A ROMANCE OF THE FUTURE
A JOURNEY IN OTHER WORLDS

By John Jacob Aator

PREFACE.

The protracted struggle between science and the classics appears to be drawing to a close, with victory about to perch on the banner of science, as a perusal of almost any university or college catalogue shows. While a limited knowledge of both Greek and Latin is important for the correct use of our own language, the amount till recently required, in my judgment, has been absurdly out of proportion to the intrinsic value of these branches, or perhaps more correctly roots, of study. The classics have been thoroughly and painfully threshed out, and it seems impossible that anything new can be unearthed. We may equal the performances of the past, but there is no opportunity to surpass them or produce anything original. Even the much-vaunted "mental training" argument is beginning to pall; for would not anything equally difficult give as good developing results, while by learning a live matter we kill two birds with one stone? There can be no question that there are many forces and influences in Nature whose existence we as yet little more than suspect. How much more interesting it would be if, instead of reiterating our past achievements, the magazines and literature of the period should devote their consideration to what we do NOT know! It is only through investigation and research that inventions come; we may not find what we are in search of, but may discover something of perhaps greater moment. It is probable that the principal glories of the future will be found in as yet but little trodden paths, and as Prof. Cortlandt justly says at the close of his history, "Next to religion, we have most to hope from science."

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INCLUDING NINE DRAWINGS BY MR. DAN. BEARD,
AND A DIAGRAM.

BOOK I.

A JOURNEY IN OTHER WORLDS.

CHAPTER 1.

JUPITER.

Jupiter--the magnificent planet with a diameter of 86,500 miles, having 119 times the surface and 1,300 times the volume of the earth--lay beneath them.

They had often seen it in the terrestrial sky, emitting its strong, steady ray, and had thought of that far-away planet, about which till recently so little had been known, and a burning desire had possessed them to go to it and explore its mysteries. Now, thanks to APERGY, the force whose existence the ancients suspected, but of which they knew so little, all things were possible.

Ayrault manipulated the silk-covered glass handles, and the Callisto moved on slowly in comparison with its recent speed, and all remained glued to their telescopes as they peered through the rushing clouds, now forming and now dissolving before their eyes. What transports of delight, what ecstatic bliss, was theirs! Men had discovered and mastered the secret of apergy, and now, "little lower than the angels," they could soar through space, leaving even planets and comets behind.

"Is it not strange," said Dr. Cortlandt, "that though it has been known for over a century that bodies charged with unlike electricities attract one another, and those charged with like repel, no one thought of utilizing the counterpart of gravitation? In the nineteenth century, savants and Indian jugglers performed experiments with their disciples and masses of inert matter, by causing them to remain without visible support

at some distance from the ground; and while many of these, of course, were quacks, some were on the right track, though they did not push their research."

President Bearwarden and Ayrault assented. They were steering for an apparently hard part of the planet's surface, about a degree and a half north of its equator.

"Since Jupiter's axis is almost at right angles to the plane of its orbit," said the doctor, "being inclined only about one degree and a half, instead of twenty-three and a half, as was the earth's till nearly so recently, it will be possible for us to have any climate we wish, from constantly warm at the equator to constantly cool or cold as we approach the poles, without being troubled by extremes of winter and summer."

Until the Callisto entered the planet's atmosphere, its five moons appeared like silver shields against the black sky, but now things were looking more terrestrial, and they began to feel at home. Bearwarden put down his note-book, and Ayrault returned a photograph to his pocket, while all three gazed at their new abode. Beneath them was a vast continent variegated by chains of lakes and rivers stretching away in all directions except toward the equator, where lay a placid ocean as far as their telescopes could pierce. To the eastward were towering and massive mountains, and along the southern border of the continent smoking volcanoes, while toward the west they saw forests, gently rolling plains, and table-lands that would have satisfied a poet or set an agriculturist's heart at rest. "How I should like to mine those hills for copper, or drain the swamps to the south!" exclaimed Col. Bearwarden. "The Lake Superior mines and the reclamation of the Florida Everglades would be nothing to this."

"Any inhabitants we may find here have so much land at their disposal that they will not need to drain swamps on account of pressure of population for some time," put in the doctor.

"I hope we may find some four-legged inhabitants," said Ayrault, thinking of their explosive magazine rifles. "If Jupiter is passing through its Jurassic or Mesozoic period, there must be any amount of some kind of game." Just then a quiver shook the Callisto, and glancing to the right they noticed one of the volcanoes in violent eruption. Smoke filled the air in clouds, hot stones and then floods of lava poured from the crater, while even the walls of the hermetically sealed Callisto could not arrest the thunderous crashes that made the interior of the car resound.

"Had we not better move on?" said Bearwarden, and accordingly they went toward the woods they had first seen. Finding a firm

strip of land between the forest and an arm of the sea, they gently grounded the Callisto, and not being altogether sure how the atmosphere of their new abode would suit terrestrial lungs, or what its pressure to the square inch might be, they cautiously opened a port-hole a crack, retaining their hold upon it with its screw. Instantly there was a rush and a whistling sound as of escaping steam, while in a few moments their barometer stood at thirty-six inches, whereupon they closed the opening.

"I fancy," said Dr. Cortlandt, "we had better wait now till we become accustomed to this pressure. I do not believe it will go much higher, for the window made but little resistance when we shut it."

Finding they were not inconvenienced by a pressure but little greater than that of a deep coal-mine, they again opened the port, whereupon their barometer showed a further rise to forty-two, and then remained stationary. Finding also that the chemical composition of the air suited them, and that they had no difficulty in breathing, the pressure being the same as that sustained by a diver in fourteen feet of water, they opened a door and emerged. They knew fairly well what to expect, and were not disturbed by their new conditions. Though they had apparently gained a good deal in weight as a result of their ethereal journey, this did not incommode them; for though Jupiter's volume is thirteen hundred times that of the earth, on account of its lesser specific gravity, it has but three hundred times the mass--i. e., it would weigh but three hundred times as much. Further, although a cubic foot of water or anything else weighs 2.5 as much as on earth, objects near the equator, on account of Jupiter's rapid rotation, weigh one fifth less than they do at the poles, by reason of the centrifugal force. Influenced by this fact, and also because they were 483,000,000 miles from the sun, instead of 92,000,000 as on earth, they had steered for the northern limit of Jupiter's tropics. And, in addition to this, they could easily apply the apergetic power in any degree to themselves when beyond the limits of the Callisto, and so be attracted to any extent, from twice the pull they receive from gravitation on earth to almost nothing.

Bearwarden and Ayrault shouldered their rifles, while Dr. Cortlandt took a repeating shot-gun with No. 4 shot, and, having also some hunting-knives and a sextant, all three set out in a northwesterly direction. The ground was rather soft, and a warm vapor seemed to rise from it. To the east the sky was veiled by dense clouds of smoke from the towering volcanoes, while on their left the forest seemed to extend without limit. Clumps of huge ferns were scattered about, and the ground was covered with curious tracks.

"Jupiter is evidently passing through a Carboniferous or Devonian period such as existed on earth, though, if consistent with its size, it should be on a vastly larger scale," said the doctor. "I never believed in the theory," he continued, "that the larger the planet the smaller should be its inhabitants, and always considered it a makeshift, put forward in the absence of definite knowledge, the idea being apparently that the weight of very large creatures would be too great for their strength. Of the fact that mastodons and creatures far larger than any now living on earth existed there, we have absolute proof, though gravitation must have been practically the same then as now."

Just here they came upon a number of huge bones, evidently the remains of some saurian, and many times the size of a grown crocodile. On passing a growth of most luxuriant vegetation, they saw a half-dozen sacklike objects, and drawing nearer noticed that the tops began to swell, and at the same time became lighter in colour. Just as the doctor was about to investigate one of them with his duck-shot, the enormously inflated tops of the creatures collapsed with a loud report, and the entire group soared away. When about to alight, forty yards off, they distended membranous folds in the manner of wings, which checked their descent, and on touching the ground remained where they were without rebound.

"We expected to find all kinds of reptiles and birds," exclaimed the doctor. "But I do not know how we should class those creatures. They seem to have pneumatic feet and legs, for their motion was certainly not produced like that of frogs."

When the party came up with them the heads again began to swell.

"I will perforate the air-chamber of one," said Col. Bearwarden, withdrawing the explosive cartridge from the barrel of his rifle and substituting one with a solid ball. "This will doubtless disable one so that we can examine it."

Just as they were about to rise, he shot the largest through the neck. All but the wounded one, soared off, while Bearwarden, Ayrault, and Cortlandt approached to examine it more closely.

"You see," said Cortlandt, "this vertebrate--for that is as definitely as we can yet describe it--forces a great pressure of air into its head and neck, which, by the action of valves, it must allow to rush into its very rudimentary lower extremities, distending them with such violence that the body is shot upward and forward. You may have noticed the tightly inflated portion underneath as they left the ground."

While speaking he had moved rather near, when suddenly a

partially concealed mouth opened, showing the unmistakable tongue and fangs of a serpent. It emitted a hissing sound, and the small eyes gleamed maliciously.

"Do you believe it is a poisonous species?" asked Ayrault.

"I suspect it is," replied the doctor; "for, though it is doubtless able to leap with great accuracy upon its prey, we saw it took some time to recharge the upper air-chamber, so that, were it not armed with poison glands, it would fall an easy victim to its more powerful and swifter contemporaries, and would soon become extinct."

"As it will be unable to spring for some time," said Bearwarden, "we might as well save it the disappointment of trying," and, snapping the used shell from his rifle, he fired an explosive ball into the reptile, whereupon about half the body disappeared, while a sickening odour arose. Although the sun was still far above the horizon, the rapidity with which it was descending showed that the short night of less than five hours would soon be upon them; and though short it might be very dark, for they were in the tropics, and the sun, going down perpendicularly, must also pass completely around the globe, instead of, as in northern latitudes on earth in summer, approaching the horizon obliquely, and not going far below it. A slight and diffused sound here seemed to rise from the ground all about them, for which they could not account. Presently it became louder, and as the sun touched the horizon, it poured forth in prolonged strains. The large trumpet-shaped lilies, reeds, and heliotropes seemed fairly to throb as they raised their anthem to the sky and the setting sun, while the air grew dark with clouds of birds that gradually alighted on the ground, until, as the chorus grew fainter and gradually ceased, they flew back to their nests. The three companions had stood astonished while this act was played. The doctor then spoke:

"This is the most marvellous development of Nature I have seen, for its wonderful divergence from, and yet analogy to, what takes place on earth. You know our flowers offer honey, as it were, as bait to insects, that in eating or collecting it they may catch the pollen on their legs and so carry it to other flowers, perhaps of the opposite sex. Here flowers evidently appeal to the sense of hearing instead of taste, and make use of birds, of which there are enormous numbers, instead of winged insects, of which I have seen none, one being perhaps the natural result of the other. The flowers have become singers by long practice, or else, those that were most musical having had the best chance to reproduce, we have a neat illustration of the 'survival of the fittest.' The sound is doubtless produced by a shrinking of the fibres as the sun withdraws its heat, in which case we may expect

another song at sunrise, when the same result will be effected by their expanding."

Searching for a camping-place in which to pass the coming hours, they saw lights flitting about like will-o'-the-wisps, but brighter and intermittent.

"They seem to be as bright as sixteen-candle-power lamps, but the light is yellower, and appears to emanate from a comparatively large surface, certainly nine or ten inches square," said the doctor.

They soon gave up the chase, however, for the lights were continually moving and frequently went out. While groping in the growing darkness, they came upon a brown object about the size of a small dog and close to the ground. It flew off with a humming insect sound, and as it did so it showed the brilliant phosphorescent glow they had observed.

"That is a good-sized fire-fly," said Bearwarden. "Evidently the insects here are on the same scale as everything else. They are like the fire-flies in Cuba, which the Cubans are said to put into a glass box and get light enough from to read by. Here they would need only one, if it could be induced to give its light continuously."

Having found an open space on high ground, they sat down, and Bearwarden struck his repeater, which, for convenience, had been arranged for Jupiter time, dividing the day into ten hours, beginning at noon, midnight being therefore five o'clock.

"Twenty minutes past four," said he, "which would correspond to about a quarter to eleven on earth. As the sun rises at half-past seven, it will be dark about three hours, for the time between dawn and daylight will, of course, be as short as that we have just experienced between sunset and night."

"If we stay here long," said the doctor, "I suppose we shall become accustomed, like sailors, to taking our four, or in this case five, hours on duty, and five hours off."

"Or," added Ayrault, "we can sleep ten consecutive hours and take the next ten for exploring and hunting, having the sun for one half the time and the moons for the other."

Bearwarden and Cortlandt now rolled themselves in their blankets and were soon asleep, while Ayrault, whose turn it was to watch till the moons rose--for they had not yet enough confidence in their new domain to sleep in darkness simultaneously--leaned his back against a rock and lighted his pipe. In the distance he saw

the torrents of fiery lava from the volcanoes reflected in the sky, and faintly heard their thunderous crashes, while the fire-flies twinkled unconcernedly in the hollow, and the night winds swayed the fernlike branches. Then he gazed at the earth, which, but little above the horizon, shone with a faint but steady ray, and his mind's eye ran beyond his natural vision while he pictured to himself the girl of his heart, wishing that by some communion of spirits he might convey his thoughts to her, and receive hers. It was now the first week of January on earth. He could almost see her house and the snow-clad trees in the park, and knew that at that hour she was dressing for dinner, and hoped and believed that he was in her heart. While he thus mused, one moon after another rose, each at a different phase, till three were at once in the sky. Adjusting the electric protection- wires that were to paralyze any creature that attempted to come within the circle, and would arouse them by ringing a bell, he knocked the ashes from his pipe, rolled himself in a blanket, and was soon asleep beside his friends.

CHAPTER II.

ANTECEDENTAL.

"Come in!" sounded a voice, as Dr. Cortlandt and Dick Ayrault tapped at the door of the President of the Terrestrial Axis Straightening Company's private office on the morning of the 21st of June, A. D. 2000. Col. Bearwarden sat at his capacious desk, the shadows passing over his face as April clouds flit across the sun. He was a handsome man, and young for the important post he filled--being scarcely forty--a graduate of West Point, with great executive ability, and a wonderful engineer. "Sit down, chappies," said he; "we have still a half hour before I begin to read the report I am to make to the stockholders and representatives of all the governments, which is now ready. I know YOU smoke," passing a box of Havanas to the professor.

Prof. Cortlandt, LL. D., United States Government expert, appointed to examine the company's calculations, was about fifty, with a high forehead, greyish hair, and quick, grey eyes, a geologist and astronomer, and altogether as able a man, in his own way, as Col. Bearwarden in his. Richard Ayrault, a large stockholder and one of the honorary vice-presidents in the company, was about thirty, a university man, by nature a scientist, and engaged to one of the prettiest society girls, who was then a student at Vassar, in the beautiful town of Poughkeepsie.

"Knowing the way you carry things in your mind, and the difficulty of rattling you," said Cortlandt, "we have dropped in on our way to hear the speech that I would not miss for a fortune. Let us know if we bother you."

"Impossible, dear boy," replied the president genially. "Since I survived your official investigations, I think I deserve some of your attention informally."

"Here are my final examinations," said Cortlandt, handing Bearwarden a roll of papers. "I have been over all your figures, and testify to their accuracy in the appendix I have added."

So they sat and chatted about the enterprise that interested Cortlandt and Ayrault almost as much as Bearwarden himself. As the clock struck eleven, the president of the company put on his hat, and, saying au revoir to his friends, crossed the street to the Opera House, in which he was to read a report that would be copied in all the great journals and heard over thousands of miles of wire in every part of the globe. When he arrived, the vast building was already filled with a distinguished company, representing the greatest intelligence, wealth, and powers of the world. Bearwarden went in by the stage entrance, exchanging greetings as he did so with officers of the company and directors who had come to hear him. Cortlandt and Ayrault entered by the regular door, the former going to the Government representatives' box, the latter to join his fiancee, Sylvia Preston, who was there with her mother. Bearwarden had a roll of manuscript at hand, but so well did he know his speech that he scarcely glanced at it. After being introduced by the chairman of the meeting, and seeing that his audience was all attention, he began, holding himself erect, his clear, powerful voice making every part of the building ring.

CHAPTER III.

PRESIDENT BEARWARDEN'S SPEECH.

"To the Bondholders and Stockholders of the Terrestrial Axis Straightening Company and Representatives of Earthly Governments.

"GENTLEMEN: You know that the objects of this company are, to straighten the axis of the earth, to combine the extreme heat of summer with the intense cold of winter and produce a uniform temperature for each degree of latitude the year round. At present the earth's axis--that is, the line passing through its centre and the two poles--is inclined to the ecliptic about twenty-three and a half degrees. Our summer is produced by the

northern hemisphere's leaning at that angle towards the sun, and our winter by its turning that much from it. In one case the sun's rays are caused to shine more perpendicularly, and in the other more obliquely. This wabbling, like that of a top, is the sole cause of the seasons; since, owing to the eccentricity of our orbit, the earth is actually fifteen hundred thousand miles nearer the sun during our winter, in the northern hemisphere, than in summer. That there is no limit to a planet's inclination, and that inclination is not essential, we have astronomical proof. Venus's axis is inclined to the plane of her orbit seventy-five degrees, so that the arctic circle comes within fifteen degrees of the equator, and the tropics also extend to latitude seventy-five degrees, or within fifteen degrees of the poles, producing great extremes of heat and cold.

"Venus is made still more difficult of habitation by the fact that she rotates on her axis in the same time that she revolves about the sun, in the same way that the moon does about the earth, so that one side must be perpetually frozen while the other is parched.

"In Uranus we see the axis tilted still further, so that the arctic circle descends to the equator. The most varied climate must therefore prevail during its year, whose length exceeds eighty-one of ours.

The axis of Mars is inclined about twenty-eight and two thirds degrees to the plane of its orbit; consequently its seasons must be very similar to ours, the extremes of heat and cold being somewhat greater.

"In Jupiter we have an illustration of a planet whose axis is almost at right angles to the plane of its orbit, being inclined but about a degree and a half. The hypothetical inhabitants of this majestic planet must therefore have perpetual summer at the equator, eternal winter at the poles, and in the temperate regions everlasting spring. On account of the straightness of the axis, however, even the polar inhabitants--if there are any--are not oppressed by a six months' night, for all except those at the VERY pole have a sunrise and a sunset every ten hours--the exact day being nine hours, fifty five minutes, and twenty-eight seconds. The warmth of the tropics is also tempered by the high winds that must result from the rapid whirl on its axis, every object at the equator being carried around by this at the rate of 27,600 miles an hour, or over three thousand miles farther than the earth's equator moves in twenty-four hours.

"The inclination of the axis of our own planet has also frequently considerably exceeded that of Mars, and again has been but little greater than Jupiter's at least, this is by all odds

the most reasonable explanation of the numerous Glacial periods through which our globe has passed, and of the recurring mild spells, probably lasting thousands of years, in which elephants, mastodons, and other semi-tropical vertebrates roamed in Siberia, some of which died so recently that their flesh, preserved by the cold, has been devoured by the dogs of modern explorers.

"It is not to be supposed that the inclining of the axes of Jupiter, Venus, the Earth, and the other planets, is now fixed; in some cases it is known to be changing. As long ago as 1890, Major-Gen. A. W. Drayson, of the British Army, showed, in a work entitled Untrodden Ground in Astronomy and Geology, that, as a result of the second rotation of the earth, the inclination of its axis was changing, it having been 23@ 28' 23" on January 1, 1750, 23@ 27' 55.3" on January 1, 1800, and 23@ 27' 30.9" on January 1, 1850; and by calculation one hundred and ten years ago showed that in 1900 (one hundred years ago) it would be 23@ 27' 08.8". This natural straightening is, of course, going on, and we are merely about to anticipate it. When this improvement was mooted, all agreed that the EXTREMES of heat and cold could well be spared. 'Balance those of summer against those of winter by partially straightening the axis; reduce the inclination from twenty-three degrees, thirty minutes, to about fifteen degrees, but let us stop there,' many said. Before we had gone far, however, we found it would be best to make the work complete. This will reclaim and make productive the vast areas of Siberia and the northern part of this continent, and will do much for the antarctic regions; but there will still be change in temperature; a wind blowing towards the equator will always be colder than one blowing from it, while the slight eccentricity of the orbit will supply enough change to awaken recollections of seasons in our eternal spring.

"The way to accomplish this is to increase the weight of the pole leaving the sun, by increasing the amount of material there for the sun to attract, and to lighten the pole approaching or turning towards the sun, by removing some heavy substance from it, and putting it preferably at the opposite pole. This shifting of ballast is most easily accomplished, as you will readily perceive, by confining and removing water, which is easily moved and has a considerable weight. How we purpose to apply these aqueous brakes to check the wabbling of the earth, by means of the attraction of the sun, you will now see.

"From Commander Fillmore, of the Arctic Shade and the Committee on Bulkheads and Dams, I have just received the following by cable telephone: 'The Arctic Ocean is now in condition to be pumped out in summer and to have its average depth increased one hundred feet by the dams in winter. We have already fifty million square yards of windmill turbine surface in position and

ready to move. The cables bringing us currents from the dynamos at Niagara Falls are connected with our motors, and those from the tidal dynamos at the Bay of Fundy will be in contact when this reaches you, at which moment the pumps will begin. In several of the landlocked gulfs and bays our system of confining is so complete, that the surface of the water can be raised two hundred feet above sea- level. The polar bears will soon have to use artificial ice. Perhaps the cheers now ringing without may reach you over the telephone.'"

The audience became greatly interested, and when the end of the telephone was applied to a microphone the room fairly rang with exultant cheers, and those looking through a kintograph (visual telegraph) terminating in a camera obscura on the shores of Baffin Bay were able to see engineers and workmen waving and throwing up their caps and falling into one another's arms in ecstasies of delight. When the excitement subsided, the president continued:

"Chairman Wetmore, of the Committee on Excavations and Embankments in Wilkesland and the Antarctic Continent, reports: 'Two hundred and fifty thousand square miles are now hollowed out and enclosed sufficiently to hold water to an average depth of four hundred feet. Every summer, when the basin is allowed to drain, we can, if necessary, extend our reservoir, and shall have the best season of the year for doing work until the earth has permanent spring. Though we have comparatively little water or tidal power, the earth's crust is so thin at this latitude, on account of the flattening, that by sinking our tubular boilers and pipes to a depth of a few thousand feet we have secured so terrific a volume of superheated steam that, in connection with our wind turbines, we shall have no difficulty in raising half a cubic mile of water a minute to our enclosure, which is but little above sea-level, and into which, till the pressure increases, we can fan or blow the water, so that it can be full three weeks after our longest day, or, since the present unimproved arrangement gives the indigenes but one day and night a year, I will add the 21st day of December.

"'We shall be able to find use for much of the potential energy of the water in the reservoir when we allow it to escape in June, in melting some of the accumulated polar ice-cap, thereby decreasing still further the weight of this pole, in lighting and warming ourselves until we get the sun's light and heat, in extending the excavations, and in charging the storage batteries of the ships at this end of the line. Everything will be ready when you signal "Raise water."'"

"Let me add parenthetically," said Bearwarden, "that this means of obtaining power by steam boilers sunk to a great depth is much

to be commended; for, though the amount of heat we can withdraw is too small to have much effect, the farther towards the centre our globe can be cooled the deeper will the water of the oceans be able to penetrate--since it is its conversion into steam that prevents the water from working its way in farther--and the more dry land we shall have."

"You see," the president continued, "the storage capacity at the south pole is not quite as great as at the north, because it is more difficult to excavate a basin than to close the exits of one that already exists, which is what we have done in the arctic. The work is also not so nearly complete, since it will not be necessary to use the southern reservoir for storing weight for six months, or until the south pole, which is now at its maximum declination from the sun, is turned towards it and begins to move away; then, by increasing the amount of matter there, and at the same time lightening the north pole, and reversing the process every six months, we decrease the speed at which the departing pole leaves the sun and at which the approaching pole advances. The north pole, we see, will be a somewhat more powerful lever than the south for working the globe to a straight position, but we may be sure that the latter, in connection with the former, will be able to hold up its end."

[The building here fairly shook with applause, so that, had the arctic workers used the microphone, they might have heard in the enthusiastic uproar a good counterpart of their own period.]

"I only regret," the president continued, "that when we began this work the most marvellous force yet discovered--apergy--was not sufficiently understood to be utilized, for it would have eased our labours to the point of almost eliminating them. But we have this consolation: it was in connection with our work that its applicability was discovered, so that had we and all others postponed our great undertaking on the pretext of waiting for a new force, apergy might have continued to lie dormant for centuries. With this force, obtained by simply blending negative and positive electricity with electricity of the third element or state, and charging a body sufficiently with this fluid, gravitation is nullified or partly reversed, and the earth repels the body with the same or greater power than that with which it still attracts or attracted it, so that it may be suspended or caused to move away into space. Sic itur ad astra, we may say. With this force and everlasting spring before us, what may we not achieve? We may some day be able to visit the planets, though many may say that, since the axes of most of those we have considered are more inclined than ours, they would rather stay here. 'Blessed are they that shall inherit the earth,'" he went on, turning a four-foot globe with its axis set vertically and at right angles to a yellow globe labelled "Sun"; and again waxing

eloquent, he added: "We are the instruments destined to bring about the accomplishment of that prophecy, for never in the history of the world has man reared so splendid a monument to his own genius as he will in straightening the axis of the planet.

"No one need henceforth be troubled by sudden change, and every man can have perpetually the climate he desires. Northern Europe will again luxuriate in a climate that favoured the elephants that roamed in northern Asia and Switzerland. To produce these animals and the food they need, it is not necessary to have great heat, but merely to prevent great cold, half the summer's sun being absorbed in melting the winter's accumulation of ice.

"When the axis has reached a point at which it inclines but about twelve degrees, it will become necessary to fill the antarctic reservoir in June and the Arctic Ocean in December, in order to check the straightening, since otherwise it might get beyond the perpendicular and swing the other way. When this motion is completely arrested, I suggest that we blow up the Aleutian Isles and enlarge Bering Strait, so as to allow what corresponds to the Atlantic Gulf Stream in the Pacific to enter the Arctic Archipelago, which I have calculated will raise the average temperature of that entire region about thirty degrees, thereby still further increasing the amount of available land.

"Ocean currents, being the result of the prevailing winds, which will be more regular than at present, can be counted upon to continue practically as they are. It may not be plain to you why the trade winds do not blow towards the equator due south and north, since the equator has much the same effect on air that a stove has in the centre of a room, causing an ascending current towards the ceiling, which moves off in straight lines in all directions on reaching it, its place being taken by cold currents moving in opposite directions along the floor. Picture to yourselves the ascending currents at the equator moving off to the poles from which they came. As they move north they are continually coming to parts of the globe having smaller circles of latitude than those they have left, and therefore not moved forward as rapidly by the earth's daily rotation as the latitudes nearer the equator. The winds consequently run ahead of the surface, and so move east of north--the earth turning towards the east--while the heavier colder surface currents, rushing towards the equator to take the place of the ascending column, coming from regions where the surface whirls comparatively slowly to those where it is rotating faster, are continually left behind, and so move southwest; while south of the equator a corresponding motion results. Though this is not the most exact explanation, it may serve to make the action clear. I will add, that if any one prefers a colder or a warmer climate than that of the place in which he lives, he need only go north or south for an hour;

or, if he prefers his own latitude, he can rise a few thousand feet in the air, or descend to one of the worked-out coal-mines which are now used as sanitariums, and secure his object by a slight change of altitude. Let us speed the departure of racking changes and extremes of climate, and prepare to welcome what we believe prevails in paradise--namely, everlasting spring."

Appended to the address was the report of the Government Examining Committee, which ran: "We have critically examined the Terrestrial Axis Straightening Company's figures and calculations, also its statements involving natural philosophy, physics, and astronomy, all of which we find correct, and hereby approve.

[Signed] "For the Committee:

"HENRY CHELMSFORD CORTLANDT,

"Chairman."

The Board of Directors having ratified the acts of its officers, and passed congratulatory resolutions, the meeting adjourned sine die.

CHAPTER IV.

PROF. CORTLANDT'S HISTORICAL SKETCH OF THE WORLD IN A. D. 2000.

Prof. Cortlandt, preparing a history of the times at the beginning of the great terrestrial and astronomical change, wrote as follows: "This period--A.D. 2000--is by far the most wonderful the world has as yet seen. The advance in scientific knowledge and attainment within the memory, of the present generation has been so stupendous that it completely overshadows all that has preceded. All times in history and all periods of the world have been remarkable for some distinctive or characteristic trait. The feature of the period of Louis XIV was the splendour of the court and the centralization of power in Paris. The year 1789 marked the decline of the power of courts and the evolution of government by the people. So, by the spread of republican ideas and the great advance in science, education has become universal, for women as well as for men, and this is more than ever a mechanical age.

"With increased knowledge we are constantly coming to realize how little we really know, and are also continually finding manifestations of forces that at first seem like exceptions to established laws. This is, of course, brought about by the modifying influence of some other natural law, though many of these we have not yet discovered.

"Electricity in its varied forms does all work, having superseded animal and manual labour in everything, and man has only to direct. The greatest ingenuity next to finding new uses for this almost omnipotent fluid has been displayed in inducing the forces of Nature, and even the sun, to produce it. Before describing the features of this perfection of civilization, let us review the steps by which society and the political world reached their present state.

"At the close of the Franco-Prussian War, in 1871, Continental Europe entered upon the condition of an armed camp, which lasted for nearly half a century. The primary cause of this was the mutual dislike and jealousy of France and Germany, each of which strove to have a larger and better equipped national defence than the other. There were also many other causes, as the ambition of the Russian Czar, supported by his country's vast though imperfectly developed resources and practically unlimited supply of men, one phase of which was the constant ferment in the Balkan Peninsula, and another Russia's schemes for extension in Asia; another was the general desire for colonies in Africa, in which one Continental power pretty effectually blocked another, and the latent distrust inside the Triple Alliance. England, meanwhile, preserved a wise and profitable neutrality.

"These tremendous sacrifices for armaments, both on land and water, had far-reaching results, and, as we see it now, were clouds with silver linings. The demand for hardened steel projectiles, nickel-steel plates, and light and almost unbreakable machinery, was a great incentive to improvement in metallurgy while the necessity for compact and safely carried ammunition greatly stimulated chemical research, and led to the discovery of explosives whose powers no obstacle can resist, and incidentally to other more useful things.

"Further mechanical and scientific progress, however, such as flying machines provided with these high explosives, and asphyxiating bombs containing compressed gas that could be fired from guns or dropped from the air, intervened. The former would have laid every city in the dust, and the latter might have almost exterminated the race. These discoveries providentially prevented hostilities, so that the 'Great War,' so long expected, never came, and the rival nations had their pains for nothing, or, rather, for others than themselves.

"Let us now examine the political and ethnological results. Hundreds of thousands, of the flower of Continental Europe were killed by overwork and short rations, and millions of desirable and often--unfortunately for us--undesirable people were driven to emigration, nearly all of whom came to English-speaking territory, greatly increasing our productiveness and power. As, we have seen, the jealousy of the Continental powers for one another effectually prevented their extending their influence or protectorates to other continents, which jealousy was considerably aided by the small but destructive wars that did take place. High taxes also made it more difficult for the moneyed men to invest in colonizing or development companies, which are so often the forerunners of absorption; while the United States, with her coal--of which the Mediterranean states have scarcely any--other resources, and low taxes, which, though necessary, can be nothing but an evil, has been able to expand naturally as no other nation ever has before.

"This has given the English-speakers, especially the United States, a free hand, rendering enforcement of the Monroe doctrine easy, and started English a long way towards becoming the universal language, while all formerly unoccupied land is now owned by those speaking it.

"At the close of our civil war, in 1865, we had but 3,000,000 square miles, and a population of 34,000,000. The country staggered beneath a colossal debt of over $4,000,000,000, had an expensive but essentially perishable navy, and there was an ominous feeling between the sections. The purchase of Alaska in 1867, by which we added over half a million square miles to our territory, marked the resumption of the forward march of the United States. Twenty-five years later, at the presidential campaign of 1892, the debt had been reduced to $900,000,000, deducting the sinking fund, and the charge for pensions had about reached its maximum and soon began to decrease, though no one objected to any amount of reward for bona fide soldiers who had helped to save the country. The country's wealth had also enormously increased, while the population had grown to 65,000,000. Our ancestors had, completed or in building, a navy of which no nation need be ashamed; and, though occasionally marred by hard times, there was general prosperity.

"Gradually the different States of Canada--or provinces, as they were then called--came to realize that their future would be far grander and more glorious in union with the United States than separated from it; and also that their sympathy was far stronger for their nearest neighbours than for any one else. One by one these Northern States made known their desire for consolidation with the Union, retaining complete control of their local affairs, as have the older States. They were gladly welcomed by

our Government and people, and possible rivals became the best of friends. Preceding and also following this, the States of Mexico, Central America, and parts of South America, tiring of the incessant revolutions and difficulties among themselves, which had pretty constantly looked upon us as a big brother on account of our maintenance of the Monroe doctrine, began to agitate for annexation, knowing they would retain control of their local affairs. In this they were vigorously supported by the American residents and property-holders, who knew that their possessions would double in value the day the United States Constitution was signed.

"Thus, in the first place, by the encouragement of our people, and latterly, apparently, by its own volition, the Union has increased enormously in power, till it now embraces 10,000,000 square miles, and has a free and enlightened population of 300,000,000. Though the Union established by Washington and his contemporaries has attained such tremendous proportions, its growth is by no means finished; and as a result of modern improvements, it is less of a journey now to go from Alaska to the Orinoco than it was for the Father of his Country to travel from New York or Philadelphia to the site of the city named in his honour.

"Adequate and really rapid transportation facilities have done much to bind the different parts of the country together, and to rub off the edges of local prejudice. Though we always favour peace, no nation would think of opposing the expressed wishes of the United States, and our moral power for good is tremendous. The name Japhet means enlargement, and the prophecy seems about to be literally fulfilled by these his descendants. The bankrupt suffering of so many European Continental powers had also other results. It enabled the socialists--who have never been able to see beyond themselves--to force their governments into selling their colonies in the Eastern hemisphere to England, and their islands in the Western to us, in order to realize upon them. With the addition of Canada to the United States and its loss to the British Empire, the land possessions of the two powers became about equal, our Union being a trifle the larger. All danger of war being removed by the Canadian change, a healthful and friendly competition took its place, the nations competing in their growth on different hemispheres. England easily added large areas in Asia and Africa, while the United States grew as we have seen. The race is still, in a sense, neck-and-neck, and the English-speakers together possess nearly half the globe. The world's recent rate of progress would have been impossible without this approximation to a universal language. The causes that checkmated the Continental powers have ceased to exist. Many millions of men whose principal thought had been to destroy

other members of the race became producers, but it was then too late, for the heavy armaments had done their work.

"Let us now glance at the times as they are, and see how the business of life is transacted. Manhattan Island has something over 2,500,000 inhabitants, and is surrounded by a belt of population, several miles wide, of 12,000,000 more, of which it is the focus, so that the entire city contains more than 14,500,000 souls. The several hundred square miles of land and water forming greater New York are perfectly united by numerous bridges, tunnels, and electric ferries, while the city's great natural advantages have been enhanced and beautified by every ingenious device. No main avenue in the newer sections is less than two hundred feet wide, containing shade and fruit trees, a bridle-path, broad sidewalks, and open spaces for carriages and bicycles. Several fine diagonal streets and breathing-squares have also been provided in the older sections, and the existing parks have been supplemented by intermediate ones, all being connected by parkways to form continuous chains.

"The hollow masts of our ships--to glance at another phase en passant--carry windmills instead of sails, through which the wind performs the work, of storing a great part of the energy required to run them at sea, while they are discharging or loading cargo in port; and it can, of course, work to better advantage while they are stationary than when they are running before it. These turbines are made entirely of light metal, and fold when not in use, so that only the frames are visible. Sometimes these also fold and are housed, or wholly disappear within the mast. Steam-boilers are also placed at the foci of huge concave mirrors, often a hundred feet in diameter, the required heat being supplied by the sun, without smoke, instead of by bulky and dirty coal. This discovery gave commercial value to Sahara and other tropical deserts, which are now desirable for mill-sites and for generating power, on account of the directness with which they receive the sun's rays and their freedom from clouds. Mile after mile Africa has been won for the uses of civilization, till great stretches that were considered impassible are as productive as gardens. Our condensers, which compress, cool, and rarefy air, enabling travellers to obtain water and even ice from the atmosphere, are great aids in desert exploration, removing absolutely the principal distress of the ancient caravan. The erstwhile 'Dark Continent' has a larger white population now than North America had a hundred years ago, and has this advantage for the future, that it contains 11,600,000 square miles, while North America has less than 9,000,000. Every part of the globe will soon sustain about as large and prosperous a population as the amount of energy it receives from the sun and other sources will warrant; public debts and the efficiency of the governments being the variable elements.

"The rabbits in Australia, and the far more objectionable poisonous snakes in South America and India, have been exterminated by the capture of a few dozen of the creatures in the infested districts, their inoculation with the virus similar to the murus tiphi, tuberculosis or any other contagious-germ complaint to which the species treated was particularly susceptible, and the release of these individuals when the disease was seen to be taking hold. The rabbits and serpents released at once returned to their old haunts, carrying the plague far and wide. The unfortunate rabbits were greatly commiserated even by the medicos that wielded the death-dealing syringe; but, fortunately for themselves, they died easily. The reptiles, perhaps on account of the wider distribution of the nerve centres, had more lingering but not painful deaths, often, while in articulo mortis, leaving the holes with which they seemed to connect their discomfort, and making a final struggle along the ground, only to die more quickly as a result of their exertions. We have applied this also to the potato-bug, locust, and other insect pests, no victim being too small for the ubiquitous, subtle germ, which, properly cultivated and utilized, has become one of man's best friends.

"We have microbe tests that show us as unmistakably whether the germs of any particular disease--like malaria, typhoid, or scarlet fever--are present in the air, as litmus-paper shows alkalinity of a solution. We also inoculate as a preventive against these and almost all other germ diseases, with the same success that we vaccinate for smallpox.

"The medicinal properties of all articles of food are so well understood also, that most cures are brought about simply by dieting. This, reminds me of the mistakes perpetrated on a friend of mine who called in Dr. Grave-Powders, one of the old-school physicians, to be treated for insomnia and dyspepsia. This old numskull restricted his diet, gave him huge doses of medicine, and decided most learnedly that he was daily growing worse. Concluding that he had but a short time to live, my friend threw away the nauseating medicines, ate whatever he had a natural desire for, and was soon as well as ever--the obvious moral of which is, that we can get whatever treatment we need most beneficially from our food. Our physicians are most serious and thoughtful men. They never claim to be infallible, but study scientifically to increase their knowledge and improve the methods of treatment. As a result of this, fresh air, regular exercise for both sexes, with better conditions, and the preservation of the lives of children that formerly died by thousands from preventable causes, the physique, especially of women, is wonderfully improved, and the average longevity is already over sixty.

"Our social structure, to be brief, is based on science, or the conservation of energy, as the Greek philosophers predicted. It was known to them that a certain amount of power would produce only a certain amount of work--that is, the weight of a clock in descending or a spring in uncoiling returns theoretically the amount of work expended in raising or coiling it, and in no possible way can it do more. In practice, on account of friction, etc., we know it does less. This law, being invariable, of course limits us, as it did Archimedes and Pythagoras; we have simply utilized sources of power that their clumsy workmen allowed to escape. Of the four principal sources--food, fuel, wind, and tide--including harnessed waterfalls, the last two do by far the most work. Much of the electrical energy in every thunderstorm is also captured and condensed in our capacious storage batteries, as natural hygeia in the form of rain was and is still caught in our country cisterns. Every exposed place is crowned by a cluster of huge windmills that lift water to some pond or reservoir placed as high as possible. Every stiff breeze, therefore, raises millions of tons of water which operate hydraulic turbines as required. Incidentally these storage reservoirs, by increasing the surface exposed to evaporation and the consequent rainfall, have a very beneficial effect on the dry regions in the interior of the continent, and in some cases have almost superseded irrigation. The windmill and dynamo thus utilize bleak mountain-tops that, till their discovery, seemed to be but indifferent successes in Dame Nature's domain. The electricity generated by these, in connection with that obtained by waterfalls, tidal dynamos, thunderstorms, chemical action, and slow-moving quadruple-expansion steam engines, provides the power required to run our electric ships and water-spiders, railways, and stationary and portable motors, for heating the cables laid along the bottom of our canals to prevent their freezing in winter, and for almost every conceivable purpose. Sometimes a man has a windmill on his roof for light and heat; then, the harder the wintry blasts may blow the brighter and warmer becomes the house, the current passing through a storage battery to make it more steady. The operation of our ordinary electric railways is very simple: the current is taken from an overhead, side, or underneath wire, directly through the air, without the intervention of a trolley, and the fast cars, for they are no longer run in trains, make five miles a minute. The entire weight of each car being used for its own traction, it can ascend very steep grades, and can attain high speed or stop very quickly.

"Another form is the magnetic railway, on which the cars are wedge-shaped at both ends, and moved by huge magnets weighing four thousand tons each, placed fifty miles apart. On passing a

magnet, the nature of the electricity charging a car is automatically changed from positive to negative, or vice versa, to that of the magnet just passed, so that it repels while the next attracts. The successive magnets are charged oppositely, the sections being divided halfway between by insulators, the nature of the electricity in each section being governed by the charge in the magnet. To prevent one kind of electricity from uniting with and neutralizing that in the next section by passing through the car at the moment of transit, there is a "dead stretch" of fifty yards with rails not charged at all between the sections. This change in the nature of the electricity is repeated automatically every fifty miles, and obviates the necessity of revolving machinery, the rails aiding communication.

"Magnetism being practically as instantaneous as gravitation, the only limitations to speed are the electrical pressure at the magnets, the resistance of the air, and the danger of the wheels bursting from centrifugal force. The first can seemingly be increased without limit; the atmospheric resistance is about to be reduced by running the cars hermetically sealed through a partial vacuum in a steel and toughened glass tube; while the third has been removed indefinitely by the use of galvanized aluminum, which bears about the same relation to ordinary aluminum that steel does to iron, and which has twice the tensile strength and but one third the weight of steel. In some cases the rails are made turned in, so that it would be impossible for a car to leave the track without the road-bed's being totally demolished; but in most cases this is found to be unnecessary, for no through line has a curve on its vast stretches with a radius of less than half a mile. Rails, one hundred and sixty pounds to the yard, are set in grooved steel ties, which in turn are held by a concrete road-bed consisting of broken stone and cement, making spreading rails and loose ballast impossible. A large increase in capital was necessary for these improvements, the elimination of curves being the most laborious part, requiring bridges, cuttings, and embankments that dwarf the Pyramids and would have made the ancient Pharaohs open their eyes; but with the low rate of interest on bonds, the slight cost of power, and great increase in business, the venture was a success, and we are now in sight of further advances that will enable a traveller in a high latitude moving west to keep pace with the sun, and, should he wish it, to have unending day."

CHAPTER V.

DR. CORTLANDT'S HISTORY CONTINUED.

"In marine transportation we have two methods, one for freight

and another for passengers. The old-fashioned deeply immersed ship has not changed radically from the steam and sailing vessels of the last century, except that electricity has superseded all other motive powers. Steamers gradually passed through the five hundred-, six hundred-, and seven hundred-foot-long class, with other dimensions in proportion, till their length exceeded one thousand feet. These were very fast ships, crossing the Atlantic in four and a half days, and were almost as steady as houses, in even the roughest weather.

"Ships at this period of their development had also passed through the twin and triple screw stage to the quadruple, all four together developing one hundred and forty thousand indicated horse-power, and being driven by steam. This, of course, involved sacrificing the best part of the ship to her engines, and a very heavy idle investment while in port. Storage batteries, with plates composed of lead or iron, constantly increasing in size, had reached a fair state of development by the close of the nineteenth century.

"During the second decade of the twentieth century the engineers decided to try the plan of running half of a transatlantic liner's screws by electricity generated by the engines for driving the others while the ship was in port, this having been a success already on a smaller scale. For a time this plan gave great satisfaction, since it diminished the amount of coal to be carried and the consequent change of displacement at sea, and enabled the ship to be worked with a smaller number of men. The batteries could also, of course, be distributed along the entire length, and placed where space was least valuable.

"The construction of such huge vessels called for much governmental river and harbour dredging, and a ship drawing thirty-five feet can now enter New York at any state of the tide. For ocean bars, the old system of taking the material out to sea and discharging it still survives, though a jet of water from force-pumps directed against the obstruction is also often employed with quick results. For river work we have discovered a better method. All the mud is run back, sometimes over a mile from the river bank, where it is used as a fertilizer, by means of wire railways strung from poles. These wire cables combine in themselves the functions of trolley wire and steel rail, and carry the suspended cars, which empty themselves and return around the loop for another load. Often the removed material entirely fills small, saucer-shaped valleys or low places, in which case it cannot wash back. This improvement has ended the necessity of building jetties.

"The next improvement in sea travelling was the 'marine spider.' As the name shows, this is built on the principle of an insect.

It is well known that a body can be carried over the water much faster than through it. With this in mind, builders at first constructed light framework decks on large water-tight wheels or drums, having paddles on their circumferences to provide a hold on the water. These they caused to revolve by means of machinery on the deck, but soon found that the resistance offered to the barrel wheels themselves was too great. They therefore made them more like centipeds with large, bell-shaped feet, connected with a superstructural deck by ankle-jointed pipes, through which, when necessary, a pressure of air can be forced down upon the enclosed surface of water. Ordinarily, however, they go at great speed without this, the weight of the water displaced by the bell feet being as great as that resting upon them. Thus they swing along like a pacing horse, except that there are four rows of feet instead of two, each foot being taken out of the water as it is swung forward, the first and fourth and second and third rows being worked together. Although, on account of their size, which covers several acres, they can go in any water, they give the best results on Mediterraneans and lakes that are free from ocean rollers, and, under favourable conditions, make better speed than the nineteenth-century express trains, and, of course, going straight as the crow flies, and without stopping, they reach a destination in considerably shorter time.

Some passengers and express packages still cross the Atlantic on 'spiders,' but most of these light cargoes go in a far pleasanter and more rapid way. The deep-displacement vessels, for heavy freight, make little better speed than was made by the same class a hundred years ago. But they are also run entirely by electricity, largely supplied by wind, and by the tide turning their motors, which become dynamos while at anchor in any stream. They therefore need no bulky boilers, engines, sails, or coal-bunkers, and consequently can carry unprecedentedly large cargoes with comparatively small crews. The officers on the bridge and the men in the crow's nest--the way to which is by a ladder INSIDE the mast, to protect the climber from the weather--are about all that is needed; while disablement is made practically impossible, by having four screws, each with its own set of automatically lubricating motors.

"This change, like other labour-saving appliances, at first resulted in laying off a good many men, the least satisfactory being the first to go; but the increase in business was so great that the intelligent men were soon reemployed as officers at higher rates of pay and more interesting work than before, while they as consumers were benefited as much as any one else by the decreased cost of production and transportation.

"With a view to facilitating interchange still further, our Government has gradually completed the double coast-line that

Nature gave us in part. This was done by connecting islands separated from shore by navigable water, and leaving openings for ingress and exit but a few hundred yards wide. The breakwaters required to do this were built with cribbing of incorrodible metal, affixed to deeply driven metallic piles, and filled with stones along coasts where they were found in abundance or excess. This, while clearing many fields and improving them for cultivation, provided just the needed material; since irregular stones bind together firmly, and, while also insoluble, combine considerable bulk with weight. South of Hatteras, where stones are scarce, the sand dredged from parts of the channel was filled into the crib, the surface of which has a concave metallic cover, a trough of still water being often the best barrier against the passage of waves. This double coast-line has been a great benefit, and propelled vessels of moderate draught can range in smooth water, carrying very full loads, from Labrador to the Orinoco. The exits are, of course, protected by a line of cribbing a few hundred feet to seaward.

"The rocks have been removed from all channels about New York and other commercial centres, while the shallow places have been dredged to a uniform depth. This diminishes the dangers of navigation and considerably decreases the speed with which the tides rush through. Where the obstructions consisted of reefs surrounded by deep water, their removal with explosives was easy, the shattered fragments being allowed to sink to the bottom and remain there beneath the danger line.

"Many other great works have also been completed. The canals at Nicaragua have been in operation many years, it having been found best to have several sizes of locks, and to use the large ones only for the passage of large vessels. The improved Erie and Champlain Canals also enable ships four hundred feet long to reach New York from the Great Lakes via the Hudson River.

"For flying, we have an aeroplane that came in when we devised a suitable motor power. This is obtained from very light paper-cell batteries that combine some qualities of the primary and secondary type, since they must first be charged from a dynamo, after which they can supply full currents for one hundred hours--enough to take them around the globe--while partly consuming the elements in the cells. The power is applied through turbine screws, half of which are capable of propelling the flat deck in its inclined position at sufficient speed to prevent its falling. The moving parts have ball bearings and friction rollers, lubrication being secured automatically, when required, by a supply of vaseline that melts if any part becomes hot. All the framing is of thin but very durable galvanized aluminum, which has superseded steel for every purpose in which weight is not an advantage, as in the permanent way on railways.

The air ships, whose length varies from fifty to five hundred feet, have rudders for giving a vertical or a horizontal motion, and several strengthening keels that prevent leeway when turning. They are entirely on the principle of birds, maintaining themselves mechanically, and differing thus from the unwieldy balloon. Starting as if on a circular railway, against the wind, they rise to a considerable height, and then, shutting off the batteries, coast down the aerial slope at a rate that sometimes touches five hundred miles an hour. When near the ground the helmsman directs the prow upward, and, again turning on full current, rushes up the slope at a speed that far exceeds the eagle's, each drop of two miles serving to take the machine twenty or thirty; though, if the pilot does not wish to soar, or if there is a fair wind at a given height, he can remain in that stratum of the atmosphere by moving horizontally. He can also maintain his elevation when moving very slowly, and though the headway be entirely stopped, the descent is gradual on account of the aeroplane's great spread, the batteries and motors being secured to the under side of the deck.

"The motors are so light that they develop two horse power for every pound of their weight; while, to keep the frames thin, the necessary power is obtained by terrific speed of the moving parts, as though a steam engine, to avoid great pressure in its cylinders, had a long stroke and ran at great piston speed, which, however, is no disadvantage to the rotary motion of the electric motor, there being no reciprocating cranks, etc., that must be started and stopped at each revolution.

"To obviate the necessity of gearing to reduce the number of revolutions to those possible for a large screw, this member is made very small, and allowed to revolve three thousand times a minute, so that the requisite power is obtained with great simplicity of mechanism, which further decreases friction. The shafts, and even the wires connecting the batteries with the motors, are made large and hollow. Though the primary battery pure and simple, as the result of great recent advances in chemistry, seems to be again coming up, the best aeroplane batteries are still of the combination- storage type. These have been so perfected that eight ounces of battery yield one horse power for six hours, so that two pounds of battery will supply a horse power for twenty-four hours; a small fifty-horse-power aeroplane being therefore able to fly four days with a battery weight of but four hundred pounds.

"Limestone and clarified acid are the principal parts of these batteries. It was known long ago that there was about as much imprisoned solar energy in limestone as in coal, but it was only recently that we discovered this way of releasing and using it.

"Common salt plays an important part in many of our chemical reactions. By combining it with limestone, and treating this with acid jelly, we also get good results on raising to the boiling-point.

"However enjoyable the manly sport of yachting is on water, how vastly more interesting and fascinating it is for a man to have a yacht in which he can fly to Europe in one day, and with which the exploration of tropical Africa or the regions about the poles is mere child's play, while giving him so magnificent a bird's-eye view! Many seemingly insoluble problems are solved by the advent of these birds. Having as their halo the enforcement of peace, they have in truth taken us a long step towards heaven, and to the co-operation and higher civilization that followed we shall owe much of the success of the great experiment on Mother Earth now about to be tried.

"Another change that came in with a rush upon the discovery of a battery with insignificant weight, compact form, and great capacity, was the substitution of electricity for animal power for the movement of all vehicles. This, of necessity brought in good roads, the results obtainable on such being so much greater than on bad ones that a universal demand for them arose. This was in a sense cumulative, since the better the streets and roads became, the greater the inducement to have an electric carriage. The work of opening up the country far and near, by straightening and improving existing roads, and laying out new ones that combine the solidity of the Appian Way with the smoothness of modern asphalt, was largely done by convicts, working under the direction of State and Government engineers. Every State contained a horde of these unprofitable boarders, who, as they formerly worked, interfered with honest labour, and when idle got into trouble. City streets had been paved by the municipality; country roads attended to by the farmers, usually very unscientifically. Here was a field in which convict labour would not compete, and an important work could be done. When once this was made the law, every year showed improvement, while the convicts had useful and healthful occupation.

"The electric phaetons, as those for high speed are called, have three and four wheels, and weigh, including battery and motor, five hundred to four thousand pounds. With hollow but immensely strong galvanically treated aluminum frames and pneumatic or cushion tires, they run at thirty-five and forty miles an hour on country roads, and attain a speed over forty on city streets, and can maintain this rate without recharging for several days. They can therefore roam over the roads of the entire hemisphere, from the fertile valley of the Peace and grey shores of Hudson Bay, to beautiful Lake Nicaragua, the River Plate, and Patagonia, improving man by bringing him close to Nature, while they combine

the sensations of coasting with the interest of seeing the country well.

"To recharge the batteries, which can be done in almost every town and village, two copper pins attached to insulated copper wires are shoved into smooth-bored holes. These drop out of themselves by fusing a small lead ribbon, owing to the increased resistance, when the acid in the batteries begins to 'boil,' though there is, of course, but little heat in this, the function of charging being merely to bring about the condition in which part of the limestone can be consumed, the batteries themselves, when in constant use, requiring to be renewed about once a month. A handle at the box seat turns on any part of the attainable current, for either going ahead or reversing, there being six or eight degrees of speed for both directions, while the steering is done with a small wheel.

"Light but powerful batteries and motors have also been fitted on bicycles, which can act either as auxiliaries for hill-climbing or in case of head wind, or they can propel the machine altogether.

"Gradually the width of the streets became insufficient for the traffic, although the elimination of horses and the consequent increase in speed greatly augmented their carrying capacity, until recently a new system came in. The whole width of the avenues and streets in the business parts of the city, including the former sidewalks, is given up to wheel traffic, an iron ridge extending along the exact centre to compel vehicles to keep to the right. Strips of nickel painted white, and showing a bright phosphorescence at night, are let into the metal pavement flush with the surface, and run parallel to this ridge at distances of ten to fifteen feet, dividing each half of the avenue into four or five sections, their width increasing as they approach the middle. All trucks or drays moving at less than seven miles an hour are obliged to keep in the section nearest the building line, those running between seven and fifteen in the next, fifteen to twenty-five in the third, twenty-five to thirty-five in the fourth, and everything faster than that in the section next the ridge, unless the avenue or street is wide enough for further subdivisions. If it is wide enough for only four or less, the fastest vehicles must keep next the middle, and limit their speed to the rate allowed in that section, which is marked at every crossing in white letters sufficiently large for him that runs to read. It is therefore only in the wide thoroughfares that very high speed can be attained. In addition to the crank that corresponds to a throttle, there is a gauge on every vehicle, which shows its exact speed in miles per hour, by gearing operated by the revolutions of the wheels.

"The policemen on duty also have instantaneous kodaks mounted on tripods, which show the position of any carriage at half- and quarter-second intervals, by which it is easy to ascertain the exact speed, should the officers be unable to judge it by the eye; so there is no danger of a vehicle's speed exceeding that allowed in the section in which it happens to be; neither can a slow one remain on the fast lines.

"Of course, to make such high speed for ordinary carriages possible, a perfect pavement became a sine qua non. We have secured this by the half-inch sheet of steel spread over a carefully laid surface of asphalt, with but little bevel; and though this might be slippery for horses' feet, it never seriously affects our wheels. There being nothing harder than the rubber ties of comparatively light drays upon it--for the heavy traffic is carried by electric railways under ground--it will practically never wear out.

"With the application of steel to the entire surface, car-tracks became unnecessary, ordinary wheels answering as well as those with flanges, so that no new tracks were laid, and finally the car companies tore up the existing ones, selling them in many instances to the municipalities as old iron. Our streets also need but little cleaning; neither is the surface continually indented, as the old cobble-stones and Belgian blocks were, by the pounding of the horses' feet, so that the substitution of electricity for animal power has done much to solve the problem of attractive streets.

"Scarcely a ton of coal comes to Manhattan Island or its vicinity in a year. Very little of it leaves the mines, at the mouths of which it is converted into electricity and sent to the points of consumption by wire, where it is employed for all uses to which fuel was put, and many others. Consequently there is no smoke, and the streets are not encumbered with coal-carts; the entire width being given up to carriages, etc. The ground floors in the business parts are used for large warehouses, trucks running in to load and unload. Pedestrians therefore have sidewalks level with the second story, consisting of glass floors let into aluminum frames, while all street crossings are made on bridges. Private houses have a front door opening on the sidewalk, and another on the ground level, so that ladies paying visits or leaving cards can do so in carriages. In business streets the second story is used for shops. In place of steel covering, country roads have a thick coating of cement and asphalt over a foundation of crushed stone, giving a capital surface, and have a width of thirty-three feet (two rods) in thinly settled districts, to sixty-six feet (four rods) where the population is greater. All are planted with shade and fruit trees, while the wide driveways have one or two broad sidewalks. The same rule of

making the slow-moving vehicles keep near the outside prevails, though the rate of increase in speed on approaching the middle is more rapid than in cities, and there is usually no dividing ridge. On reaching the top of a long and steep hill, if we do not wish to coast, we convert the motors into dynamos, while running at full speed, and so change the kinetic energy of the descent into potential in our batteries. This twentieth-century stage-coaching is one of the delights to which we are heirs, though horses are still used by those that prefer them.

We have been much aided in our material progress by the facility with which we obtain the metals. It was observed, some time ago, that when artesian and oil wells had reached a considerable depth, what appeared to be drops of lead and antimony came up with the stream. It finally occurred to a well-borer that if he could make his drill hard enough and get it down far enough, keeping it cool by solidified carbonic acid during the proceeding, he would reach a point at which most of the metals would be viscous, if not actually molten, and on being freed from the pressure of the crust they would expand, and reach the surface in a stream. This experiment he performed near the hot geysers in Yellowstone Park, and what was his delight, on reaching a depth scarcely half a mile beyond his usual stopping-place, to be rewarded by a stream of metal that heralded its approach by a loud explosion and a great rush of superheated steam! It ran for a month, completely filling the bed of a small, dried-up river, and when it did stop there were ten million tons in sight. This proved the feasibility of the scheme, and, though many subsequent attempts were less successful, we have learned by experience where it is best to drill, and can now obtain almost any metal we wish.

"'Magnetic eyes' are of great use to miners and Civil engineers. These instruments are something like the mariner's compass, with the sensitiveness enormously increased by galvanic currents. The 'eye,' as it were, sees what substances are underground, and at what distances. It also shows how many people are in an adjoining room--through the magnetic properties of the iron in their blood--whether they are moving, and in what directions and at what speed they go. In connection with the phonograph and concealed by draperies, it is useful to detectives, who, through a registering attachment, can obtain a record of everything said and done.

"Our political system remains with but little change. Each State has still two United States Senators, though the population represented by each representative has been greatly increased, so that the Senate has grown numerically much more than the House. It is the duty of each member of Congress to understand the conditions existing in every other member's State or district,

and the country's interest always precedes that of party. We have a comprehensive examination system in the civil service, and every officeholder, except members of the Cabinet, retains his office while efficiently performing his duty, without regard to politics. The President can also be re-elected any number of times. The Cabinet members, as formerly, usually remain in office while he does, and appear regularly in Congress to defend their measures.

"The really rapid transit lines in New York are underground, and have six tracks, two being used for freight. At all stations the local tracks rise several feet towards the street and slope off in both directions, while the express tracks do this only at stations at which the faster trains stop. This gives the passengers a shorter distance to descend or rise in the elevators, and the ascent before the stations aids the brakes in stopping, while the drop helps the motors to start the trains quickly in getting away.

"Photography has also made great strides, and there is now no difficulty in reproducing exactly the colours of the object taken.

"Telephones have been so improved that one person can speak in his natural voice with another in any part of the globe, the wire that enables him to hear also showing him the face of the speaker though he be at the antipodes. All telephone wires being underground and kept by themselves, they are not interfered with by any high-tension electric-light or power wires, thunderstorms, or anything else.

"Rain-making is another subject removed from the uncertainties, and has become an absolute science. We produce clouds by explosions in the atmosphere's heights and by surface air forced by blowers through large pipes up the side of a mountain or natural elevation and there discharged through an opening in the top of a tower built on the highest part. The aeriduct is incased in a poor heat-conductor, so that the air retains its warmth until discharged, when it is cooled by expansion and the surrounding cold air. Condensation takes place and soon serves to start a rain.

"Yet, until the earth's axis is straightened, we must be more or less dependent on the eccentricities of the weather, with extremes of heat and cold, droughts and floods, which last are of course largely the result of several months' moisture held on the ground in the form of snow, the congestion being relieved suddenly by the warm spring rains.

"Medicine and surgery have kept pace with other

improvements--inoculation and antiseptics, as already seen, rendering most of the germ diseases and formerly dreaded epidemics impotent; while through the potency of electrical affinity we form wholesome food-products rapidly, instead of having to wait for their production by Nature's slow processes.

"The metric system, now universal, superseded the old-fashioned arbitrary standards, so prolific of mistakes and confusion, about a century ago.

"English, as we have seen, is already the language of 600,000,000 people, and the number is constantly increasing through its adoption by the numerous races of India, where, even before the close of the last century, it was about as important as Latin during the greatness of Rome, and by the fact that the Spanish and Portuguese elements in Mexico and Central and South America show a constant tendency to die out, much as the population of Spain fell from 30,000,000 to 17,000,000 during the nineteenth century. As this goes on, in the Western hemisphere, the places left vacant are gradually filled by the more progressive Anglo-Saxons, so that it looks as if the study of ethnology in the future would be very simple.

"The people with cultivation and leisure, whose number is increasing relatively to the population at each generation, spend much more of their year in the country than formerly, where they have large and well-cultivated country seats, parts of which are also preserved for game. This growing custom on the part of society, in addition to being of great advantage to the out-of-town districts, has done much to save the forests and preserve some forms of game that would otherwise, like the buffalo, have become extinct.

"In astronomy we have also made tremendous strides. The old-fashioned double-convex lens used in telescopes became so heavy as its size grew, that it bent perceptibly from its own weight, when pointed at the zenith, distorting the vision; while when it was used upon a star near the horizon, though the glass on edge kept its shape, there was too much atmosphere between it and the observed object for successful study. Our recent telescopes have, therefore, concave plate-glass mirrors, twenty metres in diameter, like those used for converging the sun's rays in solar engines, but with curves more mathematically exact, which collect an immense amount of light and focus it on a sensitive plate or on the eye of the observer, whose back is turned to the object he is studying. An electrical field also plays an important part, the electricity being as great an aid to light as in the telephone it is to sound. With these placed generally on high mountain peaks, beyond the reach of clouds, we have enormously increased the number of visible stars, though

there are still probably boundless regions that we cannot see. These telescopes have several hundred times the power of the largest lenses of the nineteenth century, and apparently bring Mars and Jupiter, when in opposition, within one thousand and ten thousand miles, respectively, so that we study their physical geography and topography; and we have good maps of Jupiter, and even of Saturn, notwithstanding their distance and atmospheric envelopes, and we are able to see the disks of third-magnitude stars.

"It seems as if, when we wish any particular discovery or invention, in whatever field, we had but to turn our efforts in its direction to obtain our desire. We seem, in fact, to have awakened in the scenes of the Arabian Nights; yet the mysterious genius which we control, and which dims Aladdin's lamp, is the gift of no fairy godmother sustained by the haze of dreams, but shines as the child of science with fadeless and growing splendour, and may yet bring us and our little planet much closer to God.

"We should indeed be happy, living as we do at this apex of attained civilization, with the boundless possibilities of the future unfolding before us, on the horizon of which we may fairly be said to stand.

"We are freed from the rattling granite pavement of only a century ago, which made the occupant of an omnibus feel like a fly inside of a drum; from the domination of our local politics by ignorant foreigners; and from country roads that either filled the eyes, lungs, and hair of the unfortunates travelling upon them with dust, or, resembling ploughed and fertilized fields, saturated and plastered them with mud. These miseries, together with sea-sickness in ocean travelling, are forever passed, and we feel that 'Excelsior!' is indeed our motto. Our new and increasing sources of power have so stimulated production and manufacturing that poverty or want is scarcely known; while the development of the popular demand, as a result of the supplied need, is so great that there is no visible limit to the diversification of industry or the possibilities of the arts.

"It may seem strange to some that apparently so disproportionate a number of inventions have been made in the last century. There are several reasons. Since every discovery or advance in knowledge increases our chance of obtaining more, it becomes cumulative, and our progress is in geometric instead of arithmetical ratio. Public interest and general appreciation of the value of time have also effectively assisted progress. At the beginning of each year the President, the Governors of the States, and the Mayors of cities publish a prospectus of the great improvements needed, contemplated, and under way within

their jurisdiction--it may be planning a new boulevard, a new park, or an improved system of sewers; and at the year's end they issue a resume of everything completed, and the progress in everything else; and though there is usually a great difference between the results hoped for and those attained, the effect is good. The newspapers publish at length the recommendations of the Executives, and also the results obtained, and keep up public interest in all important matters.

"Free to delve in the allurement and fascination of science, emancipated man goes on subduing Nature, as his Maker said he should, and turning her giant forces to his service in his constant struggle to rise and become more like Him who gave the commandments and showed him how he should go.

"Notwithstanding our strides in material progress, we are not entirely content. As the requirements of the animal become fully supplied, we feel a need for something else. Some say this is like a child that cries for the moon, but others believe it the awakening and craving of our souls. The historian narrates but the signs of the times, and strives to efface himself; yet there is clearly a void, becoming yearly more apparent, which materialism cannot fill. Is it some new subtle force for which we sigh, or would we commune with spirits? There is, so far as we can see, no limit to our journey, and I will add, in closing, that, with the exception of religion, we have most to hope from science."

CHAPTER VI.

FAR-REACHING PLANS.

Knowing that the rectification of the earth's axis was satisfactorily begun, and that each year would show an increasing improvement in climate, many of the delegates, after hearing Bearwarden's speech, set out for their homes. Those from the valley of the Amazon and the eastern coast of South America boarded a lightning express that rushed them to Key West at the rate of three hundred miles an hour. The railroad had six tracks, two for through passengers, two for locals, and two for freight. There they took a "water-spider," six hundred feet long by three hundred in width, the deck of which was one hundred feet above the surface, which carried them over the water at the rate of a mile a minute, around the eastern end of Cuba, through Windward Passage, and so to the South American mainland, where they continued their journey by rail.

The Siberian and Russian delegates, who, of course, felt a keen interest in the company's proceedings, took a magnetic

double-ender car to Bering Strait. It was eighteen feet high, one hundred and fifty feet long, and had two stories. The upper, with a toughened glass dome running the entire length, descended to within three feet of the floor, and afforded an unobstructed view of the rushing scenery. The rails on which it ran were ten feet apart, the wheels being beyond the sides, like those of a carriage, and fitted with ball bearings to ridged axles. The car's flexibility allowed it to follow slight irregularities in the track, while the free, independent wheels gave it a great advantage in rounding curves over cars with wheels and axle in one casting, in which one must slip while traversing a greater or smaller arc than the other, except when the slope of the tread and the centrifugal force happen to correspond exactly. The fact of having its supports outside instead of underneath, while increasing its stability, also enabled the lower floor to come much nearer the ground, while still the wheels were large. Arriving in just twenty hours, they ran across on an electric ferry-boat, capable of carrying several dozen cars, to East Cape, Siberia, and then, by running as far north as possible, had a short cut to Europe.

The Patagonians went by the all-rail Intercontinental Line, without change of cars, making the run of ten thousand miles in forty hours. The Australians entered a flying machine, and were soon out of sight; while the Central Americans and members from other States of the Union returned for the most part in their mechanical phaetons.

"A prospective improvement in travelling," said Bearwarden, as he and his friends watched the crowd disperse, "will be when we can rise beyond the limits of the atmosphere, wait till the earth revolves beneath us, and descend in twelve hours on the other side."

"True," said Cortlandt, "but then we can travel westward only, and shall have to make a complete circuit when we wish to go east."

A few days later there was a knock at President Bearwarden's door, while he was seated at his desk looking over some papers and other matters. Taking his foot from a partly opened desk drawer where it had been resting, he placed it upon the handle of a handsome brass-mounted bellows, which proved to be articulating, for, as he pressed, it called lustily, "Come in!" The door opened, and in walked Secretary of State Stillman, Secretary of the Navy Deepwaters, who was himself an old sailor, Dr. Cortlandt, Ayrault. Vice-President Dumby, of the T. A. S. Co., and two of the company's directors.

"Good-morning," said Bearwarden, as he shook hands with his

visitors. "Charmed to see you."

"That's a great invention," said Secretary Stillman, examining the bellows. "We must get Congress to make an appropriation for its introduction in the department buildings in Washington. You have no idea how it dries my throat to be all the time shouting, 'Come in!'"

"Do you know, Bearwarden," said Secretary Deepwaters, "I'm afraid when we have this millennium of climate every one will be so well satisfied that our friend here (pointing to Secretary Stillman with his thumb) will have nothing to do."

"I have sometimes thought some of the excitement will be gone, and the struggle of the 'survival of the fittest' will become less problematical," said Bearwarden.

"The earth seems destined to have a calm old age," said Cortlandt, "unless we can look to the Cabinet to prevent it."

"This world will soon be a dull place. I wish we could leave it for a change," said Ayrault. "I don't mean forever, of course, but just as people have grown tired of remaining like plants in the places in which they grew. Alan has been a caterpillar for untold ages; can he not become the butterfly?"

"Since we have found out how to straighten the axis," said Deepwaters, "might we not go one better, and improve the orbit as well?--increase the difference between aphelion and perihelion, and give those that still like a changing climate a chance, while incidentally we should see more of the world--I mean the solar system--and, by enlarging the parallax, be able to measure the distance of a greater number of fixed stars. Put your helm hard down and shout 'Hard-a-lee!' You see, there is nothing simpler. You keep her off now, and six months hence you let her luff."

"That's an idea!" said Bearwarden. "Our orbit could be enough like that of a comet to cross the orbits of both Venus and Mars; and the climatic extremes would not be inconvenient. The whole earth being simultaneously warmed or cooled, there would be no equinoctials or storms resulting from changes on one part of the surface from intense heat to intense cold; every part would have a twelve-hour day and night, and none would be turned towards or from the sun for six months at a time; for, however eccentric the orbit, we should keep the axis absolutely straight. At perihelion there would simply be increased evaporation and clouds near the equator, which would shield those regions from the sun, only to disappear again as the earth receded.

"The only trouble," said Cortlandt, "is that we should have no

fulcrum. Straightening the axis is simple enough, for we have the attraction of the sun with which to work, and we have but to increase it at one end while decreasing it at the other, and change this as the poles change their inclination towards the sun, to bring it about. If a comet with a sufficiently large head would but come along and retard us, or opportunely give us a pull, or if we could increase the attraction of the other planets for us, or decrease it at times, it might be done. If the force, the control of which was discovered too late to help us straighten the axis, could be applied on a sufficiently large scale; if apergy----"

"I have it!" exclaimed Ayrault, jumping up. "Apergy will do it. We can build an airtight projectile, hermetically seal ourselves within, and charge it in such a way that it will be repelled by the magnetism of the earth, and it will be forced from it with equal or greater violence than that with which it is ordinarily attracted. I believe the earth has but the same relation to space that the individual molecule has to any solid, liquid, or gaseous matter we know; and that, just as molecules strive to fly apart on the application of heat, this earth will repel that projectile when electricity, which we are coming to look upon as another form of heat, is properly applied. It must be so, and it is the manifest destiny of the race to improve it. Man is a spirit cursed with a mortal body, which glues him to the earth, and his yearning to rise, which is innate, is, I believe, only a part of his probation and trial."

"Show us how it can be done," shouted his listeners in chorus.

"Apergy is and must be able to do it," Ayrault continued. "Throughout Nature we find a system of compensation. The centripetal force is offset by the centrifugal; and when, according to the fable, the crystal complained of its hard lot in being unable to move, while the eagle could soar through the upper air and see all the glories of the world, the bird replied, 'My life is but for a moment, while you, set in the rock, will live forever, and will see the last sunrise that flashes upon the earth.'

"We know that Christ, while walking on the waves, did not sink, and that he and Elijah were carried up into heaven. What became of their material bodies we cannot tell, but they were certainly superior to the force of gravitation. We have no reason to believe that in miracles any natural law was broken, or even set aside, but simply that some other law, whose workings we do not understand, became operative and modified the law that otherwise would have had things its own way. In apergy we undoubtedly have the counterpart of gravitation, which must exist, or Nature's system of compensation is broken. May we not believe that in

Christ's transfiguration on the mount, and in the appearance of Moses and Elias with him--doubtless in the flesh, since otherwise mortal eyes could not have seen them--apergy came into play and upheld them; that otherwise, and if no other modification had intervened, they would have fallen to the ground; and that apergy was, in other words, the working principle of those miracles?"

"May we not also believe," added Cortlandt, "that in the transfiguration Christ's companions took the substance of their material bodies--the oxygen, hydrogen, nitrogen, and carbon--from the air and the moisture it contained; for, though spiritual bodies, be their activity magnetic or any other, could of course pass the absolute cold and void of space without being affected, no mortal body could; and that in the same manner Elijah's body dissolved into air without the usual intervention of decomposition; for we know that, though matter can easily change its form, it can never be destroyed."

All assented to this, and Ayrault continued: "If apergy can annul gravitation, I do not see why it should not do more, for to annul it the repulsion of the earth that it produces must be as great as its attraction, unless we suppose gravitation for the time being to be suspended; but whether it is or not, does not affect the result in this case, for, after the apergetic repulsion is brought to the degree at which a body does not fall, any increase in the current's strength will cause it to rise, and in the case of electro-magnets we know that the attraction or repulsion has practically no limit. This will be of great advantage to us," he continued, "for if a projectile could move away from the earth with no more rapid acceleration than that with which it approaches, it would take too long to reach the nearest planet, but the maximum repulsion being at the start by reason of its proximity to the earth--for apergy, being the counterpart of gravitation, is subject to Newton's and Kepler's laws--the acceleration of a body apergetically charged will be greatest at first. Two inclined planes may have the same fall, but a ball will reach the bottom of one that is steepest near the top in less time than on any other, because the maximum acceleration is at the start. We are all tired of being stuck to this cosmical speck, with its monotonous ocean, leaden sky, and single moon that is useless more than half the time, while its size is so microscopic compared with the universe that we can traverse its great circle in four days. Its possibilities are exhausted; and just as Greece became too small for the civilization of the Greeks, and as reproduction is growth beyond the individual, so it seems to me that the future glory of the human race lies in exploring at least the solar system, without waiting to become shades."

"Should you propose to go to Mars or Venus?" asked Cortlandt.

"No," replied Ayrault, "we know all about Mars; it is but one seventh the size of the earth, and as the axis is inclined more than ours, it would be a less comfortable globe than this; while, as our president here told us in his T. A. S. Company's report, the axis of Venus is inclined to such a degree that it would be almost uninhabitable for us. It would be as if colonists tried to settle Greenland, or had come to North America during its Glacial period. Neither Venus nor Mars would be a good place now."

"Where should you propose to go?" asked Stillman.

"To Jupiter, and, if possible, after that to Saturn," replied Ayrault; "the former's mean distance from the sun is 480,000,000 miles; but, as our president showed us, its axis is so nearly straight that I think, with its internal warmth, there will be nothing to fear from cold. Though, on account of the planet's vast size, objects on its surface weigh more than twice as much as here, if I am able to reach it by means of apergy, the same force will enable me to regulate my weight. Will any one go with me?"

"Splendid!" said Bearwarden. "If Mr. Dumby, our vice-president, will temporarily assume my office, nothing will give me greater pleasure."

"So will I go, if there is room for me," said Cortlandt. "I will at once resign my place as Government expert, and consider it the grandest event of my life."

"If I were not afraid of leaving Stillman here to his own devices, I'd ask for a berth as well," said Deepwaters.

"I am afraid," said Stillman, "if you take any more, you will be overcrowded."

"Modesty forbids his saying," said Deepwaters, "that it wouldn't do for the country to have all its eggs in one basket."

"Are you not afraid you will find the surface hot, or even molten?" asked Vice-President Dumby. "With its eighty-six thousand five hundred mile diameter, the amount of original internal heat must have been terrific."

"No, said Cortlandt, "it cannot be molten, or even in the least degree luminous, for, if it were, its satellites would be visible when they enter its shadow, whereas they entirely disappear."

"I do not believe Jupiter's surface is even perceptibly warm," said Bearwarden. "We know that Algol, known to the ancients as

the 'Demon Star,' and several other variable stars, are accompanied by a dark companion, with which they revolve about a common centre, and which periodically obscures part of their light. Now, some of these non-luminaries are nearly as large as our sun, and, of course, many hundred times the size of Jupiter. If these bodies have lost enough heat to be invisible, Jupiter's surface at least must be nearly cold."

"In the phosphorescence of seawater," said Cortlandt, "and in other instances in Nature, we find light without heat, and we may soon be able to produce it in the arts by oxidizing coal without the intervention of the steam engine; but we never find any considerable heat without light."

"I am convinced," said Bearwarden, "that we shall find Jupiter habitable for intelligent beings who have been developed on a more advanced sphere than itself, though I do not believe it has progressed far enough in its evolution to produce them. I expect to find it in its Palaeozoic or Mesozoic period, while over a hundred years ago the English astronomer, Chambers, thought that on Saturn there was good reason for suspecting the presence of snow."

"What sort of spaceship do you propose to have?" asked the vice-president.

"As you have to pass through but little air," said Deepwaters, "I should suggest a short-stroke cylinder of large diameter, with a flat base and dome roof, composed of aluminum, or, still better, of glucinum or beryllium as it is sometimes called, which is twice as good a conductor of electricity as aluminum, four times as strong, and is the lightest of all known metals, having a specific gravity of only two, which last property will be of great use to you, for of course the more weight you have to propel the more apergetic repulsion you will have to develop."

"I will get some drawing-paper I left outside in my trap," said Ayrault, "when with your ideas we may arrive at something definite," saying which, he left the room.

"He seems very cynical in his ideas of life and the world in general," said Secretary Stillman, "for a man of his age, and one that is engaged."

"You see," replied Bearwarden, "his fiancee is not yet a senior, being in the class of two thousand and one at Vassar, and so cannot marry him for a year. Not till next June can this sweet girl graduate come forth with her mortar-board and sheepskin to enlighten the world and make him happy. That is, I suspect, one reason why he proposed this trip."

CHAPTER VII.

HARD AT WORK.

In a few moments Ayrault returned with pencils, a pair of compasses, and paper.

"Let us see, in the first place," said Deepwaters, "how long the journey will take. Since a stone falls 16.09 feet the first second, and 64+ feet the next, it is easy to calculate at what rate your speed would increase with the repulsion twice that of the ordinary traction. But I think this would be too slow. It will be best to treble or quadruple the apergetic charge, which can easily be done, in which case your speed will exceed the muzzle-velocity of a projectile from a long-range gun, in a few seconds. As the earth's repulsion decreases, the attraction of mars and Jupiter will increase, and, there being no resistance, your gait will become more and more rapid till it is necessary to reverse the charge to avoid being dashed to pieces or being consumed like a falling star by the friction in passing through Jupiter's atmosphere. You can be on the safe side by checking your speed in advance. You must, of course, be careful to avoid collisions with meteors and asteroids but if you do, they will be of use to you, for by attracting or repelling them you can change your course to suit yourself, and also theirs in inverse ratio to their masses. Jupiter's moons will be like head and stern lines in enabling you to choose the part of the surface on which you wish to land. With apergy it is as essential to have some heavy body on which to work, within range, as to have water about a ship's propellers. Whether, when apergy is developed, gravitation is temporarily annulled, or reversed like the late attraction of a magnet when the current is changed, or whether it is merely overpowered, in which case your motion will be the resultant of the two, is an unsettled and not very important point; for, though we know but little more of the nature of electricity than was known a hundred years ago, this does not prevent our producing and using it."

"Jupiter, when in opposition," he continued, "is about 380,000,000 miles from us, and it takes light, which travels at the rate of 190,000 miles a second, just thirty-four minutes to reach the earth from Jupiter. If we suppose the average speed of your ship to be one- five-hundredth as great, it will take you just eleven days, nineteen hours and twenty minutes to make the journey. You will have a fine view of Mars and the asteroids, and when 1,169,000 miles from Jupiter, will cross the orbit of Callisto, the fifth moon in distance from the giant planet. That will be your best point to steer by."

"I think," said Ayrault, "as that will be the first member of Jupiter's system we pass, and as it will guide us into port, it would be a good name for our ship, and you must christen her if we have her launched."

"No, no," said Deepwaters, "Miss Preston must do that; but we certainly should have a launch, for you might have to land in the water, and you must be sure the ship is tight."

"Talking of tight ships," said Bearwarden, passing a decanter of claret to Stillman, "may remind us that it is time to splice the 'main brace.' There's a bottle of whisky and some water just behind you," he added to Deepwaters, "while three minutes after I ring this bell," he said, pressing a button and jerking a handle marked '8,' "the champagne cocktails will be on the desk."

"I see you know his ways," said Stillman to Bearwarden, drooping his eyes in Deepwaters's direction.

"Oh, yes, I've been here before," replied Deepwaters. "You see, we navy men have to hustle now-a-days, and can't pass our time in a high-backed chair, talking platitudes."

At this moment there was a slight rumbling, and eight champagne cocktails, with the froth still on, and straws on a separate plate, shot in and landed on a corner of the desk.

"Help yourselves, gentlemen," said Bearwarden, placing them on a table; "I hope we shall find them cold."

"Do you know," said Deepwaters to Ayrault, while rapidly making his cocktail disappear, "the Callisto's cost with its outfit will be very great, especially if you use glucinum, which, though the ideal metal for the purpose, comes pretty high? I suggest that you apply to Congress for an appropriation. This experiment comes under the 'Promotion of Science Act,' and any bill for it would certainly pass."

"No, indeed," replied Ayrault; "the Callisto trip will be a privilege and glory I would not miss, and building her will be a part of it. I shall put in everything conducive to success, but will come to the Government only for advice."

"I will send a letter to all our ambassadors and consuls," said Stillman, "to telegraph the department anything they may know or learn that will be of use in adjusting the batteries, controlling the machine, or anything else, and will turn over to you in a succinct form all information that may be relevant, for without such sorting you would be overwhelmed."

"And I," said Deepwaters, "will order the commanders of our vessels to give you a farewell salute at starting, and to pick you up in case you fail. When you have demonstrated the suitability of apergy," he continued, "and the habitability of Jupiter and Saturn--,which, with their five and eight moons, respectively, and rings thrown in, must both be vastly superior to our little second-rate globe--we will see what can be done towards changing our orbit, and if we cannot swing a little nearer to our new world or worlds. Then we'll lower, or rather raise, the boats in the shape of numerous Callistos, and have a landing-party ready at each opposition, while a man or two can be placed in charge of each projectile to bring it back in ballast. Thus we may soon have regular interplanetary lines."

"As every place seems to have been settled from some other," said Cortlandt, "I do not see why, with increased scientific facilities, history should not repeat itself, and this be the point from which to colonize the solar system; for, for the present at least, it would seem that we could not get beyond that."

"As it will be quite an undertaking to change the orbit, said Deepwaters, "we shall have time meanwhile to absorb or run out all inferior races, so that we shall not make the mistake of extending the Tower of Babel."

"He is putting on his war-paint," said Stillman, "and will soon want a planet to himself."

"I see no necessity for even changing the orbit," said Bearwarden, "except for the benefit of those that remain. If this attempt succeeds, it can doubtless be repeated. An increase in eccentricity would merely shorten the journey, if aphelion always coincided with opposition, which it would not."

"Let us know how you are getting on," said Deepwaters to Ayrault, "and be sure you have the Callisto properly christened. Step lively there, landlubbers!" he called to Stillman; "I have an appointment at Washington at one, and it is now twenty minutes past twelve. We can lunch on the way."

Ayrault immediately advertised for bids for the construction of a glucinum cylinder twenty-five feet in diameter, fifteen feet high at the sides, with a domed roof, bringing up the total height to twenty-one feet, and with a small gutter about it to catch the rain on Jupiter or any other planet they might visit. The sides, roof, and floor were to consist of two sheets, each one third of an inch thick and six inches apart, the space between to be filled with mineral wool, as a protection against the intense cold of space. There were also to be several keels and supports

underneath, on which the car should rest. Large, toughened plate-glass windows were to be let into the roof and sides, and smaller ones in the floor, all to be furnished with thick shades and curtains. Ayrault also decided to have it divided into two stories, with ceilings six and a half to seven and a half feet high, respectively, with a sort of crow's nest or observatory at the top; the floors to be lattice- work, like those in the engine-room of a steamer, so that when the carpets were rolled up they should not greatly obstruct the view. The wide, flat base and the low centre of gravity would, he saw, be of use in withstanding the high winds that he knew often prevailed on Jupiter.

As soon as possible he awarded the contract, and then entering his smart electric trap, steered for Vassar University along what was the old post-road--though its builders would not have recognized it with its asphalt surface, straightened curves, and easy grades--to ask his idol to christen the Callisto when it should be finished.

Starting from the upper end of Central Park, he stopped to buy her a bunch of violets, and then ran to Poughkeepsie in two hours.

Sylvia Preston was a lovely girl, with blue eyes, brown hair, and perfect figure, clear white skin, and just twenty. She was delighted to see him, and said she would love to christen the Callisto or do anything else that he wished. "But I am so sorry you are going away," she went on. "I hate to lose you for so long, and we shall not even be able to write."

"Why couldn't we be married now," he asked, "and go to Jupiter for our honeymoon?"

"I'm afraid, dear," she answered, "you would be sorry a few years hence if I didn't take my degree; and, besides, as you have asked those other men, there wouldn't be room for me."

"We could have made other arrangements," he replied, "had I been able to persuade you to go."

"Won't you dine with us at Delmonico's this evening, and go to the play?" she asked. "Papa has taken a box."

"Of course I will," he said, brightening up. "What are you going to wear?"

"Oh, I suppose something light and cool, for it's so hot," she answered.

"I'll go now, so as to be ready," he said, getting up and going towards the door to which Sylvia followed him.

A man in livery stood at the step of the phaeton. Ayrault got in and turned on the current, and his man climbed up behind.

On turning into the main road Ayrault was about to increase his speed, when Sylvia, who had taken a short cut appeared at the wayside carrying her hat in one hand and her gloves in the other.

"I couldn't let you go all by yourself," she said. "The fact is, I wanted to be with you."

"You are the sweetest thing that ever lived, and I'll love you all my days," he said, getting down and helping Sylvia to the seat beside him. "What a nuisance this fellow behind is!" he continued--referring to the groom-- "for, though he is a Russian, and speaks but little English, it is unpleasant to feel he is there."

"You'll have to write your sweet nothings, instead of saying them," Sylvia replied.

"For you to leave around for other girls to see," answered Ayrault with a smile.

"I don't know what your other girls do," she returned, "but with me you are safe."

Ayrault fairly made his phaeton spin, going up the grades like a shot and down like a bird. On reaching New York, he left Sylvia at her house, then ran his machine to a florist's, where he ordered some lilies and roses, and then steered his way to his club, where he dressed for dinner. Shortly before the time he repaired to Delmonico's--which name had become historical, though the founders themselves were long dead--and sat guard at a table till Sylvia, wearing his flowers and looking more beautiful than any of them, arrived with her mother and father, and Bearwarden, whom they knew very well.

"How are the exams getting on, Miss Preston?" Bearwarden asked.

"Pretty well," she replied, with a smile. "We had English literature yesterday, and natural history the day before. Next week we have chemistry and philosophy."

"What are you taking in natural history?" asked Bearwarden, with interest.

"Oh, principally physical geography, geology, and meteorology,"

she replied. "I think them entrancing."

"It must be a consolation," said Ayrault, "when your best hat is spoiled by rain, to know the reason why. Your average," he continued, addressing Sylvia, "was ninety in the semi-annuals, and I haven't a doubt that the finals will maintain your record for the year."

"Don't be too sure," she replied. "I have been loafing awfully, and had to engage a 'grind' as a coach."

After dinner they went to the play, where they saw a presentation of Society at the Close of the Twentieth Century, which Sylvia and Ayrault enjoyed immensely.

A few days after the Delmonico dinner, while Bearwarden, Cortlandt, and Ayrault sat together discussing their plans, the servant announced Ayrault's family physician, Dr. Tubercle Germiny, who had been requested to call.

"Delighted to see you, doctor," said Ayrault, shaking hands. "You know Col. Bearwarden, our President, and Dr. Cortlandt--an LL. D., however, and not a medico."

"I have had the pleasure," replied Dr. Germiny, shaking hands with both.

"As you may be aware, doctor," said Ayrault, when they were seated, "we are about to take a short trip to Jupiter, and, if time allows, to Saturn. We have come to you, as one familiar with every known germ, for a few precautionary suggestions and advice concerning our medicine-chest."

"Indeed!" replied Dr. Germiny, "a thorough knowledge of bacteriology is the groundwork of therapeutics. It is practically admitted that every ailment, with the exception of mechanical injuries, is the direct result of a specific germ; and even in accidents and simple fractures, no matter what may be the nature of the bruise, a micro-organism soon announces its presence, so that if not the parent, it is the inseparable companion, in fact the shadow, of disease. Now, though not the first cause in this instance, it has been indubitably proved, that much of the effect, the fever and pain, are produced and continued by the active, omnipresent, sleepless sperm. Either kill the micrococcus or heal the wound, and you are free from both. It being, therefore, granted that the ills of life are in the air, we have but to find the peculiar nature of the case in hand, its habits, tastes, and constitution, in order to destroy it. Impoverish the soil on which it thrives, before its arrival, if you can foresee the nature of the inoculation to which you

will be exposed, by a dilute solution of itself, and supply it only with what it particularly dislikes. For an already established tubercle requiring rapid action of the blood, such as may well exist among the birds and vertebrates of Jupiter and Saturn, I suggest a hypodermic rattlesnake injection, while hydrocyanic acid and tarantula saliva may also come in well. The combinations that so long destroyed us have already become our panacea."

"I see you have these poisons at your fingers' ends," said Ayrault, "and we shall feel the utmost confidence in the remedies and directions you prescribe."

They found that, in addition to their medicine-chest, they would have to make room for the following articles, and also many more: six shot-guns (three double-barrel 12-bores, three magazine 10-bores,) three rifles, three revolvers; a large supply of ammunition (explosive and solid balls), hunting-knives, fishing-tackle, compass, sextant, geometrical instruments, canned food for forty days, appliance for renewing air, clothing, rubber boots, apergetic apparatus, protection-wires, aneroid barometer, and kodaks.

CHAPTER VIII.

GOOD-BYE.

At last the preparations were completed, and it was arranged that the Callisto should begin its journey at eleven o'clock A. M., December 21st--the northern hemisphere's shortest day.

Though six months' operations could hardly be expected to have produced much change in the inclination of the earth's axis, the autumn held on wonderfully, and December was pronounced very mild. Fully a million people were in and about Van Cortlandt Park hours before the time announced for the start, and those near looked inquiringly at the trim little air-ship, that, having done well on the trial trip, rested on her longitudinal and transverse keels, with a battery of chemicals alongside, to make sure of a full power supply.

The President and his Cabinet--including, of course, the shining lights of the State and Navy Departments--came from Washington. These, together with Mr. and Mrs. Preston, and a number of people with passes, occupied seats arranged at the sides of the platform; while sightseers and scientists assembled from every part of the world.

"There's a ship for you!" said Secretary Stillman to the

Secretary of the Navy. "She'll not have to be dry-docked for barnacles, neither will the least breeze make the passengers sick."

"That's all you landlubbers think of," replied Deepwaters. "I remember one of the kings over in Europe said to me, as he introduced me to the queen: 'Your Secretary of State is a great man, but why does he always part his hair in the middle?'

"'So that it shall not turn his head,' I replied.

"'But with so gallant and handsome an officer as you to lean upon,' he answered, 'I should think he could look down on all the world.' Whereupon I asked him what he'd take to drink."

"Your apology is accepted," replied Secretary Stillman.

Cortlandt also came from Washington, where, as chief of the Government's Expert Examiners Board, he had temporary quarters. Bearwarden sailed over the spectators' heads in one of the Terrestrial Axis Straightening Company's flying machines, while Ayrault, to avoid the crowd, had come to the Callisto early, and was showing the interior arrangements to Sylvia, who had accompanied him. She was somewhat piqued because at the last moment he had not absolutely insisted on carrying her off, or offered, if necessary, to displace his presidential and Doctor-of-Laws friends in order to make room.

"You will have an ideal trip," she said, looking over some astronomical star-charts and photographic maps of Jupiter and Saturn that lay on the table, with a pair of compasses, "and I hope you won't lose your way."

"I shall need no compass to find my way back," replied Ayrault, "if I ever succeed in leaving this planet; neither will star-charts be necessary, for you will be a magnet stronger than any compass, and, compared with my star, all others are dim."

"You should write a book," said Sylvia, "and put some of those things in it." She was wearing a bunch of forget-me-nots and violets that she had cut from a small flower-garden of potted plants Ayrault had sent her, which she had placed in her father's conservatory.

At this moment the small chime clock set in the Callisto's wood-work rang out quarter to eleven. As the sounds died away, Sylvia became very pale, and began to regret in her womanly way that she had allowed her hero to attempt this experiment.

"Oh," she said, clinging to his arm, "it was very wrong of me to

let you begin this. I was so dazzled by the splendour of your scheme when I heard it, and so anxious that you should have the glory of being the first to surpass Columbus, that I did not realize the full meaning. I thought, also, you seemed rather ready to leave me," she added gently, "and so said little; you do not know how it almost breaks my heart now that I am about to lose you. It was quixotic to let you undertake this journey."

"An undertaker would have given me his kind offices for one even longer, had I remained here," replied Ayrault. "I cannot live in this humdrum world without you. The most sustained excitement cannot even palliate what seems to me like unrequited love."

"O Dick!" she exclaimed, giving him a reproachful glance, "you mustn't say that. You know you have often told me my reason for staying and taking my degree was good. My lot will be very much harder than yours, for you will forget me in the excitement of discovery and adventure; but I--what can I do in the midst of all the old associations?"

"Never mind, sweetheart," he said, kissing her hand, "I have seemed on the verge of despair all the time."

Seeing that their separation must shortly begin, Ayrault tried to assume a cheerful look; but as Sylvia turned her eyes away they were suspiciously moist.

Just one minute before the starting-time Ayrault took Sylvia back to her mother, and, after pressing her hand and having one last long look into her--or, as he considered them, HIS--deep-sea eyes, he returned to the Callisto, and was standing at the foot of the telescopic aluminum ladder when his friends arrived. As all baggage and impedimenta bad been sent aboard and properly stowed the day before, the travellers had not to do but climb to and enter by the second-story window. It distressed Bearwarden that the north pole's exact declination on the 21st day of December, when the axis was most inclined, could not be figured out by the hour at which they were to start, so as to show what change, if any, had already been brought about, but the astronomers were working industriously, and promised that, if it were finished by midnight, they would telegraph the result into space by flash-light code.

Raising his hat to his fiancee and his prospective parents-in-law, Ayrault followed them up. To draw in and fold the ladder was but the work of a moment. As the clocks in the neighbouring steeples began to strike eleven, Ayrault touched the switch that would correspond to the throttle of an engine, and the motors began to work at rapidly increasing speed. Slowly the Callisto left her resting-place as a Galatea might her pedestal,

only, instead of coming down, she rose still higher.

A large American flag hanging from the window, which, as they started, fluttered as in a southern zephyr, soon began to flap as in a stiff breeze as the car's speed increased. With a final wave, at which a battery of twenty-one field-pieces made the air ring with a salute, and the multitude raised a mighty cheer, they drew it in and closed the window, sealing it hermetically in order to keep in the air that, had an opening remained, would soon have become rarefied.

Sylvia had waved her handkerchief with the utmost enthusiasm, in spite of the sadness at her heart. But she now had other use for it in trying to hide her tears. The Callisto was still going straight up, with a speed already as great as a cannon ball's, and was almost out of sight. The multitude then began to disperse, and Sylvia returned to her home.

Let us now follow the Callisto. The earth and Jupiter not being exactly in opposition, as they would be if the sun, the earth, and Jupiter were in line, with the earth between the two, but rather as shown in the diagram, the Callisto's journey was considerably more than 380,000,000 miles, the mean opposition distance. As they wished to start by daylight--i. e., from the side of the earth turned towards the sun--they could not steer immediately for Jupiter, but were obliged to go a few hundred miles in the direction of the sun, then change their course to something like a tangent to the earth, and get their final right direction in swinging near the moon, since they must be comparatively near some material object to bring apergy into play.

The maximum power being turned on, the projectile shot from the earth with tremendous and rapidly increasing speed, by the shortest course--i. e., a straight line--so that for the present it was not necessary to steer. Until beyond the limits of the atmosphere they kept the greatest apergetic repulsion focused on the upper part of their cylinder, so that its point went first, and they encountered least possible resistance. Looking through the floor windows, therefore, the travellers had a most superb view. The air being clear, the eastern border of North America and the Atlantic were outlined as on a map, the blue of the ocean and brownish colour of the land, with white snow- patches on the elevations, being very marked. The Hudson and the Sound appeared as clearly defined blue ribbons, and between and around the two they could see New York. They also saw the ocean dotted for miles with points in which they recognized the marine spiders and cruisers of the North Atlantic squadron, and the ships on the home station, which they knew were watching them through their glasses.

"I see," said Cortlandt, "that Deepwaters has been as good as his word, and has his ships on the watch to rescue us in case we fail."

"Yes," replied Bearwarden, "he is the right sort. When he gave that promise I knew his men would be there."

They soon perceived that they had reached the void of space, for, though the sun blazed with a splendour they had never before seen, the firmament was intensely black, and the stars shone as at midnight. Here they began to change their course to a curve beginning with a spiral, by charging the Callisto apergetically, and directing the current towards the moon, to act as an aid to the lunar attraction, while still allowing the earth to repel, and their motion gradually became the resultant of the two forces, the change from a straight line being so gradual, however, that for some minutes they scarcely perceived it. The coronal streamers about the sun, such as are visible on earth during a total eclipse, shone with a halo against the ultra-Cimmerian background, bursting forth to a height of twenty or thirty thousand miles above the surface in vast cyclonic storms, producing so rapid a motion that a column of incandescent gas may move ten thousand miles in less than ten minutes. Whether these great streaks were in part electrical phenomena similar to the aurora borealis, or entirely of intensely heated material thrown up by explosions within the sun's mass, they could not tell even from their point of vantage.

"I believe," said Cortlandt, pointing to the streamers, "that they are masses of gas thrown beyond the sun's atmosphere, which expand enormously when the pressure to which they are subjected in the sun is removed--for only in space freed from resistance could they move at such velocities, and that their brilliancy is increased by great electrical disturbance. If they were entirely the play of electrical forces, their change of place would be practically instantaneous, which, however rapid their movement, is not the case."

BOOK II.

CHAPTER I.

THE LAST OF THE EARTH.

Finding that they were rapidly swinging towards their proper course, and that the earth in its journey about the sun would move out of their way, they divided their power between repelling the body they had left and increasing the attraction of the moon,

and then set about getting their house in order.

Bearwarden, having the largest appetite, was elected cook, the others sagely divining that labour so largely for himself would be no trial. Their small but business- like-looking electric range was therefore soon in full blast, with Bearwarden in command. It had enough current to provide heat for cooking for four hundred hours, which was an ample margin, and it had this advantage, that, no matter how much it was used, it could not exhaust the air as any other form of heat would.

There were also a number of sixteen-candle-power incandescent lamps, so that when passing through the shadow of a planet, or at night after their arrival on Jupiter, their car would be brightly illuminated. They had also a good search-light for examining the dark side of a satellite, or exploring the spaces in Saturn's rings. Having lunched sumptuously on canned chicken soup, beef a la jardiniere, and pheasant that had been sent them by some of their admirers that morning, they put the bones and the glass can that had contained the soup into the double-doored partition or vestibule, placing a large sheet of cardboard to act as a wad between the scraps and the outside door. By pressing a button they unfastened the outside door, and the articles to be disposed of were shot off by the expansion of the air between the cardboard disk and the inside door; after which the outside door was drawn back to its place by a current sent through a magnet, but little power being required to reclose it with no resisting atmospheric pressure. As the electricity ran along a wire passing through a hermetically sealed opening in the floor, there was no way by which more air than that in the vestibule could escape; and as the somewhat flat space between the doors contained less than one cubic foot, the air- pressure inside the Callisto could not be materially lessened by a few openings.

"By filling the vestibule as full as possible," said Bearwarden, "and so displacing most of its air, we shall be able to open the outside door oftener without danger of rarefaction."

The things they had discharged flew off with considerable speed and were soon out of sight; but it was not necessary for them to move fast, provided they moved at all, for, the resistance being nil, they would be sure to go beyond the range of vision, provided enough time was allowed, even if the Callisto's speed was not being increased by apergy, in which case articles outside and not affected would be quickly left behind.

The earth, which at first had filled nearly half their sky, was rapidly growing smaller.