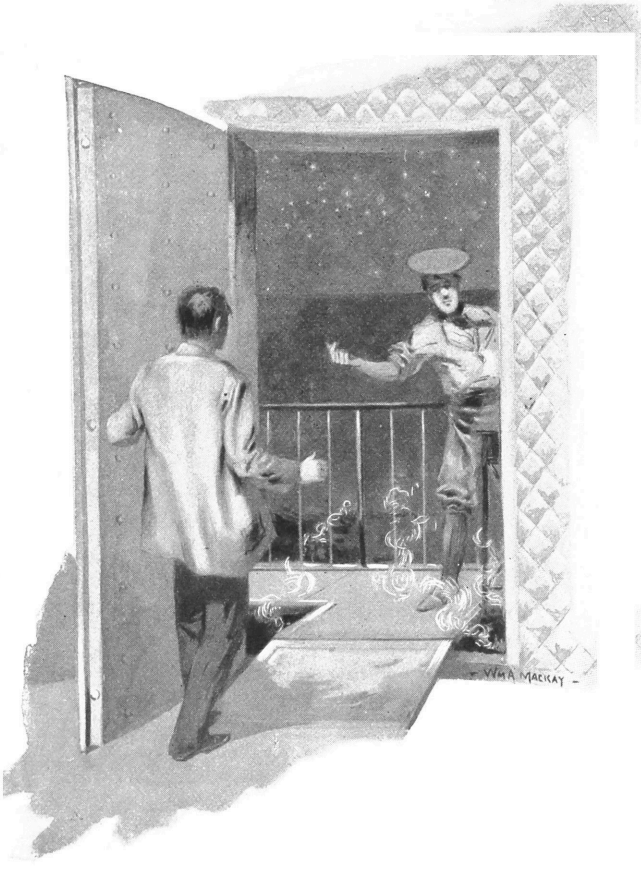
THE YESTERDAY THAT DAWNED AGAIN

"  AKE haste," said the workman, shaking our hero somewhat roughly, to bring him back to the consciousness of the present danger. "Follow me, or the liquid fire will be upon us before we can reach a place of safety."

"But—" said William.

"No 'buts'; you will have plenty of time to talk after we are safely settled in the submarine boat."

The man was right; there was not a moment to lose; for before the boat had gone a couple of miles the expected catastrophe happened. The molten matter in the tube, launched forth by the enormous pressures in mid-earth, flew up to a great height, while the hissing of the mass of fire as it fell into the water warned our friends that their boat would do well to seek a greater depth.



"'MAKE HASTE,' SAID THE WORKMAN. 'FOLLOW ME.'"

When the danger was over William turned to his companion.

"Excuse me," said he, "but I really don't know whether I am awake or dreaming. The events that have passed are so unnatural that I feel somewhat like Rip Van Winkle, and should not be surprised to learn that what have seemed to me to be minutes have really been years. Can you tell me, first, what time it is?"

"It is nearly midnight," replied the man.

"Midnight!" repeated our hero, astounded. "Why, it seems to me barely an hour since I started this morning." Then a new idea struck him. "What day is it, may I ask?"

"January the 5th," replied the man.

"January the 5th!" exclaimed William, aghast. "Why, then I have been gone a whole year! I started on January 6!"

But his fears were now thoroughly aroused.

"In what year are we?" he demanded eagerly.

"Why, 1993, of course," replied the man, gazing at him in astonishment. "It seems a strange question to ask."

"January 5, 1993!" repeated William. "Come, you are joking with me. At midnight on January 5, 1993, I was sleeping on one of the benches in

an Australian park. I sha'n't forget the date in a hurry; it 's marked in my memory with the blackest of black inks."

"You forget," said the man, "that, as you have come from Australia, you have gained twelve hours. You have traveled faster than the sun, and have consequently arrived here eleven hours *before* you started from the other side. You are now having yesterday over again."

"But how about that snow?" said William. "When I left Australia it was during a sweltering hot summer's day, and when I arrived here the ground was covered with snow. How do you explain that?"

"Simply enough. You must remember that, Australia being below the equator, there is a difference of six months between the seasons here and there. You have your summer while we have our winter, and *vice versa.* January 5, which comes during your hottest summer weather, is with us the period of snow and blizzards, and you might well have arrived in a regular northeaster."

It was exactly true. William had left the Australian side at eleven o'clock on the morning of January 6, and had arrived at the New York end of the tube at about twelve o'clock of the night

before! He had left Australia on a sultry summer's day, and had reached the United States in the depths of winter! Of all the wonderful events of his most extraordinary trip, this was perhaps the most marvelous, and he could hardly recover from his surprise.

At this juncture the boat, which was now sailing on the surface of the ocean, was hailed by another, which soon came alongside, and a young man stepped on board:

"Is this Mr. William Swindon?" he asked.

"Yes, sir; that 's my name," said William.

"Well, I am the representative of the Universal Press Association, central branch, New York city. I should like a full account of your trip for the morning papers, and will pay you a hundred thousand dollars cash for the exclusive right to use it in every country on the face of the globe. Will you consent?"

Would he consent! William felt that, though his trip was ended, his surprising adventures had only begun, and this last stroke of fortune completely unnerved him.

THE rest of our story is soon told. Our hero, after sending the tale of his adventures to the

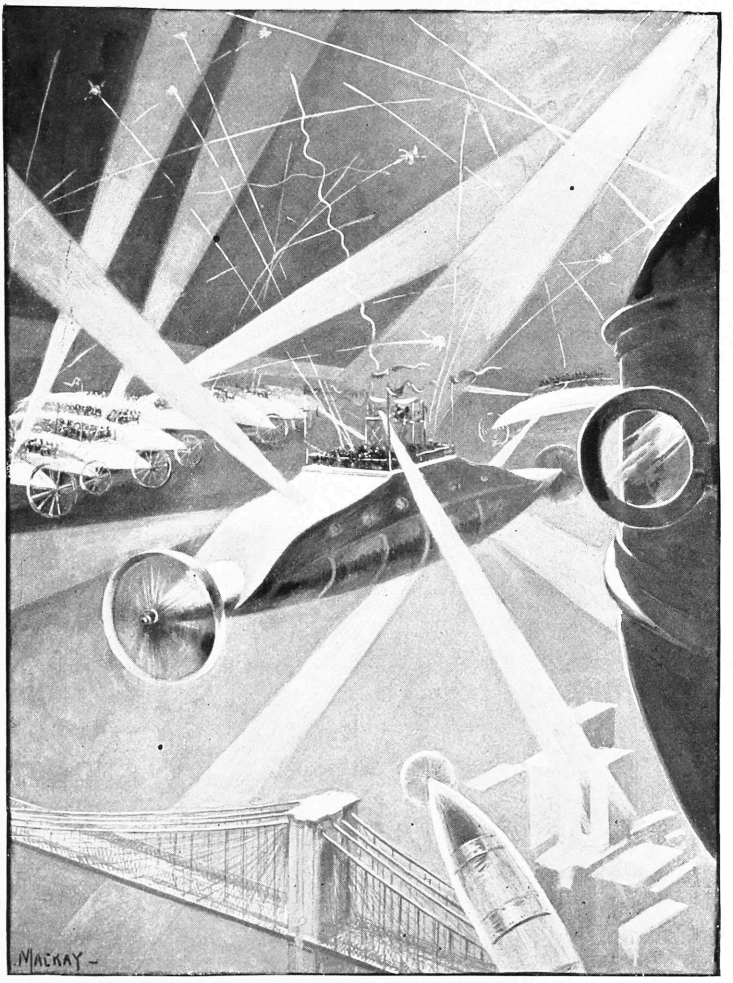
papers, telephoned to his mother and friends to let them know he was safe, and then leisurely made his way home, stopping at all the interesting countries on his long journey.

Wherever William went he was hailed as a hero. Magnificent pageants of air-ships bearing wonderful electric lights were arranged in honor of the intrepid youth who had dared to make the first journey through the earth. In a word, he was everywhere received with ovations that might well have turned the head of a less sensible lad.

An hour had sufficed to make the trip going, but it took him over a month to return. He was rich now, and neither he nor his mother need ever fear want again. Dr. Giles received him with open arms, and Flora fairly beamed with delight as she listened to the tale of his curious adventures.

The account of our hero's trip was published far and wide, and the celebrity thus obtained brought him numerous demands for contributions from the various magazines of the day, and thus led him to take up writing as a vocation, a field in which he achieved a high degree of success.

As for the transportation company Dr. Giles had organized, I regret to say that it was dissolved, as the dangers from the central heat of the earth



"MAGNIFICENT PAGEANTS OF AIR-SHIPS BEARING WONDERFUL ELECTRIC LIGHTS WERE ARRANGED IN HONOR OF THE INTREPID YOUTH."

were found to be too great to be risked with impunity.

Mr. Curtis was jubilant, and repeated "I told you so" a dozen times a day, as though it were better for humanity that he should have been in the right than that a great improvement in the methods of transportation should have been effected. But Dr. Giles readily forgave him, for he could not help remembering that, had it not been for this gentleman's timely warning in regard to the centrifugal force of the earth, William would certainly have paid the penalty of the oversight with his life.

Dr. Giles regretted the failure of his enterprise deeply; but as for the stock-holders, it is pleasant to be able to say that they lost nothing, as the returns from the electrical power they had furnished to different cities during the five years in which the construction of the tube was in progress not only paid for all the capital sunk in the enterprise, but left a handsome margin of profit besides.

EPILOGUE

HE following wedding announcement, which appeared in the New York "Herald" for June 5, 1999, is given here in full, as it will probably interest all who have read the story of our hero's extraordinary adventures.

The marriage of Miss Flora Curtis to Mr. William Swindon took place yesterday evening, at the home of the bride's father. Relatives and a few intimate friends were invited to attend the ceremony, and an informal reception followed.

The bride was attired in a handsome gown of white silk trimmed with duchess lace, and a tulle veil, caught up with orange blossoms and a diamond pin of beautiful design, a present from Dr. Joshua Giles, the well-known scientist.

Mr. William Swindon is known the world over for his astonishing trip through the earth. His literary work has also attracted great attention, and has earned for its author a well-deserved fame.

The young couple, after their honeymoon, propose to come to the United States, where Mr. Swindon intends to take up his residence. Let us hope, in the words of the good old fairy-tales, that the bride and groom will "live happily together ever afterward."