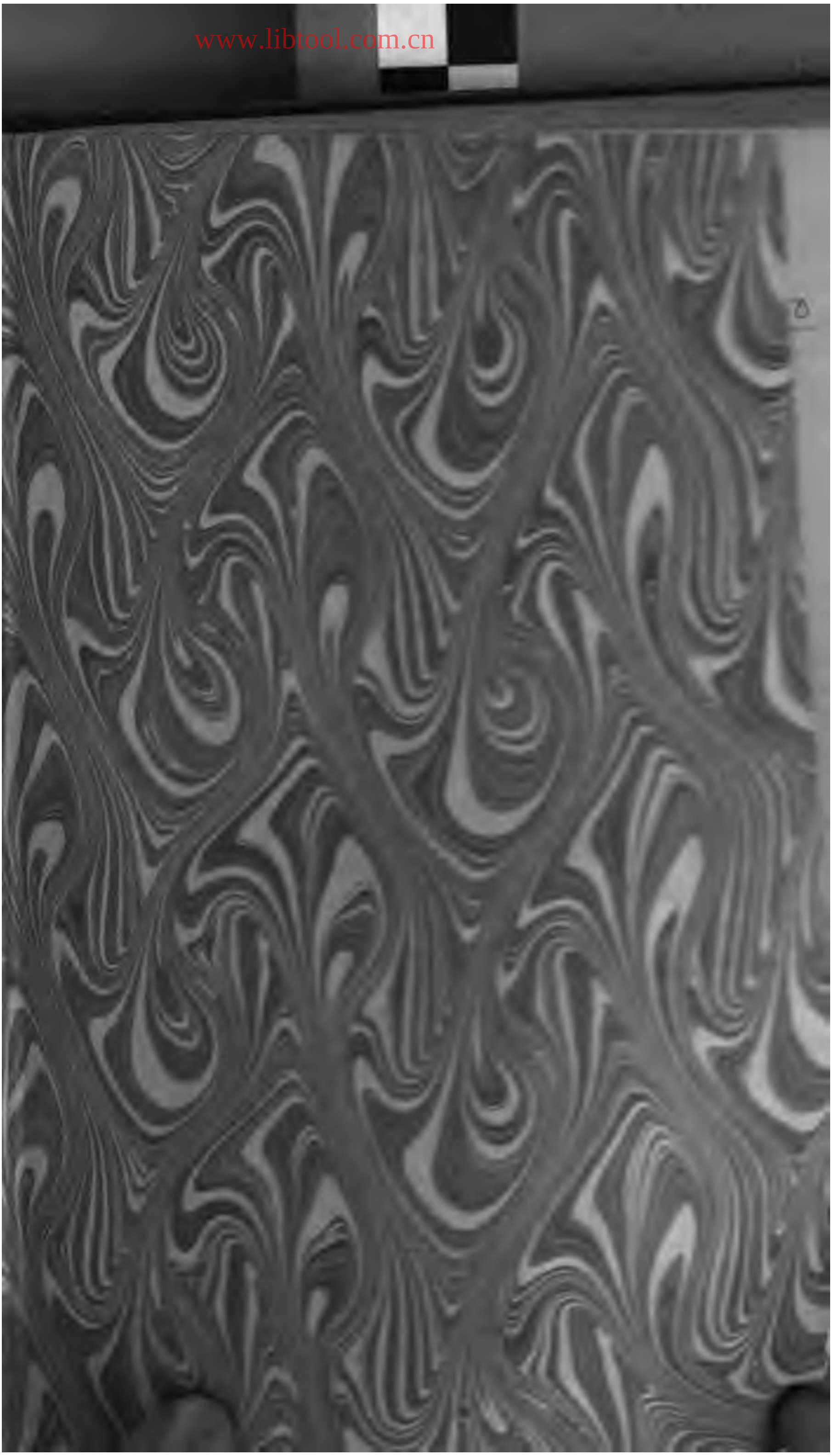

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Walter Wellman.

THE AERIAL AGE

A Thousand Miles by Airship Over the Atlantic Ocean

Airship voyages over the Polar Sea

THE PAST, THE PRESENT AND THE FUTURE OF AERIAL NAVIGATION

BY

WALTER WELLMAN
(JOURNALIST, EXPLORER. AERONAUT)

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CONTENTS

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LIST OF ILLUSTRATIONS

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TO MY READERS

Will you walk with me a while in the paths of adventure? For that is what this book is to deal with—adventures in Polar Ice, far out upon the broad sea, and high up in the air which covers them both. By adventure I mean strange and thrilling experiences which come to one who sets out, not for adventure, not for hardships, not for narrow escapes from death, but with a desire to achieve something in the way of exploration and scientific progress for the good of mankind and the advancement of knowledge; and who, in this spirit endeavoring, experiences more of adventure, danger and hardship, and ill fortune followed by the fair that leaves life intact after hope had almost gone, than he had ever dreamed of—so much, perhaps that if he could have foreseen it all he would never have had the courage to venture forth from the quiet of his home.

Scientific achievement was the purpose and moving spirit, adventure and danger the incidents which the fates would have, of all the activities with which this volume deals. I make no apology for thus frankly characterizing it: for in my philosophy even adventure for mere adventure's sake (and ours, as I say, is much more) is always worth while. In this plodding commercial age, this day of humdrum money grubbing and of the routine though admirable round of quite duty doing, it is a good thing, I think, for the few of us who can to leave the beaten track, fare forth into strange fields, and strive mightily to do things which are exceedingly difficult and dangerous and the more fascinating because they are difficult and dangerous. It is a good thing to stir the blood into faster coursing through the veins, to warm the heart with sympathy and anxiety for one's comrades, to dream a few waking dreams, to live a few romances in real life.

My comrades? Yes, I like to speak of them. They are close to my heart. I shall tell you much about them in these pages. It has been my fortune to have with me, in polar sledging trips, in long Arctic nights, in airship voyages over the ice fields and glaciers of the far north, and in a thousand mile flight over the stormy waters of the Atlantic, men brave, true, loyal, heroic. They have won my love and admiration: and I want them to have yours. With joy I shall tell you of their deeds of daring, their endurance, their valor. Without them I should have done little.

Always, in every campaign, they did far more than I. And yet, no mock modesty, no straining for effect, shall preclude my speaking of myself whenever and wherever I am a proper part of the story. For the story is the thing, after all.

This history of scientific adventure will, I trust, do much better than thrill or amuse the reader. It is my hope to put in these pages so much of scientific fact and data concerning the polar regions, the ocean of the atmosphere, navigation of the air and all the physics, chemistry, arts, sciences, mechanics, involved in it—the range is almost as wide as the horizon of human achievement—and to write it all in such clear, simple, plain, unpretentious, popular way that in the end my reader shall be forced to confess he has not only been entertained but instructed; and perchance that he has acquired the very information and insight as to the mysteries of aerial navigation which he had long sought and never before found.

All my life I have been writing for the people. To please, to inform, to help educate, to win the approval of the people, is, I admit, the very breath of life in my nostrils. Always have I looked upon the masses of the people as my masters, upon myself as their servant. I lay no claim to great scientific knowledge, nor to honors or titles. As a plain, simple man, coming from the farm through the country school house and the village printing office to metropolitan journalism, association with presidents and the highest in the land, studying and writing of life and questions and policies and great events, and finally as a man of action trying to do a few things in the world on my own account, I have never for a moment lost or desired to lose any of this feeling that far beyond my humble deserts there exists a strong bond of sympathy and mutual understanding between the people—the real people who make up the bulk of the pyramid of society, not the few who imagine themselves as composing its apex—and myself.

If this book, which in a sense is the story of my life of activity apart from my quarter century of work in journalism, shall serve to preserve and perpetuate that happy relationship between the people and the penman, no other reward or compensation do I crave.

Walter Wellman.

THE AERIAL AGE

CHAPTER I

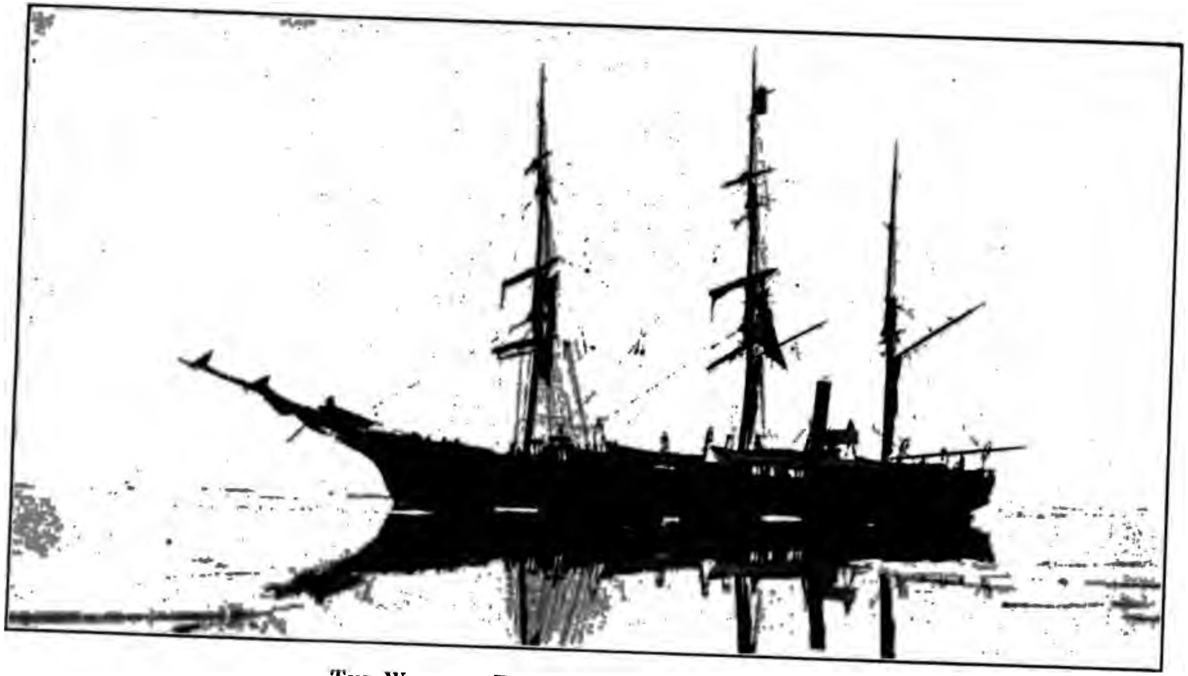
EARTH EXPLORATION AND AIR NAVIGATION

For a century or more man has had two great aspirations in the field of progress—one to conquer the unknown parts of the earth, the other to conquer the air. He had already possessed himself of most of the surface of the globe, and now he wished to take possession of the remainder. He had learned to travel over the land, and to sail the sea. Now he wished to navigate the great atmospheric ocean which everywhere surrounds and covers the land.

It happened that my activities in the field of earth exploration brought me into the field of air navigation. At first, aerial navigation was with me only a means to an end, and the end in view was attainment of the North Pole—to push farther and farther forward the frontiers of man's knowledge of the earth.

My plan and effort were to take the progress that had been made in the aeronautic art and so proof of this is that the brave and resourceful men of many nations tried it for two centuries, without success. Recently it seemed to many of us the time had come to adopt new methods, to make an effort to substitute modern science for brute force, the motor-driven balloon for the muscles of men and beasts stumbling along like savages in their heroic struggle to accomplish the almost impossible. All such effort is worthy; but not the least worthy, I think, is the one which tries to take a step forward from barbarism and make one science serve another.

Always keenly interested in all geographic exploration, and Arctic work in particular, about seventeen years ago I read again the story of a voyage toward the North Pole which had been made by the celebrated English traveler, Captain Parry, in 1827. He had reached North Spitzbergen with his sailing ships. Thence, in the summer season, with heavy ship's boats weighing a ton or more each, only ordinary sailors, and no special equipment, he had set out to sledge and pull the clumsy boats over the rough sea ice toward the Pole. Despite the handicap of heavy weights under which he had struggled, fair progress was made. Indeed, Captain Parry reached latitude 82:45 north, which stood as the record of man's northerly advance till Lockwood and Brainard of the Greely



The Wellman Expedition Steamship Frithjof.

expedition beat it about thirty miles in 1884, in North Greenland.

Believing that if Parry could do as well as this in the summer season, with such heavy boats, much more might be done with lighter craft and a more modern equipment, I visited Norway in 1893 to investigate conditions and possibly to prepare for an expedition of my own. Consulting many Norwegian skippers who had sailed in Spitzbergen waters, and gaining encouragement from them, I returned to America, secured the necessary capital, organized an expedition, chartered an old ice-steamer in Norway—she was named the *Ragnvald Jarl*—and built three boats of aluminum for use on the trip, with special sledges and other equipment designed to facilitate travel over the polar pack in the summer of the year.

In April, 1894, with three American companions, Charles R. Dodge, O. B. French, from the Coast and Geodetic Survey, and Dr. Mohun, we were at Aalesund, Norway, the famous fishing port of the west coast, getting our ship ready for her voyage. The remainder of our crew was made up of Norwegian scientific men, athletes, and sailors experienced in Arctic ice. April 30th we sailed from Aalesund, and four days later from Tromso. Though warned not to attempt to reach Spitzbergen so early in the year, we immediately steamed away from the Norwegian coast and set our prow to the northward. We were favored by an unusually open sea. Ordinarily, as I have since learned in many voyages to and fro, one cannot be sure of getting through to North Spitzbergen before the middle or latter part of June. This year we were able to reach and enter the Danish Strait, near the extreme northwestern part of Spitzbergen, May 10th, one of the earliest passages on record.

Spitzbergen is an uninhabited group of islands, some of them quite large, lying between the 76th and 81st parallels of north latitude. It thus extends about 350 statute miles north and south, and it has a breadth of about the same extent. It is true Arctic country. There is no foliage, save stunted brush in the southern part. The mountains are covered with eternal ice, and the valleys are filled with glaciers. Some grass grows in the sheltered parts during the short Arctic summer, and flowering poppies and mosses are seen here and there. Upon the mosses many herds of reindeer live.

Spitzbergen was two centuries ago the seat of rich right whale fisheries. The catch of seal and walrus, killing polar bear, and gathering the down of the eider duck from their myriad nests in the rocky cliff, were other industries carried on by hunters, penetrating the wilderness of snow and ice with their little sloops from Norway, Holland, Russia, and Scotland. In the palmy days of the whale fisheries the Dutch established upon Smeerenburg point, a long strip of sand on the north shore of the Danish Strait, a summer city. And what a city it must have been! The only industry was the trying out of whale blubber —hence the name, Smeerenburg. Hundreds of whaling ships made this port their rendezvous. Houses were built, and thatched with Dutch tiles. Cafes, dance halls, and worse places to get money out of the sailors existed. At times the population rose to three or four thousand souls, all men save a hundred or two women—of a certain class. There was much drinking and fighting, the country being then as now without laws or police authority or supervision. But this reeking city of blubber existed only in summer. In the autumn all went home to Holland, to come out and try their luck the next year. A large number of graves scattered about on Smeerenburg point and the adjacent lands, indicate the lawless life led by the denizens of that strange summer town, and their defiance of all laws of right living. At that time it was deemed almost sure death to attempt to endure a winter in Spitzbergen, and scurvy did claim for its victims a large per cent. of those who, caught by shipwreck or storm, were unable to get away in the autumn.

Scurvy is no longer a terror of the Arctics. Men winter far north in health and comfort if they only provide themselves with proper food, bathe occasionally and take a proper amount of exercise.

CHAPTER II

SHIPWRECKED IN SPITZBERGEN

We paused but a few hours in the Danish strait, little thinking that moment that it was to be the scene of so much of our future activity, struggle and disappointment. We found on shore there a good Arctic house which had been built in Norway, taken down and reërected on the shore of the strait by an English sportsman named Pike, who had passed a winter in it hunting bear and foxes. Before proceeding farther north we established a depot of supplies in this house, to fall back upon in case of disaster, and left a man in charge of it.

As a result of this incident I a little later got my first taste of newspaper sensationalism and misrepresentation. The man we left in charge of our depot in Pike's house was a Norwegian scientist, who had asked to be permitted to remain there, as he wished to carry on geological work in the neighborhood. We offered to leave one man with him for comrade, but he objected to that, and preferred to remain alone. There was indeed no reason why he should not remain

... sealing sloops from

would be running in there two
as was their habit in the middle
And yet upon returning to
autumn I was amazed to discov
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having cruelly abandoned a poc
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abandoned man had a house full of
money could buy—enou...

northeastward along the north coast of Spitzbergen, and soon found ourselves at the Seven Islands, which are the most northerly of the Archipelago, just under the eighty-first parallel of latitude. But a few miles to the north lay the polar ice-pack which no ship can penetrate and navigate, and so we prepared to carry out the original plan of the expedition, which was to make headway over the pack toward the north with sledges and our light aluminum boats.

We did indeed set out, and at first made fairly good progress along the land ice, looking for a place where the pack was not so rough and so much broken up for launching our little caravan upon the rugged frozen surface of the polar sea. But in a few days two things happened which seriously interfered with the success of the trip. A storm came out of the northwest, drove the pack-ice down upon the land with terrific force, heaping it mountain high, and, worse still, catching our steamship in a vice and wrecking it. Captain Bottolfsen, an experienced Arctic navigator, was responsible for the safety of the ship. At Walden Island, near where the great Nelson, then a midshipman, had killed a bear while with an English exploring ship years before, Bottolfsen had anchored the *Ragnvald Jarl* behind a projecting tongue of heavy ice, where it seemed she would be safe. But after we left the ship, and when the storm came down from the northwest, bringing the great ocean pack with it, that tongue had given way, the ship was caught in the jaw, great masses of ice went right through her hull as you would stick the tines of a fork through an egg-shell, and the *Ragnvald Jarl* was no more.

Messengers were sent out and overtook us some miles to the northeast. I hastened back to the ship, and found her a total wreck. She was held up only by the ice that had pierced her; when this was withdrawn she was sure to sink to the bottom of the sea. I went aboard her, and with great difficulty made my way to what had been my cabin, but which was now a mass of wreckage, and where my trunk was swimming about in the water. Captain Bottolfsen and some of the sailors helped me rescue the trunk, all the time protesting that the ship was likely to go to the bottom at any moment. In that trunk I had my evening clothes, probably the only case on record of a dress suit being wrecked in the ice of the far north. It was here because I had it with me in England and Norway; had taken my trunk upon the steamer because I wanted the papers and other clothing it contained; and though I had no possible use for evening clothes in the far north had permitted

"SUPPER IS READY, THE ONLY GLORIOUS HOUR OF THE DAY."

it to remain where it was as the easiest solution of the problem of what to do with it.

Upon shore Capt. Bottolfsen and his men had erected a house, half of timbers from the wreck, half of sailcloth, had installed therein the ship's galley, and were not so very uncomfortable. They had saved some of the stores, and were in no immediate danger of famine. Having assured myself they were safe, and after making an arrangement with Capt. Bottolfsen to take a small boat and proceed with a picked party to the south in search of a ship, I returned to my sledging expedition, running on Norwegian ski or snowshoes.

We decided to go on with our trip, though forced in prudence to modify the plan in important particulars, because our ship had been destroyed behind us, and there was no certainty of finding another. The same storm which had wrecked our vessel had piled the ice mountain high against all the islands in that part of Spitzbergen, making it impossible to get out upon the normal pack, where travel, though difficult, is still practicable. Advised by my Norwegian comrades that we might find better ice farther east, we traveled in that direction. After several days of arduous work, pulling our heavy sledges and boats, we found it necessary to

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at Liege in the former country k
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They endured quite well the voyag
regions, and were strong enough to
But they could not get accusto
strange surroundings. They were
sick, just as I have seen many mer
from their customary life and put in
what lonely and trying work of th
Worst of all, these dogs suffered fr
their feet. The snow and ice worke
their toes, drew the blood, and our t
was marked with streaks of red wh
perhaps even more than it hurt the
who left it there as they ambled a
ingly with their loads behind them
relief when open water

of bathing. Just before we came to the belt of open water requiring us to take to the boats there chanced to be near us, one day when we stopped for luncheon, sitting upon our sledges, a most inviting natural bath tub. The top layer of ice, about six feet in thickness, had parted and left an opening down to the older ice about eight feet in width and perhaps twenty feet in length. This crystal bath-tub had been partly filled with snow water, melted by the heat of the sun—for freezing in the shade and thawing in the sun is a common occurrence in the summer and late spring of the Arctic regions. This pool of purest water, glistening in the sunlight, proved too fascinating to be resisted; and amid the astonishment of my Norwegians I stripped to the skin and had a five-minute dip in the limpid pool. It was cold, and that's the truth; but the most disagreeable thing about it was not the coldness of the water, but the snow squeezing up between my toes as I walked from the sledge to my icy tub and back again. Later on a number of us bathed in the Arctic Sea, diving off the ice, greatly to the astonishment of some seals that were swimming about hard by.

We went on as far as the Platen Island, lying off the coast of the Northeast Land of Spitzbergen. There we made a comfortable camp, finding plenty of driftwood that had come all

we should need. Po
That part of the Arctic regio
by hunters because of the diffi
of ice-navigation there; and t
parently had never seen men be
fear.

There is a tradition that all
Spitzbergen have descended fron
which Baron Nordenshiold of
the north coast from Lapland a
ago, thinking to use them inst
draw sledges over the pack-ice to
One stormy night all his deer esc
his polar expedition was ruined.
the evidence is clear that reinde
existed in Spitzbergen. Whenev
along the coast I have found
some of them apparently hundre
In that country wood and bone
The skeleton of the Dutchmen
exposed graves

CHAPTER III

STRUGGLING AGAINST THE IMPOSSIBLE

From the Platen Island we made a desperate effort to get out upon the polar pack and start toward the Pole. But it was simply impossible. The storm of which I have spoken had driven hundreds of millions of tons of ice down upon the land—an example of an irresistible force encountering an immovable body—and the result was mad chaos. Ice-blocks as large as houses piled high in the wildest confusion. Between them deep pockets filled with treacherous slush and brash ice upon which we could get no firm footing and through which the water could not be forced. We had many narrow escapes whilst working in this mass of frozen stuff over the deep sea. Many times we pulled one another out of the water. After these cold baths we went on with our work as if nothing had happened, not taking the trouble to change our soaked clothing for dry. It is nothing when you get used to it.

Defeated in the main purpose of our expedition, we had to think of returning to that part of Spitzbergen where we could hope to find a ship. So we started back for Walden Island. On the way we had many adventures. The advancing summer rotted the ice. For miles and miles we could make headway only by shoving the aluminum boats through the slush-ice, we half walking, half swimming alongside, jumping in the boat when we came to an open pool, out again and leaping from ice cake to cake in the broken-up fields. We were wet to the middle from morning till night. We did not mind it so much when the sun shone and the weather was fine. But it was pretty dreary work in wind and rain, and worse still in the thick fogs, so dense that we could not see much more than a boat's length.

It was particularly awkward to camp at night —as we were sometimes forced to do—upon ice so rotten that we could not step a couple of paces from the boats without danger of going down into the salt water underneath. Many such duckings we all had, and sometimes it was not easy to pull a man out after he had gone down in the ice to his middle.

One of my best and bravest Norwegians, Herr Alme, a fine athlete, broke a bone in his foot one day, leaping from one floe of ice to another. He suffered excruciating pain. That night, after his foot had been dressed by Dr. Mohun, I found the poor fellow lying in his boat crying bitterly. When I asked him if he was suffering so much, he replied:

"My foot is easier, but the doctor says I can't walk for a month. That means I can't help pull the boat."

"Don't worry about that. We'll get along all right."

"But—but you won't leave me out here in the ice, will you?"

The secret was out. The brave boy knew we would have to drag him in the boat, making our work so much the harder. And he had actually feared we would abandon him to perish out there in the wilderness of ice!

Several polar bear—ice-bear the Norwegians always call them—we killed on the way, and so did not lack for an occasional meal of fresh meat. One day at luncheon, sitting on our boat and sledges, we saw an ice-bear trying to catch a seal. The seal was basking in the sun, by the side of his ice-hole; if he was sleeping, it was with one eye open for his mortal foe, the big white bear. The bear was approaching most stealthily. He had gone around to the leeward so that the wind should not carry scent of him to his prey. Hiding first behind one ice hummock and then another, he peered out to see if the seal were still asleep, and then slid along

than instinct and must be put
reason. Apparently he realize
himself along through the snow
invisible because his coat was as
rounding. "But my black nose
thought. "Will not the seal se
the alarm?" And so this clev
out with one of his forepaws, c
snout with his white foot, and
along with three legs.

At last there was no hummoc
and his intended victim. With
Mr. Bear rushed upon the seal.
peared to us the hunter had his
his clutches, plump into the ice-
dark, fat seal. No one ever saw
bear. He stuck his head down i
deep that it seemed he could never
When he

"THE DOGS . . . LEAPED TO THE RESCUE."

he could at least have the next best thing—a nice bath. And so he wallowed for several minutes in one of these natural ice-pools like the one I had taken a dip in some weeks earlier.

Pretty soon he came round where he got our scent, and slowly and cautiously approached us. The polar bear is almost blind in summer. He depends vastly more upon smell than sight in hunting his food, which consists almost entirely of seal. But he could not quite make us out. He had never scented such game before. So he came up slowly, pausing every few rods to rise on his haunches and move his head to and fro in the air, sniffing and trying to solve the riddle. At this juncture Paul Bjoervig, one of our Norwegians—you will read more about him in these pages—thought to play a joke on the visitor. Getting down in the snow in front of our sledges he crawled along on all fours, throwing out his arms in imitation of the flippers of a seal, and perfectly mimicking a seal's short grunts. The bear was now close enough to see this bogus seal. This time he felt sure of his dinner! With a mad rush he leaped toward Bjoervig, who was lying there in the snow laughing. As the bear rushed his prey two of our guns cracked and the beast turned in a flash and made off at a speed of about forty miles per hour. I had told the men not to kill him. We already had all the bear meat we needed; and, besides, I felt a sincere sympathy and admiration for this beast who had had the wit to cover his black snoot with his white paw while stalking the seal.

After some weeks of struggle we arrived at Walden Island, and found the sailors there all well in their camp. Capt. Bottolfsen had gone south in one of our aluminum boats to find a ship and summon help. After waiting some time, and seeing no signs that the ice was likely to leave the coast and permit a vessel to come to us, we started south with two aluminum boats and the heavy lifeboats which had been saved from the wreck of the *Ragnvald Jarl.* Storms came on, the ice was drifting violently to and fro, and we had many close calls from being crushed and wrecked. Once in the nick of time we managed to pull the boats upon an iceberg, while masses of ice were crashing together all about us. There we were held prisoners till the wind changed and permitted us to find a little open water in which the boats could be launched again. Finally we reached the edge of the drift-ice, and there found a sealing sloop which had come as far north as she could get looking for us. In her we returned to our depot at Virgo Bay, and thence to Norway.

CHAPTER IV

PLANNING TO USE A BALLOON

It was whilst pushing and pulling the heavy sledges and boats over the rough ice on this expedition that the idea first came to me of using an aerial craft in Arctic exploration. Often I looked up into the air and wished we had some means of traveling that royal road, where there were no ice hummocks, no leads of open water, no obstacles to rapid progress. Why could not a balloon be used to take three or four men, sledges, dogs, provisions, all the necessary equipment, from the coast of Spitzbergen to the neighborhood of the Pole, by starting in a south wind? And if the aerial craft were to carry such a party somewhere near the Pole, in a day or two, could they not descend upon the ice, and with sledges and dogs complete the work of exploration, and by the same means find their way back over the pack to their headquarters or to some other land where they could get game and find safety? And, with this idea in my mind, I selected Pike's house, in Virgo Bay, on the shores of the Danish Strait, across from old Smeerenburg, as an advantageous site for the inflation of such a balloon and a start toward the Pole. Advantageous, because this place can be reached every summer by ship from Norway, and because it is only 600 nautical or about 700 statute miles from the Pole, being, in fact, just halfway between Tromso, the smart town in northern Norway, and the Pole.

Going to Paris, I spent several weeks in conference with the firm of Godard and Surcouf, leading balloon builders. They supplied the aeronautic skill, I the requirements and details for an Arctic voyage. We planned to build a monster balloon, one capable of lifting a total of some fifteen thousand pounds, one which could carry the crew, dogs, sledges, and plenty of food as well as a small boat and all the other necessaries so that at any moment the aerial expedition could in case of need be converted into a fully equipped sledging party prepared to travel the pack for many months.

The cost of this expedition was to be about $100,000. And whilst I was wondering where I could raise so much money, and debating with myself whether or not I wished to go into the enterprise even if the money could be found, a strange thing happened—one of those freaks of fate which so often mould the lives of men for good or evil.

An old friend, H. H. Kohlsaat, the Chicago newspaper publisher, was then in Paris. I did not know he was there, but he knew I was. He tried to find me. Like other Americans, I usually register my address at the Paris office of the New York *Herald;* this time, for some reason, I had not done so. Mr. Kohlsaat inquired at the *Herald* office, and many other places, but could not find me.

And what do you suppose he wanted of me? Just before this he had sold real estate in Chicago for nearly a million dollars, expecting to use a part of the money buying out the interest of his partner, Wm. Penn Nixon, of the Chicago *Inter-Ocean.* But it turned out that Mr. Nixon used his option and bought Mr. Kohlsaat's interest for a large sum in cash, and the result was Mr. Kohlsaat had in hand more than a million dollars. He had heard something of my Arctic plans; and while he knew nothing of the details of such expeditions, he did know me, and evidently had some faith in me as a man. For he was hunting me in Paris with the intention of offering me the capital to equip another expedition!

All this I did not learn till long afterward. Meanwhile, reflecting upon the proposed polar effort by balloon, I had lost faith in the idea. There seemed to be little prospect of success with a motorless balloon, a mere toy of the winds, without propulsive power or ability to steer to the right or left; and I made no effort to raise the capital for the venture.

But, if Mr. Kohlsaat and I had met in Paris, and he had offered me the money before my enthusiasm had cooled with reflection, it is quite probable I should have accepted his generous aid. And in that case I should have been back in Spitzbergen in 1895 with a polar balloon designed to drift toward the Pole.

One year later Professor Andree, of Stockholm, did take up the balloon idea; had a balloon built in Paris—not as large and good a one as we had planned; took it to Spitzbergen in 1896, and, strangely enough, built his balloon house and established his base at the very spot on the shores of Dane's Island I had picked out two years before!

Andree, it will be remembered, was unable to make his flight in 1896, and was attacked by the yellow press of his own and other countries as a bluffer and fakir because he had sense enough not to start before the conditions were favorable. Brave as he was in ignoring the cowards who love to throw printer's ink and other nasty stuff at a man who tries to do something and doesn't do it quickly enough to suit the mob—the mob that always howls to have the gladiator kill the beast or the beast eat the gladiator the first half hour or damns it as a poor show—he at last fell victim to their goadings.

By the following year he had learned that his balloon was a poor one; that it did not hold gas well. He realized it was not fit for such a voyage, even if the plan itself was sound. But Andree knew if he failed to start, the yellow press would hound him into his grave, and he preferred death in the Arctics.

I know from men who were with him that Andree said, just before he sailed, in July, 1897, that he was committing suicide. He did not dare abandon his effort and go home to face the newspapers. He did start; his balloon drifted to the north, then to the east and a little south.

It was pretty well settled that within thirty to forty hours it came down in the ice-strewn Barentz Sea to the east of Spitzbergen. Andree and his two brave comrades were never more heard of.

CHAPTER V

FRANZ JOSEF LAND

There is an old saying that if a man goes once to the Polar regions, he is sure to go again—that the lure of the north is irresistible. It proved to be so in my case. In 1898–9 I determined to have a real try at the Pole by the ship and sledge method. With great difficulty enough money was raised, the late President McKinley, Vice-President Hobart, J. Pierpont Morgan, William C. Whitney, Cornelius Bliss, Judge Lambert Tree, Levi Z. Leiter, Helen Gould, William K. Vanderbilt, my brother Arthur Wellman, and other friends assisting. By putting in what little I had—and facing a debt of $6,000, which was paid out of my earnings as a journalist after my return—an expedition was organized and equipped, the ice-steamer *Frithjof* chartered, and a small company of Americans and Norwegians started from Tromso, Norway, for Franz Josef Land, a considerable archipelago, which lies to the east and north of Spitzbergen and north of Russia, and which then had been only in part explored.

[redacted]

"I SUDDENLY DROPPED STRAIGHT DOWN IN THE SNOW."

[redacted]

There were three Americans with us—Dr. Edward Hofma, of Michigan; Quirof Harlan, from the Coast and Goedetic Survey, and Evelyn Baldwin, who had been with Peary in one of his expeditions to Greenland. Among my Norwegian crew were Paul Bjoervig, of whom I have already written; Emil Ellefsen, who had also been with me in the Spitzbergen trip, his brother Olaf, Daniel Johansen, and Bernt Bentzen, who had been one of the crew of the famous *Fram* on the three-year drift voyage through the Polar Sea.

June 26, 1908, we sailed from Tromso, in the expedition steamer *Frithjof,* a staunch ship specially built for hard work in heavy ice. At Archangel, Russia, we took on board eighty-three draught dogs, which Alexander Trontheim, of Tobolsk, had procured for us in sub-Arctic Siberia, among the Ostiaks, who live near the mouth of the River Ob. A two thousand mile journey across mountains, tundras, steppes, and rivers had the faithful Trontheim brought his pack, assisted by others, and a caravan of reindeer.

Leaving Archangel, July 4th, we steamed northward through the White Sea to the Arctic Ocean, and in a week met the pack-ice at the 77th parallel of latitude. Very discouraging was our first onslaught upon the frigid bulwarks with which the well-nigh impregnable Pole is surrounded. We found it impossible to break way through the pack, but did soon discover that our bunkers were running low of coal, and so we went back to Norway for reinforcements. Then north again, and soon we were once more struggling with the pack-ice. A week of ramming, shoving, crowding, shivering through leads and openings, forcing them often where they did not exist, varied by frequent fogs in which it was necessary to lie to because we could not see a ship's length ahead, brought us at last near the shores of Franz Josef Land.

Happy indeed were we all when, on July 27th, we first beheld the glacier-capped mountains of this remote region. To our imaginations it presented itself as a paradise of opportunity. Next day, with anxious hearts, we anchored at Cape Flora, which for three years had been the headquarters of the Jackson-Harmsworth (English) Expedition. Here it was that Nansen and Jackson had had their dramatic meeting two years before—a chance encounter which doubtless saved the lives of Nansen and his faithful comrade, Lieutenant Johansen. Here, too, we had hoped to find another intrepid traveler. When last heard from, Andree's balloon was drifting in this direction from Spitzbergen, and as he knew of the existence at this point of a good house amply stocked with provisions, it was not impossible he had been able to make his way hither the previous autumn. Great was our disappointment when we saw the doors and windows of Jackson's house all boarded and barred, for we realized that thus ended all reasonable expectation that the brave Swedes were to be seen again among the living.

We vainly endeavored to push our ship northward throught a strait, and later tried to steam round the southeastern islands where the Austro-Hungarian ship *Tegetthoff* was lost in 1874, and thus to the north. But finding the way everywhere blocked with heavy ice, we finally decided to establish our headquarters at Cape Tegetthoff, Hall Island, latitude 80:05; and there we set up our little hut and landed our stores, equipment and dogs.

In three days the ship sailed for Norway, and we were left alone for at least a year in the wilderness of ice. We were the only human inhabitants of that vast region, and our nearest neighbors were Russians and Samoyedes in Nova Zembla, five hundred miles to the southward. A month or two of working weather remained before the winter should come down upon us and we lost no time in setting our column in motion.

Two days after the ship left us, a party under the command of the meteorologist, Mr. E. B.

Baldwin, of the United States Weather Bureau, set out to establish an outpost farther north, the farther the better. They started with sledges, two small boats, dogs and provisions, traversing a solid sheet of comparatively smooth ice upon bay and strait. The outlook was promising. But conditions often change with surprising rapidity in the Arctics, and in less than forty-eight hours this party found the apparently sound and safe ice breaking up under their feet and drifting rapidly out to sea in strong off-shore winds. They had to leap from one floating floe to another, now and then hurriedly launching one of their small boats, only to pull them up again as quickly as possible to save them from being crushed in the ice. Nothing but desperate, even heroic work enabled them to escape with their lives and outfit and leap to solid land. Along the shore, over rough stones and precipitous glacier-débris, now moving a part of their loads short distances by boat in open water, again taking to the ice-covered mountain side for a hazardous journey over fissures and crevasses, they struggled for fully a month. Then the oncoming winter and the broken, drifting ice which filled the channel before them compelled a halt for good.

They stopped upon a rocky point called Cape Heller, a little south of the eighty-first parallel of latitude. Only once had human feet trod these shores, and that was a quarter of a century before, when Payer, the discoverer of Franz Josef Land, passed nearby on a sledge trip. A few miles to the westward, on the other side of the sound, Nansen and Johansen had spent the winter of 1895–6 in a little hut or cave. Our men at once set to work to establish a post.

The first thing was to build a hut. For this work they had better tools than Nansen and his comrade, but no better materials—only such as the country afforded. They gathered rocks and piled up the rough walls of a house. Two pieces of drift-wood, brought from Siberian rivers by current and tide, formed the ridge-pole. The dried skins of walrus which were killed in a bay served for a roof. A chimney was built at one side and upon a hearth of flat rocks small blocks of dried driftwood and hunks of walrus blubber were burned, not for purposes of heating, but to boil the coffee and soup and fry the savory steaks of polar bear.

Tons of walrus meat were cut in small squares out of the huge carcasses of fifteen of the sea-horses and stored away in an ice house (good refrigerator) for the sustenance of the forty dogs during the long winter. A ton of condensed food for human use was accumulated here, most of it designed for the sledging parties the next spring. With blocks of snow and ice, the men built huge walls around the hut to afford some protection from the winter's storms, making the camp look very much indeed like a fort; and so they named it Fort McKinley.

Our men had some lively adventures hunting walrus in the bay near Fort McKinley. As a rule the walrus is a harmless brute. His attentions to the human beings who invade his realm are usually confined to swimming about the boat for half an hour or longer, alternately diving and coming to the surface again. Whenever his ugly head appears above the water, curiosity and good nature are seen bulging from his little round eyes. He acts as if this visitation of human beings, with their boats and oars and things, was a sort of circus got up for his special amusement; but wound a cow or calf, and you may have a different story to tell.

That is what our men did one day. They shot a mother walrus that had a calf under her flippers, and they were trying their best to secure the two carcasses before they should sink in the bay. Suddenly they were surrounded by five or six big bulls, roaring and snorting in their anger at this murderous attack upon their tribe. One bull walrus, with his weight of from 1200 to 1500 pounds, which he is able to throw half out of water, and with his huge tusks a foot and a half in length, which may rip the boat and capsize it, is a dangerous foe when you are out in a boat only fifteen feet long. But here were half a dozen, all ferociously angry, and all making for the one small boat in which our three men sat. The lives of those men depended upon the manner in which they met the onslaught. Fortunately they were experienced walrus-hunters, and not a man of them lost his nerve. Bernt Bentzen, he of the mighty shoulders, gave a few strokes with the oars, and sent the boat flying so that the enemy might not all be able to board at the same instant. Paul Bjoervig, who knows walrus as well as he knows his own children, told Mr. Baldwin, who had the one gun in the party, when and where to shoot, that not an instant or a bullet might be wasted, and he, good shot, quick as a cat, emptied the chamber of his Winchester with telling effect.

Bull after bull retreated with a ball in his eye, the only spot worth hitting in a walrus, for his skin is an armor-plate of gristle and blubber, four inches in thickness. The bay was red with blood, the waters were lashed into foam and the bellowing of the bulls filled the air with a horrid din. They came finally faster than Mr. Baldwin could take care of them. Then Bernt and Paul rose up, each with an oar in his hands and beat the beasts over the head. Every time one of the ugly snoots rose by the side of the boat, with the wicked tusks gleaming white, there was an oar to meet it, or perchance a leaden ball. For fully a quarter of an hour the battle raged, and then, to the great relief of our weary men, the enemy suddenly withdrew one by one, leaving two of their number floating lifeless upon the bay.

Late in October, pursuant to his instructions, Mr. Baldwin prepared to return to Harmsworth House, our headquarters at Cape Tegetthof. He called for two volunteers to remain at the outpost during the winter to care for the dogs and guard the stores and equipment. All the men offered themselves. Paul Bjoervig and Bernt Bentzen were chosen, whereat Emil and Olaf Ellefsen and Daniel Johansen were grievously disappointed. As for Bjoervig and Bentzen, they were delighted. Neighbors and comrades at home, adventurous spirits both, this chance of spending an Arctic winter together in a snug little hut, with plenty to eat and smoke, was to them the realization of a dream. Little did they know what the fates had in store for them.

"The cub bravely attempted to defend himself."

CHAPTER VI

THROUGH THE ARCTIC WINTER

The three of us who had remained at the camp where the *Frithjof* landed us had plenty to do. Well do I remember the day we began our strange life in this remote region. It was August 2, 1898. The steamer was to start for Norway in the morning. This, therefore, was letter-day, and every man of us was writing to family and friends at home. It is not often one sits down to write the last words that can be despatched for at least a year; and it is astonishing how many people one wishes to write to at such a moment, and what a lot he has to say to certain persons.

Anything but a joyful moment was it that morning when we stood upon the wind-swept plateau of Cape Tegetthoff, and watched the *Frithjof* steam away. To go with her meant return to home, family, friends, all the comforts of life. To stay meant a long struggle against cold, darkness, and storm, lonely hours, weary tramps through slush and snow, yet not one of us wished to be upon the ship. Already we were under the influence of the Arctic spell. Its glamour was in our eyes, its fever in our blood. We were in the mood to appreciate the beauties which nature had lavishly strewn about our future home.

This far-off northern world was bathed in the most brilliant sunlight, glistening upon sea and icebergs and glaciers, and illumining the somber cliffs of the mountains. None of us had ever seen a more entrancing picture than the immense glacier of McClintock Island, fifteen miles to the west. It rose from the ice-strewn, shimmering sea a perfect sheen of purest white, studded with billions upon billions of refracting crystals, to a height of some 2000 feet. At the crest two eminences appeared, side by side, each in its way characteristic of this region; one, bold, rugged, and black, as if by a mighty effort the rocks had shaken themselves loose from the grip of the ice-king, standing forth in sullen independence, a landmark for forty miles around; the other more graceful, submissive, but still proud, lifting its head toward the sky, erect and majestic, though wearing the white robes of its frigid conqueror to the very summit.

In the foreground were the cliffs of Cape Tegetthoff, showing black where the snow and frost had fallen from their precipitate sides; and the glaciers debouching into the little valleys,

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melting in the heat of this mid-summer sun, and pouring musically-gurgling streams down to the sea. Out over the waters were to be seen a number of low, rounded, white islands, and near the southern margin of one of them we knew the exploring ship *Tegetthoff* had a quarter of a century before been abandoned by the Austrians, who, through the accident of an ice-bound, aimless drift, had discovered this land. To the northeast several capes rose darkly from the marble-sheeted land, guide-posts along our route to the unexplored regions beyond.

The task of house-building was at once begun, and in four or five hours we ate our first meal in the most northerly inhabited house in the world, and, in fact, the most northerly of all habitable dwellings, excepting only two—the Greely house in Grinnell Land, and the hut which the Wellman expedition of 1894 erected out of the timbers of the ice-crushed steamer, the *Ragnvald Jarl,* at Walden Island, Spitzbergen.

This was about the queerest sort of house that human beings ever passed an Arctic winter in. It was made in England, in sections all ready to be fitted together. For three years it had stood at Cape Flora, where the Jackson-Harmsworth expedition had used it as a storehouse, and Mr. Jackson had said it was not fit for human occupation. It really was a poor thing in comparison with the Russian-built log-house in which he had passed his three winters. The Russians know how to build for cold weather. In Archangel we had seen the richest citizens living in great massive houses, like our "frame" structures in America, but each one surrounded by tight walls of dressed and closely matched logs, with an air-space left between the inner and outer shells.

We proceeded to borrow one idea from the Russians. Indeed, our collapsible house was designed upon the same principle, but its two walls were very thin, merely three-quarter-inch boards. There were ten sections of these boards, all fitting together with bolts, and they also matched the floor, which was likewise in ten pieces. Over this structure of decagonal shape were stretched two thicknesses of oiled canvas, again with the highly desirable air-space between them.

Though fairly good for a summer house, we knew it would never do in that condition for an Arctic winter. So we proceeded to build another shell around it by means of planks, well braced and converging round the stove-pipe at the apex of the roof. Thus we had three walls with two air-spaces around us, and as the art of keeping warm, whether in house or clothing, is not to keep the cold out, but to hold the heat within, we extended this principle in two ways; first, we stretched over the roof an old mainsail, which had been discarded from the *Windward,* the Jackson-Harmsworth ship, afterward presented to and used by Peary, giving us three layers of cloth and two air-spaces over head; second, we built a snow wall around the entire structure.

Then we put up a storehouse of planks at one side of the decagonal structure, and added a vestibule outside that. We built double doors, "chinked" the walls with moss, and covered the whole with a layer of "Arctic marble," as we called the slabs of frozen snow, which were sawed out of an old drift and to any desired shape or size. When the storms came later in the fall, the whole camp, living-room, store-shed, vestibule and all, was buried under a snow drift. The windows were closed with five-foot walls of snow, and as winter came on, about all one could see reminding him of a human habitation was the dark little hole in the snow bank, through which we crawled when going in and out, and the diminutive black stove-pipe, working away for dear life at the top of the white peak.

In this house we passed a comfortable winter. Our stove was a small one, only fifteen inches in diameter, and it never burned more than fifty pounds of coal in a day; but we sank it through the floor to lower the fire-box, and so got all the heat out of it that was possible. True, the temperature often sank below zero in our living apartment, and frost formed not only upon the ceiling, but upon the walls against which we reclined with our backs, as we sat each in his own "corner." But in such a life men speedily accustom themselves to slight inconveniences of that sort.

Indeed, familiarity breeds contempt of cold. At home we used to think it cold out of doors if the temperature dropped below the freezing point, and heavy overcoats and warm gloves were in order, while Americans think they cannot endure a temperature lower than sixty-five degrees in their houses. But up here at Cape Tegetthoff we habitually wrote letters, sewed at our clothing, played cards, read books, and ate our meals in temperatures hovering about the freezing point. When the temperature outside was no lower than 15 or 20 minus, and not much wind blowing, we let the fire go out after supper, in order to save coal.

We had our regular baths, too, even in the coldest weather. As one of the few rules of the house was "no bathing indoors," on account of the condensation of moisture, the bather took his tub of warm water out into the storehouse, stripped to the skin, and enjoyed himself, even though the temperature out there was usually from 15 to 25 below. This we did without taking cold. In fact, such a thing as a cold, the writer has never had in the Arctic regions.

One day in early December I had been hard at work for an hour or two, testing the traction of various sledges, pulling a two-hundred-pound load up the hill and through the deep snow. Perspiring at every pore, it occurred to me to make a test of whether or not it was possible to take cold up there. Though attired in ordinary clothing, such as one wears at home in mild winter weather, I sat down in the snow for thirty minutes by the watch, and woolly dogs came and climbed all over me in excess of affection. The temperature was really thirty below, and though it did grow a bit chilly before the half hour was up no "cold" was taken. In order to inure myself to cold, I always washed face and hands in snow before breakfast, no matter how great the cold, and have often washed my feet in the same way, out-doors, in low temperatures. It is refreshing, but in amusing himself this way one must look sharp or he may get a frost-nip—our pampered feet are so sensitive to cold.

Wool is far and away the best fabric for Arctic wear. Even wool will gather moisture, but it is infinitely better than fur. Wool permits the moisture of the body to pass through the fabric and congeal outside, where it can be brushed or shaken off, while furs retain it within. Two, three, or more thicknesses of wool are better than one of equal weight. I used to wear two pairs of woolen mittens; the outer pair was stiff with frost, while the inner pair was nearly dry and quite warm. But one had to be careful what he did with his mittens, when he took them off, for in a few moments they would freeze so stiff that it was torture to put them on again.

Of course, one needs plenty of clothing in the far north, but wool is the thing. Upon our dash northward, in temperatures of from 10 to 48 below zero, I had nothing except a pair of reindeer-skin moccasins upon my feet. But within these moccasins, I had from three to five pairs of thick woolen stockings; and outside the stockings was loose, dry grass, to absorb the moisture. I never once had cold feet, and even after I had met with an accident which practically stopped all circulation of the blood below the knee, in my injured leg, I suffered no frost-bites. Upon my body I wore four suits of woolen underclothing and a jacket outside. In this attire I was warmer than my Norwegian companions in big cumbersome "kooletahs" of reindeer skin.

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Greeting Felix Riesenberg in the Spring.

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CHAPTER VII

WONDERFUL CLIMATE OF THE ARCTICS

Contrary to the prevailing belief, it is not always cold in the Arctic regions. Many people do not understand that the summers in the Polar zones are comparatively mild. When the sun shines brightly in July and August, and often far into September, thawing is rapid and the snow disappears from exposed places. The summer temperature in the shade, ranges pretty steadily about the freezing point. In the sun I have seen the mercury go up to 80 in a Fahrenheit thermometer. Just such weather as this, without any doubt, will be found up to the Pole itself. The North Pole lacks a good deal of being the coldest place in the world. It is colder in Siberia and in the northern part of our own continent. A sunny summer day up near the Pole is altogether delightful, provided the wind does not blow. Many times have I lain down in the snow on such days and gone to sleep without so much as a blanket over me.

What may be done in summer is well shown by an adventurous trip which two of us made up the coast of Nordenskiold Bay. We had with us a sledge and five dogs, but no tent or sleeping-bags, as we did not expect to remain out over night. Having crossed a big glacier, about a mile and a half in extent, we found ourselves upon lower and very rough and broken ice. It was almost as if we were upon a stretch of rocky fragments thrown up by an earthquake. Fissures and cracks ran in every direction, and we had to be exceedingly careful in our movements.

The dogs did not at all like this sort of traveling, with its imminent risk of tumbling at any moment down a crevasse, a hundred or two hundred feet deep, and it was interesting to note how, amid these surroundings, they appeared to place implicit trust in their masters. Ordinarily they liked to pick the road themselves, rushing along pellmell, pulling their drivers after them. But here they would not budge a foot unless one of us led the way. They followed us with confidence, though not without watching our steps with the most alert eyes. Up to this time the beasts had been doing a good deal of skylarking and fighting, but now they were as sober as judges. They did just what we told them to do, too, something new in our experience, and here for the first time we were able to teach them to obey the good American "Whoa!" Theretofore we had been compelled always to employ the Samoyede synonym, "Sass!"

At length, while leading the team through a suspicious bit of broken ice, I suddenly dropped straight down to the snow to my arm-pits, and had the unpleasant feeling that there was nothing but air under my feet. I had fallen through a snow bridge, and was sustained by my outstretched arms. Somewhere down below I could hear a dislodged piece of ice striking and echoing on its way to the depths. Fainter and fainter the echoes came, and then ceased altogether. For all I know that piece of ice is dropping to this day. The interesting question with me at that particular moment was whether or not the crumbling bridge of snow would support my weight till my companion could manage to get me out of the danger of taking a drop too much myself.

Shortly afterward a storm blew up and as the air was filled with flying snow, making it impossible to see a sledge length ahead, it was simply suicide to go on. If we did not fall down a crevasse, we should be in danger of losing our way, and falling over the edge of the glacier into the sea. So we made the best sort of camp we could and managed to boil a little coffee over our petroleum lamp. But how the winds did whistle and the snow did fly down the surface of that glacier! It was as much as one could do to stand on his feet.

As there appeared to be no prospect of getting away before morning, the problem which confronted us was how we were to get a little sleep. It was solved in a novel manner. Each of us had brought along a "kooletah," a big sack-like coat of reindeer-skin, and so we took off our boots and lay down upon the ice with our backs to the winds and our heads pointed in opposite directions. Then we telescoped ourselves together as far as we could, each running his feet under the other's coat. My comrade's toes were in the small of my back, while mine were snug and comfortable on his abdomen. Lapping the skirts of our coats, and pulling the hoods over our faces, we were quite comfortable so far as the cold was concerned.

The chief trouble was the hardness of the ice, and the numbness and cramps in the legs and hips due thereto. But despite all drawbacks we managed to get both rest and sleep. To help us out, the dogs came and snuggled up as close as they could get, and though it was scarcely fair of them to persist in shoving their noses up under our hoods and kissing our faces, we could not well object so long as they helped to keep us warm.

In August, after our advance party had

gone, we tried to use our small boats in forwarding more provisions toward the north. But the sea beat heavily upon the beach nearly all the time, and we had to watch for chances to launch our tiny craft. On one occasion Olaf and Daniel, with Dr. Hofma, started across Nordenskiold Bay in a small wooden rowboat, towing a canvas scow heavily laden with stores. The bay was comparatively smooth when they started; but a storm blew up with incredible suddenness, and kicked up such a heavy sea that the waves were soon rolling over the gunwales of both boats and threatening to swamp them. With quick decision the Norwegian boatmen turned and ran with the wind toward an ice-floe nearby, and, reaching it, tied up the scow, leaving Dr. Hofma in charge, and made for the shore to unload their own cargo.

In a quarter of an hour Dr. Hofma found himself in a most dangerous situation. His ice-floe was rearing and plunging in the waves, and the canvas scow was liable to go down at any moment. Surf was beating over him and his goods, and the half dozen dogs which had been left with him were howling in terror. Worse than all, he was drifting straight toward a glacier-face from fifty to seventy feet perpendicular, against which the sea was beating with terrific force, churning up and down in wildest fashion the accumulated débris of ice-floes. To drive into this maelstrom meant instant destruction.

The brave Norwegian youths put off from the shore in the teeth of the storm. They bent their sturdy backs, and rarely have oarsmen worked closer to the last notch of endurance than our boys did this day. In the nick of time they reached the doctor, who was imperturbably baling out his water-logged scow; and, taking that craft in tow, they made once more for the shore. Now followed another struggle, and for a time a doubtful one. The wind appeared to be determined to add the two boats to the chaos it had kicked up at the foot of the glacier, while the oarsmen were bent upon cheating the elements of their prey. At last muscle and courage won the battle, greatly to the joy of my companion and myself, who had run over from the house and stood now watching the struggle.

By this time the ice was running in at a frightful pace, and at one moment it looked as if the boats were surely caught and destroyed between two heavy floes crushing together; but by a dextrous movement the boatman slipped through a narrow channel and into safe water. Fortunately, the beach was shelving sand, and the shoal prevented the heavy ice coming close in shore and formed a protecting pier three or four rods out. The boats could not get quite in either, and the only way in which we could unload them was by wading out in the surf and carrying things in, piece by piece. At first plunge these ice-water baths are not so very pleasant; but the plunge once taken, one doesn't mind them at all.

During the winter we had many auroral displays of great beauty, and one in particular on December 8th. It was a perfect specimen of the true corona aurora, a form not often seen. From near the horizon at all points of the compass great white and colored streams of light shot toward the zenith, and there mingled their rays in a common center. It was just as if all the steam power in the world had been multiplied a million fold, all of it turned to the generation of electricity, and all this voltaic energy were poured through the lenses of vast searchlights placed in every city, town and village the world round; and then at a preconcerted signal by telegraph, all were set playing and dancing upon the very apex of the heavens.

A day and a night up near the North Pole compass a year. At the Pole itself there is but one sunrise and but one sunset in a twelvemonth. About March 20th sunlight reaches the spot which marks the northern termination of the axis of our earth, and it does not go away until September 20th. When it goes, it goes for good; the six-months day is followed by the six-months night. At our winter camp, 600 geographical miles south of the Pole, the sun rose above and disappeared below the horizon each 24 hours during about seven weeks in the spring and a like period in the fall. But practically we had only one day and one night.

Every part of the earth's surface receives theoretically the same amount of sunlight as every other part. Nature makes no discriminations in this respect. The North Pole has just as many hours of sunlight in a year as the Equator, and at Cape Tegetthoff we had the satisfaction of knowing that not even sunny Italy was basking in the great orb's favor to a greater extent than we.

The difference is that in the Arctic regions we get our sunlight—and also our darkness—in a lump. At the Pole the lumps are six months long. At the 80th parallel of latitude, where we were, we had the midnight sun in the heavens for 127 nights, that being the long day; and later we had no sun at all, not even at noon, for 127 days, and that was the long winter night of our discontent.

Mr. Wellman looking down on Paris in his first Balloon Ascent.

CHAPTER VIII

ROYAL SPORT WITH POLAR BEARS

We had much work and hardship but not a little sport during our year up there near the Pole. Take it all in all, I think we had more fun out of polar bears than anything else. Forty-seven, all together, fell before our rifles, and the amount of sport involved in all this slaughter would almost make a book of itself. The day the sun disappeared for a little matter of eighteen weeks—October 19th—I find this record in my journal:

"The loss of the sun to-day was compensated for by a most extraordinary bear-hunt. Dr. Nansen said his Siberian dogs would not attack bears. We wish Dr. Nansen could have been with us to-day to see our pack of twenty loose dogs pursue and attack the big white fellow who came shuffling leisurely over the hill. As usual, Ursus, our black bear dog, was the first to approach the enemy. Bruin simply looked at him in a half-conscious, half-indifferent sort of way, as much as to say:

… fastening not hi
duct altogether becoming

the isles. But when Ursu
half a dozen, and then a do
comrades, and the whole p
the bear, yelping and dancin
teeth, but never quite gettin
bear concluded that, after a
serious job on his hands.

"But he made a fatal mis
If he had simply run away,
as his great legs could have car
have been quite safe, for dogs
a full-grown bear, even if the
one. Instead, he showed fight
to reach the tormentor neare
savage lunge this way, now th
ing mouth wide open, displa
needed only one chance to p
vitals of the toughest dog th
four legs. But th

[redacted]

him, as the dogs had no wish to come in contact with those terrible incisors; but a fire in the rear always caused him to wheel round, and thus the circle closed up again.

"The war-dance continued till the poor bear was beside himself with rage and fatigue. Now the swirling, yelping mass had reached the base of the sharp incline that led up to the basalt mountain peak. Up the steep, icy surface the bear now attempted to escape his pursuers. With prodigious strength he crept rapidly upward, but the dogs were constantly at his side. They were in front of him, behind him, all around him; and though some of them lost their footing and slipped to the bottom of the glacier, others took their places and the luckless brute found no peace.

"Suddenly the bear's huge paws slipped their grip, and down he came—a veritable avalanche of flesh and fur that roared as it rolled. Fully 250 feet he slid, most of the way at an angle of forty-five degrees, and by the time he struck the nearly level plateau he had an impetus which carried him rolling, bounding, ricochetting among the rocks, ploughing through the snow fully a hundred feet farther. His course lay directly over the spot where we stood waiting for him, and we politely and rather hastily stood aside to give him right of way. Some of the dogs had been carried down with the rush, and the others were too eager to wait to run down, and so did a bit of tobogganing on their own account. Before the bear could get upon his feet the dogs were all about him once more. We were there too, and a few Winchester 45.90s brought this most sensational bear-hunt to an end."

A rather pathetic bear-hunt was one we had a few days later. Mother and cub came ambling along the plateau side by side, and of course the dogs soon had the pair surrounded. When we arrived upon the scene, after a sharp run of a mile, the battle was in full course, with the dogs getting decidedly the best of it. The poor dam had been harried almost into a state of exhaustion. Still, she kept up the desperate struggle, and never once permitted her young hopeful to get five feet from her side. After each lunge at the nearest dog, she quickly returned to her baby, and this fat graceful little fellow did his best, you may be sure, to keep close under mama's protecting paws.

It seemed impossible to shoot without hitting a dog, but I decided to risk it, and sent a Krag-Jorgensen bullet clean through her body. With the blood streaming from both sides, she continued to fight for her cub, and as more bullets crashed through her body and she felt her hour at hand, her last instinctive movement was to gather the little fellow to her breast with her fore-paws, that her tusks might give him protection to the last. Then she died.

Feeling his mother's grip upon him relax, the cub climbed upon her body and bravely attempted to defend himself. We were not yet so hardened in the stern life of this region that we could step up and put a bullet through the heart of that trusting youngster without suffering qualms of conscience. Soon mother and son were blending their blood there upon the ice. Two of our best dogs had this she-bear killed in her fierce defense of her young.

The day before Christmas a lank, lean, hungry bear came near evening up some of the score against his tribe. Though the day was very dark and stormy, I took my usual walk out of doors, to and from the beach. The bear sneaked stealthily after me, and when I turned to walk back toward the sea once more, there he was in the path only a dozen feet away, crouching to spring. For an instant only did I hesitate, and that moment the bear and I stood looking one another in the eye. There was something about his personal appearance I did not like, and instinctively I resented any closer acquaintance with him. Then I raised my arms and shouted at him, and for answer he leaped at me. I sprang to one side, toward a spot where I knew half a dozen dogs had been lying out of the wind, in the lee of a packing box. Two seconds later, I felt a heavy blow upon my shoulder, and as I fell into the snow I had the weight of a big paw on my body.

"In another moment," I said to myself, "he will have my head in his mouth."

But he didn't. At that most interesting juncture I heard the welcome bark of the dogs; they had scented the enemy and leaped to the rescue. That heavy paw was lifted from my back, and as I scrambled up there was the bear, six or eight feet away, with the precious dogs yelping about him. As luck would have it, things turned out a good deal worse for the bear than they did for me. I had only a lame shoulder and a scratch on the neck, while the bear's skin, made into a rug, lies under my feet as I write.

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CHAPTER IX

THE DASH FOR THE POLE

All through the winter we were preparing for the sledge journey northward the following spring—spring in this case having no significance such as we are accustomed to in the temperate zones, balmy air, budding flowers, all nature living and glad again; the Arctic spring means simply the return of the sunlight to travel by, intense cold, many storms. But eager indeed were we for the day.

To make ready for a sledge trip seems a simple thing, but it is like organizing an army corps for campaigns far from base in an enemy's country. Day or night the leader of the expedition had but one thought, one dream, and that was to arrange the countless details for the field work, with the fewest possible mistakes and the greatest possible number of things that made for strength and security. A thousand picturesque or interesting incidents of this winter in the darkness were almost forgotten in the concentration of mind and effort upon the arrangements for the sledge trips.

One journey was to be made to Fort McKinley and beyond—straight northward—as far as we could go before diminution of supplies and advancing summer commanded return. This was "the dash for the North Pole," which formed one part of our general expeditionary plan. The other journey, subsequently successfully carried out, compassed the second part of our general plan, which was to explore the then unknown eastern part of the Franz Josef Land archipelago.

Acutely did we realize that if we were to beat all records in our approach to the Pole and have our chance actually to reach it if we found unusually favorable conditions, we must get up right early in the Arctic morning. The records of the past had been established from bases much farther north. Thus Lockwood and Brainard of the Greely party, who had carried the stars and stripes to 83:24, had set out from headquarters at 81:40. Dr. Nansen and Lieutenant Johansen, who had reached 86:14, had started from the *Fram* at 84:04. To eclipse the latter achievement we should have to travel 440 miles. But this much at least we all believed we should do, barring accident, if only we could get an early start. Consequently, on the morning of February 18th, while I was standing in the hut for a last flash-light photograph, one of my Norwegians stuck his head in at the door, and called out: "Everything is ready, Sir."

"And so am I."

Saying good-by to my American comrades, not quite sure that I should ever see them again, I went out and took my place at the head of the little caravan. Each of the three Norwegians had a sledge and team of dogs in charge. A snow storm was raging, but we were ready to start and could not stop for a little storm. I led the way, "tracking" for the dogs as best I could in the darkness and snow-laden air. The sun had not yet risen, but in the middle of the day was near enough to the horizon to give us a gray, hazy dawn-light. The snow was soft, and we sank into it to the ankles and often to the knees. Underneath there were frequent ridges and protuberances of rough ice to trip the weary feet.

A strange experience it was, this stumbling along like drunken men in a gloom, unable much of the time to see far enough ahead to make course by landmark, and compelled, therefore, to pick our way with compass constantly in hand. Where it was smooth enough we used Norwegian ski to advantage, but in the rougher spots snowshoes were of no avail. Upon our feet we had finsko, or moccasins of reindeer-skin; and though these are the best of all footwear for Arctic use, their soles are so slippery that, travel-

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a month earlier than the ea
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lengthened, and we struggled

Fort McKinley was our goa
to take on more sledges and
our load of provisions. How h
passed the winter of their exil
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the north. The plan was to s
Bentzen back to headquarters,
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question, and we had to be content with pegging down its corners and crawling under—any place to escape the fury of the icy blast. When better weather came, we made hard marches, and on the afternoon of the 27th we had the satisfaction of seeing the ridge behind the fort loom up in the white distance.

Soon the dogs at the fort set up a shout of welcome to their approaching brethren, and the latter, just to show what they could do when they had a personal object in view, started off at a rapid run, dragging sledges, men and all after them, although hitherto they had crawled at a snail's pace and had made progress at all only when helped by their drivers. At the foot of the hill the men stopped and held the excited teams, that I might walk on before and be the first to greet the two exiles. But aside from an overturned boat, half buried in the snow, a collection of empty biscuit and provision tins, and a group of dogs chained to the top of a bank of ice, I could see nothing at all indicating a human habitation.

"The hut is just before you, Sir, right behind the dogs," said Emil Ellefsen.

CHAPTER X

AN EXTRAORDINARY TRAGEDY

There is not an atom of superstition in my mental composition. I never had a presentiment, or anything of that sort. But it is the plain truth that, as I picked my way up the rough snow bank and through an array of shaggy dogs all howling and leaping and straining at their leashes, I knew something had gone wrong at the hut.

That instant a rough human figure emerged from the mouth of a tunnel leading down into the snow bank. The man held a rifle in his hand. He was dressed in furs. His face was as black as a stoker's.

"Bjoervig, how are you?"

"I am well, Sir, but—but poor Bentzen is dead."

We stood silent for a moment, hands grasped, and looking into each other's eyes. A tear trickled down Bjoervig's soot-blackened cheek and froze there. Then his countrymen came up, and when he told them the news, these simple-hearted fellows were as dumb as I had been. It was Bjoervig who did the talking. We only listened and watched him, being but dimly conscious of the true nature of the tragedy within the shadow of which we stood. Bjoervig talked and laughed and cried by turns, but he did not forget his hospitality. "Come in, Sir, come in and have some hot coffee. You must be tired from your journey."

He dived down into the mouth of the tunnel, pulling me after him. First we entered a little cavern where a mother dog lay, nursing a hairy, squeaking brood. Hardy puppies these, opening their eyes and gulping milk in a temperature 70 degrees below freezing. The mother dog licked Bjoervig's hand and growled at me. Now we went down upon our hands and knees, and crawled through an opening in the rock wall of the hut. A bear-skin was hung there for a door. Once inside, I tried to stand erect and bumped my head against the ice with which the ceiling was covered. It was so dark in there I could see nothing, and Bjoervig led me to a seat.

"Sit down, Sir, sit down and rest yourself, and I'll have the coffee ready in a moment."

At one side of the hut, in a niche in the rocky wall, a fire was smoldering. Bjoervig put on a few pieces of driftwood and a big hunk of walrus blubber, and the flames burst out. Very cheerful and bright the fire looked, but not a particle of heat did we get from it. What was not used in boiling the coffee went up the chimney. Three feet from the flames the rocks were white with a thick coat of frost, and all the walls and roof glittered like a bed of diamonds.

It was a strange little den, and to me it seemed colder than out of doors. The brilliant fire was but mockery. Fairly well illumined was the end of the hut where we sat, but beyond was a gloomy recess from which the light of the flames was cut off by a pier of rocks which served as a support for the roof. There was no window.

Bjoervig told me about Bentzen. The poor fellow had been taken ill early in November. All through that month and December he had been unable to get out of the house, and most of the time he lay in his bag. Occasionally he was delirious. Death came the day after New Year's. Paul paused, and for lack of something else to say I asked him where he had buried the body.

"I have not buried him, Sir," was the reply. "He lies in there," pointing to the dark end of the hut.

"Why did you not bury him, Paul?"

"Because, Sir, I promised him I wouldn't."

I shall never forget that moment. At first the words did not appear to me to mean very

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much—only that a dead man had not been buried. Gradually the full proportions of the tragedy dawned upon my consciousness. This man with the black face who was cutting up walrus meat and feeding the fire had been compelled to pass two months of the Arctic night in this cavern with no other companion than the body of his friend. I lit a little oil lamp—a bicycle lamp it was—and made my way into the dark end of the hut.

On the floor at my feet lay a one-man sleeping bag, empty, with a blanket tumbled over it and showing signs of occupancy the night before. Just beyond within arm's reach lay a similar bag. This one was occupied. The flap at the top had been pulled carefully over the face of the sleeper within. Bag and contents were frozen as hard as a rock. There, side by side, the quick and the dead had slept for eight weeks.

As I looked at this weird scene amid the shadows under the scintillating roof of hoarfrost, and thought of the long days that were as nights and the long nights that were no darker than the days, and of the ordeal it is for any one of us when compelled at home to sit even for a single night with companions in a brilliantly lighted apartment by the side of a dead friend, and of this living man who had for months lain there absolutely alone by the dead, I marveled that Paul Bjoervig was still sane.

Just then the men came in from giving the dogs their supper, and I heard Bjoervig talking to them. He had not known what was the matter with Bentzen. In his delirium the sick man had talked of his home and his wife in Norway, of the green hills there, of Dr. Nansen and Captain Sverdrup, and the cruise of the *Fram;* at times he was once more in the ward-room of that famous ship; again he was after bear or walrus with Bjoervig and the boys in our little Lapp-boat; now he was on a sledge trip to the Pole "with Mr. Wellman."

"That was the hardest of all for me," said Bjoervig, "when poor Bentzen was out of his head and I couldn't do anything for him. Once he caught me crying, though I tried not to let him see, and he brightened up and said: 'Paul, what's the matter with you? I'm all right. I'll be well in a week or two. See what an appetite I have.' And he got up and boiled some coffee and cooked some bacon, and sat here eating and laughing, just to cheer me up, and then he fell over in a faint. I dragged him to his bag, and —and he's there yet."

"And how did you happen to promise him not to bury him?"

"Oh, he was low-spirited one day, and he

H. R. H. THE PRINCE OF MONACO AND MR. WELLMAN.

called to me. 'Say, Paul, I'm not going to die up here, but if I do, old fellow, promise me you won't try to bury me out in the snow.' 'I'll promise you that on one condition, Bernt,' said I, 'and that is that, in case I die first, and my chances are just as good as yours, you'll not bury me, either.' Bernt smilingly agreed, and so we made our bargain. He was silent for a few minutes, and then he looked over at me and said: 'Paul, I don't want the bears and foxes to get me.' "

"And what could induce you to go through such an experience again, Paul?" asked Olaf.

"Well, if it's money you're talking about, there isn't enough in the Bank of England. But if I had to do it over as a matter of duty, why, I'd just do it, that's all."

My heart went out to the brave fellow who had kept his promise through such an unprecedented ordeal. I felt as if it were my duty to say something to him, to give some expression to the homage that was deep in my soul. But I could not put my thoughts into words, so I took his hand in mine there before his comrades, and said nothing. And one after another we all shook his hand, without speaking, and we felt rather queer, and the silence was becoming painful, when Bjoervig himself spoke up:

"The coffee is ready, Sir."

CHAPTER XI

FIGHTING TO THE NORTHWARD

The 17th of March we set sail from Ft. McKinley on our sledge trip to the farther north, taking Paul Bjoervig with us. It was a hard life. For eleven successive days we had temperatures ranging from 40° to 48° below zero. The winds were worse than the cold. In such work as this one needs all his vitality, all his endurance, all his physical and moral resistance if he is to keep going. Three days later we were approaching the 82nd parallel on the eastern shores of Crown Prince Rudolph Land—a large island which had once been visited by man. Now the light was increasing, and we hoped to be able to travel still more rapidly, though up to this time we had done fully as well as we had expected. Our loads were getting lighter and more easily handled. The dogs were better trained and much more serviceable than at the beginning of the journey.

Better still, ahead of us, glistening in the sun, we could plainly see the outlines of islands hitherto unexplored and unknown. Eager indeed were we to get to them, and beyond them out upon the great Arctic Sea, to 84°, 87°, 88°, and even ninety did not seem wholly impossible in case we were willing to take some little risk about ever getting back again.

In view of what has happened and what I have tried to do since this Franz Josef Land effort, it is rather curious to go back to my journal of those days and find what I wrote then. Witness the following extract:

"It is only by sledging that any one now proposes to reach the North Pole. The old idea of an open polar sea and the navigation of the very top of our earth in a ship is abandoned. After Andree's disastrous attempt to find a royal aeronautic road to the Pole, no one else is likely to try that method. The plan of all modern Pole-seekers is to get as far north as possible with a ship, establish headquarters upon the land and then make a dash for the Pole and back again with dog sledges. Nansen varied this plan by leaving his ship when she had drifted farther north than man had ever been before, within 415 statute miles of the Pole; and if he had had a supply depot in north Franz Josef Land to return to, so that he could prudently have remained longer in the field, he might have made the ninetieth degree.

"To march from an outpost in any of those far northern lands to the Pole and back is a very large order; but there are men of experience who still think it can be done. How difficult the task is only those who have actually attempted it can know. The popular idea is that the feat may be performed if only one will give enough time to it; that he should push one depot of supplies out beyond another, advancing step by step, through a chain of such stations, till the Pole be reached.

"This would all be very well if we had the land to work upon. If we had land running to the Pole from lower latitudes, say the eightieth parallel, attainment of that objective of man's adventurous ambitions would be a simple matter. But we haven't. So far as we know, there remains between the most northerly land and the Pole about 500 miles of sea. It is possible to travel over the ice which covers this sea, rough and shifting as it is; but it is useless to establish depots there, for the odds are a hundred to one they can never be found again. Returning from his attempt to reach the Pole, Dr. Nansen made no effort to find the *Fram,* because she was drifting to and fro, though at no time could she have been more than 150 miles from him, and the probabilities are that on his southern journey he passed within thirty or forty miles of her.

"The season of the year through which one can travel over the ice-sheet is limited. The winter months are too dark and the summer months—oddly enough—are too warm. The best season is from about the first of March to the end of May—say a hundred days in all. Before March, the sun is far below the horizon and the gloom too dense. After May the snow is too soft and sticky, and the ice too much broken up. It is true that some traveling might be done in October and early November, after the snow has hardened again, and this suggests the plan of using the 100 days of spring for reaching the Pole, and the autumn for returning to headquarters.

"But it must be remembered that, after once leaving the land and taking to the sea-ice, no game can be had; everything the travelers eat, and the fuel for melting ice and cooking food, must be carried with them. The more they carry the slower they must travel. Two pounds a day is the minimum ration per man, of the most approved modern "condensed" food. This means 200 pounds per man for a journey of 100 days, to say nothing of weight of sledges, instruments, tent, fuel, sleeping-bags, and packing. With the help of dogs this much may be carried, and the period of absence from land may be extended to 125 or even 140 days, though at first the loads will be very heavy. If, however, a party sets out on a journey of nine months' duration, nearly 600 pounds per man would represent the minimum load simply of food for men alone and excluding all other things, among them the sustenance of the dogs—clearly an impossible burden.

"So there is nothing for it but a quick journey out from the land and back again. It makes no difference whether the base used be North Greenland, Franz Josef Land, or a ship that has drifted into the inner polar sea—it is necessarily "a dash for the Pole," and nothing but a dash. It is, practically, a campaign of 100 or 115 days, beginning in the midst of the Arctic winter and ending at the commencement of summer. The man who can get his base established just right; who can so organize his party and so arrange his weights and his motive power as to be able to cover an average of 10 miles a day, and who can manage to avert all serious accidents, has the Pole within his grasp.

"Ten miles a day, a mile an hour, seems very little. But try it once if you want to know how difficult it is. Our party was as well organized as any party could be. We had the best of everything and not too much of it. Simplicity is the first essential of a successful sledge trip. Yet work as hard as we could, we made an average of only six miles a day, about the same as

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Tourist Ship at Camp Wellman — Mrs. Vaniman and the Misses Wellman arrive.

Nansen and Johansen had made. Of course our loads were heaviest these days, for we were carrying four months' supplies.

"Each of the five of us had a sledge and a team of dogs. Much of the road was very rough. The previous fall, before the ice had frozen solidly, northeast winds, driving down against the land, had smashed the floes into a forest of hummocks and ridges. Between these elevations there were pockets of deep snow. Winding in and out, up and down, over and through these obstacles, we made our painful way by dint of much lifting, shoving, pulling, and an incessant shouting at the poor dogs."

CHAPTER

OUR GOOD FRIEND,

"Without dogs one can do
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are not equal to dogs in rou
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sults. On a smooth road th
superior to dogs, but amid hum
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smooth road, the Pole woul
covered long ago. One great
use of dogs is their ability to e
the way of cold. Fifty below
rors for them.

"I remember one camp we
February, shortly after our sta
sun had risen

with the wind, and it was almost more than we could do to keep them anywhere near the course. Much of the time we had to drag the dogs, sledges, and all, with the icy wind blowing the breath out of our bodies. The storm increased in fury, and as it was absolutely impossible to camp on this smooth bare ice, we looked eagerly for some hummocks or ridges where we might make the tent-pegs hold, or at least bury them in the snow so that they would not be blown miles away the moment we let go of them.

"At last we found some small hummocks and stopped to make camp. Usually this is the most pleasant of tasks. One takes keen delight in preparing for the night, and heavenly it seems to crawl in out of the wind, and to hear the lamp sing as it boils the coffee and the soup. But this was a most bitter camp-making. It seemed impossible to do anything. The air was so filled with snow that we could barely see one another.

"'Make the dogs snug first,'" I said, "'or they'll perish.'

"So we scooped out a sort of trench, and buried the dogs in the snow, and then tried to rig up some sort of shelter for ourselves. It was not easy. No tent could stand in that blast, and so we fastened down the ends of the canvas, crawled under, boiled some coffee, and spread the sleeping-bags. A few hours later the violence of the storm was moderated, and I looked out to see how things were coming on.

"There were the dogs lying on top of the snow, as happy as they could be, though a stiff breeze was still blowing and the temperature was about thirty-five degrees below zero. In trying to make these dogs comfortable I had frozen my nose and my cheeks, and some of the men had suffered similar trifling frost nips. So after this we permitted the dogs to hunt their own shelter. It was never too cold for them. Some times on breaking camp in the morning we had to dig them out of snow-drifts; but once a dog has shaken himself vigorously, straightened out his cramped legs, quarreled with one or two of his neighbors, and wagged his tail a few times at his master, he is ready for business.

"A Siberian dog will pull only a quarter as much as a man can pull, and he needs about a pound of food per day, or half as much as the man. But he requires no sleeping-bag or tent, no extra clothing and boots, no water has to be melted for him, he smokes no tobacco. Best of all, if he gets hurt, or becomes ill or exhausted, you don't have to drag him on a sledge or turn back. You convert him into fresh meat for the survivors. That is the economy of dog-sledging in these dashes for the Pole.

"Your four-legged comrade drags fifty or sixty pounds of load, and he carries twenty-five or thirty pounds of meat "on the hoof." But killing these faithful fellows who have worked in harness by your side, who lick the hand that is about to smite them, and look up into the murderer's eyes with true dog trustfulness, was the bitterest of all the bitter things we had to do. We killed only a half dozen, using a rifle, and did the job off a little way from camp, behind a hummock, in a sneaking sort of way, as if we were ashamed of it, as we were.

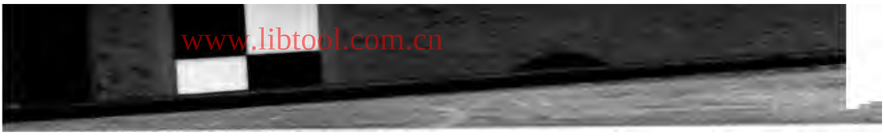
"Good boys, those dogs. I became very fond of my team, rogues though they were, some of them. Dogs name themselves, and mine bore the cognomens of "The Deacon," "The Dandy," "The Assassin" (the latter had killed only half a dozen of his brethren the previous winter), "The Lady," "The Fox," "The Judge," and "The Sport." "The Assassin" was the leader, and a noble draft-dog he was. He pulled just like a mule. His only fault was that he wanted to be at the head of the procession all of the time. If put behind another sledge, he would not "track," but cut cross-lots at every turn of the trail. He broke two sledges in this way in the rough ice, to say nothing of some of my good resolutions. I tried to discipline him by putting him back among the team; but he felt the disgrace, and wouldn't pull at all, so I had to make him leader again.

"With all their mean tricks, I loved these dogs. You see, I had to work right alongside them, with a harness over my shoulders. On good ice the dogs would pull the load, but whenever the sledge stuck in a rough place or pocket of deep snow—and this was once in three or five minutes—I had to keep it going, or start it if it stopped. The dogs would pull only when they felt motion behind them. They had a sly way, too, of watching me out of the corners of their eyes, and when the sledge dragged a little hard and they saw I was not pulling, they stopped short, as much as to say:

" How do you expect to get along if you don't do your share of the pulling?'

"But I fooled them by pretending to work very hard when actually I was not moving ten pounds. At every step they got even with me by twisting themselves up into knots, tangling their trace lines in the most hopeless way, and then lying down to rest while I, with frost-nipped fingers and such patience as I could command, straightened things out.

"But there were compensations for all these annoyances in the fine way the beasts worked. It was not necessary to beat them, and whipping or beating was not allowed on this trip. It was



wonderful what we could do with these dogs by talking cheerily to them. They didn't know what we said to them, but they were as keen to scent the tone in which we said it, as they were to smell a bear or a seal. When we were blue and talked snappishly or petulantly to them, they became discouraged, too, and didn't work half so well. Brace up and sing to them, and call them "old boy," and put a jolly ring in your voice, and they would pull their legs off for you.

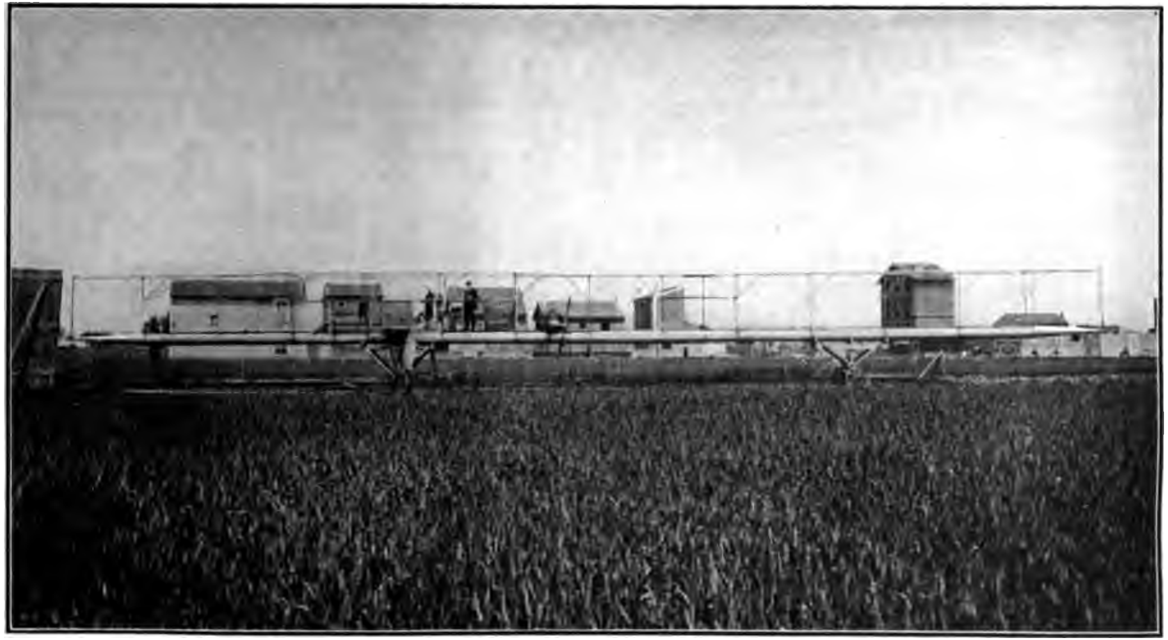
"All but 'The Fox,'—he was a born shirker. He used to go lame all of a sudden, so that he couldn't pull; and at first I sympathized a good deal with him and called him pet names. Then I discovered that he was shamming and that a genteel touch with the end of my ski-stick served to cure his lameness in a jiffy. But the habit of going lame when he became tired he never got over, and for months he tried two or three times a day to deceive us, always with the same result."

CHAPTER XIII

THE JOYS OF POLAR SLEDGING

Polar sledging is anything but a joy ride. The cold is not the worst part of it, that is, directly: so far as actually feeling the cold was concerned, we had no trouble, and a few frostbites didn't count. Hardest to endure was the indirect effect of the cold, coupled with the absence of a fire to dry things. The camping hour arrives. You have been working hard all day, pulling and tugging in a temperature ranging from twenty-five to forty-five degrees below zero, and perhaps with a nice cool wind blowing from the north. Outside you are a mass of frost, and inside your skin is wet with perspiration.

Be careful in pitching the tent that you do not leave your mittens off more than a few seconds, or you will not only freeze your fingers, but find the mittens frozen so hard you cannot get them on again. The best way is to put them inside your jacket till you want them. When the tent is pitched, one man goes to cut fresh ice—ice that is at the top of the hummocks, fifteen or eighteen feet above the sea—and break it up fine for melt-



FULL LENGTH VIEW OF THE STEEL CAR OF THE AMERICA -- 1907.

ing over the petroleum-gas lamp. This is the only way to get water, and it is not an easy way, for the ice is almost as hard as a rock.

Another man feeds the hungry dogs their meager ration of frozen meat. Poor beasts, it is a small bit and swallowed at a single gulp, and then nothing more than snow for them to eat till the next night. It makes one very sad to see the hungry fellows sitting about watching with wide eyes their busy masters, and wagging their tails in expectancy of a crumb or two. But it is a hard life for both man and beast, and rations must be strictly adhered to, no matter how many good dogs go to sleep in the snow with empty stomachs. They'll jump into their work all right in the morning just the same.

Two men get the big sleeping-bag off the sledge and carry it into the tent. There they try to unroll it. Half an hour of tugging, yanking, pounding is needed to accomplish this feat, so fast is it frozen from the moisture of the previous night's use. When it is spread flat in the snow we begin getting in. Preliminary to this we beat and scrape some of the frost from one another's clothing, but it is impossible to get it all off. The remainder goes into the bag with us. We don't take off any clothing, not even our moccasins or our hats. Yes, we do take off our reindeer-skin shoes, but it is only for the purpose of turning them inside out that they may the better dry during the night, and that we may take out the senne grass or hay which we have worn in them to absorb the moisture and keep the feet dry.

The art of keeping warm feet is to keep dry feet, and three or four pairs of woolen stockings and a nicely packed bunch of this hay work to a charm. Whatever else we got in this excursion, we did not get cold feet. Scattered out to freeze, the hay can be shaken entirely free of frost next morning, and so will be fairly dry to put on again. But what a job it is to turn these frozen moccasins night and morning with our frost-nipped, tender fingers! More than once have I seen a big, brave fellow shedding tears and swearing together while at this job—it hurt so.

We start kicking our way into the sleeping-bag. It is frosty, icy, hard in there, and it takes a lot of kicking and shoving to straighten it out and work our way well down in. By the time this is done, supper is ready, and this brings in the only glorious hour of the day. Hot soup, hot coffee, biscuits; a piece of cheese; bacon, sometimes, raw, sometimes boiled in the soup; oatmeal porridge; a nice chunk of butter, hard as a rock, but it tastes good in the coffee; and a big drink of ice water when we are lucky enough to have any water left over. If there isn't any left over, we go thirsty, as we can't afford to use more oil.

We sit up in the bag like birdlings in a nest, and eat this supper with voracious appetites, and with mittens on our fingers. The steam is converted into frost and the white particles fall all over us; but we don't mind that as long as there is anything to eat. The saddest moment is when everything is gone and the ration exhausted.

Then a pipe for consolation—a pipe and the pleasant task of writing up one's journal in a temperature of seventy degrees or more below freezing. There was once a time when I didn't believe it possible for a man to write two or three hundred words in half an hour in such cold, with bare hands; but now I know it can be done, and, what is more surprising, the man can actually read what he has written.

The next thing is to push one's self all the way down into the now fairly-well thawed-out sleeping-bag, pull up the flap and button it tight, and get snuggled for the night. All this is easier said than done. The predominant idea of comfort in a sleeping-bag prevailing among my Norwegian comrades was to slide down somewhere near the bottom and telescope themselves together; but I had always to have a smell of fresh air, no matter how cold it was.

There were four of us in one bag, and none of us was small, and we had to lie "spoon-fashion." When one turned over all had to turn. As we were packed in like Smyrna figs in a box, and as I occupied one edge of the bag, where the coverlid was drawn down over me as tight as a drumhead, it sometimes took me a quarter of an hour to turn over. It was quite an athletic feat, but it had its advantage in that it helped one to warm up. The effort to turn about-face usually started perspiration, though the jacket I wore was so stiff with frost that on first getting into bed it was difficult to bend the arms. We always wore our mittens in bed, at least during the first part of the night, when we were struggling to get our blankets straightened out. These were like pieces of sheet metal to start with; but the heat of our bodies and the persistent bending and breaking of them finally licked them into shape.

Surprising, the power of this body heat of a vigorous man! In the course of a couple of hours it thawed most of our clothing into wet compresses, made the blankets limp and soggy, and even softened parts of the sleeping-bag itself. Something like a hundred minutes after buttoning the flaps down over our heads we found ourselves lying with pools of water under our bodies, while frost still adhered to our trousers. By this time two or three of my

Norwegian bed-fellows were snoring like threshing-machines, trolley-cars, boiler-shops and batteries of artillery. Then, generally without much loss of time, I suppose I joined in the chorus.

All these and countless other annoyances are small matters when once you get accustomed to them, and as long as one is in full possession of his health and strength. But I cannot conscientiously recommend an Arctic tent as a hospital, nor a dog sledge in rough ice and bad weather as an ambulance.

CHAPTER XIV

CAUGHT IN AN ICE-QUAKE

March 20th is the day all Arctic travelers impatiently await. It is the day the sun reaches the North Pole, not to go away again for six months. Up near the Pole this day marks the end of the dark period; though the sun continues to set for a few hours at midnight—gradually lessening the diurnal duration of his disappearance till he remains above the horizon night as well as day—a fast-diminishing twilight is the only semblance of darkness we have above the 80th parallel after March 20th. As I have said, we were going along very well to the northward, and I had begun to feel quite proud of the progress I could make with my sledge and dog team.

But pride goeth before a fall. On this very morning which marked the end of the Arctic night and the dawn of the brighter day, a little accident happened. It was a trivial thing in itself, tremendous in its consequences. My sledge, carrying 500 pounds of weight, had stuck in a rough place. As usual, I called to the dogs

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and threw my weight into the harness A lunge forward, and down into a little crack in the ice—a tiny little crack such as we had crossed every day by the scores—went my right leg. The momentum threw me forward upon my face, and my shin bone received the full force of the thrust. At first I thought the leg was broken in two or three places, so great was the pain. For a few moments I felt faint. But when I had picked myself up and found that I had nothing worse than a bruise and sprain, I counted myself very lucky, and went on my way as contented as if nothing had happened.

Next morning of course I was sore and lame, and the prudent thing would have been to stop for a week or ten days and get all right again. But I kept going, the leg getting worse and worse, and I suppose I should have been rash enough to go so far that I never could have gotten back had not something else happened. Fortunately, this other thing did happen, and it came down upon us like a thief in the night, in the shape of an ice-pressure which acted just like an earthquake under our camp and destroyed sledges, dogs, stores and instruments in the twinkling of an eye, and came within an ell of getting all of us.

It was a strange disaster which overtook us. We had covered about 140 of the 700 statute miles which lay between our winter headquarters and the Pole, and felt confident of our ability to cover a good deal of the remaining distance before turning back—for at this time there was no realization of the fact that the injury to my leg was so severe. Retreat at once was imperative if my life was to be saved. We had no thought of retreating; the leg would be better to-morrow or the day after; and if the fates had not interposed, it is certain we should have gone on and on to the north—so far that at least one of us could never have returned. But the fates did intervene with what at the moment seemed a most cruel hand to save us from worse things beyond. March 22nd was a day of storm from the northeast, and we could not make the dogs face the blast. By evening the wind had died away, but as the nights were still pretty dark, we crept into our sleeping-bags at six o'clock, with orders for breakfast at three in the morning and an early start. At midnight we were aroused by the ominous sound of ice crushing against ice, accompanied by a slight jarring of the frozen crust which lay between us and the sea. In an instant all five of us were outside the tent. We could see nothing. The storm had blown up again, and the air was filled with drifting snow. Two men were detailed to make a reconnaissance, the others creeping back into

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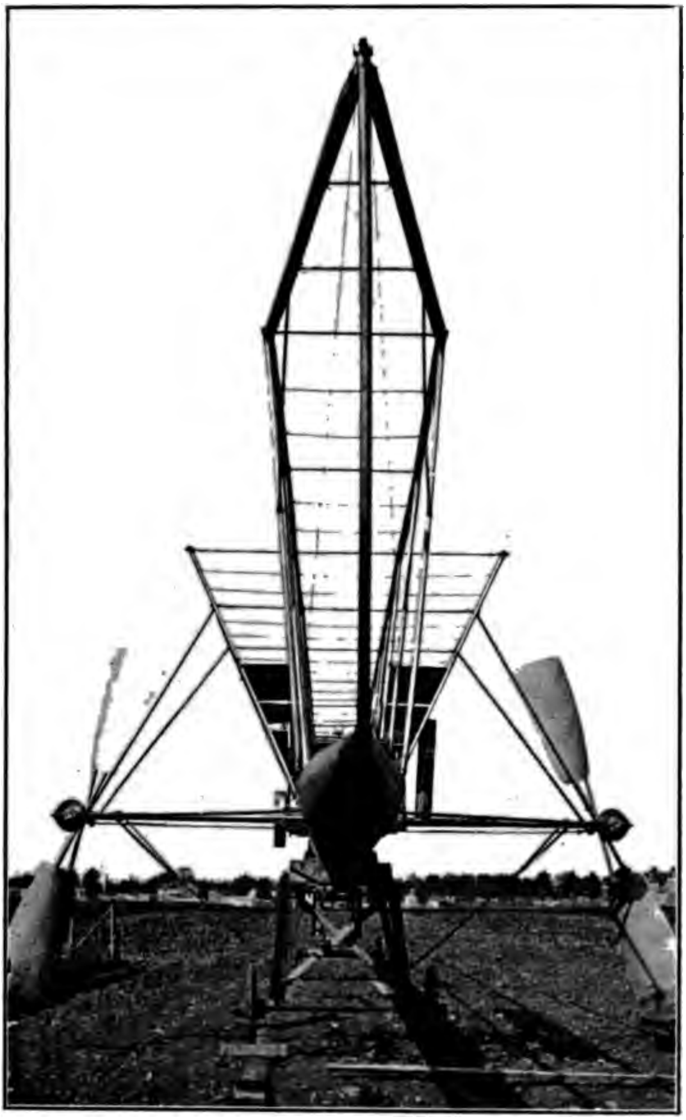

The steel car of the Airship America — 1907.

the tent out of the blast. But in two or three seconds there came another movement of the ice; another low, sullen, rumbling sound.

A crack had opened directly under our sleeping-bags, and in its black depths we could hear the waters rushing and seething. Running out of the tent into the darkness, one of us stepped into an opening, wetting his foot, and no sooner had he withdrawn his leg than the crack closed like a vice, and with such force that the edges of the blocks were ground to fragments and the débris was pushed up into a quivering ridge. Ten feet away lay a dog with his head cut clean off by a similar opening and closing of the ice upon which he had been sleeping. How the animal had managed to get caught in the trap we could not imagine; but there he was, as neatly beheaded as if an executioner had done the job.

The remaining dogs were howling dolefully. Some of our sledges, with their precious stores, were already toppling into the waters where the ice had upheaved underneath them. Under our feet and all around us the ice was shaking and breaking—here pushing up, there sinking down—and the violently agitated sea was spouting through the openings. We were caught in an ice-quake.

For a few moments, oddly enough, we did not fully realize our danger. To none of us was an ice pressure a new thing, and familiarity had doubtless bred in us, if not contempt for the ice-king, certainly a somewhat superfluous confidence in ourselves. But when, a few moments later, the very pieces of ice upon which we stood reared up and assumed angles of from thirty-five to forty-five degrees; when our entire camp started revolving as if it were in a maelstrom; when we saw our tent, sleeping-bags, and cooking-kit threatened by a rushing mass of sludge and water, we knew that whatever was to be done must be done right quickly.

There was no panic. There was not the slightest sign that any one of us was even excited. We cut the harness of such dogs as we could get at, that they might save themselves. In the very nick of time three of us sprang out upon the floe which held the tent, tilted though as it was with one edge down in the boiling sea and the other up in the air, and after a sharp struggle, we succeeded in rescuing the precious sleeping-bags, the cooking-outfit, and the tent itself.

Obviously it was imperative that we run away from this convulsed spot as quickly as possible. But whither should we go? In the darkness and storm it was impossible to see anything around us but the shaking, quaking ice-blocks. I asked

Paul and Emil to go hunt a sound floe, if such a thing remained in the Arctic Seas, upon which we could take refuge. They instantly set out, scrambling over the rolling, shaking slabs, and as they disappeared in the gloom I said to myself: "Well, that's the last I shall ever see of those boys." Yet I was not much concerned about it. For some reason, which I never expect to understand, I was unable to get up more than an indifferent sort of interest in what was going on. The most acute sensation I had was in a thought of how much more pleasant it would be back in the snug bag, and whether it was really worth while to stay out in this bitter wind trying to save things.

In a few moments Paul and Emil returned with word that twenty or thirty rods away they had found a floe which appeared to be sound and safe. Then, for the first time, we all began to feel that there was something worth hurrying for. Laying hold of a sledge, we hastened with it over the quaking pieces and across a chasm in which the water was running like a mill-race, to a place of safety upon the large floe beyond. Three trips there and back we made, each time finding the chasm considerably wider than before.

It was all we could do to get the third sledge over, and when we attempted to return for the fourth there was before us a river—a mad-rushing, ice-strewn current. The spot where our camp had stood, and where but a few moments before we had all been at the work of rescue, was in a volcanic state of eruption. Masses of ice were gushing up into the air like flames. The brittle blocks were crushing, grinding, snarling, biting at one another. The sea was rushing wildly through and over the débris. From within this swirling maelstrom of ice and water came the doleful howling of a number of dogs, whose fastenings we had been unable to cut.

We stood at the margin of the upheaval and listened. The volume of cry from the dogs became fainter and fainter. Soon it dwindled to the moan of a single dog. A second more and there was no sound to be heard save the cracking, crunching of the ice, the swishing, hissing of the waters. As I stood there in the storm by the wreck of a great hope I noticed how strangely like the roar of a fierce conflagration were the mutterings of this Polar paroxysm.

Without a word we turned back to our rescued sledges, moved them farther on, and, as soon as we felt quite secure, stopped and put up the tent to escape the force of the wind. While cook was preparing coffee and oatmeal we made an inventory of our losses. One-third of our dogs and all of our dog food were missing; also

300 or 400 pounds of bacon and condensed food; bags of reserve clothing and footwear; all our ski and our canvas canoe; and worst of all, our basket of instruments. The Polar dash was at an end. It would be nothing but suicide to go on.

When the light returned and the storm had abated, we walked back to the place where our camp had been. A strange scene lay before us. Where our tent had been pitched there were now masses of pressed-up ice, rising in places thirty feet above the level of the sea. The solid crystal sheet, from eight to fifteen feet in thickness, had been shattered into a million fragments, turned bottom up, block packed on block, and in between the elevation were pockets of débris—the powdered pulverized detritus produced by these Titanic forces.

Now all was still and calm, and where the sea had rushed up and formed little pools in the sludge, new ice was forming in the thirty-degrees-below-zero temperature, and all was shining brilliantly in the morning sun. Not a trace of sledge, or dog, or canoe, or ski, or anything whatsoever that had been ours, was to be seen in the wreck. Had the strongest ship that was ever built been caught in this convulsion, it would been ground into kindling wood and the kindling wood into powder.

Now we could plainly see the cause of the disaster, hitherto inexplicable. We had pitched our camp about half a mile from an enormous iceberg, fragment of a glacier, that had drifted here perhaps years before and grounded. It was about as big as a modern New York or Chicago "sky-scraper," rising forty feet above the surface of the water with its feet upon the earth perhaps 150 feet below. There it stood, like a mountain, now only a hundred yards away. The storm that blew up while we slept had started the whole field of ice in motion. It had driven the ice down upon the great berg just as the sawyer moves his board against the saw, or as you may push a piece of cardboard against a fixed knife. And our camp had been in the line of the cut!

It was all plain enough. The mountainous berg had sawed the ice-sheet, and into the channel thus formed—here, as elsewhere, nature will have no vacuum—the pressure of billions of tons, coming from rear, right, left, had jammed, rolled, revolved, uplifted, down-thrust, crunched, crushed, powdered the fragments of floes into a death struggle for mere place to exist.

All along that coast, as far as we could see this bright morning, the one spot—the one little rood out of all these millions of acres—where our camp could have been pitched only to be destroyed was the very spot where it had been pitched. All other spots for miles and miles were just as they had been. Start an ant crawling across a newspaper. Take a pair of shears, shut your eyes, make one random clip, and cut the insect in two. We were the ant creeping across the surface of this great ice-sheet, and that is what chance did for us—the one out of millions that saved at least one human life.

CHAPTER XV

THE BITTER RETREAT

For a man with red blood in his veins it is easy to fight, to work, to suffer, to endure. The hardest thing in the world to do is to surrender. But in this case there was nothing else to be done. The bitterest hours of my life were these which immediately followed realization of the fact that our journey was at an end. It was a crushing disappointment. I am not ashamed to say that I wept—trying to conceal my woe from my comrades. But there is not much privacy in a sleeping-bag occupied by four men.

Next morning we started back to Cape Tegethoff with our now sadly broken-up outfit, thankful to be alive after the frightful night we had passed, thankful to have a sleeping-bag to crawl into when the day's march was over. What would have become of us if we had lost our bags in the ice-quake, as we came so near doing, the good Lord only knows. Men cannot live without sleep; to try to sleep in that temperature without a bag for shelter is to slumber without waking;

Section of the steel car of the America — 1907.

and we were ten days or a fortnight from our camp.

They were pretty hard days, that march in retreat. The cold was bitter—45 to 50 below most of the time. The Norwegians managed the sledges and dogs, and I attempted to go ahead and pick the road in the rough ice, and it was nearly all rough. Sometimes I got far ahead of the sledges, and was trudging on alone in the flying, drifting snow, little caring what happened to me. More than once my men warned me I might at any moment meet a bear, and as I carried no weapon of any sort, such a meeting as that could have but one ending. To please them I tried to stay nearer the little caravan.

One stormy day we stopped and put up the tent for midday luncheon in order that we might have some shelter from the cruel wind. As we stood in the tent waiting for the coffee to boil, I chanced to see a big bear about twenty yards from us, and coming straight toward us. I called to Daniel Johansen, who was at the tent door, to get a gun, and be quick about it. Our rifles were packed in the sledge-loads, a little distance away. Would Daniel be able to get his gun before the beast plunged in upon us? It was pretty doubtful. Now bruin has the scent good and strong; now he is leaping for us; now

—a crack of Daniel's rifle, and the bear falls over almost at the door of the tent.

It is nice to have fresh meat walk right into your kitchen that way. And we proceeded to make good use of that which the gods had sent us. There was no more sledge-travel that day. We flensed the bear, filled the pot full, gave the hungry dogs all they could eat, and lay in our bags all afternoon and night, every one of us consuming amazing quantities of steak, liver and heart. I really believe the bear's heart and liver are the finest delicacies this world produces.

As the days wore on and we worked our way southward, my injured leg got worse and worse. It was filled with inflammatory product from toes to trunk, and was swollen much beyond its natural size. Two or three times I fainted and fell down in the snow, going on again after the men had picked me up and set me on my pins. They urged me to give up walking and ride on the sledge. But I was too proud for that. Thinking something might be done in the way of treatment, I got out the "Hints to Travelers," looked over the medical pages, and finally found what one should do in case of bruise to a leg:

"The patient should lie perfectly quiet. The injured member should be constantly bathed in hot water and be permitted to rest upon soft pillows."

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Somehow the contrast between these gentle things and the icy actuality I faced angered me; and with an exclamation, "Hot baths and soft pillows be blowed!" I threw the book as far as I could out in the snow.

My comrades rescued it. They also took me bodily the next morning and placed me in a sleeping-bag on one of the sledges, and calmly informed me that if I dared to climb out they would put me back again. A nice bit of mutiny! But I had just sense enough to realize it was no longer a case for pride, but one of getting out alive, if I could. And if it had not been for my comrades, I shouldn't.

Pretty soon we arrived at Fort McKinley and spent a night there. I believe this was the coldest night I ever saw. You would think it might be warm in the hut. But it seemed colder there than in the tent. By this time the circulation in my hurt leg must have been virtually stopped by suffusion of inflammatory matter. I felt the leg freezing, and told my comrades about it. They cut open my trousers and underwear, and with their rough, frost-nipped hands—we were all much frost-bitten—they rubbed me hour after hour till a semblance of blood circulation was restored. That was a close call to having a leg frozen—and whatever that was sure to mean.

Finally we reached our winter hut—I riding on a sledge—and found our three Americans there all well. Dr. Hofma did all he could for me; but there was not much that could be done. My leg was a sight; my nervous system was a wreck under the physical strain, the low, constant fever which the inflammation produced. Nearly four months I lay flat on my back on the floor of the hut, tormented with the most agonizing itching, weak, feverish, despondent, sleepless. I had never been and am not a teetotaller. Yet throughout this long ordeal it was a matter of pride with me not to drink. Bottles and demijohns of liquor were within reach of my right hand—and in the 15 weeks of imprisonment I took about four swallows!

After a short rest in Harmsworth House, our Norwegians took the field again, along with Mr. Baldwin, the meteorologist. I had planned to lead this party, but of course was unable to go. Up to this time the eastward extent of the Franz Josef Land archipelago was unknown and was a moot question among geographers. Our party delimited the archipelago to the northeast, discovering many new islands. One of them of considerable area, beyond Wilscek Land, I named after Alexander Graham Bell, then president of the National Geographic Society. Other islands, capes and straits I named in honor of friends who had helped me finance the expedition. Another important part of our geographic work was correction of the earlier maps made by Payer and Jackson. Payer, though an honorable and competent explorer, had been deceived into placing a great glaciated land and many islands where we found that only ice-covered sea existed.

Jackson had mapped two or three islands in the southern part of the group where we found nine or ten. It is easy to err in the deceptive light of the far north in the early part of the year. I felt sure I had seen at some distance, two islands east of Rudolph, and north of the Liv Island of Dr. Nansen, and put them on my map with dotted lines to indicate I had observed but not visited them, and named them after two most valued friends, Ben T. Cable and Tom Johnson. The Duke of Abruzzi expedition afterward found that what I had taken for two islands must have been only ice hummocks, in the distance looking like lands in the refraction of March.

After a long, long wait, at last a big ship was reported steaming toward us. She proved to be the steamer *Capella,* chartered by my brother Arthur to come after us. How good it was to get letters and newspapers from home after more than a year of wandering, and to be able to steam away to the south ourselves. On our way out of Franz Josef Land we met the *Stella Polare,* the Duke of Abruzzi's ship, coming in. As I was the old settler it fell to me to make the first call upon the newcomer. Crawling down into a boat I was rowed over. The Duke, Capt. Cagni and the other officers and I and my American comrades had a pleasant visit, and I formed a great admiration for the sterling young prince who has done so much for geographic research. Rather a strange meeting, this, between a son of kings and the son of a western farmer who had been a private soldier. But we met on terms of equality—science and adventure level all rank distinctions.

The Duke and his party were more fortunate than we had been. Where we had tried in vain to force the *Frithjof* northward through the ice, they now had open water before them. The *Stella Polare* actually reached the coast of Rudolph Land, and the Duke was able to establish his headquarters almost as far north as we had sledged. From this base, the following summer, Capt. Cagni was able, by a splendid and plucky effort, to beat the record which Dr. Nansen had made from the *Fram* a few years earlier.

CHAPTER XVI

BY AIRSHIP TO THE POLE

This is the age of progress, of remarkable mechanical, engineering and scientific development. After returning from Franz Josef Land, addressing the British Association for the Advancement of Science, the National Geographic Society, the Arctic Club of America, and many other scientific bodies, the desire to go north again was strong within me. Two years were needed for the recovery of my health, and a longer time to pay off, out of my earnings as a journalist and writer, the indebtedness I had incurred in the Franz Josef Land trip. But instead of organizing a new expedition (as I was strongly tempted to do), I determined to watch the progress of the arts and mechanics to see if some better means than the primitive sledge could not be found for advancing upon the Pole.

It did seem that some such better means should be found—better than the barbaric employment of sheer brute strength. Naturally, I looked to the then rapidly developing automobile for a superior instrument. If one only had a smooth surface to travel upon, it would not be difficult to build a motor-car which could run to the Pole. But if we could find a relatively smooth road the discovery of the Pole would be easy by sledging —in fact, the Pole would have been reached long ago. The smooth road does not exist.

One thing I did plan, and afterward tried to execute, was a motor-sledge. The theory was that a motor-car would be of no avail on account of the roughness of the road—over a hummocky ridge, now a deep pocket of soft snow, and here and there an open water lead where the ice-floes had separated with wind or current. A heavy car or vehicle of any sort would be useless. But a light vehicle, weighing only 150 or 200 pounds, or less than a loaded sledge, would be different. Two men could easily lift it over the hummocks and ridges. So I planned to build a light motor-sledge that could be used, not to carry loads, but to pull them. It was to be a little locomotive, drawing its string of lightly-loaded sledges behind it. On all the smoother stretches—and there are intervals of good ice or snow upon the polar sea-ice—the motor traction vehicle could pull a good load at a rapid pace. The men in charge of it could ride, and thus be rested by the time the next ridge of hummocks was reached; and there the little locomotive, and the small-unit loaded sledges behind, could be

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quickly lifted over, and when all was in order the motor-vehicle could be set working once more.

Let me explain to the reader, at this juncture, what the surface of the polar sea is like. It is ice which never melts, and which has an average thickness of about eight feet. But it is not a continuous field of ice. It is broken up into innumerable floes or pieces. Some of them are small, only a few rods across, others may be miles in width. These masses of ice are almost never at rest. They are set in motion by the tides, by the currents, and above all, by the winds. Their movement is not equal. Due to various causes, one may move faster than another. Occasionally neighboring floes drift in opposite directions. When they come into collision we have a majestic display of force. The edges of these massive fields of thick ice crumple up as if they were paper; the broken-off pieces, as large as houses, are thrown up into the air. "Ice-screwing," as the Norwegians call these mighty collisions, produce a roaring, crackling noise much like that of a great conflagration. They leave behind them scenes of wreck and chaos—an irregular ridge of huge blocks of ice heaped up in the wildest confusion.

When one of these ridges is freshly-made the blocks of ice are blue, sharp-edged. But when, as is more likely, the upheaval which produced them occurred many years before, they are rounded off by melting in the summer sun, and much flying snow has drifted in and around them, they thus become a line of hummocks, usually conical, the larger blocks standing fifteen or twenty feet above the normal level of the ice-fields. One ridge of hummocks may have another for its neighbor only a few yards away; or the nearest one may be a half mile, a mile, or even several miles distant. Between them the floe is fairly level, though often broken up by minor disturbances of past ages; and the snow is likely to be deep and difficult to travel.

The best season for sledging over the polar ice is, of course, the spring—after the light has returned with the northward-going sun, when the snow is likely to have a hard crust able to bear men, dogs and sledges, and when the floes are less likely to have open channels between then, because the cold is very great. After May the heat of the sun softens and melts the snow. Sledges do not run well upon a wet, soft surface. The feet of men and dogs sink deep. Progress is at a very slow rate, and with enormous expenditure of energy.

But the cold period, while affording the best road, brings in other difficulties such as I have described in the story of our Franz Josef Land

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expedition. Men are weakened morally and physically by the nightly ordeal in the so-called sleeping bags. They awake in the morning—or what corresponds to the morning—but little refreshed. Day after day and week after week of this work, fighting for sleep after exhausting days, never knowing one hour of real comfort, clothing wet and icy, fingers, noses and cheeks frost-bitten—it is not surprising men become less efficient, that the marches drag alone at a snail's pace.

Realizing all this in bitter experience, I planned not only the motor-sledge to pull loads over all the good surface at an accelerated pace, but a warmed tent for the men to sleep in. If I had organized another sledge expedition it would have been equipped with a tent of three thicknesses of silk, arranged to have two air-spaces between the fabrics, and within a small petroleum or gasoline-heating stove. In an ordinary tent, even while the coffee is being boiled, the temperature is almost as low as it is outside. But experiments which I made with a triple tent, air-spaces between the walls, showed that with a very small expenditure of fuel per night the temperature could be raised thirty or forty degrees above that of the surrounding atmosphere.

In the Arctic regions as elsewhere most things are relative. We found it a dreadful ordeal to cook, write, sew and sleep at 40 to 50 below zero. But when, later in the year, warmer days came, 10 below zero up to zero or a little higher seemed a paradise of comfort and luxury. At home we think a room cold if the temperature within it falls below 60 or 70; and freezing weather, 25 to 32, is very cold. But with sledging parties anything better than 5 or 10 below is fine, even in the kitchen, the library, the dining-room and the bedchamber!

So I had reckoned it all out that we should save far more of physical strength and effectiveness by having a fairly comfortable tent in which to live than it would cost us in energy to haul the small quantity of fuel required to warm the tent during the coldest weather. I also calculated that the motor-sledge of light weight would be more efficient than dogs, though the plan was to use dogs as well as motor-vehicles. But other plans eventually took the place of these interesting suggestions.

I had never lost sight of the air as a royal road. Confidence in the ordinary balloon, without engine or rudder, a mere toy of the winds, was at low ebb after Andree's tragedy, though it is not at all improbable another attempt of the same sort might have had a more fortunate outcome.

But in the autumn of 1905, while at the Portsmouth Peace Conference, my attention was

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drawn to the practical success of the Lebaudy dirigible balloon in France. This airship, with a total lifting capacity of about 7,500 pounds, had made a large number of short voyages and had been adopted by the French Government as a military machine. It at once occurred to me that if this type of airship was good enough for the purposes of war, it ought to be good enough for geographic exploration, as an instrument with which to extend man's knowledge of the earth. And action quickly followed the inspiration.

CHAPTER XVII

PREPARING FOR THE AIRSHIP POLAR EXPEDITION

Going to Paris the first of January, 1906, I at once set on foot an exhaustive inquiry as to the practicability of motor-balloons in polar exploration. All the known experts and authorities were consulted. Among them were Henri Julliot, who had built the Lebaudy, and who afterward built La Patrie, La Republique, and other airships; Commandante Bouttieaux, of the French Military Aeronautic establishment at Meudon; Captain Ferber, who since lost his life in an aeroplane flight; Colonel Renard, the well-known authority on aeronautics; the constructors, Maurice Mallet, Edouard Surcouf, Louis Godard; F. S. Lahm, an American who is prominent in aeronautic circles in Paris; the veteran Wilfred de Fonvielle, who took a big balloon out of Paris during the siege in 1872; Count de la Vaulx, who holds the long-distance spherical balloon record, and many others. Santos Dumont, the young Brazilian who had done such valuable experimental work with motor-balloons, thought so well of our project that at one time he seriously considered joining me in the effort. All sorts of opinions were drawn from the men who spoke from experience and knowledge of the art, but the general judgment was favorable to the project.

The idea of seeking the Pole in a motor-driven balloon—a true airship—caught the imagination of the French people, and I was given cordial welcome everywhere. The eminent scientist and astronomer, Prof. Janssen, of the Observatory, said: "Andree's voyage was suicide; yours promises success." He presented me to the famous French Academy of Sciences, where much encouragement was generously extended by the savants. I was made a member of the Aero Club of France, and addressed by invitation the Aerial Navigation Society, the Meteorological Society, and other bodies.

Thorough investigation of details having convinced me that the airship afforded at least a promising means of reaching the Pole, I determined to build such a ship, and to build it, if possible, quick enough to enable us to take it to the Arctic regions during the summer then approaching, and to have at least an experimental voyage with it. Airships and polar expeditions cost a great deal of money, and I was fortunate enough to have the necessary capital at my command.

Before leaving America I had placed my project before the owners of the newspaper with which I have been associated for a quarter of a century, the *Chicago Record-Herald.* Mr. Frank B. Noyes, then publisher of the paper, and the President of the Associated Press, the greatest news-gathering organization in the world, liked the idea, and took me to Mr. Victor F. Lawson, then the owner of the *Record-Herald,* and also of the Chicago *Daily News.* After a full and searching discussion it was agreed that we should organize the Wellman *Chicago Record-Herald* Polar Expedition. This title was dreadfully long and clumsy, but nothing else would do. Mr. Lawson subscribed for most of the stock of the corporation, and did so through public spirit and his desire to aid in doing something for progress. Only incidentally did he think of advertising his newspaper, and he knew that as a business proposition it would be a losing one—that if it was advertising he wanted he could get much more in other ways at far less cost.

Nevertheless, when the plan of the expedition was announced, a part of the press received it with skepticism and sneers. In their opinion it was nothing but an advertising scheme. Worse still, emboldened by their narrow imagination, many declared the project was only a fake, a

THE STEEL CAR OF THE AIRSHIP — 1909.

bluff, that there was no serious intention of trying to reach the Pole, and so on to the end of the string of denunciation and slander. Of course it was useless to reply to these criticisms. One could only go ahead with his work and do the best he could.

One theory I have always held, and still cling to it. It is that the great newspapers of the world should take the lead in all good works for the public benefit—reformations, constructions, experiments, explorations, furtherance of all worthy activities in all the fields of progress and endeavor. In my efforts I have had the support of some of the greatest journals on both sides of the Atlantic, and I am proud of it. I hope the day may come when our newspapers will be still more enterprising in these fields, and when journalistic breadth will be found sufficient to welcome, recognize and encourage all good work, no matter if made under the auspices of others in the profession. The old idea that newspapers are rivals, and must fight one another, ignore the other's activities or belittle and sneer at them—even questioning the motives and assailing the character of individuals—is a narrow, short-sighted one, savoring far more of the country cross-roads than of metropolitan journalism.

That our project should be received with general skepticism was perfectly natural, and no one could complain of that. Few people in America knew what had been done or could be done with modern airships. They could not get out of their minds the idea that an airship was nothing but a balloon, and that its car was only a basket. Even the newspapers which attacked and sneered were guilty of like lack of information. Some of the caviling editors plainly showed they did not know the difference between an aeroplane and a motor-balloon; supposed it was always fifty below zero in the Arctic regions; and were unaware whether Spitzbergen was a town in Norway or an island off the coast of Sweden. One editor, who attacked us fiercely, spoke of Smeerenburg as a populous city where we could get all the labor we required!

Those early months of 1906 were days of feverish activity. Perhaps it would have been better not to try to go on with the expedition that summer, but we Americans like to do things rapidly, and the rapidity of our operations astonished the slow-going people of Europe. By the end of January I had finished my conferences with experts and decided upon the size and plan of the airship. The contract for building this huge ship in all its parts was let to M. Louis Godard, a well-known constructor and aeronaut, who was believed to stand at the head of his profession.

A staff of engineers and experts was organized, including M. Gaston Hervieu, gas engineer, Alexander Liwenthaal, an architect, and M. Colardeau, a mechanical expert. In Norway I chartered a steamship to carry us to Spitzbergen, again securing the old *Frithjof,* which had taken us to Franz Josef Land in 1898. A hydrogen gas apparatus of large capacity was built in Paris to be transported to Spitzbergen. One hundred and ten tons of sulphuric acid for making hydrogen were ordered from Reher and Ramsden, Hamburg, and seventy tons of iron turnings were secured in Norway. Tons of provisions were purchased from Armour & Co., Chicago, and Acker, Merrall & Condit, New York, and shipped across the Atlantic. A shipload of timber and building material of all sorts was procured in Norway, clothing and general outfit in London, also instruments for navigational purposes. Sledges were ordered built to my specifications. Steel boats I ordered from Mullins, the well-known builder of Salem, Ohio, and a good suppy of malted milk from the celebrated Horlick establishment at Racine, Wis. Pumping engines, a steam engine and boiler, lathes, drills and tools for a machine shop were ordered in London.

This incomplete list will give the reader an idea of the wonderful lot of work which is involved in the preparation of an expedition like this—an expedition which ran into most of the arts and sciences and involved prodigious foresight and care if everything was to be attended to in proper fashion. Spitzbergen being an uninhabited country, and there being no means of communication between our headquarters and Norway, save by sending our steamer to and fro—a voyage of from 15 to 20 days at the least—it was necessary to take with us everything necessary for our large and complex building, mechanical, aeronautic and chemical operations. I am proud to say that not a tool or nail or appliance or material was lacking. Not only in this first campaign, but the two campaigns which followed, there never was a demand from any of our departments which was not filled from the stock we had with us.

As it was my plan from the first to equip the airship in such manner that its crew could at any moment, if necessary, bring the craft down to the surface of the ice-fields, and then convert themselves into a sledging party, it was necessary to have dogs for the sledges. Alexander Trontheim I could not get hold of this time, but after overcoming many difficulties managed to get another resident of Siberia to send men down the Ob river to the Ostiak tribes on the Arctic coast and from them procure a pack of thirty selected sledge dogs, to be delivered at Archangel by a certain day. The dogs were delivered in time, at a cost of about $70 per dog, though I dare say the natives got not much more than the equivalent of a two dollar bill apiece for them. Instead of sending the *Frithjof* all the way round to Archangel to take these dogs aboard, as I had done in 1898, arrangements were made to have them shipped by regular steamer across the White Sea to Norway. Another complication was met at this juncture. The laws of Norway do not permit alien dogs to be landed in the country. But the Norwegian government at Christiania made a special dispensation in our behalf, as they had done before, and the unfailing courtesy of these officials I wish to acknowledge.

An effort was also made to build motor-sledges, in accordance with the plans I had previously prepared. But it was not successful. I was compelled to go to America and to leave the details in the hands of assistants. They built the sledges far too heavy—good for work on smooth ice, as they proved when tested out on the lakes of Norway, but useless upon the rough ice of the polar ocean.

In America, as well as Europe, many scientific bodies gave us recognition and encouragement. The National Geographic Society of

Washington formally endorsed our Expedition and appointed a committee with Prof. Henry Gannett as its chairman to aid us in preparations for scientific work. Through the then President of the Society, Prof. Willis Moore, Chief of the United States Weather Bureau, Major Henry B. Hersey, Inspector of the Weather Bureau, who had volunteered for the service, was attached to the Expedition as meteorologist and also as navigator, and later I made him executive officer. He served with the Expedition two years. Felix Riesenberg, a young sailor from the U. S. Revenue cutter service (now of Columbia University) was also engaged, and Dr. W. N. Fowler, of Bluffton, Ind., was signed as medical officer. A few skilled machinists were taken from Paris, and about 25 mechanics and general workmen were engaged at Tromso, Trondhjem and Hammerfest, Norway, including Paul Bjoervig, who had been with me both in Spitzbergen and Franz Josef Land, and Olaf Ellefsen, who had been a valued member of the Franz Josef Land party.

The *National Geographic Magazine* for April, 1906, published the following:

"At a meeting of the Board of Managers of the National Geographic Society on March 16, 1906, President Willis L. Moore in the chair, the following resolution, moved by Dr. Alexander Graham Bell and seconded by Rear Admiral Colby M. Chester, U. S. N., was unanimously adopted:

"'*Resolved,* That it is the sense of the Board that the plans outlined by Mr. Walter Wellman for reaching the North Pole are carefully and thoroughly considered, and give good promise of success;

"'That the Board heartily approves of these plans, and will do everything in its power to aid in carrying them out;

"'That the Board accepts Mr. Wellman's proposition to send a scientific representative, and will, as far as possible, see that such representative is equipped for the work involved.'

"Major Henry E. Hersey has been appointed the representative of the National Geographic Society to accompany Mr. Wellman, and the scientific program is now being arranged by the Research Committee of the Society, consisting of Vice-President Henry Gannett, Chairman; Prof. C. Hart Merriam, F. V. Coville, Prof. A. J. Henry, Prof. O. H. Tittmann, C. W. Hayes, Prof. L. A. Bauer, W. H. Holmes, O. P. Austin, and Admiral C. M. Chester.

"When the Spanish-American war began, Major Hersey was in the charge of the climate and crop work of the U. S. Weather Bureau in Arizona. He obtained leave of absence, raised a regiment, and offered his services to the government. Only part of the regiment was needed, so that Major Hersey was transferred as captain to the Rough Riders, of which he was the ranking major when the war closed. Since then he has been connected with the U. S. Weather Bureau. Probably two additional men will accompany Mr. Wellman and Major Hersey in the airship voyage.

"The first announcement that Mr. Wellman would attempt to reach the North Pole in an airship was made on December 31, 1905. Mr. Victor Lawson, the principal owner of the *Chicago Record-Herald* and a life member of the National Geographic Society, supplies the money. His public spirit and generosity in thus supporting an expedition which will probably cost more than $250,000 before it is complete is deserving of the highest respect and appreciation. The expedition has been incorporated under the laws of Maine, with Mr. Lawson, president; Mr. Frank B. Noyes, editor of the *Chicago Record-Herald*, treasurer, and Mr. Wellman, general manager. The plans of the airship were determined after much deliberation with the leading experts in aeronautics of France.

"Among Mr. Wellman's advisers were Alberto Santos-Dumont; the engineer, Henri Julliot, who built the Lebaudy dirigible and who has

THE AMERICA STARTING ON HER VOYAGE — 1907.

just been accorded the grand cross of the Legion of Honor; Commandant Renard, of the army, representative of the distinguished family whose names are famous in the history of aerial navigation; Commandant Bouttiaux, chief of the army aerostatic station at Meudon; Captain Voyer, assistant chief and a man of great experience in aeronautics and with dirigibles; M. Goupil, well-known mathematician, the greatest authority in France on aerial screws, engineer, and chevalier of the Legion of Honor; Captain Ferber, an expert not only in aeronautics, but in aviation; M. Edouard Surcouf, a well-known constructor and engineer, who is now building a dirigible for M. Deustch (de la Meurthe); M. Louis Godard, the aeronaut and constructor who has built scores of ships of the air, and who has made 500 ascensions; and many others."

The De Forest Wireless Telegraph Company had undertaken to equip the *Frithjof* with wireless, and also to establish stations at Hammerfest, Norway, and one also in Spitzbergen, so that constant communication could be maintained from our camp to civilization. Owing to internal troubles, the De Forest Company did not complete its contract. They did send instruments to Europe, and one man; but I had to take charge of the operation and endeavor to secure results. We equipped the *Frithjof,* and built a tall mast and station at Hammerfest, at great expense. The number of messages we were able to get through in nowise compensated us for the outlay of money, labor and annoyance.

With all these affairs of men and materials and supplies and outfitting and construction and preparation on my hands, it may be imagined that I was a pretty busy man. And at the same time we were building the second largest airship in the world.

CHAPTER XVIII

BUILDING THE POLAR AIRSHIP

Airship construction and operation is an art which has not made much progress in this country, although Knabenshue, Baldwin, and perhaps others have done interesting and valuable work on a small scale. In this country the prevailing conception of an airship is that of a gas bag of small size, relatively, covered with a netting of ropes or steel wires, and with sufficient lifting capacity, when inflated with hydrogen gas, to carry the balloon, a light framework of bamboo or wood, one or two men, and a small motor, with a sufficient supply of fuel to run it for a few hours.

Our polar dirigible is an entirely different sort of affair. Its great size enables it to lift not only the balloon, but the car of wood and steel, the three motors, comprising a total of eighty horsepower, two screws or propulseurs, a steel boat, five men, food for them for seventy-five days, instruments, tools, repair materials, lubricating oils, and 5,500 pounds of gasoline for the motors. It will be seen that in its cargo capacity our ship of the air, with its eight tons of carrying power, much more resembles a vessel to navigate the water than the small contrivances used by Santos-Dumont, Knabenshue, and Baldwin in aerial experimentation.

The instructions given by me to M. Godard, and embodied in the contract, were to spare neither weight nor expense in his efforts to make a balloon that should give the maximum of security and endurance. It is known that the unfortunate Andree met his fate partly through faulty construction of his balloon; that it lacked the gas-tightness which should have enabled it to remain a long time in the air, and that the fabric of which it was composed did not possess sufficient tensile strength to enable it to resist the elements and give its navigators a fair chance for their lives. I was determined to avoid such mistakes if care and prudence and outlay could suffice to do it. For in one particular, and in one only, speaking broadly, is our enterprise comparable to that of Andree—the solidity and endurance of the gasbag is as essential to us as it was to him, despite the fact that his aerial craft was a mere toy of the winds, without motive power or steerability, while ours is to have both.

In the past most balloons have been made of silk, varnished with from two to five coatings: but in recent constructions of important character cotton tissues have been employed in one or more thicknesses, coated with a thin film of pure rubber applied by means of special machinery similar to the calenders of paper mills. The Lebaudy airship had two tissues of this cotton, both rubbered. After careful consideration and elaborate calculations of pressures and strains, three thicknesses of fabric were decided upon for our ship—two of cotton material and one of silk—with three coatings of rubber. All three are consolidated into one fabric, giving great tensile strength. Counting from the interior of the balloon, the envelope is made up as follows:

	OUNCES PER SQ. FOOT.
Strong silk	.278
Caoutchouc (Para pure)	.344
Cotton	.344
Caoutchouc	.213
Cotton	.328
Caoutchouc	.147
Total	1.654

In the central zone embracing the "maitre couple," or greatest diameter, the pressure of the gas rises to 95 pounds per square foot. It is upon this central zone the envelope is applied as outlined above—one strong silk and two thicknesses of cotton, with three coats of rubber. These three thicknesses of material, consolidated into one, give a total tensile strength of about 575 pounds per square foot. Hence we have this result: Maximum strain, 95 pounds per square foot; tensile strength, 575 pounds per square foot; coefficient of safety, 6 to 1.

In the next zones the pressure ranges from 315 to 450 kilos per square meter. With a maximum of 450 kilos to provide for, a lighter silk is used in these zones, reducing the weight of the envelope to 455 grammes per square meter, but retaining 2,400 kilos of tensile strength, which means a coefficient of more than 5 to 1.

In the outer sections the maximum pressure is 350 kilos and here the envelope is composed of two thicknesses of cotton with three coatings of rubber, omitting the silk, and again saving in weight, but securing 1,800 kilos of strength per square meter—again with a coefficient of safety of more than 5 to 1.

In the Lebaudy airship the coefficient of safety was 3½ to 1. We have a coefficient of more than 5 to 1 throughout.

The tensile strength of the fabrics is not a matter of guesswork. Samples of each consignment from the manufacturer are submitted to the

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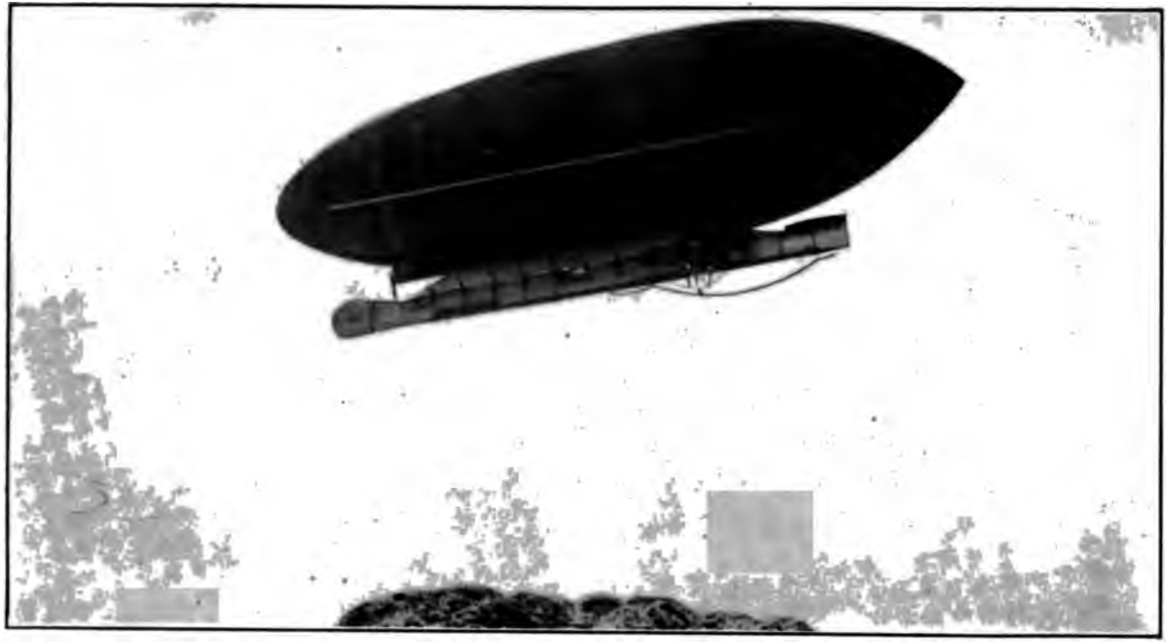
Paris Chamber of Commerce, tested by dynamometer, and officially stamped. These tests are under the regulations of the chamber of commerce, and the certificates are made the bases of contracts and their fulfillment.

In computing the work of the gas upon the fabric of the balloon it is assumed that the interior pressure is equivalent to 30 millimeters of water, or about 6 pounds per square foot. This pressure is maintained by means of the ventilator or blower which inflates with air the balloonet or interior balloon, and which is operated by an independent motor of 5 horsepower in the engine-room. The use of the pressure is to maintain the rigidity of form of the great balloon, as there are no interior frames or other stiffening devices. The integrity of form is maintained solely by interior pressure, and though it is unlikely the interior pressure within our balloon will ever exceed 25 millimeters, the fabric of the envelope has strength sufficient to give a factor of safety of 5 to 1 at 30 millimeters.

In addition to the tensile strength of the envelope, every seam, whether circumferential or longitudinal, is reinforced. The material is lapped about 25 millimeters (one inch), and doubly sewn. Inasmuch as there is danger that the hydrogen may escape through the little holes made by the needle, all the sewing lines are covered with bands of fabric cemented to the envelope—first a band covering the seam, and over that still another and wider one. The primary purpose of these interior bands is to make the envelope as nearly as possible gas-tight, but they also add greatly to the tensile strength of the skin.

The outer surface of the balloon is quite smooth. There is no netting of cordage or of wires to hold moisture, snow, or frost. Besides, the outer surface is a coating of rubber, which will serve to shed the rain and snow and prevent moisture entering the fabric. In effect the double reinforcing bands which cover the seams, circumferentially and longitudinally, act as an interior netting, consolidated with the envelope, and increasing materially its powers of resistance to all stresses. This added tensile strength is not computed in the coefficient of 5 to 1.

No means has as yet been found of making, with fabrics, an absolutely gas-tight reservoir. In varnished silk balloons, even when of two or three thicknesses of material, the loss ranges from 1½ to 3 per cent daily. With fabrics coated with caoutchouc these losses are materially reduced; and with our threefold material and three coatings of rubber we shall, according to the experts, approximate very closely to gas-



Airship America above the mountain top, Spitzbergen — 1907.

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tightness. The contract called for an envelope from which the loss by leakage should not exceed $1\frac{1}{2}$ per cent in 24 hours.

The weights of the various materials entering into the construction of the huge balloon were approximately as follows:

	POUNDS.
Fabric of the envelope, and rubber coatings	2,200
Reinforcing bands	225
Etraves and relingues (for suspension of car)	100
Five valves	110
Balloonet of light varnished silk	225
Total	2,860

Allowing for the three thicknesses, for the laps, and for wastage in cutting, approximately 12,000 square yards of fabric will be required. The cost of material is about $1.50 per yard as it comes from the factory.

CHAPTER XIX

"A SCIENTIFIC VILLAGE IN THE ARCTICS"

In June, 1906, we were able to send *Frithjof* from Tromsö, Norway, in charge of Major Hersey, with a full cargo of timber, machinery and supplies, and more than a score of workmen. They were instructed to land at Virgo Bay, Dane's Island, and there begin at once the erection of the buildings needed by the Expedition. Thus again was the site of Andree's ill-fated enterprise to be the scene of strange activity, denoting man's restless search for the unknown. The *Frithjof* made a good voyage, but found the Dannish Strait full of ice, and a landing of the timber and material was effected only with great difficulty. Some snowstorms—a snowstorm may come any day of the year in that region—also delayed operations. But as soon as possible they took their cargo ashore and at once sent *Frithjof* back to Tromsö to fetch the airship and my party.

But I was having troubles of my own, and plenty of them. The contractor of the airship, M. Godard, had been delayed by strikes, and was unable to finish the mechanical part of the ship in time to permit the motor trials which had been agreed upon. In fact, the principal motor —there were to be two engines—was not delivered by the manufacturers, and I soon found myself facing these horns of the dilemma: To hold the contractor to his bargain, and have no airship to take to Spitzbergen; or, go in with money and energy and try to help him finish his work. American like, I decided upon the latter course. I bought a Clement 50–60 horsepower motor at a high price and had it immediately installed. A day was set for testing out the machinery, and all the aeronautic world of Paris, and many scientific men, government officials, ambassadors and others of distinction, came to witness the trials.

M. Godard was by trade a balloon-maker. In that branch of the art he excelled, and the huge balloon he had built for us was of excellent material and workmanship. He was not so fortunate in his mechanical construction. The car, or "nacelle," was of wood reinforced with steel —a platform about thirty feet in length and five feet wide. Upon it were placed the motors and machinery. Each motor was to drive a propeller of wood with canvas facings placed at either end of the car. A tent-like roof gave protection to the crew from wind and weather, and a huge basket was to be swung underneath the car for carrying supplies of gasoline and provisions.

Though far from being satisfied with many of the details of this installation, rather than have the Expedition postponed one year, I decided to accept it, hoping to get it all in better order with our own staff of mechanics at Spitzbergen. So much time had been lost that in order to catch the *Frithjof* at Tromsö, and reach our base at Spitzbergen early enough to have a chance to finish our work of preparation and get a voyage that summer, it was necessary to charter a special train to carry the airship from Paris to Antwerp, where the steamer *Frigga* was waiting to carry the cargo to the south Norwegian coast, thence to be taken on 1,000 miles to Tromsö in the far north. We sent our own men with the cargo to make sure everything was properly handled, caught every connection, and July 4th left Tromsö with everything aboard the *Frithjof*.

Tromsö is one of the most northerly towns in the world. It is near the 70th parallel of north latitude, which places it in about the same latitude as Cape Farewell, the southern end of Greenland, and the northern shores of Alaska. The chief industry of the place is fishing, though there is a little agriculture. Among the 5,000 inhabitants are some of the most delightful people in the world, and the society there is refined and elegant. The climate is peculiar. In winter there are about eight weeks during which the sun does not rise at noon. At that period the people light their lamps or turn on the electric light when they get up in the morning, and keep them burning till they go to bed at night. In mid-summer, of course, there is a period of the same length throughout which the sun does not set at midnight, and weeks more in which the nights are almost as light as day. In these darkless nights of midsummer the Tromsö people roam the streets, row in the strait, climb the mountains, spend much time in the beautiful city park which lies on the hills above the town. They sleep little in the light period, but make up for it all in the dark winter.

After a quick voyage we arrived at Virgo Bay, July 8th, and had expected to see our buildings well under way, especially the big balloon house, about which we were most anxious. But to our surprise and disappointment, only the living house and the machine shop had been erected. Major Hersey had named the place "Camp Wellman," but it was as yet only the beginning of a camp. Our men were still living in Pike House, and our workmen continued living there. Next day the staff members moved into our own house, doubtless the best house ever put up in the far north. It has an outer corridor for stores, surrounded by double walls. The enclosure within is lighted by overhead windows, and also has double walls, with air-space between. Thus the habitation is always warm and dry, even in the depth of the Arctic winter—quite a contrast with the damp, freezing den in which we passed a winter in Franz Josef Land. There is a well-equipped kitchen, and a fine bath-room with a porcelain tub.

Great was my surprise upon arriving here to see on shore a little green tent over which a German flag was flying. They told me its occupant was a Berlin newspaper correspondent who had said he knew me. In a short time Herr Otto von Gottberg, a famous correspondent representing the *Berlin Lokal Anzeiger,* came up and greeted me. We were indeed old friends, and had sat at the same table at Wentworth Hotel, Portsmouth, during the Russo-Japanese Peace Conference. Herr Von Gottberg had been sent up here to report our Expedition for his paper, and had chartered the little *Express* steamer, under the command of Captain Theodore Lerner, a well-known Arctic traveler and sportsman, for the voyage. Herr von Gottberg was at first very anxious lest I should not permit him to remain, having absorbed from American papers the false notion that we were working this Expedition as an advertising affair, and that therefore we might not wish the representatives of other newspapers to be present to get information. We quickly informed him of his error and of the fact that he was welcome to stay as long as he wished.

From now our work was pushed with great energy. The first thing to do was to select a site for the big balloon house. The reader will understand that an airship, with its complicated mechanical adjustments and the long and laborious process of inflating it with hydrogen, must be sheltered from wind and weather whilst it is being made ready for a voyage. Otherwise it would be threatened with destruction by every strong wind that came along. It was not easy to find a good site for so large a house in the little bit of bare ground we had at the foot of the hills. And the site we decided upon had to be prepared by blasting out many feet of eternal ice, and also great rocks as large as small houses. It was difficult work. Then the foundations had to be prepared. For this part of the structure we drew upon the timbers which remained of the wreck of Andree's balloon house, a few hundred yards distant. Meanwhile *Frithjof* had to go back to Norway for a third cargo of materials.

The Arctic summers are short. It is impossible to get through the ice and reach Spitzbergen before the middle of June in an average year, and one must get away early in September, unless he wishes to run the risk of being caught for the winter by the ice coming down upon the coast. Spitzbergen is most favorably situated for a far northerly advance by ship during the summer. The prevailing winds are northeast, and to the westward of the Archipelago runs the great Arctic current southward between Spitzbergen and Greenland, the chief outlet of the Arctic Sea. The ice fields have a tendency to move to the westward, and in summer there is little ice on the Spitzbergen coast and much on the Greenland side. Usually ships not built for ramming ice can reach our headquarters in July and August, and advantage of these conditions is taken by the managers of shipping companies to send their tourists to the real Arctics. Every year we at our base were visited by tourist ships, hundreds of visitors descending upon us with their cameras, their autograph hunting and their innumerable questions. These tourist ships even venture to run north to the edge of the ice-pack, and have been known to pass the 80th parallel, which is farther north than Franklin, Kane and many of the early Arctic explorers were able to get on the American side of the

The Hydrogen Gas Apparatus at Camp Wellman, Spitzbergen.

globe, where no such favorable conditions for navigation exist.

Our force of men worked hard all summer, but were unable to finish the balloon house and the other buildings in time to make it possible to inflate the airship and get it ready for a voyage. The Engineer Liwenthaal had undertaken to complete the balloon house within three weeks after reaching our base. It was all he could do to finish it in nine weeks. My experience with engineers and constructors in charge of the details of operations has invariably been that they may be exceedingly skillful so far as technique is concerned, but few of them can form any adequate idea either of the time required for an operation or the cost thereof.

This balloon house was no small job. It had to be built of arches fashioned on the spot, bent and bolted together on bending frames. As fast as the arches were finished they were raised by means of a huge pyramid or derrick manned by a score of men. When the arches were all up they were moved to their proper places and bridges or spans thrown across to bind them together. The whole was covered with nearly an acre of strong canvas prepared in Norway for the purpose. The structure was 210 feet long, 85 feet wide and 85 feet high. The floor was completely covered with boards. It would not have been finished the first summer if I had not, in hopes of being able to complete it and get the airship inflated and tested, taken the responsibility of reducing the number of arches from nine to five. This weakened the structure, and got us into trouble the following summer, but at the time it seemed to be the only thing to do.

When all our work was finished we had a living house, a well-equipped machine shop, a balloon house, a hydrogen gas apparatus, a boiler house, a pumping house, and had upon the ground nearly two hundred tons of gas-making material. The *London Illustrated News* called it "Mr. Wellman's scientific village in the Arctics." Such it was, but unfortunately the summer was at an end, and it was impracticable to go on with the real work in view, which of course was inflation of the *America,* as our airship was named, and a voyage in her through the air. Though we had struggled with all our strength to get results this first summer, and were unable simply because of the magnitude of the operation and the short season in which the work could be carried on, in some way an impression was spread by the yellow journals that we were purposely delaying the voyage which we had come up here to make!

While waiting in the vain hope that the balloon house might be completed I had put the mechanical staff to work setting up the car of the airship, installing the motors and testing out the machinery by actual running. It was well we did so. And as it turned out it would have been impossible to make an airship voyage that year even if the buildings had been finished in time, because the mechanical part of the *America* was a failure. The motors could not be made to work right, the driving gear went to pieces, and the propellers could not stand even half of the strain which it was designed to put upon them.

During this summer we were favored with visits not only from a number of tourist ships, but by the Prince of Monaco. He came to our little port with his magnificent yacht, the *Princesse Alice,* and spent several days with us, having us out to dinner, and accepting the rude hospitality of our house in return. We found the Prince a charming man, democratic and companionable. He has done splendid work in scientific exploration of the deep seas, in Spitzbergen surveys, and other scientific pursuits. He had with him Prof. Hergesell, of Berlin, who has done so much in the way of exploration of the upper air by means of captive balloons carrying recording instruments, and smaller balloons set free to go to great heights and also carrying recording instruments with them, these being usually recovered with their records after the flicted upon that noble friend of research and progress, the late Samuel Pierpont Langley. It is well known that Prof. Langley, now honored throughout the world, died of a broken heart because of the ridicule heaped upon him by the newspapers of his own country.

Recently, the spectacular success of the airship of Count Zeppelin in Germany, and less sensational successes by other motor-balloons in various countries, accompanied by the triumphs of the Brothers Wright and others, both in America and Europe, with mechanical flight machines, have roused the whole world to an intense interest in everything connected with navigation of the air. Men who a year or two ago sneered at the plan to reach the North Pole by airship as the dream of a madman, now look upon that project as wholly within the bounds of practicability. If any vindication of the rationality of the central idea of our enterprise were needed, it has been found in the long voyages made by Count Zeppelin and in the demonstration that extensive journeys in the air have now become practicable. No such vindication was needed in the eyes of men who really understood all the factors involved in the problem; for they have known all along, for several years, that the construction of a motor-balloon able to make a voyage of 1,500 or 2,000 miles is simply a matter of adaptation of means to the end in view, and of the seizure of occasions not too unfavorable for the actual achievement.

As is so often the case, the general public, its imagination stimulated by the daily press, has rushed from one extreme to the other. From decrying all aerial navigation as crazy experiments it has rushed to the conclusion that within a year or two we shall have regular aerial express ships carrying passengers and mails across the continent at high speed and with such safety and certainty as to assure the commercial success of the enterprises. Men who know what cannot be done in aerial navigation, as well as what may be done, do not need to be told that the general public is as far from a correct understanding in its present bubbling optimism as it was a short time ago in its equally undiscriminating skepticism.

Count Zeppelin has, indeed, expressed his faith that a line of commercial airships to ply between German cities may be established in the near future. Thomas A. Edison has declared that while the present machines for air-navigation are not practicable in the true sense, the ultimate solution of the problem is near, and that then the reaching of the North Pole and the crossing from America to Europe will be very simple. Sir Hiram Maxim predicts the revolutionizing of all warfare by the introduction of aerial battleships and cruisers. Prof. Simon Newcomb, in the Nineteenth Century, sharply calls attention to the limitations which physical laws have seemingly placed upon both types of aerial craft—lighter than air and heavier—and scouts the idea that such ships can be useful in any important way for the ordinary or commercial service of society, or even for war. When the doctors disagree, who shall decide? In later chapters I shall give my ideas of the future of aerial navigation.

For the present, we are concerned with the North Pole. The plan to reach the Pole by airship was not at all the reckless and visionary project uninformed critics have chosen to call it. We may say the task was a difficult one—as was reaching the Pole by any means—but not impossible.

In our airship an effort had been made to secure the highest degree of adaptability in size, form, method, speed, power, endurance, safety, in every mechanical detail.

The most striking difference between our ship and the ships built by Zeppelin and others lies in the fact that the latter were designed for

Workmen adjusting one of the motors of the Airship — 1909.

high speed for relatively short voyages, while ours was planned for lower speed and a longer voyage.

In settling upon the most effective and economical speed, all things considered, exhaustive analysis was made of the winds in the Arctic Ocean. As to those winds nothing whatever can be predicated upon the direction in which they are likely to blow at any given moment. Much may be predicated upon their minimum, mean, and maximum velocity. The factors of the problem which we had to work out were: 1. The distance to be traveled. 2. The probable winds to be encountered.

It happens that we have a great deal of knowledge of the winds of the Arctic Ocean. The *Fram,* Dr. Nansen's ship, was three years in drifting through the polar sea, from north of Siberia to Dane's Island, Spitzbergen. During all that time careful observations were made of all meteorological phenomena, and these records of temperatures and winds I thoroughly analyzed before embarking upon the airship enterprise. I found that in the months of July and August the mean of wind probabilities for any given period of 10 days, or 240 hours, was as follows:

NUMBER OF HOURS	AVERAGE FORCE OF WIND, MILES PER HOUR
10	0
15	4
40	6
50	7
25	9
25	11
30	12
25	14
15	17
5	24
240	(Average) 10

Inasmuch as there were likely to be some winds so strong (30 to 35 miles per hour) that an airship could not make headway against them, and inasmuch as most of the winds were of small force, it was deemed prudent not to try for high speed. This seemed to be a wise decision in view of the further facts that high speed is very costly in the way of fuel consumption per mile, and also because it involves other difficulties in airship construction and operation.

The distance from our headquarters in Spitzbergen to the Pole being 700 statute miles, it was deemed prudent to build a ship theoretically able to travel at least three times that distance. We

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found we could carry, after everything else necessary had been put aboard, about 6,000 pounds, or three tons, of gasoline for the motor. If we were to attempt a speed of thirty miles per hour, equal to the highest velocity of the winds likely to be encountered, we should need an engine of 250 horsepower. The fuel consumption of such an engine would be 175 pounds per hour. With 6,000 pounds of fuel we could run about thirty-four hours, or a total of 1,000 miles, not equal to the distance from our base to the Pole and return. But if we were to reduce the speed to eighteen miles an hour that could be attained with an engine of seventy horsepower, a fuel consumption of less than fifty pounds per hour, and at this rate 6,000 pounds of gasoline would give us 120 hours of motoring, or a radius of action of more than 2,100 miles.

It was also found that in some respects the Arctic regions presented a field less favorable for the operations of an airship than the temperate zones, but in other respects more favorable. Conspicuous among the first, of course, is the fact that if the voyage should for any reason be interrupted, the crew must descend upon the ice-fields which cover the polar ocean, where they would find neither food nor help; and repairs beyond what they could themselves make in the air would be out of the question.

But apart from these inconveniences, and perhaps we should say these extra hazards to the crew, the Arctic regions are favorable to aeronautics in important ways.

Chief among these is the equability of the temperature. The cold itself is not a problem, because the temperature in July and August (the only months in which such a venture is practicable) rarely falls more than 3 or 4 degrees Fahrenheit below freezing. Nor is there, as many also suppose, an obstacle to be met in the power of the cold to condense the gas and diminish its lifting power. It is the variability of temperature which exhausts the vitality of a gas-buoyed airship.

In Europe or America there is always the alternating day and night, with high temperatures at midday, low temperatures at midnight or after. The difference between the two, within twenty-four hours, is often 30 to 40 degrees Fahrenheit. A change of 20 degrees Fahrenheit in the temperature of the air changes the lifting power of a ship like the *America* about 1,000 pounds.

Again, what is known as the guide-rope method, but for which "equilibrator" is a better word, cannot be used save on rare occasions, in settled countries, and may be used whenever necessary in the Arctic regions, where there are

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no forests, buildings, electric wires or other obstuctions in the way.

The *Zeppelin* had no equilibrator; the *America* was fitted with one weighing 1,200 pounds, when packed, ready for use whenever necessary to deposit a part of that weight upon the surface of the earth, to keep the ship from descending and to avoid the throwing overboard of ballast to accomplish the same purpose. A guide rope or equilibrator is simply ballast which may be used without losing it.

Our equilibrator was the much-talked of "stuffed serpent" or "sausage," a long steel-scaled cylinder of leather, water-tight, buoyant in water, and seventy-five per cent. of its whole weight made up of reserve food for the crew.

Thus we see in summary that in the polar regions we escape the greater part of the evil which afflicts aerostats in the temperate zones—loss of vitality through alternating expansions and contractions of the gas—and in the north we are able to employ a simple device for minimizing what difficulty there is from this source. The difference is a very great one.

If the *America* were to set out for a prolonged voyage in the United States or Europe the following may be taken as an average experience:

Start Monday afternoon with air temperature 60 degrees. During the night this temperature falls to 35 degrees. Loss of lifting force, and ballast to be thrown overboard, 1,000 pounds. At 3 P.M. Tuesday the air temperature rises to 65, and the temperature of the gas in the areostat, on the principle of absorption of heat which always operates in balloons, to 85 degrees. There is at this time a corresponding loss of gas due to expansion, but no loss of lifting force or ballast. That loss comes with redoubled intensity the second night, when the air temperature again falls to 35 degrees, and the gas gradually cools to that level, resulting in a loss of 50 degrees Fahrenheit, or about one-tenth of the entire lifting force in a few hours: Ballast to be thrown overboard, 2,000 pounds. It is obvious it would be impossible, under such conditions, to prolong the voyage more than two days and nights, because the exhaustion of buoyant force by these temperature changes would require the carrying of so much ballast as to leave little room for the carrying of fuel, and it is the fuel supply, of course, which gives the radius of action.

If the *America* were to set out upon a voyage from our base in Spitzbergen, with air temperature 32 degrees, during the next 24 hours the greatest rise or fall of temperature would be 10 degrees Fahrenheit, involving a loss of 400 pounds of lifting force. If the lightening of the cargo by fuel consumption of the motor were not sufficient to compensate this loss, as much of the weight of the equilibrator as might be necessary could at any time be permitted to drag upon the surface of the earth. It might happen, at any time, that during an interval of bright sunshine the gas absorbed radiant heat and reached a temperature 20 degrees higher than that of the surrounding air, and that the rapid cooling of the gas, due to clouds or snowstorm, might involve a rapid loss of 30 degrees or 1,200 pounds of buoyancy. But in such case, instead of wasting ballast, the equilibrator is ready to be used in full compensation. It will be seen that the equilibrator is merely ballast which can be used over and over again without throwing it away.

CHAPTER XXI

THE CAMPAIGN OF 1907

Returning to Paris in the autumn it was with the determination to enlarge and improve the *America* for the campaign of 1907. To make sure that the envelope of the balloon was still in good condition, I had it inflated with ordinary coal gas in the Galerie des Machines of the old Exposition Buildings. That fall the James Gordon Bennett balloon race cup was won by Lieut. Lahm of the American Army, with Major Hersey as his aide, they making a fine voyage from Paris almost to the coast of Scotland. Through Lieut. Lahm's father, F. S. Lahm, I was able to employ as chief mechanic in rebuilding the airship, Melvin Vaniman, an American who had been associated with Mr. Lahm in aeroplane experimentation. Vaniman proved to be a splendid mechanic, and for the first time I felt that I could prepare designs and make plans with a reasonable degree of certainty that they would be executed.

Vaniman himself suggested the idea of the V-shaped car of steel tubing and solid wire stays,

SOME OF THE SLEDGE DOGS CARRIED ON THE AIRSHIP IN 1909.

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and I added the plan of making the backbone or apex of this car a long, staunch steel reservoir for holding the gasoline to be carried on the trip. The car as thus perfected proved to be a mechanical and practical success, and we have held to that design in all our work. The balloon was lengthened from 165 to 185 feet, adding nearly 2000 pounds to the lifting force, and bringing the total lift of the *America* up to nearly 19,000 pounds. The steel car suspended by steel suspension cables underneath was 115 feet in length, and 12 feet in width at the top, the whole being enclosed with oiled silk, making a long and roomy cabin. Many other improvements were added; and to familiarize myself with work in the air I renewed the voyages in free balloons which I had begun the previous spring, greatly enjoying the trips over beautiful France—and if you want to realize how truly beautiful rural France is, see it from a balloon sailing along at an altitude of two or three thousand feet. Ballooning is a most delightful sport, being free from the nerve-racking vibration and anxiety which one feels in a motor-driven ship.

On one of these balloon trips, Mr. F. S. Lahm being the pilot, we encountered a wind and rainstorm while over the Seine, just after we had started, and for a time it looked as if we were going to get a ducking in the river or be dashed against the buildings which lined its banks. But with extraordinary skill Mr. Lahm managed to make a safe descent in the yard of a stone mason —a yard where there was just space enough between the walls for the balloon to come down.

In June, 1907, we were on our way north again, and at Tromsö once more embarked upon the old *Frithjof*, all arrangements having been made for us by our agent, Consul Andreas Aagaard, who has been my business representative in Norway in five Arctic campaigns; and a man of most excellent business judgment he is, as well as a delightful companion and faithful friend.

Arriving at Camp Wellman late in June we found all well. Felix Riesenberg, Paul Bjoervig and Morton Oliasen had passed a comfortable winter. Groundless proved our fears that the framework of the balloon house had been destroyed by gales. With an early start, we felt sure of being able to get the *America* ready for her trial voyage in the latter part of July. This expectation would have been realized had not the summer proved to be the stormiest known in Spitzbergen for thirty years, according to the testimony of the masters of sealing vessels which go every midsummer to those waters. July 4th the balloon house was partly wrecked by a gale, and for four weeks we struggled to save the remainder of the structure from destruction—a struggle which whitened the hair of more than one of us. For weeks I tried to sleep where my anxious ears could hear the ticking of a registering apparatus electrically connected with the anemometer outside, and unfortunately learned to know the velocity of the wind by counting the ticks. When the ticks came faster and faster, indicating stronger winds, my nerves could stand it no longer. Out of bed I jumped, and ran to see if the precious balloon house was still standing, often finding it necessary to summon the entire force to renew the fight. Thus it went night after night and week after week.

But at last, near the middle of August, the *America* was ready for her first voyage in the air. Then ensued a long wait while gale after gale swept over the islands. We were impatient to be off. The big ship also seemed eager to try her wings in the element for which she had been designed, as she constantly strained at her leashes and set up such violent swaying to and fro under the influence of the air currents which crept in the cracks of the building that at times we doubted our ability to hold her fast, even with the strong cables with which she was secured.

The *America* as she stands is the second largest airship in the world, second in size only to the *Zeppelin.* She is twice the size of the excellent ships built by the Engineer Julliot for the French army—*La Patrie* and *La Republique*—and thirteen times larger than the *Baldwin* ship purchased by the United States government. The *America* is 185 feet in length; greatest diameter, 52 feet; volume, 258,500 cubic feet; total lifting force, at sea level, 19,000 pounds; weight of triple-tissue, caoutchouc-coated balloon-envelope, 3,600 pounds; weight of steel car, 115 feet long, and containing a steel gasoline reservoir of like length, 18 inches in diameter, and capacity of 1,200 gallons, 8,500 pounds. Engine, Lorraine-Dietrich 70–80 horsepower, driving two steel screws each 11 feet in diameter. Aboard also were ten sledge-dogs, sledges, small boat, all the accoutrements of a sledging party, provisions for the crew for 10 months, repair tools and materials, 250 pounds of lubricant, 300 pounds of fresh water, and 5,750 pounds of gasoline for the engine.

While waiting for favorable weather for a trial trip and start, I wrote the following memoranda on the plan of the voyage:

"To achieve success it is only necessary for the *America* to carry us somewhere near to the Pole, because, as already explained, we go prepared to do the remainder of the work and the return journey by sledging. The *America* can proceed with her engines for 120 hours at a rate of 18 miles per hour. The average wind of the polar ocean in July and August is 10 miles an hour. If we were so unfortunate as to have a wind of average force blowing directly contrary to our course throughout the whole time, we could still make headway at the rate of eight miles per hour for 120 hours, or a total of 960 miles. The distance from our headquarters to the Pole is 717 miles (statute).

"Assuming the Pole once attained, and the fuel supply exhausted, there is every reason to believe the *America* could remain in the air, using her equilibrator, several days longer; and in that time there is a large chance that the winds would carry her, as a free or drifting balloon, far toward or perhaps to some land, and any land would mean safety for the crew.

"Should this alternative fail, we have not put all our eggs in one basket, nor in two baskets, for there is the third recourse, already spoken of —sledging our way out; and, as shown, we go prepared not only for the summer and autumn, but with provisions enough to enable us to remain out, in case of need, the entire winter, sledging back the following spring, which is the most favorable season for Arctic travel."

CHAPTER XXII

FIRST AIRSHIP VOYAGE OVER THE POLAR SEA

Because of the unfavorable weather, it was not till September 2, 1907, that we could get a chance to take the *America* out for her trial trip. That was too late in the season to start for the Pole, as winter was approaching; and yet we were determined to start should the conditions be fair and the ship work right. There were only three of us in the crew. Our force of men led the big ship out of the balloon house, and at the word of command they let her go high up in the air. Still she was not free. A tow-line was attached to the *Express,* a small steamer which had brought to our headquarters Prof. Elias and a party of German officers sent out to study our craft. The *Express* towed us out around Smeerenburg point, and there, though the weather was anything but good, I gave the order to cut the tow-line. This was soon done, and the airship was at last thrown upon her own resources.

The engine was started, and the *America* leaped forward. With a thrill of joy we of the

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crew felt her moving through the air. Looking down from our lofty perch, we could see the equilibrator swimming along in the water, its head in the air, much like a great sea-serpent. We soon ran away from the steamer, and could hear the men upon her cheering us as we lost sight of her. Soon the wind freshened from the northwest, accompanied by snow. We were in danger of being driven upon the mountainous coast, which would mean the destruction of the ship and probably the loss of our lives as the steel car went tumbling down the cliffs into the sea.

Everything depended upon the engine. Vaniman kept it running, and increased its effective output as the danger of shipwreck became most pressing. Inch by inch we fought our way past the mountains, one after another, clearing the last by only a few rods. The open Arctic Ocean was before us; and well satisfied with the working of engine and ship up to this time, it was with great satisfaction I gave the order to Riesenberg at the wheel to "head her north!" We should have a try at it, at least.

But we had not run far before the snow-squall increased in violence. Just then we learned our compass had been deranged by an accident. The air was so thick with flying snow we could not see the mountains, and were lost in a snowstorm threatening to drive us to destruction upon a lee coast. Three times we came up so near the mountains, looming suddenly ahead out of the thick air, that we thought all was over, but each time the motor and propeller brought us round to temporary safety, with the helm thrown hard over.

At last, after some two hours of this, during which we must have covered 35 miles, we realized there was but one thing to do, and that was to try to land the ship where she could be saved. In a momentary break in the thickness of the weather we saw before us a glacier—a mass of ice filling a valley between two mountains—and decided to make an effort to bring the *America* down upon its smooth surface.

But before we could descend upon the glacier we must drag our equilibrator, and also the retarder (which we had now let down into the sea) up the face of the great ice-wall—a vertical cliff of ragged, rugged ice rising nearly 100 feet sheer from the sea. Was it possible for our serpents to climb this frightful barrier? We should soon see, for now the wind was driving us straight toward the frightful precipice. As the *America* swept over the glacier the two serpents crawled up the wall without getting foul and apparently without injury. Arriving at the top, they wound between and around giant

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Part of car and one of the motors — 1909.

rocks of the moraine. As we moved inland the serpents fell into deep crevasses in the ice, and then crept out again.

Finally, by pulling the valve-cord and letting out gas we brought the airship down near to the surface of the glacier. At the right moment the ripping knife was run into the sides of the huge envelope overhead, the gas rushed out, with a sigh the *America* gave up her life-breath, and settled down upon the ice. The descent was made so gently that our clockwork registering instruments ran right along as if nothing had happened. As we stepped out of the car the cloth of the balloon lay in a great heap alongside, and we saw that the *America* lay across two crevasses. And there, still attached to the ship, were the two serpents, virtually uninjured after their rough experience.

In a few hours the *Express* and the *Frithjof* overtook us. Their crews came up to help us, roped together Alpine-fashion as they made their way across the treacherous crevasses. A force of workmen were brought from camp, and in three days we had all the valuable part of the airship back at our headquarters, after a most remarkable adventure.

At the moment we felt bitter because we had not been able to continue our voyage northward toward the Pole; but afterward, noting that the wind continued to blow from the northwest and north for several days, we realized that even if we had got farther from land we could never have made a long voyage. We had no chance at all; and we were pretty lucky to get out of it as well as we did.

We had, however, had a trial of the ship. She had traveled about thirty-five miles through the air, including her evolutions along the coast. We knew now what the *America* could do and could not do. Also, we had tested our equilibrating and retarding devices. The first of these is the old principle of the guide rope, used for many years in ordinary spherical ballooning. An airship's lifting force is constantly changing, due to expansion or contraction of gas as the temperature goes up or down, or the pressure of the air fluctuates.

The usual way of meeting these changes of lifting force is by throwing out ballast to prevent too great descent and by letting out gas to prevent going too high. The guide rope is ballast which can be used both ways without losing it. That is to say, a part of its weight being carried in the air, upon the lifting force of the balloon, and a part on the surface of the earth, we have this effect: If the balloon goes up a few yards it must lift that length of guide-rope from the earth, adding so much to the load carried, and thus checking the ascent.

Conversely, if the balloon goes down a few yards it deposits that much more of the guide rope upon the earth, and thus lightens the load carried and checks the descent. The guide rope is, within the limits of its effectiveness, an automatic control of upward and downward movements of the aerostat.

Our equilibrator was simply a development and perfection of the old guide rope principle. We needed in the guide rope a total weight of about 1,200 pounds, and not wishing to take all of this weight in dead material like hemp or steel, and very much wishing to carry all possible food and other vital supplies, we worked the problem out this way. We made a strong cylinder of leather about eight inches in diameter and 120 feet long; divided it into thirty compartments; stuffed the interior with reserve food, so that the total weight was seventy-five per cent. provisions and twenty-five per cent. leather and other materials; and to protect the leather from wear and tear on the ice, covered the entire reservoir with thousands of thin steel scales about as big as a silver half dollar, all riveted on, each lapping the other very much as the scales of a fish are placed by nature.

The retarder was built much in the same way, of leather stuffed with food, but for a different purpose. It would be practicable to use an ice anchor and firmly anchor the airship to the ice floes, there to ride during head winds instead of drifting backward on the course. But there was danger, with fast anchorage, that the strain on the ship might lead to breakage or accident.

So we compromised. Instead of the fast anchorage we adopted the old principle of the drag anchor, used for centuries by sailing vessels in strong head winds, and made a leather serpent covered with thousands of short, sharp steel points to scratch upon the surface of the ice or snow as it was dragged along over the ice-fields, and by making a certain resistance check the drift of the airship in head winds, thus greatly reducing the distance lost, without incurring the dangers incident to firm anchorage. The equilibrator or guide rope, with its smooth steel scales, was designed to make the smallest possible resistance; the retarder, on the other hand, with its steel scratchers, to make the greatest resistance its weight could effect as it was dragged along in contrary winds.

Both of these devices we severely tested this day and found strong and serviceable. Thus our short trial trip in the snowstorm, and the descent upon the glacier, was of the greatest

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value in teaching lessons for the future. The season being at an end, and winter setting in, the *America* was returned to Paris, there to be overhauled and improved for the next campaign. We had no idea of giving up the fight.

CHAPTER XXIII

SECOND AIRSHIP VOYAGE IN THE ARCTICS

In 1908 it was my duty to remain in the United States, representing my newspaper in the Presidential campaign of that year. But in 1909, having secured the necessary capital from among my friends, and Mr. Lawson having generously given me the use of the airship and all the Expedition property, without charge, I prepared for another aerial onslaught upon the Pole. How much trouble I could have saved myself if I had only known that Peary had reached the Pole before I sailed from America!

Vaniman was with me again. We had added another engine and another pair of propellers to the motive force of the airship. The old *Frithjof* having been lost, with all of her crew but one man, the previous fall, after she had left our service, on the coast of Iceland, Consul Aagaard this year hired for me a new motor schooner, the *Arctic*. She was not a successful ship, very slow and uncertain. Again it was necessary to make two voyages. My brother Arthur went out in charge of the first trip, and with a poor ship and bad ice nothing but his resoluteness and courage enabled him to reach our camp at all. The skipper wanted to turn back to Norway, but my brother said:

"No, never. Walter ordered me to go to Camp Wellman, and to Camp Wellman we are going, if it takes all summer."

Finally they managed to break through the ice, and bad news awaited them. There was brave old Paul Bjoervig, alone with the dogs! Again the fates had played him a cruel trick. He and his comrade were out hunting on the sea-ice one day during the winter, when an ice-cake turned turtle, a man fell into the icy sea, and was lost. Once more Bjoervig was the sole survivor of an Arctic wintering party.

Worse still, from the Expedition point of view, was the ruin of the balloon house. During the winter it had been completely destroyed in severe storms. All that remained was a tangled mass of broken timbers, buried under mountains of snow. It looked like a hopeless task indeed, that of clearing away the wreck and building a new house and getting the ship assembled, inflated, and making a voyage during one short Arctic summer. But our men went at it. Fortunately I had sent up a cargo of timber and other building materials, fearing some such disaster might have befallen us.

When Vaniman and I arrived, three weeks later, the *Arctic* having gone back to Tromsö to fetch us, the wreck had been cleared, and my brother had his force working night and day building and erecting new arches.

Spurred on by promises of extra pay, and favored by good weather, our force of twenty mechanics rebuilt the huge structure with amazing rapidity—much more expeditiously than a similar house was built at Atlantic City in the summer of 1910, though there the contractor had unlimited resources of men and materials to draw upon. Between the first of July and the middle of August the hangar or airship hall was finished, the *America* inflated and put in order, and everything made ready for the voyage. The new ship was larger and stronger than ever before, equipped with two complete motors and driving systems instead of one. Again we carried dogs, sledges, small boat, and enough provisions and fuel to enable the crew to stay out the whole winter, in case of need, making a comfortable camp on the ice with the thousands of square yards of cloth of the balloon, and sledging back the following spring, the only season in which travel with sledges is fairly practicable over the Arctic sea-ice.

August 15, 1909, we started on the second voyage the *America* had made over the polar sea.

View of Camp Wellman, Spitzbergen — Balloon House in Foreground.

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In the crew were Vaniman and I, cool-headed, resourceful Louis Loud, who is Vaniman's brother-in-law, and Nicholas Popoff, a daring and clever young Russian, who later took up aviation, and won the cup at Nice by a fine flight out over the Mediterranean and back.

Again we carried the leather equilibrator which had been so severely tested in the flight of 1907, when, in making our descent upon the Spitzbergen mainland through a snowstorm, the serpent climbed the rugged vertical glacier face, a hundred feet of sheer ice, wound in and out among the great boulders brought down in the moraine of the glacier, plumped deep into crevasses and crawled out of them again, and was with us practically uninjured when the ship finally came to rest in the valley of ice.

This second voyage began propitiously. The weather was fine, a light breeze blowing from the south. At the wheel I steered her several times around the strait which lay in front of our camp to learn if everything was in good order. All going well I headed her north. We passed out over Smeerenburg point of Amsterdam Island, where the Dutch whalers had a blubber-boiling station two centuries past. The equilibrator just touched the sands where the summer town reeked with whale oil and rum in the long ago.

One look back to our camp showed the men there waving their hats in excited glee and running for the hilltops, the better to see the airship as she moved toward the northern horizon. It was with inexpressible joy we of the crew noted how strong and fast we were going north. The engine was running steadily. The ship was not pitching or rolling. The equilibrator seemed to be riding well. Helped a little by the breeze, we were making close to twenty-five knots per hour, northward, toward the Pole.

At last our three years of arduous work, our long vigil of worry and planning, our weeks and months of struggle against gales and all sorts of obstacles, seemed in a fair way to be rewarded. The ship we had so painstakingly built and perfected was giving a splendid account of herself.

We had made a fine start. To the east the icy mountains and huge glaciers of the Spitzbergen coast glistened in the sunlight. To the north the ice-pack's white was looming in view. Far to the southwest our steamer, the *Arctic,* was headed our way, a dot on the waters, moving with such clumsy slowness compared with our ship of the air. Below us the dark green waters of the polar sea glided past, our equilibrator's lower end thirty or forty yards above them.

So elated were we, one and all, that we hallooed to one another, and laughed, and cracked our

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jokes, Vaniman and Loud in the engine room smiling up at Popoff and me at the wheel.

I gave the helm to Popoff and prepared to take my "departure" from the land, as the basis of our dead reckoning. The whole north coast of Spitzbergen, with its sharp-pointed black peaks, its valleys filled with gleaming ice-fields, was rising to our vision, a wondrous Arctic panorama.

At the rate we were going we could reach the Pole in less than thirty hours! It is no wonder we were happy.

Remembering the compass derangement of 1907, I climbed to the upper deck, hung there suspended between the heavens and the earth, and noted with content that the reserve or standard compass was steady and true, though the steering compass below was a little erratic, due to the vibration of the ship. Then I returned to the work of writing up the log and preparing the data for the navigation of the ship.

In a pause I looked over the side at the waters far below, now flecked with small fields of floating ice, the main pack being but a few miles farther north. At that instant I saw something drop from the ship into the sea. Could one believe his eyes? Yes—it was the equilibrator.

The leather serpent, so thoroughly tested t years before, had played us false. It within a yard of the top, and plump down into the ocean went 1,200 pounds of our balancing device and its contents of reserve provisions. Relieved of this load, the *America* shot into the clouds.

Instantly we all knew the voyage was at an end, that without the equilibrator the ship would soon become unmanageable. The provisions we could do without in a pinch, because we had more in the car. But the equilibrator was indispensable.

Vaniman sang out to me, "We'll have to fight our way back to Spitzbergen!" And seeing the look on my face, he added, "There is no help for it—you'll have to do it."

CHAPTER XXIV

AN AIRSHIP STRUGGLE OVER THE ICE-PACK

Our ears were ringing with the rapidity of our ascent. It was growing colder at this great altitude. Vaniman jumped for the valve line and pulled it far down to let enough hydrogen out of the top of the balloon to prevent us going to still greater heights. Before the *America* stopped climbing we had the whole northern part of Spitzbergen spread out in one great frozen picture before our eyes, and I imagined that away in the east I could see Walden Island where the old *Ragnvald Jarl* had been crushed in the ice in 1894. Would the Arctics never bring me anything but bad luck?

And whilst Vaniman was working to stop our flight into the cloud I sat there wondering if I had the right to take the lives of my crew in my hand by holding her head to the north, equilibrator or no equilibrator. My own life, yes; theirs, no. And in bitterness inexpressible, I told Popoff at the wheel to turn her around and steer for Spitzbergen.

Then ensued a struggle which none of us engaged in it will ever forget. At the higher altitude the wind was strong from the southwest. We were carried so far over the ice-pack that the Spitzbergen coast began to fade away in the distance, sixty or seventy miles away. At the lower altitude to which the *America* was presently brought down by letting out gas, the wind was not so strong, and, the motor still working well, we were able to make headway to the southward.

In addition to her equilibrator the *America* carried a similar serpent of leather covered with steel points designed to serve as a retarder or drag-anchor against adverse winds. I asked Vaniman and Loud to let this down to take the place in part of the lost equilibrator when the ship was to descend to the earth. With almost infinite trouble they managed to effect the maneuver, and we had the weight of the retarder, 400 pounds, to protect the ship from touching the ice.

Unfortunately, this improvised equilibrator had a loop of steel cable dragging from its lower end, and every ten or fifteen minutes this loop caught fast upon the sharp edge of an ice floe. Popoff and I soon became quite expert in swinging the ship about with her helm, describing full or half circles, till that pesky steel loop would slide off the ice hook in which it had made fast.

Thus we fought our way south, mile by mile and hour by hour, often delayed by the cable loop fouling anew in the ice below, but still making headway, the *America* giving a right good account of herself as a ship of the air under unfavorable circumstances.

Once we heard strange, uncanny sounds from the aft of the ship, near where the sledge dogs lay in their kennel. We recognized Popoff's voice, and knew he was there. But the sounds were unearthly Afterward, we three compared notes and found all had had the same experience. The blood had seemed to run cold and clammy from our hearts, for each of us felt sure our comrade from Russia had lost his reason and become a jibbering maniac up there in the air over the polar sea.

Ten minutes later the mystery was explained. Popoff had gone back to feed the dogs. One had snapped at him, and the unearthly sounds we had heard with dismay were only Popoff's remonstrance in his native tongue, talking to the dogs, trying to quiet them.

Poor, brave Popoff! He survived the perils of that day, won his spurs as an aviator, was invited to fly before the Czar, but fell one day to the earth and was broken and battered till the wonder was life still remained within him. For months he has been in a hospital, and as we hear nothing from him, fear his reason may have been lost, after all.

Soon we saw a little steamer working her way out from the coast of Spitzbergen, headed toward us. We knew she was the *Farm,* a Norwegian government vessel, which Captain Isachsen had at Red Bay, where he was carrying on survey work.

For several hours the *Farm* steamed toward us, and we motored toward the *Farm.* We met at the edge of the ice-fields, beyond which line, of course, the *Farm* could not come.

Without much doubt the *America* could have made her way back to our camp under her own power, but we wished to do everything prudence could suggest to make sure of saving our ship. So we gave a tow line to the *Farm,* and the remainder of the afternoon was spent in steaming homeward in this strange manner, a little steamer towing our airship twenty times her size, we up aloft hallooing down to the men on the boat as if they were pigmies of the earth.

But the *America* did not tow well. She ran up alongside of the *Farm,* now on one side, now on the other, and then came around with a jerk and shock which threatened to tear in pieces the steel framework of our car.

An hour or so of this and then the wind strengthened. The danger of a smashup of the

TAKING ASTRONOMICAL OBSERVATIONS — 1909.

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car was so great we resolved to let the airship down till it just touched the surface of the sea, hoping she would tow more easily and safely there. So we let out more gas, and soon were wallowing about in the trough of the sea. The *Farm* sent her boats to us, and we managed to get the instruments and dogs over to the steamer. The dogs had been quiet during their voyage in the air. The moment they were put in the boat they fell to fighting one another. Captain Isachsen has written in a Norwegian magazine that he and his officers were every moment expecting to see the frail car of the *America* break up in the sea, and were wondering if it would be practicable to save the crew.

"We were reassured," he writes, "when we saw Mr. Wellman take out a big cigar, light it, and sit there calmly smoking while he gave orders to his men, which were as calmly obeyed."

After a great deal of trouble we saved all valuables from the *America* and then the *Farm* towed her back to camp. Here she got away from us. In putting her up on the beach a gust of wind upset the gas bag, spilled off the car and engines, while the envelope, relieved of the weight, blew high in the air and then exploded. It was recovered, not seriously damaged. The steel car was partly destroyed; but that was small loss, as we should not have used it again in any event. All the motors, machinery, and instruments were saved.

The *America* had done pretty well, and but for the loss of her trailer could probably have gone straight to the Pole or its vicinity. As it has been already pointed out, we had not put all our eggs in one basket, but were prepared, if necessary, to abandon the airship at the farthest north, and continue the journey to the Pole and back therefrom to our headquarters or some other land, by traveling over the ice with sledges and dogs. In the two hours before the trailer broke we had made about forty miles northward from our headquarters, or to the edge of the ice-fields. After our involuntary ascent into the clouds we motored and drifted about twenty miles north-northeast. It took us two hours to work back against the wind to the ice edge, where we met the *Farm*. Thus the voyage of the *America* under her own power before she took tow from the steamer was about eighty miles, with and against the wind. We left camp at ten in the morning, August 15, 1909, and it was late in the evening before we returned after a voyage totaling 120 miles and a day of most extraordinary adventures.

Captain Isachsen, aboard the *Farm,* had been able to get a remarkable series of photographs of the *America*—first while she was far distant from the little steamer, next while working her way southward over the ice fields against the wind, then near at hand at the edge of the ice, and finally while she was being towed in the air and through the water after our intentional descent into the sea.

Captain Isachsen and his skipper, Captain Hermansen of the Norwegian navy, told us they had never had any faith in the airship method of reaching the Pole; "but when we saw the *America* so swiftly and majestically sailing straight northward from Spitzbergen we changed our minds and realized that with a little luck you were sure to get there."

I wish to make public acknowledgment of the splendid service these Norwegian sailors rendered us, and to thank them for it. Also to add that the little luck we had was of the wrong sort.

Our two voyages by airship over the Arctic Sea had in nowise diminished our confidence in the practicability of our plan. The second voyage, in particular, reassured us. The airship itself was all right. But for the accident to the auxiliary device, the equilibrator, due to an undetected flaw in the leather, the *America* might easily have reached the Pole or its vicinity in from 25 to 30 hours after we left Spitzbergen.

In our three campaigns and two voyages we had learned much; and we were so determined to continue the quest for the Pole with a new and enlarged *America* that before leaving our camp we lengthened the balloon house so that it might accommodate the new *America*, with which we had intended going on in the early summer of 1910.

But, as it turned out, the Pole had been reached already. Commander Peary, with admirable pluck and persistence, had kept at it with the old or brute strength method, and had so perfected his organization and equipment that he was at last able to win the prize.

In the recent few years the race for the Pole was really a struggle between the old and the new methods—the sledge versus the airship—and the former won, after nearly a century of use. I am convinced that if the airship had had one or two years more in which to be perfected and developed the victory would have perched on its banner.

CHAPTER XXV

COOK AND PEARY

Sailing down the coast of Norway on my return from Spitzbergen, in September, 1909, newspaper men came aboard the steamer at a stopping port and showed me a telegram announcing that "Doctor Frederick A. Cook, an American, had reached the North Pole." A few details of his story were given—just enough to give me an inkling of the false character of his claim. Partly through intuition, and in part through logic, I felt sure his tale was not true. Hence I declined to make any expression for publication, but said in confidence to my comrades who were with me that I had not the slightest confidence in Cook's good faith. Twenty-four hours later, at Trondjem, I had Cook's story in full, as it was first cabled, and then knew from its own inherent evidence that his story was not true, that he had not been anywhere near the Pole.

Two days later we passed through Copenhagen. Cook had arrived there a day or two earlier, and was being lionized. Between trains

I had plenty of time to call upon him, and was, in fact, within a minute's walk of his hotel. If I had had faith in him it would have been my pleasure as an American citizen to offer him my hearty congratulations upon his great achievement; and as an Arctic man it would have been my duty to do so. But under the circumstances I could not shake his hand, and proceeded to Paris without seeing him. For this I was written down in many newspapers as one who had permitted pique to influence me.

When the news came that Peary had reached the Pole I knew it was true, and cabled him my congratulations. Upon returning to the United States I found the Cook-Peary controversy raging bitterly. It is in my nature to abhor deceit and imposture. This attempt to hoodwink the public, and to rob an honest man of his just dues, seemed to me particularly detestable, because it put a dark stain upon the pages in which were recorded the efforts of so many brave men of all nations. In my indignation, and my desire to help the cause of truth, I prepared and gave to the press, without a penny of compensation, a review of Cook's story in which it was shown that he had approached to within about 500 miles of the Pole and then turned back.

Well did I know this was the unpopular side.

The public as a rule was friendly to Cook and indignant at Peary because he had used plain language. If I had been in Peary's place I should have used even stronger language than he did. Who would not, having in his possession absolute evidence of imposture? Who fails to cry "Stop, thief," when he chances to be eye-witness to a crime? That I was on the unpopular side soon became plain enough. Hundreds of letters poured in upon me denouncing me in savage terms. Scores of newspapers took up the hue and cry, and said I was a worse faker than Cook. I did not mind that; I had simply done what I thought was my duty.

It is with no thought of being harsh to Dr. Cook that these lines are written, but only to record the facts. I have never been able to subscribe to the mental derangement theory. There is nothing in Arctic work that I have ever seen—and I have had a little experience—which tends to destroy the mental balance. Cook's trouble was not hallucination, but habit; he had imposed upon the world with his untrue story of ascending Mt. McKinley, and as that went fairly well he bethought him of trying for a larger prize in the field of imposture.

For Cook I ask charity and sympathy. He is an erring brother. He fell before temptation, and is now repentant. He should be judged with lenience, not with harshness.

In 1907, a party of German officers and scientists spent the summer at our headquarters, closely watching our operations. Among them was Prof. H. Elias, of Berlin, a recognized authority on aerial navigation, and editor of the *Illustrierte Aeronautische Mitteilungen.* Dr. Elias and the officers who were with him not only made a report upon our work to the General Staff of the German Army, but Dr. Elias published an exhaustive analysis and description from the viewpoint of one who had been on the spot and who had watched us day by day throughout all our efforts. He says:

"Wellman's attempt to reach the North Pole with an airship, as is well known, was not successful this year. Though a real success is not yet to be recorded, the undertaking, considering its high aim, is interesting enough to justify a closer study. As a member of the expedition fitted out by the *Berlin Lokal-Anzeiger,* I had the opportunity to witness the preparations for the start, as well as the trial trip. I do not hesitate to say that during that time I entirely changed my opinion in regard to this undertaking. According to the reports in the papers I had expected to find an advertising scheme that would, relying upon the difficulties

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THE AMERICA READY TO LEAVE BALLOON HOUSE, SPITZBERGEN — 1909.

presented by the locality, drag on the preparations for the final flight in order to keep the world in a state of suspense. Instead of this I found men who went ahead fired with earnest thought and self-sacrifice, willing to risk both health and life to accomplish their task. That the expedition is a sincere and serious undertaking is an established fact, and no reason can be found justifying its being held under suspicion or ridicule."

Dr. Elias adds:

"One often hears the remark that the attempt (to reach the Pole by airship) should not be made until the problem of long distance flights in Europe has been solved. With this I do not agree. The conditions in the far north are much more favorable for long flights than they are here."

The distinguished German scientist then calls attention to the relatively light winds usually prevailing in the Arctic regions in summer, the small variation of the temperature, the use of the drag rope which is possible in the north and not in Europe, and to other conditions. He describes in detail all the preparations for the trial, and the voyage itself, approves most of the methods adopted and criticizes only some of the smaller details, says the *America's* speed was up to the calculations, and concludes his review, made as a wholly disinterested observer, with these words:

"It would seem a pity if after so much careful preparation, and study of airships in civilized localities, this attempt in the far north should not be resumed. A long journey over the ice, perhaps a new record for the farthest north, would be almost certain. And in this way it would be proven that the airship is eminently suitable for polar exploration."

The testimony of one such witness, a man of science, and for six weeks present at our headquarters, seeing everything and talking with everyone, should be sufficient answer to all criticisms or suspicions having their origin at a distance and in complete ignorance of the facts.

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CHAPTER XXVI

COMMERCIALISM, EXPLORATION AND ADVERTISING

While I was at Spitzbergen in 1907 a letter came to me from Arthur H. Keller, a mining engineer of Santa Rosa di Copa, Honduras, expressing his appreciation of my work as journalist but his disapproval of my polar efforts, which he characterized as "an advertising scheme." As this was a type of several letters, and of much press comment, it seemed to warrant a reply in the utmost frankness. My answer was as follows:

Camp Wellman, Spitzbergen, Aug. 9, 1907.

Dear Sir: All your characterizations of my work as journalist, observer and writer, are more than kind—they are generous, even extravagant. If any part of your praise be merited, it is your expressed recognition of my sincerity, of my constant desire, within the limitations of my ability and influence, not only to do good work from the professional viewpoint, but good work for the country, for humanity, for progress, for the spread of knowledge. So few have recognized that, I am the more grateful because you, sitting afar in the wilderness, from your bird'seye point of vantage in the mountains, have recognized it.

But your estimate of the enterprise which for the present engages my energies I, of course, cannot agree to. If you were as sympathetic with all sorts of dignified human endeavor as you are kind enough to imply I am, you would be sympathetic with this effort, too. You voice keen appreciation of my humble labors in another field. This is because that is a field in which you happen to be interested, wherefrom you derive something of value, of satisfaction. You are, apparently, not interested in polar exploration; it does not appeal to you. Which is not at all surprising, since it is impossible for all of us to be interested in all of the great complex life and work of our era. But, because you do not happen to be interested, does it follow that no one else is, or should be? Because it does not chance to be one of the things that appeal to you, may it not appeal to many others?

As for myself, I take not the slightest interest in mining engineering. It does not happen to appeal to me. If I were to consult only my prejudices and smother my sympathies and understanding, I might say it is a very prosaic vocation, a mere refinement of the savage instinct to dig from the earth something desirable, like edible roots and bulbs—nothing but a mechanical grubbing for vulgar money! But my intelligence tells me it is a most admirable, a most useful and dignified profession, and I take off my hat to men like you who have won distinction in it because they have worked for it and deserved it.

Because I care not a fig (for myself as an individual) for commercialism, for money-hunting or fortune-making, it would be foolish of me to question the dignity, the worthiness of those who do believe in it and devote their energies to it. It seems to me equally foolish of men who do love industrial and commercial work to deny the dignity and worthiness of pursuits which have other aims than the commercial or fiscal. I should not choose to dig for gold, or grow potatoes, or make boots, but I have the highest respect, even admiration, for the man who does any or all of these, so he but do it well.

We are not rational if we fail to recognize the fact that our whole civilization rests upon complexity of endeavor. When man was primitive, every one had the same occupation as every other—chasing game, or digging in the ground, or fishing in the waters, for food for his stomach. It was a long time before the bakers, the butchers, the millers, the tailors made their appearance; and with their coming came civilization.

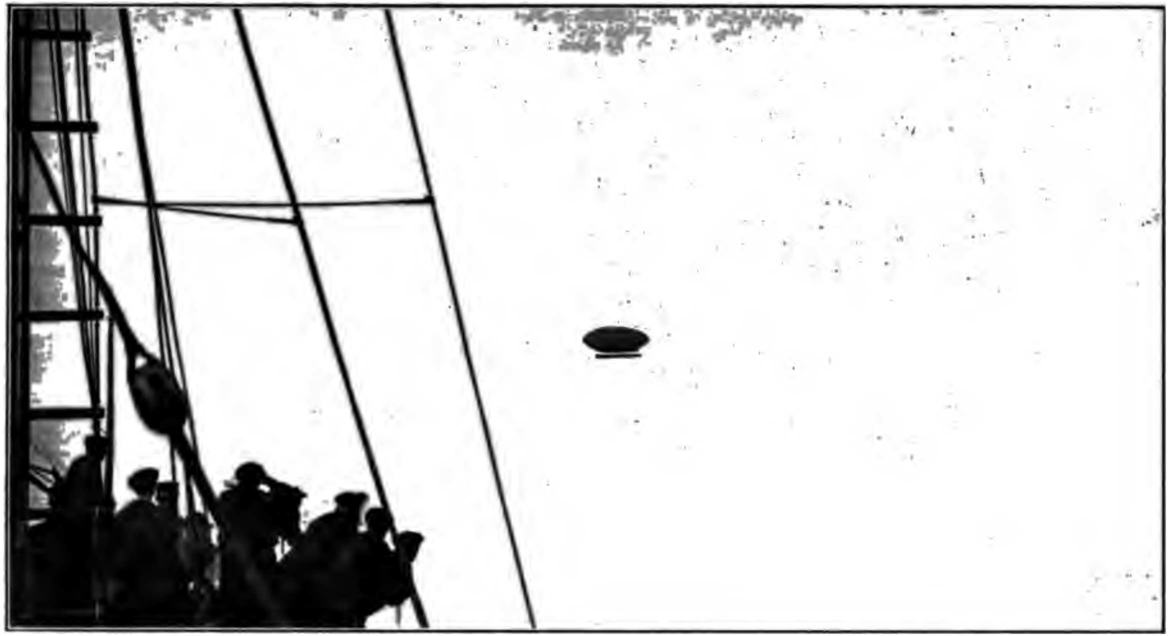
It took a longer time to evolve from the man with a stone slung in a sapling, pounding and mauling for bits of bright metal, the scientific mining engineer. It has required a still longer time to produce men who love the pursuit of knowledge for itself and not for the money or bright bits of metal they may win from it. And all these are among the millions of milestones which mark the progress of our race. The astronomer who looks down from the milky way with contemptuous glance at his milkman, deeming him but a human clod, only one remove from his cow, is as wrong as the milkman who tells the servant girl at the next house that the astronomer is daft in his upper story and would better spend his time growing cabbage than in "all them silly star-gazings." The point is: Is the astronomer a good and earnest one, does he really add something to the sum of human knowledge? Does the milkman keep his cows sanitary and water his stock, but not the product thereof? All work is worthy and dignified, as all love is; for work, and love, are life.

Nor can we separate the purely useful, from the æsthetic or intellectual, calling one the sheep that bear wool for warm clothing and yield meat for the hungry, and therefore worthy of protection and encouragement, while naming the other mere grotesque billy-goats which have no legitimate right to live. To apply only utilitarian tests to human endeavor is to push civilization back I do not know how many hundreds of thousands of years. One class of utilitarians—the narrowest and least intellectually developed—can see little good in anything beyond bread, butter, bed. The second class, with just a little broader horizon, pronounce crazy one who engages in an enterprise which promises no money reward. A third class, and a very numerous one, are sympathetic enough with the particular aims intellectual or æsthetic which happen to interest them, but cry "idiotic" as to all others. I hope you will avoid falling into this last category, my dear Mr. Keller.

That you love literature and science and history and poetry is obvious from the books which you tell me you have on your library shelves. Polar exploration has and is all of these, with a dash of adventure and daring thrown in for flavor. By implication you ask, as many have asked before: "Of what use is trying to reach the North Pole?" Yet you would be the first to hit with a metaphorical brick (which as a mining engineer you know so well how to do) the dolt who might ask: "What good does it do to write a great poem or paint a great picture or make a great drama or mould a great statue?" And so I shall have to ask you: "What is polar exploration but an epic—an epic written in deeds, not mere words?"

Man was endowed with many passions; and one of the noblest of these is his passion for *knowing things*. He hungers and thirsts to know everything in the world and round about it—even the unknowable. This passion for knowledge is as strong as his passion for life itself and for recreation of that life. It is a part of man, and one of the best parts. It stops at nothing. It leads one man one way, one another, all impelled forward by the same aspiration. One it takes to the bottom of the sea. Another to the bowels of the mountains. A third to the geologic records left by the feet of time in ages and æons past. Still others to analyses, chemical or microscopic, of all matter and of all the atoms and molecules of all substances. It is a passion which leads some to the library, some to the laboratory, some to the stars, some to the remotest parts of the earth. Whereever there is something *unknown* man hears the imperious call, "Come, find me out—know me if you can and dare." The Pole thus challenges him. In the beautiful lines of Chester Firkins the North Wind musters him to the unknown of the farthest north:

"From the dark of the boreal seas,
From the midnight morn of the Pole,



THE AMERICA IN FLIGHT OVER THE POLAR PACK.
(Photographed from the Steamer Farm.)

To the sands of your southland leas,
  Where sweltering cities roll;
From the still of the Caves of the Cold,
  To the resonant marches of men,
By the wind that runs, I summon my sons
  To the arms of the North again.

To the ships of the scurrying main,
  Where the stern-wheels southward thrum,
To the lands of the Sun and the Rain,
  On the winds of the dark I come;
And never thy Love, nor the lure
  Of thy Fame shall make thee free,
For a sail or a soul, at my rallying roll,
  Must turn to the North with me.

"Ye have fathomed the fines of the East,
  And the reach of the West ye know.
And the wilds of the Earth, as the beast,
  Ye have tamed to the whip and the hoe;
But the breath of my pitiless plains
  Ye have faced—Ye have failed of the goal;
And the drums of the North, they shall summon ye forth,
  Till ye win to the prize of the Pole!"

Many better men than I have in the past heard this summons, as many more will hear it in the future. The North Pole stands simply as the symbol of the unknown but knowable contained in a million square miles of unexplored area at the very top of our earth. Man's passion for attaining it is centuries old. It is a quest which has its history, its literature, its traditions, its chronicles of courage, suffering, endurance, disappointment, death. Some of the best men of all countries and times have engaged in it. Around it has grown up an international rivalry, friendly and sympathetic, but keen. The man who can see no good in it, not even a sentimental if not a practical good, the man who finds himself unable to thrill even a little bit with this aspiration to substitute knowledge for ignorance, the man who can sneer at those who think differently, the man who can class seeking the symbol of the polar unknown with going over Niagara in a barrel, is perhaps as narrow as the goodly but straight-laced soul of our Puritan ancestry who placed on the same level the mountebank performing sleight-of-hand tricks on the street corner as an incident to the sale of patent nostrums, and the great tragedian interpreting on the stage the mightiest passions of men as limned by the genius of a Shakespeare—first on the list of books in your own library. He "never did like them ungodly theatricals, nohow!"

You are generous enough to regret what you call my sacrifice to the "Moloch of an advertising scheme." I am glad for your regard, but sorry for your judgment. This is not an advertising scheme, in the sense you mean it. The idea was mine; it was born, not in wish to do anything spectacular, but out of desire, long

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existing, and twice before expressed in expeditionary action, to attain the Pole; this method was a means to an end, that is all; the idea was to endeavor to substitute modern science for the mere brute force of men and dogs dragging sledges. You believe in that sort of progress, or efforts to attain it, I suppose. You employ scientific hydraulics, and explosives, and chemistry in your mining, when you can, instead of the pick and shovel, do you not? Well, I took this idea to the owners of the newspaper with which I have been associated most of my active life. They could not see in it anything for them in the way of profit, direct or indirect. They could see only outgo. But they did see something in the idea itself; saw that it might work; that it might achieve great results; that it was worth trying; and they put their money in, disinterestedly, splendidly, and have put in a great deal more than they at first thought of doing, and have done it without grumbling, without hope of any other reward than the satisfaction of aiding the cause of human progress and the extension of knowledge. Do you like that sort of men? I do.

Suppose it were nothing but an "advertising scheme?" Here again is a test of the catholicity of your sympathies. As a savant servant of industrialism you must know that advertising is as much a part of modern business as bookkeeping or payday. Very little business is done without it. It is a part of the machinery of diffusion, of marketing, like solid merit in the wares, like the eternal struggle that is going on throughout the world to make things better and cheaper than one's rivals which is such a mighty agency in the progress of civilization and the lifting and broadening of the standard of comfort and convenience among hundreds of millions of people. If goods are to be manufactured to meet the demands of modern civilization, they must be sold. Advertising is a part of the selling machinery. It is just as worthy and dignified, if it be done honestly, as the honest day's work of the man in the mill making the goods. To sneer at advertising is to sneer at civilization itself. Because you do not happen to need advertising in your particular field of activity, would you condemn it in all others? In your country you perhaps need no overcoats; then it must be ridiculous and grotesque in your eyes to wear overcoats in more rigorous climes.

More than anything else in the world, advertising has served to make industrialism, commercialism, the handmaidens of literature, of art, of science, of the diffusion of knowledge and culture among the human mass. So, please do not take advertising out of our modern life. If you do, at a blow you stop all the magazines and newspapers, cut short the careers of thousands and thousands of writers and illustrators, send the world backward to the dullness of the *Quarterly Review* read by one man in a hundred thousand, make the almanac and the family bible the principal literature of the masses, and give us a taste of the gayety of life in the time of Noah, when man thought of nothing but his bread and meat, his herds, his wives and concubines; when the only incentive he had to a voyage of exploration was his desire to save himself, his wives, his swine, his poultry, from high water!

At the last, with just a trace of delicious inconsistence, you leave your original ground that exploration of the unknown is not worth while, and question if the means we have adopted are efficient for the purpose in view. On this point there is ample room for differences of opinion. You are entitled to your views, we to ours. You do not know, we do not know. But I submit to you as a man of science, engineering and mechanics: The spirit that sends one forth to *try,* even at the risk of failure, is better for the cause of progress than the doubt which says, "It can't be done, at least not that way," and sits at home toasting its shins by the fire, reading Plutarch, and grubbing for gold.

My dear sir, the warmth of your sympathy for me as writer and man, shows how good your heart must be. Let it soften and broaden a little toward the activities and aspirations of all your kin, no matter what direction they may chance to take, whether toward the purely useful, the intellectual, the æsthetic, the scientific, or the sentimental. Then we may continue this correspondence and be brothers of man together in our old age after our life's work, each to his kind, is done.

Gratefully and sincerely yours,

WALTER WELLMAN.

Arthur H. Keller, E. M.,
Santa Rosa di Copa.

[redacted]

CHAPTER XXVII

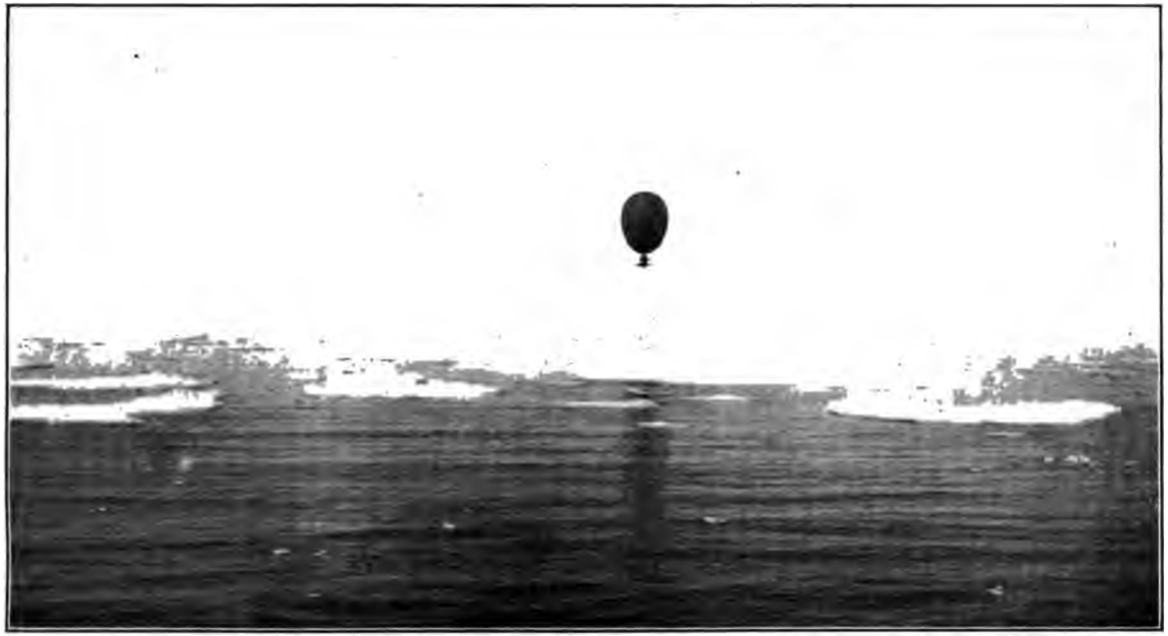
ACROSS THE ATLANTIC BY AIRSHIP

Having satisfied myself beyond peradventure that Peary had reached the Pole, and realizing that this great quest was at an end, I turned next to a project which had long been in my mind—to attempt a crossing of the Atlantic Ocean by airship. We made that voyage in October, 1910. All the world was kind enough to watch our effort with keen interest and warm sympathy. All the world now knows the result. In future chapters I shall ask the reader to accompany my comrades and myself on that memorable voyage, that strange journeying for three days and nights through the air over the stormy sea, a voyage which had the grim specter ever hovering near, which broke all airship records for time and distance, and which in the end was brought to a fortunate conclusion by one of those combinations of chance so rare and strange as to seem almost miraculous.

Before taking the reader with me upon this remarkable adventure, I want him—and doubtless he wants for himself—to know more of what has gone before; what the enterprise really was; why it was called into being; how the idea had its genesis; what the plan, what the difficulties in its way, and how we had contrived and striven to overcome them. The story of the voyage itself will be rapid, vivid, full of action, life, human interest, peril, adventure. But a great part of that story will be only half clear, will lose much of its true value and significance, if the reader has not become familiar beforehand not only with the soul and heart, but with the lungs, the muscles, the sinews of the project.

As we stole forth through the fog that morning of the fifteenth of October and set our prow to the eastward over the waters of the broad Atlantic, we were a half dozen human pigmies astride a great machine weighing a total of about 26,000 pounds—thirteen tons of steel, silk, rubber, gasoline, engines, provisions, hydrogen, a thousand things welded together in a modern lighter-than-air aerial craft.

Whether this frail combination of art, artifice, and science was to prove a true and serviceable ship of the air, or a grim Frankenstein, we did not know. That is precisely what we were trying to find out. We were trying to achieve with steel, power, engineering and man's mechanical cunning such mastery of space and distance through an aerial ocean never yet traversed as



The America fighting her way south over the Ice Pack.
(Photographed from the Trent.)

would constitute the realization of a splendid dream.

That was what made it worth while. It is always worth while to strive, to venture, to work, to dare—and leave the rest to the gods—in an effort to realize man's dreams of conquest of the elements; to do something—be it much or little—for progress, to widen the frontiers of knowledge and achievement.

It is even worth while to try and fail, because failure often teaches as much as success. Of course it is far better to try and win. But the men who do try in any of these fields of endeavor, be they fit for their work, have a way of looking all the possibilities squarely in the eye.

Our effort to cross the ocean by airship we had always regarded as a great scientific experiment whose outcome, like that of all experiments, must be in doubt. Everyone can see the dramatic aspect of sailing forth upon a voyage three thousand five hundred miles through the air over a stormy sea, despite the fact that the longest airship voyage thitherto made was only about nine hundred miles, and that over land.

Everyone could see that such a venture was audacious, possibly heroic, probably epic. But a voyage like this, with all its danger and with the chances heavily against success the first try, should have better justification than the mere desire to perform a sensational feat. The moving spirit should be not simply a desire to astonish the world, but to confer lasting benefit upon mankind.

Our hope and aim were not primarily commercial utilization of airships. Our dreams carried us not toward the regular lines of aerial trans-ocean transportation which so many optimists see in their visions.

Whatever the aeroplane may bring forth—and that the future alone can determine—we know full well the limitations of air travel by such motor-balloons as ours. These limitations probably, we cannot say surely, fall short of the requirements of true commercial utility. Commercial use inevitably means a high degree of safety, of regularity of service, certainty of arrival at a predetermined destination—all these as elements of the indispensable operation for profit.

In our opinion, all these objections not only hold but are likely to continue to hold against the motor-balloon. The operation of a lighter-than-air ship is essentially extra-hazardous. Under favorable conditions the craft may do much; under unfavorable conditions loss or disaster quickly follow. Being inevitably extra-hazardous, it is adaptable—at least in its present stage—only to purposes wherein the price of the hazard may be paid. That is not in commerce. But it is in sport, in exploration, and in war. In all of these, extra risks being inevitable and acceptable, the motor-balloon is available.

We have nothing to do with sport in the air —dignified and admirable as it may be. We have had something to do with aerial exploration, and we wish to have something to do with aerial warfare. Growing out of my experience in designing, building, equipping and navigating the second largest airship in the world had come certain ideas of making the motor-balloon a terribly destructive engine of war. It is my belief that through methods of our own, evolved from actual experience, the motor-balloon is to play an important part in the war plans of the future, and aid materially in making war so scientific, so destructive to property, that in the end there will be no more wars. The transatlantic voyage was deliberately planned to further this idea, to call the attention of the governments of the world to the military and naval value of such air-craft. Dreamers we may have been, but we had had some experience. We were not mere tyros or adventurers, and a definite and dignified aim, not bald and bold sensationalism, moved us.

So much for the soul and heart of the dream; now for the material side, the lungs, the muscles.

The airship *America* with which we had made two voyages from Spitzbergen in our efforts to reach the North Pole, one of more than a hundred miles out over the Arctic Sea, was generously lent us by Mr. Victor F. Lawson, of Chicago, president of the association which had built the ship and supported the polar expeditions. But for a chance to cross the Atlantic the airship required enlargement, improvement, a new steel car, new engines, fittings, appliances of all sorts, costing a large sum of money.

All my life a journalist, and proud of it, always a believer in the principle that journalism of the best sort is alert and enterprising in trying to do something for progress, I again turned to journalism for financial assistance.

I am proud of the fact that I was able to form a combination of the greatest newspaper in the old world, the *London Daily Telegraph*, with the journal which is generally regarded as being the foremost in the eastern part of our own country, the *New York Times*, and the leading paper of interior America, the *Chicago Record-Herald*, with which I have been connected all of my active life.

These great journals, assuming no direct responsibility for the voyage, but leaving all that to me, advanced the forty thousand dollars which we had estimated to be necessary to put the project through. It was not their fault that the unexpected cost of reconstruction and outfit of the airship made it necessary for us to make up a considerable deficit out of our slender private purses.

CHAPTER XXVIII

THE SECRETS OF A GREAT AIRSHIP

The airship *America* was a strange, a marvelous craft. To people who saw her for the first time she seemed mysterious, inexplicable, a nondescript, indeed, unlike anything else that was ever known for sailing upon the seas or running upon the land.

Originally designed to make a long voyage—1,500 to 2,000 miles from our base in Spitzbergen to the Pole and return—we now tried to equip her with the endurance, the safety, the stability, the radius of action, that would enable her to cope with the distance which separates America from Europe, 3,000 knots, 3,500 statute miles.

No one realized more clearly than we the difficulty of the task, the largeness of the order. Perhaps it was its very difficulty that made it so fascinating in our eyes. We have been accused of going at it lightly, with confidence, with optimism. The truth is that we approached the problem with long and earnest consideration of every element of doubt and danger we could think of.

Imagine a huge balloon-like reservoir 228 feet long—nearly a city block in New York—sharp pointed at one end, rounded at the other, 52 feet thick in all the central part. When you stand underneath it, the bottom just above your arms' reach, the top is as high above your head as a five-floor building from the sidewalk. Massive, huge, still she is as graceful as a yacht under sail.

This great reservoir is composed of cotton, silk, and rubber. Where the diameter is greatest (and the upward push of the gas within most powerful) the fabric is three-ply, with three emulsions of rubber cementing the cloth together. The silk and cotton give great strength to resist the outward pressure of the gas; the rubber emulsions hold the gas with but a small percentage of leakage.

Splendidly tailored is this huge bag, all seams being wide lapped, sewn, and gummed, and extra strips glued over to cover the needle holes and prevent the escape of the precious hydrogen. All told there are about 4,000 square yards of this rubberized cloth, weighing approximately a pound to the yard, with a tensile or sustaining strength of 100 pounds to the square inch.

Wonderful, indeed, is the power attained by wholesale multiplication of the seemingly insignificant. Measure off with your hands what will approximate a cubic foot of air. It is apparently impalpable, without substance or weight. Yet our physics tell us this cubic foot of air has a weight approximating 1.2 ounces.

Now, if we have a box containing exactly one cubic foot of air, and if we force the air out and put in its place hydrogen weighing only .1 ounce per cubic foot, the box is 1.1 ounces lighter than it was before. If the box should be made of a substance so filmy that its weight was only one ounce, it would rise in the air, because it and its contents together are lighter than air.

Multiply our one cubic foot by 345,000—the volume of the gas reservoir of the airship *America*—and what do we have? We have taken out 345,000 cubic feet of air, weighing 414,000 ounces, or 25,800 pounds; and we have put in 345,000 cubic feet of hydrogen weighing 34,500 ounces, or 2,150 pounds. By this simple means we have gained a lifting force of 23,650 pounds—the difference between the weight of the air displaced and the gas which displaces it. In the case of the *America* the gas bag, with its valves, inner balloons for air, and other appurtenances, weighs approximately 4,700 pounds; hence, the net lifting force is 18,950 pounds. In other words, the gas can carry the weight of the balloon and a load of nearly 9½ tons besides.

Airship America being towed by the Steamer Farm -- 1909.

Although hydrogen has a weight only about one-twelfth that of air, it takes more than a ton of it to fill the reservoir of our airship. The manufacture of this quantity of gas was not an easy or inexpensive operation. A special apparatus was built in Paris, brought to Atlantic City, New Jersey, and there assembled.

More than one hundred tons of sulphuric acid, sixty tons of iron turnings, and hundreds of tons of water were used in the generating process. Ten men in each shift worked night and day for a week feeding the apparatus. The total cost of one filling of the gas reservoir, for labor and material, was $5,000.

Before being admitted to the balloon the gas was thoroughly washed with water and dried by passing through cylinders of coke, permanganate of potash and calcium of lime, thus making it light of weight, and taking out all acids which might destroy the costly fabric of the balloon. Pure hydrogen is odorless. If it escapes from a receptacle it gives no sign of its presence. Therefore we used several gallons of oil of peppermint to perfume it and enable us by the odor to detect it.

Many people speak of aircraft of the type of the *America* as a balloon. That is as correct as it would be to call a locomotive a car; a car it is, being a vehicle which runs on wheels; but it is much more than a car—it is an engine, equipped with power. The *America* is a balloon, in the sense that a gas reservoir is employed to give lifting force. But when you put engines under a balloon, to drive it through the air, and attach a rudder to steer it to the right or to the left, it ceases to be a balloon and becomes an airship, just as any vehicle fitted with steam power and driving wheels ceases to be a car and becomes a locomotive.

The French call a powered balloon a "balloon dirigible," that is, directible. The Germans, more simply, call it a motor-balloon. "Airship" is perhaps the most appropriate name. An aeroplane is not, strictly speaking, an airship. It has no buoyant force of itself; it does not float in the element for which it is designed, but is driven through it. Mechanical flight machines, carrying one, two, or three passengers, and a hundred or two hundred pounds of fuel for the motor, are more like motor-cycles or automobiles or motor-boats for aerial trips than they are like true ships of the air.

The *America* is a true ship of the air. Her buoyant force in the atmospheric ocean is nearly twelve tons, or nine and one-half tons in addition to the hull or gas reservoir. Some place must be provided for the engines and fuel, for the crew, their provisions, all the machinery and

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instruments. Some way must be devised to take up the lift of the gas bag, 9½ tons. To meet these two needs a great steel platform or car is constructed to swing underneath the balloon.

As in our polar construction, I suggested that the bunkers of the ship, that is, a huge steel tank for carrying the tons of gasoline needed for the engines, be made the backbone of this car, giving it strength and rigidity. Engineer Vaniman at once perceived the value of the idea, and proceeded with marvelous ingenuity to utilize it. He fashioned a frame of the highest-grade steel tubing and wires, strung as a bridge, capable in places of withstanding strains of ten tons, the whole 156 feet long, 8 feet wide at the top, V-shaped, and at the bottom of the V throughout all the central section a staunch steel cylinder two feet in diameter, divided into ten compartments, and with a capacity of 1,500 gallons of gasoline.

This huge steel frame, enclosed with varnished canvas, is hung up under the balloon and attached thereto by eighty steel cables coming down from the relingue or attach belt sewn in the cloth about ten feet below the equator. No net or hood is used upon the gas reservoir to add to its resistance whilst moving through the air, and the outer skin of the balloon part of the ship is as smooth and tight as the head of a drum.

The nine and one-half tons of car, machinery, and cargo are lifted by 188 hempen cords, attached at as many points to the big reservoir and terminating in eyes from which hangs the cradle of suspension cables passing under the car. Celluloid windows are placed at intervals in the canvas sides of the car enclosure; and about the engine room steel gauze replaces the canvas, and asbestos and asbestos paint are employed to minimize the danger of fire.

CHAPTER XXIX

THE ENGINES OF THE SHIP

How much engine power should we install in our ship? What speed should we aim at? It would not be difficult to put in a motor of 200 or even 300 or 400 horse power. Indeed, at one time we thought of using a 200 horse power engine, and ordered a special motor of that size built in England, though it was not finished in time for our use. Now, a 200 horse-power engine would give the *America* a speed, in still air, of about twenty-seven statute miles per hour. The fuel consumption of the engine would be approximately 135 pounds per hour, or five pounds per mile. Could we afford this relatively high speed?

A moment's calculation showed that for motoring 3,500 miles at this speed we should need at least 17,500 pounds of fuel in our bunkers, and at that should have no reserve. What could we do with a smaller motor—say one of 80 horse power? It would yield twenty miles per hour in still air, or nearly four-fifths as much as the engine of two and a half times greater power.

The reader may be surprised at this. But he should remember that with airships, as with all other forms of propelled vehicles, an increase of speed calls not merely for a corresponding increase of energy, but that the energy applied must theoretically be augmented as the square of the speed, and in practice somewhat more.

We knew from our two voyages in Spitzbergen that a motor of 80–90 horse power, running at an output of 70, would drive the *America* about twenty statute miles per hour at a cost of forty-five pounds of gasoline, or less than 2.5 pounds per mile; and that therefore with this power and speed we could theoretically motor the 3,500 miles which separate Europe from America with about 8,000 pounds of fuel.

Now, in the enlargement of the airship we planned to carry about 9,000 pounds of gasoline in our bunkers, but could not well undertake to provide lifting force for nearly double that quantity, which would be necessary if we tried to drive the ship at the higher speed. Hence, we decided upon equipping the *America* with the same engines she carried in August, 1909, when she sallied forth from our base in Spitzbergen, and was making more than twenty miles per hour over the ice-fields of the Arctic Sea toward the Pole when an accident compelled us to turn about and make for the land.

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Each of these motors is rated at eighty to ninety horse power, according to the number of revolutions per minute. One is a Lorraine-Dietrich automobile engine, heavy, trustworthy, enduring, solid, economical of fuel. It weighs, with its radiator and equipment, nearly one thousand pounds. It drives, at 500 revolutions per minute, a pair of twin wooden screws each twelve feet in diameter, placed at either end of the engine shaft, that, on either side of the steel car. The other is an E. N. V. automobile or aeronautic engine, eight cylinders, an admirable engine that runs almost without vibration and that is capable of working a long time at a stretch. It drives a pair of wooden propellers, 10.5 feet in diameter, 750 revolutions per minute.

These propellers, by an invention of Engineer Vaniman's, patented in Europe, may at any moment be turned to any angle of thrust we may desire. That is to say that while normally they work, as do the pair on the other engine, in pushing the ship straight forward, if we wish to utilize all or a part of the thrust to send the craft upward or downward we are able to do so, while the engine is running, by turning a wheel which operates a miter gear. Under some circumstances this may be a highly advantageous arrangement.

We did not plan to run both of our propelling engines at the same time, though we could do so in an emergency. Though both together would give the ship a speed of about 25 miles per hour, the extra five miles would be too costly in consumption of fuel. Each engine a propulsive system is independent of the If one should be temporarily or permanentl abled the other is in reserve.

By running one motor at a time, each in turn, while the other cools and is lubricated inspected, both should be kept in first class condition throughout a long voyage, barring accidents. Our hope was that we might have a driving motor in operation virtually the whole duration of the voyage. With our 9,000 pounds of gasoline and lubricant, we should have in our bunkers almost, if not quite, 200 hours of motoring with one engine, equivalent to approximately eight days, or a theoretical 4,000 miles (about 3,500 knots.)

Thus, so far as advance calculations are of value, and considering gasoline alone, the *America* was to set forth with a rather small margin of fuel endurance—enough for a run of about 3,500 knots, with a voyage of 3,000 knots before her.

Thousands of visitors to the airship at Atlantic City asked if we carried along with us any means of replenishing the gas during the trip. We

NORWEGIAN GOVERNMENT STEAMER FARM NEARING THE AIRSHIP—1909.

[redacted]

did not. It could be done; that is, h... cent. of could be carried in steel bottles, compres... nd are 125 or 150 atmospheres, and be emptied int... stern reservoir overhead in case of need, the steel b... tles being thrown overboard to lighten the shi... e is ... nd But it was not necessary in our case.

The balloon part of our airship was so well made, so nearly gas tight, that we did not look for any loss by leakage of gas of more than 1½ or 2 per cent. per day. A few years ago we inflated the balloon with ordinary coal gas in the old Exposition Building at Paris, and found the rate of loss to be not more than .6 of one per cent. daily, indicating an average loss of about 1.5 per cent. when using hydrogen.

Later at Spitzbergen we confirmed this indication. And at Atlantic City, where the ship was inflated for several weeks, we found the envelope of the reservoir to be in substantially its original good condition of gas tightness. During the voyage we reckoned that the loss of lifting force due to leakage of gas should not exceed, at the highest, 2 per cent. daily, or under 500 pounds. Now, we expected the motors to consume 1,000 pounds of gasoline, perhaps a little more, each day, reducing by that much the load carried by the ship. Hence, instead of losing lifting force by gas leakage, we should gain an average of about 500 pounds daily.

. c the winds might do to help or hinder the *ıca* on her long voyage was an exceedingly ortant factor. Before this effort was de- led upon, a thorough study was made of wind ınd weather conditions over the Atlantic Ocean. The United States Weather Bureau, under the direction of the eminent practical meteorologist, Professor Willis L. Moore, publishes monthly forecasts of the winds of the North Atlantic, based upon reports from vessel masters during the past twenty-five years.

In these admirable and comprehensive records the sea is divided into rectangular spaces each containing five degrees of latitude and five degrees of longitude. In each of these spaces a diagram, known in meteorology as a wind rose, gives the probabilities of wind movement for the month in number of hours out of one hundred, from the various points of the compass, with the force of the wind on the Beaufort scale.

Analysis of these "roses" told us just the sort of wind we might expect. We found the general trend of the air currents to be from west to east throughout the months of July, August, September and October, there being little difference between the months, as to prevailing direction, but the winds growing in force as the autumn comes on.

Along the transatlantic steamer routes in

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September the winds blew about 60 per cent. of the time from the western semicircle, and are somewhat stronger than those from the eastern semicircle. In October the time percentage is a little greater for the winds from the west, and the force of all winds markedly increases.

We found that the prevalent direction of the winds was not only favorable to our voyage, but that the conditions were remarkably well distributed throughout the whole of the prospective course. Careful analysis in detail showed that in September (the month in which we reckoned upon being able to start) we might expect an average net wind movement of from six to eight miles in our favor.

Upon these facts we based our hope of a successful voyage. With our airship equipped to cross the ocean, theoretically at least, with her own power and fuel, considering the winds as neutral, or helping as much as they hindered, it seemed reasonable to hope for a fortunate outcome at a time of the year when the wind resultant is distinctly in our favor.

Often we were asked if we are not afraid of running into a cyclonic storm coming up from the West Indies—if there would not be danger of the airship being torn in pieces if caught in one of the gales which are born of the progress of an area of low barometer across the Atlantic.

We were not afraid of cyclones from the West Indies. In fact, we think we should have welcomed the appearance of one in our wake after we got well out to sea.

These cyclonic storms from the West Indies almost invariably turn to the northeastward off Hatteras and make for the British Islands with increasing velocity, their average speed across the North Atlantic, or at least a part of the way, running from twenty to thirty miles per hour. Their general course is so well defined that we did not fear them on the score of the direction in which they would carry our ship.

It is true that occasionally one of these storms —"lows," in which the revolving currents move in a direction contrary to the hands of a watch —veers far off to the north in midocean. Should we have been involved in one of these the *America* might have been carried northward, possibly to her old headquarters at the 80th parallel of north latitude in Spitzbergen. But that was a remote chance which we were willing to risk.

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CHAPTER XXX

CURIOUS FACTS ABOUT AIRSHIPS

There are many strange things about airships. In the following paragraphs an effort is made to explain some of these. We are here considering the *America* as if she were free in the air and had no equilibrator in connection with the earth. As a matter of fact, the resistance of the equilibrator in passing through the water to some extent modified the principles which we here explain; but the principles remain.

A steamship or sailing vessel is buffeted by wind and wave; but it is partly immersed in an ocean of fluid which offers great resistance and subjects it to violent shocks.

An airship is completely immersed in a medium which offers so little resistance that shocks are impossible. It is not an easy fact to grasp —but is still a fact—that the only resistance an airship offers to the wind, the only strain or pressure upon her parts, is that which she herself creates with her engine and propellers.

To understand this principle, imagine an airship far out over the ocean. It is calm; no engine is running; the crew, perchance, is asleep. Up springs a gale, fast gathering force till it reaches a velocity of fifty miles per hour. Nothing whatever in the motion, the vibration, the pitching or rolling of the ship alarms and awakens the crew. The ship being a "free balloon," because no engine is turning, simply becomes a part of the wind, so to speak, moves with the wind, offers no resistance to it, floats along as peacefully as if it still were dead calm. A member of the crew awakes, rubs his eyes, goes to his post; but if it be night, and he cannot see the ocean, he has no idea whether the ship is standing still or moving fifty miles per hour. If he strikes a match to light his pipe the flame curls straight upward, precisely as if he were in a closed room—an experience which many of us have had in ordinary spherical ballooning.

Suppose now the crew be roused. An engine is started, a pair of propellers set in motion. Then, and then only, does the ship offer resistance to the wind; and the measure of her resistance is the energy exerted by the propellers—just that, no more. Nor does it make any difference whether the velocity of the wind be ten or a hundred miles per hour; nor yet any difference whether the ship be headed into the wind, or with it—the result is the same. If the propellers exert a force sufficient to give the craft a movement of twenty miles per hour in still air, that is her resistance to the wind, regardless of the wind's force or direction.

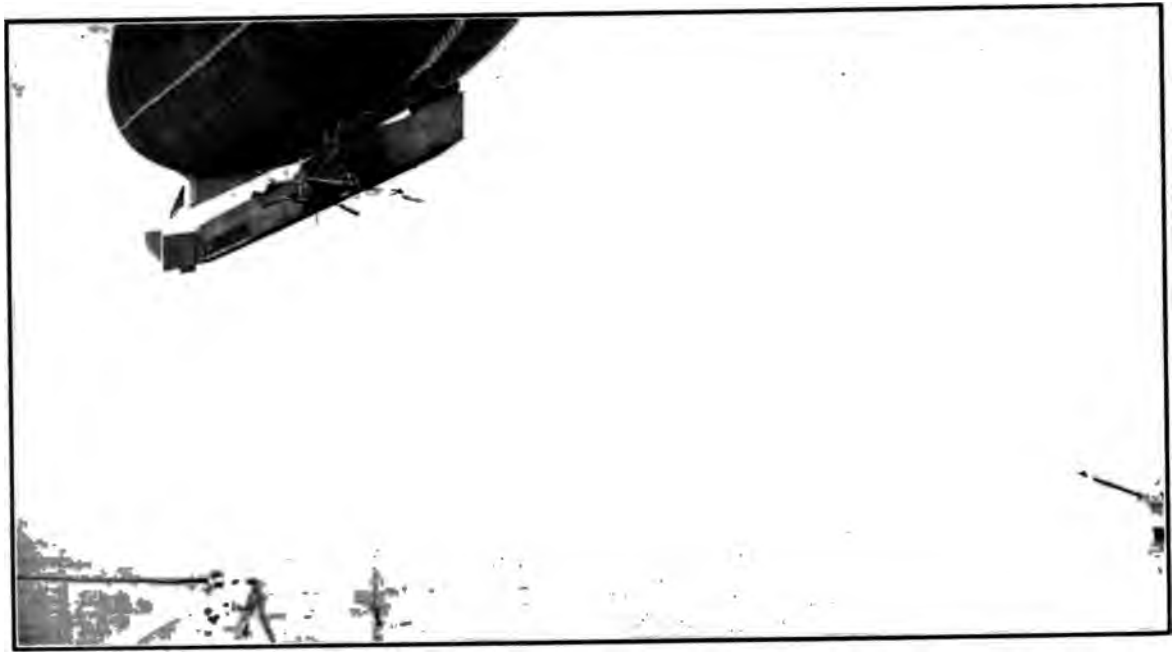
Steering into the eye of a wind of fifty miles per hour the airship would lose thirty miles per hour; running with such a gale she would make seventy miles per hour on her way. Obviously, as long as the ship has sea room—can keep herself up in the air—no storm that ever blew can hurt her. That is, if she be wholly free from contact with the earth through drag rope, equilibrator, or other trailing device.

Another vital factor in the endurance of an airship—its ability to make a long voyage—is its continued buoyancy under all conditions. We have already pointed out that the leakage of hydrogen through the envelope was expected to amount to a loss of less than 500 pounds of lifting force per day, while the load carried was to be lightened twice as much by the consumption of half a ton of gasoline in the engines every twenty-four hours. But this is not all of the story.

An airship is peculiarly sensitive to any change in meteorological conditions. It is affected by winds, sunshine, clouds, heat, cold, moisture, atmospheric pressure. All these mutations must be taken into account by the aeronautic engineer, who, all things considered, may be regarded as rather a busy man, dealing with a wide range of the arts and sciences—physics, mechanics, chemistry, metallurgy, motors, meteorology, nautical astronomy, seamanship, sextants, compasses, human nature, finance, fuels, and food, in fact almost everything under the sun.

The buoyant force of the airship *America* was nearly 24,000 pounds when the temperature of the surrounding air and of the gas within the reservoir was at a certain standard, say seventy degrees Fahrenheit, and the barometric pressure is normal, say 29.92 inches or 760 millimeters of mercury. Temperature and air pressure are constantly changing, and the volume of gas, and constantly the lifting power, changes with them. Both temperature and atmospheric pressure change not only from hour to hour and from day to day, due to general conditions, but change with every variation of the altitude of the ship.

The reader should first understand that all of the 345,000 cubic feet of gas in the balloon in our airship was contained in a single compartment or reservoir, tightly closed, and kept constantly under a small pressure that the form of the balloon may always be maintained. The only openings in this reservoir were three in number—one for putting gas in, two valves for letting gas out. One of the latter was at the top



UNDER VIEW OF THE AMERICA — 1909.

of the balloon, worked only by a cord from the car. The other was at the bottom, well aft, and set to open at a pressure of 12 millimeters of water, equal to 12 kilogrammes per meter square —oh, that the United States as an approximately civilized country could enjoy the blessing of the metric system of weights and measures!—or about 2½ pounds per square foot. When the pressure rises to this height the valve opens automatically, gas blows out till the pressure is reduced to the standard, when it closes again. When the gas contracts and reduces the pressure below the standard, air is pumped in by a special apparatus installed in the car until the required pressure is regained.

Within the balloon are six inner reservoirs for air. These are empty when the ship sets out upon a voyage, the desire being of course to take the largest possible quantity of gas and therefore the maximum of lifting force. As hydrogen escapes, or is let out, air is pumped into these six bags to replace the loss, always maintaining the integrity of the balloon's form. If the balloon should become "flat," that is, not be quite full and distended, "pockets" would be formed in its forward part, greatly increasing its resistance to the wind.

In the *America* six of these inner compartments were provided so that air—which is so much added weight or ballast—might be put in that part of the ship where it seems most needed, and to prevent the rolling to and fro of the relatively heavy air, as would be the case if it were introduced to a single great compartment.

An airship sets forth on a voyage. It is, say, the afternoon. As night comes on the temperature of the air falls. The gas, which has been warmed by the sun during the day, rapidly cools by radiation. All gases expand or contract $\frac{1}{491}$st part of their volume for each degree Fahrenheit of heat or cold. Gas within a balloon subjected to hours of warm sunshine will absorb heat, much as a greenhouse does, till it is far warmer than the surrounding air. If the temperature of the gas in the afternoon should be 100° Fahrenheit, and during the night it were to cool to 50° Fahrenheit, it would suffer a contraction equal to about one-tenth of its volume.

This is an extreme case; but a contraction of one-twentieth of the volume is not improbable. With the *America* that would mean a loss of approximately 1,200 pounds of lifting force. In other words, to keep the ship from going down to earth 1,200 pounds must be taken from the load which she carries.

At the same time the atmospheric pressure may increase, still further contracting the gas. Rain may deposit 500 to 1,000 pounds of water upon the 4,000 square yards of the balloon and its appurtenances. To lighten ship under such circumstances ballast is usually carried in the form of sand or water to be thrown overboard.

Assuming that the ship by these means has weathered the night, the following morning the sun comes out bright and warm. The gas absorbs heat and expands; air is expelled from the balloonets or inner balloons when the pressure passes the fixed point, and opens the valves of the air compartments; every cubic foot of air out lightens the ship 1.2 ounces; the accumulated moisture upon the envelope and the car is evaporated by the sun's heat, and under all these influences the craft rapidly rises in the air.

For many reasons it is not desirable to go very high. Chief among these is the fact that if a ship is at great altitude when the gas begins to contract and starts her upon a descent she acquires momentum going down, and desperate measures must be adopted to avert disastrous collision with the earth's surface. To prevent rising to an undesirable altitude the valve cord is pulled, and gas deliberately let out at the commencement of a period of expansion.

It is obvious that an airship operated by the usual means—throwing over ballast on the one hand or letting out hydrogen on the other—must not only carry a heavy weight of water or sand, thus reducing the quantity of fuel that can be taken for the engines, but that her vitality and endurance will be quickly exhausted by these alternating drafts upon her resources. For the reasons just set forth an airship depending upon the usual means could not hope to make a voyage of more than two or three days' duration.

[redacted]

CHAPTER XXXI

THE FAMOUS EQUILIBRATOR

An important, and as it turned out, a crucial part of our equipment, was the equilibrator. So much has been written and said of it, and there has been so much misapprehension concerning it, that I shall try to explain with the utmost clearness its purpose and function, though the reader who has attentively gone through the preceding chapters doubtless understands it very well now.

As I have already pointed out, an equilibrator, or some other device that performs the same function, is an absolute essential to a long voyage with a motor-balloon. The purpose of this auxiliary, it is well to say at the outset, is not to keep the airship from going high in the air, but to prevent it falling into the sea. For a long voyage one must reckon upon remaining six to ten days in the air. That is the time we calculated would be necessary for crossing the Atlantic.

Now, with the lower temperature of every night the gas cools and contracts, thus diminishing the volume of gas in the balloon. Air must be pumped within the interior reservoirs or balloonets so that the balloon part of the airship may preserve its form. Air weighs about 1.2 ounces per cubic foot. The more air pumped in, the heavier the contents of the ship. But, so far as the buoyancy or lifting force of the balloon is concerned, it makes no difference whether air is or is not injected. With air pumped in, the contents of the balloon have greater weight. Without air in, the balloon, shrinking with contraction of the gas, displaces just so much smaller volume of air, and therefore lifts just so much less. It is as broad as it is long in its effect upon the lift of the ship. In other words, the volume of air which equals the shrinkage of gas weighs the same whether it is within or outside the balloon. But it is necessary to put air in so that the form of the balloon may be preserved; and this is necessary to keep down resistance and to make sure that the suspension works normally.

When the gas contracts during the night and the balloon loses lifting force it is obvious the airship will go down into the sea unless the load carried upon it be diminished to the extent of the lost buoyancy. Without an equilibrator, this weight must be thrown overboard—sand, or water, or gasoline, or something. Once over-

[redacted]

board, it is lost, and cannot be recovered. If you must repeat this process of lightening ship by throwing over ballast every night you are out, it is apparent that for a long voyage the total weight to be carried for this purpose rises to high figures.

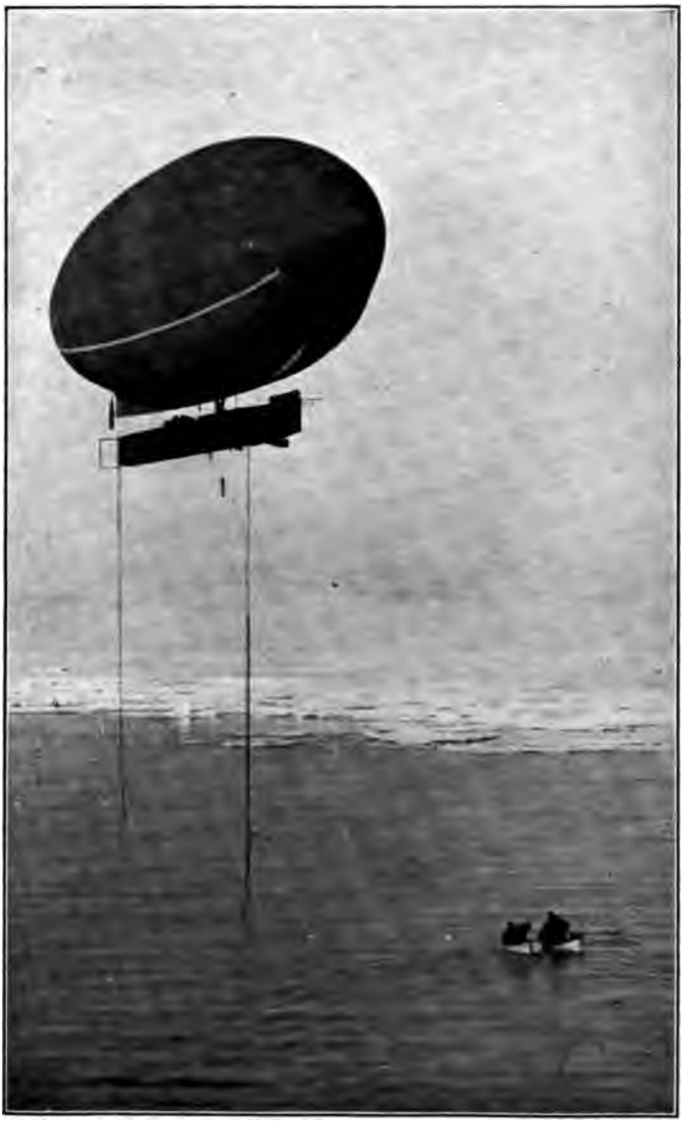
But with an equilibrator, or trailing device, instead of throwing ballast overboard, you permit your trailer to descend upon the surface of the sea and float there. The ship is relieved of that much load, but the ballast is not lost; it may be used over and over again. The same weights used Monday night to lighten ship are used Tuesday night, and Wednesday night, and so on throughout your voyage. Moreover, these same weights are useful during the day to prevent the ship going too high when under the hot sun the gas expands, lifting force rapidly increases, and the ship rises. As she goes up she must lift more and more of the trailer and thus take upon herself more and more load.

As already explained, I had suggested and experimented in the polar regions with devices built to serve this function. The first equilibrator for use in the Arctic was a series of steel reservoirs or tanks. Then we tried the leather serpent in two voyages, with the results described in previous chapters. For the transatlantic trip we came again to the steel tanks.

are strung upon a staunch steel
through these tubes. Each reservoi
at its forward end and convex at t
that one fits into the other like a cup
is padded with felt to take up shocks a
wear and abrasion. A special clamp
tank to the cable at the required pla
cup-like joints give to the series great
and ease of adaptation to the surface
waves.

All of the reservoirs are filled with
and each tank and its contents has a
about 100 pounds. Gasoline is not pu
cause we wish to carry fuel in this ma
because the equilibrator, to be effecti
purpose for which it was designed, mu
certain weight, and it is far better to
weight made up largely of a useful
rather than of such dead weights as
wood.

[redacted]



THE AMERICA AFTER THE ACCIDENT — 1909.

being lifted up to the engine room and its contents utilized in the motors.

Before we set out upon our voyage across the Atlantic, I wrote as follows concerning the equilibrator:

"The reader will readily understand the purpose for which this strange device was constructed. More than 300 feet in length, with a total weight of nearly two tons, its lower end will ride upon the surface of the sea. This lower end is composed of forty solid wooden blocks tapering to a very small diameter, much like the tail of a snake.

"The wooden blocks, and the steel tanks as well, are buoyant and flexible, and the whole will swim in the wake of the *America,* partly upon the surface of the sea, partly lifted in the air—a giant steel sea serpent with a wooden tail, its head erect, and making for Europe as convoy of the first ship of the air ever seen over the waters of the broad ocean.

"Suppose half of our great snake of steel, his belly full of gasoline, is upon the water, and half in the air. Night comes on; the gas cools; rain falls; the conditions already described are upon us; the *America* droops more and more to the sea. As she goes downward one after the other of the constituent steel tubes of the serpent is deposited upon the surface of the ocean. For

. ... now floating along b

"In the morning the sun rises brig The reverse process follows—the exp sends the ship upward. As she rises another of the steel reservoirs must be l the sea, 100 pounds more weight upo for every four feet of her ascent.

"Thus the steel serpent becomes an governor upon the upward and downw ments of the ship due to meteorological Hence the name 'equilibrator,' or 'sta The huge snake and its valuable stuffing ballast which may be used over and ov without ever losing it.

"It is unnecessary to carry sand or throw overboard. Our serpent, if he be well as a well-made reptile ought, sho the *America* at an altitude of from 15 feet above the ocean, save us ballas means fuel—on one hand, save us ga other, and enable ...

the rough sea? We confess we do not know. We believe—but are not quite sure—that it will be so 'soft' upon the waves as to give us little trouble in the way of shocks or jerks upon the airship. We have tried the same principle over the Arctic Sea, and there the device rode smoothly, and being a continuous body made no considerable resistance of the progress of the ship towing it.

"But the Arctic waters were not rough, and we are very curious as to how our new and improved sea serpent will behave upon the Atlantic. Will he serve or sting us? At any rate, a voyage of 3,500 miles by airship is impracticable without the aid of some such device; and this one is the best we can do out of our experience and study."

According to the original plan, only a small part of the serpent was expected to float upon the surface of the ocean. In other words, under normal conditions the lower end of the tail—a few of the wooden blocks—was to be skimming the crest of the waves. Or, the trailer might be entirely out of water. It is always easy to prevent an airship going high. That is done by simply pulling the valve and letting out a little gas. This is not an unnecessary loss of gas, because with a hot sun the gas will expand and a part of it be lost, anyway; and by keeping the

At the level of the sea the

the atmosphere is 760 millime
of mercury. If you ascend
3,280 feet, atmospheric press
millimeters (26.38 inches) of m
words, the pressure of the air
face of a balloon or airship
proportion of 90 to 760, or r
and, assuming that the temper
same, you have therefore lost
of all the contents of your b
cause alone.

The valves of your balloon a
to open automatically at a
The first to open, because set fo
sure, are the air-valves. And
much air in the inner reservoi
the size of the *America* would
feet of gas from diminution
pressure in taking an altitude o
the

[redacted]

lifting the equilibrator and all high in the air, due to sun heat and expansion by altitude.

We realized from the first that to have a serpent weighing 3750 pounds all the time trailing in the sea would retard the progress of the airship, probably interfere seriously with her steering, and by its drag-effect and its leaping from wave to wave in heavy seas tend to strain the airship and pull it down toward the surface of the ocean. All this we knew nearly as well before the voyage as we did during and after the voyage. For the equilibrator we have been much criticized.

But we never intended to use it the way in which it was used. We had planned to start the voyage with not more than one-half of the equilibrator upon the surface of the sea—1,500 to 1,800 pounds. Each 24 hours we reckoned to lift 500 or 600 pounds of this on account of burning so much gasoline in the motors. If this plan could have been carried out, the serpent would not have interfered with the successful navigation of the airship. The small part of it down upon the sea would not have given us any trouble, or very little. And after the first day the equilibrator would have worked precisely as it was designed to work—that is, carried chiefly in the air, suspended vertically, as a reserve weight to be used in keeping the airship from going down to the ocean whenever the cold or other conditions greatly diminished the lifting force of the balloon.

Circumstances which we could not control changed this plan materially and unfavorably. I shall tell frankly what these circumstances were.

[redacted]

CHAPTER XXXII

THE WEIGHT PROBLEM IN AERONAUTICS

The design of the transatlantic airship was carefully made. It was symmetrical, well-balanced, effective engineering. Everything was taken into account—the distance, the speed of the ship, the probable effect of the winds, the total lifting force, the quantity of fuel that would be needed. To meet all these requirements the balloon was enlarged in the spring of 1910. Forty-one feet were added to its length in the mid-section, increasing the volume 87,000 cubic feet, and the total lifting force nearly three tons. With this enlargement we calculated upon being able to carry 9,000 pounds of gasoline, the life-boat, a crew of six men, in addition, of course, to the ship and all her machinery, and to start with not more than one-half of the equilibrator upon the sea.

For one who knows the aeronautic art and the mathematics of it in all its branches, it is not difficult to prepare a good plan. My design was good. The difficult thing is the execution of it. In an airship, even more sharply than in a steamship or land vehicle, limitation of weight is the essence of life and success. If you cannot build within the predetermined weights perhaps you would do better not to build at all; for then you will escape much trouble and disappointment.

Probably it is possible to find mechanics and constructors who can take a rational engineering plan and carry it out pretty close to the schedule of weight and cost, but I have never been fortunate enough to find one. When the work is finished, it is invariably found that weights have overrun, and cost has greatly exceeded estimates. In both particulars one learns to allow a fair margin, but even a liberal margin does not seem to assure protection against having good plans marred or spoiled by faulty execution.

From an airship voyage over the Arctic Ocean in August, 1909, to a steamship race up the White Nile almost to the equator in March, 1910, was a rather quick transition, a pretty far cry.

After the plan of our transocean voyage had been agreed upon, and the actual work started, it was necessary for me to go up the Nile to meet ex-President Roosevelt. In the course of that journalistic assignment it became a part of my duty to hire a special steamer and race rival newspaper men several hundred miles above

[redacted]

Boat's crew from the Farm attaching the tow line to the America.

Khartum for the satisfaction of being the first to meet the ex-President—a race which I won with several hours to spare. Col. Roosevelt and I had breakfasted together aboard his steamer going down the Nile, after breakfast had sat down and settled all the affairs of all the nations to our mutual satisfaction, and I had written my cablegram describing the race and my little triumph before the smoke of my rivals' boat was seen down the river, puffing toward us as fast as she could with a party of very much discomfited journalists aboard her.

While up the Nile with Roosevelt a cable message informed me something had gone wrong with the arrangements for our transatlantic airship trip. A misunderstanding had arisen which free use of the cable at fifty cents per word did not serve to straighten out. It was not till after I had accompanied the ex-President all through Europe to London, and myself reached America early in June, that the misunderstanding was removed. This delay cost us dearly. Mr. Vaniman, who had been in charge of our construction work, though not an engineer in the true sense, is a clever mechanic and foreman, and had done the best he could under the discouraging circumstances. Being compelled to build hurriedly, perhaps it is not surprising that he was not as careful about the weights as he should have been, and as he probably would have been under other and more favorable conditions, though, like all mechanics executing the designs and working to the calculations of another, he is naturally more keen about strength than for adhering closely to a weight schedule.

For important parts of the mechanical and aeronautic equipment he was compelled to rely upon contractors and various factories, and when they overran the stipulated weights no time was left for rebuilding to cut weights down. An example is found in the weight of the lifeboat carried upon the *America.* I had stipulated that its weight should not exceed 1,000 pounds. The builder undertook to keep within that limit; the boat when finished was reported to weigh 800 pounds. When we put it upon the scales at Atlantic City we found its weight was just twice as much!

So it went with many things—so many that by the time the great airship had been assembled and made ready for a voyage it was found she was about 4,000 pounds short of the net lifting force the designs called for. Instead of carrying 9,000 pounds of gasoline for the motors, the total was about 5,500. And much of that was in the tanks of the equilibrator, from which not a gallon was ever drawn during the voyage.

[redacted]

Worse still, in order to have enough lifting force to carry gasoline in the big steel reservoir of the car—its capacity was 1,300 gallons, and we started with the reservoir about one-third full—it was necessary to lift less of the serpent than the plan called for; and thus we began the voyage with almost all of the equilibrator down upon the water, instead of only one-half of it.

These facts are cited, not in any effort to escape my individual responsibility, nor as an apology, but only to show how circumstances sometimes press one into a venture with the preparations falling far short of his plans and ideals; and how duty at times compels a man to take an imperfect apparatus, and without a word of explanation or reproach or repining, go out with it and do the best he can, no matter at what cost or risk.

Long before we were ready to leave Atlantic City for the voyage over the ocean it was realized the plan had not been adequately executed, and that we must start under this great handicap of overweight. It was impossible to change the construction; and the overload must be endured. Still, there was not the first or faintest thought of failing to start. In fact, eagerness to be off instead of hesitation to go, was the predominant note from first to last. All the tales told in the

.. prepare the *America* for her

not surprising that many spectato
patient as the weeks dragged alc
work was complex and difficult,
patience. It was not easy to fin
chanics, though we paid high wages
right and left for efficient men. I
Vaniman had cabled me from Pa
have the *America* ready for a voyag
after his arrival in Atlantic City,
could have two more weeks in Pa
him one more week in Paris, and then
the balloon, the unfinished car and m
the United States. He and his ex
large staff of general helpers began
assembling August 9th. But so man
were the difficulties in the way that t
not completed and the airship ready
out till the afternoon of October 12th.
out all this period every one of us
all possibl

us as seeking delay when we were breaking our hearts because things did not go faster.

The *America* started on her voyage within 60 hours after she was ready.

She started from a huge balloon house which had been erected at a cost of $12,000 by the enterprising members of the Aero Club of Atlantic City. These men had invested their money for the promotion of a great scientific project. They did not expect to get their money back from the small admission fee, and in fact they did not. During all the long period of preparation they were patient and fair. They were more interested in the attainment of a scientific success than in the commercial side of the venture.

The cause of aeronautic progress owes much to such men as Joseph W. Salus, Albert T. Bell, Harry B. Cook, Daniel S. White, John J. White, J. Haines Lippincott, Louis Kuehnle, Henry W. Leeds, Charles D. White, Walter J. Buzby, Dr. J. B. Thompson, Walter E. Edge, P. E. Lane, John Vogler, S. P. Leeds and many others. They are fine types of American business men—men who have broad views and a generous public spirit.

CHAPTER XXXIII

PROBLEMS OF AERIAL NAVIGATION

The navigation of an airship out of sight of land involves problems somewhat different from those attending the navigation of a ship upon the water. All these problems had our most careful study. For example, in every observation of a heavenly body for ship's position the height of the eye above the surface of the earth is an important factor, provided the sea horizon be used as the base of the observed angle. In the books on navigation corrections for this "dip" of the horizon are carried only to a hundred feet. I carried our table to 6,000 feet.

In fact, I worked out an elaborate system for the navigation department which surprised and delighted many old navigators who saw it. I made special charts, a log book adopted to aerial conditions, and found it necessary to work up many special tables and calculations fitting the peculiar task of taking astronomical observations and working dead reckoning in the air. We even built some special instruments for taking the altitude of heavenly bodies.

With these, and also with the ordinary sextant, we were prepared to take observations of the sun, stars, moon, and planets as do other navigators, for latitude, longitude, time, and compass corrections by azimuth. But we had this advantage—there was no need of our working with seconds of time or arc. The refinements of navigation meant little to us.

We aimed at no particular port or even country. We feared no collisions with other ships, except that we did not care to have our serpent run foul of a vessel. It was not necessary for us to avoid rocks or shoals. Navigation "to the nearest minute" was quite good enough for our needs, or five or ten minutes of arc, for that matter, as it made little difference whether we were a half dozen or a dozen miles more or less to the northward or eastward.

Navigation of an airship is different from that of a steamship in other important particulars. A steamship will pretty closely follow her head; an airship will not. If, for example, we are steering east and making twenty miles an hour, and a wind of twenty miles per hour is blowing from the north, the actual course of our craft over the sea is not eastward, but to the southeast—a component of the two forces, one the movement of the ship due to the operation of her engines, the other her drift with the wind as a vessel may drift in a current.

An airship can theoretically head into or take any desired angle to any wind, no matter what its force, up to the limit of the propulsive energy of the screws. But the actual course the ship makes cannot be told by the compass alone if a wind is blowing, nor can we know from what quarter and with what velocity the wind comes until we have ascertained the ship's course and speed.

To do this we must have a point of reference upon the earth itself—it cannot be had from the air alone. So we note by the compass the wake of the equilibrator as it moves over the water, or trails behind us in the sea, a fine wire a mile or more in length. It moves an indicator upon a dial in the navigating room, where the steering wheel and compass are placed, and the angle of this indicator shows whether we are following our direct course or swerving from it.

For dead reckoning we must depend upon the leeway indicator for direction and the old-fashioned harpoon log for speed, casting the log at frequent intervals, then pulling it in and reading its dial. This log is a tube of metal about two inches in diameter and two and one-half feet long, shaped like a harpoon, its after end fin-shaped, revolving according to its velocity through the water as it is towed at the end of a

Another view of the disabled Airship — 1909.

long line, the number of revolutions being marked upon a dial indicator.

Given the head of the ship by the standard compass, the actual course by the leeway line, the approximate speed by the harpoon log, and the normal speed of the ship in still air, a component of all these factors will enable us to ascertain the direction and force of the prevailing wind.

These are not simple problems. Dead reckoning under ordinary conditions, must be only a rough one, and under unfavorable conditions would be of small value. Without occasional astronomical observations we should at times be at considerable loss to know just where we were.

We have had some experience with airships, and the *America* seemed to us a pretty staunch ship-like craft. She was well arranged and well equipped, as aircraft go. In the forward part of the car was the navigating deck—the bridge. Here were the compass binnacle, the leeway indicator, the steering wheel. From the latter the rudder cables ran to the stern and moved the wonderful triplane rudder built of steel tubing and varnished canvas—light as a feather and strong as a young ox. Here also were carried the meteorograph, barograph, thermograph, statoscope, manometer, and other instruments.

[redacted]

Nearby was one of the two winches which worked the equilibrator cables. Celluloid windows gave outlook, and the canvas enclosure protected the crew from wind and weather.

Speaking tubes led to the engine room, just aft, where two men were expected to be always on duty. Here, in addition to the two driving engines already spoken of, was a 10–12 horsepower motor, our donkey or service engine, used to work the air-blower, and also to start either of the larger engines without cranking.

Here also was the dynamo which operated ten twelve-candle power electric lights distributed throughout the ship and in the lifeboat swung underneath the car. It also charged the accumulators in the lifeboat, and provided power for the Marconi wireless installation, which was placed in the lifeboat. Fire extinguishers were hung at convenient intervals in the engine room.

The Marconi apparatus used approximately 250 watts, a standard ten-inch Marconi induction coil being used to charge the condenser. With this small amount of power we were assured by the Marconi Company there would be no danger of troublesome sparking.

The steel frame of the car was used as the wireless radiator, and the equilibrator cable gave the earth connection or ground.

J. R. Irwin, an Australian by birth, long in the service of the Marconi Company, and lately running on the *St. Louis,* was the wireless operator. He was selected by the Company out of many volunteers on account of his skill and pluck. By actual test this Marconi apparatus is able to transmit messages seventy-five miles, and by its aid we hoped to keep in almost daily communication with transatlantic steamers, and from them to the land.

A small kite was carried in the lifeboat, for use in case shipwreck should make it necessary for the crew to take to the boat. The wireless apparatus being there, and the accumulators, the electrical energy stored in the latter could be utilized in sending messages for help to passing steamers by sending up a kite with a fine wire to serve as an aerial.

The lifeboat used in the voyage, and still in existence, is twenty-seven feet long, six feet beam, and three and one-half feet depth amidships. Each end is decked and made into a large watertight compartment. Midships is a cockpit, protected by a canopy. This staunch boat was built by Saunders of East Cowes, Isle of Wight, and that celebrated builder thinks it the finest piece of work he has ever turned out. The hull is of three thicknesses of veneered mahogany and two layers of canvas stitched together, ribbed and strengthened. In the bottom is a manhole which serves two purposes—one to enable us while the airship is in flight to bring up from below the reservoirs of gasoline composing the equilibrator, the other to bail the boat automatically, in case of need after she has taken to the water.

Sailors who have seen this lifeboat admire it very much, and say it is non-capsizable and non-sinkable. It is equipped with mast and sail, but not with a motor.

Its chief value in case of accident, as we planned, was to keep us afloat until we were picked up by some passing vessel. Even if equipped with a motor it would not be practicable to carry enough fuel for a cruise of any considerable length.

Down in the lifeboat was our kitchen—a gasoline stove with aluminum utensils. We carried provisions and fresh water for thirty days, and most of these were stored in the lifeboat. Here also were kept a compass and other instruments, so that the craft was fully equipped and ready for use at any moment.

For food we took ship's bread, beans, bacon, coffee, Horlick's malted milk, boiled hams, eggs, tinned meats. The lifeboat was also the smoking room of the ship; and in it were two beds. Two more hammock-line bunks were in the car near the engine room.

[redacted]

It is worthy of note that if we had wished to do so we could install thirty or forty beds in the steel car, small as it appears in comparison with the great gas reservoir overhead. We did not carry a doctor, but depended upon a Burroughs, Wellcome & Company field medical and surgical case, which in the past we have found so valuable in the Arctic regions. Howard watches, which I had also used in the difficult conditions of the far north with admirable results, gave us most accurate time.

CHAPTER XXXIV

THE WEIGHTS OF A BIG AIRSHIP

The airship *America* was so large that if we had wished to do so we could have dispensed with the lifeboat, the provisions, most of the fuel and lubricant for the motors, and, on a short cruise, could have carried 40 passengers. Many applications for places in the ship were received, and a surprisingly large number of people were willing to risk their lives in our craft. If time had permitted the making of short trial trips, it is probable we should have taken a few passengers—not for pay, but solely through desire to give some of our friends a novel and enjoyable experience. But there was no opportunity for trial trips if we were to get started upon our long voyage.

The total lifting force of the airship was 23,650 pounds—almost 12 tons. It is a curious circumstance that the same ship would have lifted 1,900 pounds more, or a total of 25,550 pounds, if inflated at our headquarters in Spitzbergen, where the prevailing summer temperature is 32° Fahrenheit, and the air displaced has a weight of 1.293 kilos per meter cube, instead of 1.200 kilos per meter cube at the higher average temperature of the Atlantic Coast, which we assumed at 70° Fahrenheit.

Approximately the weights carried by the *America* were as follows:

The airship and its equipment—

THE AIRSHIP AND ITS EQUIPMENT—	Pounds.
Balloon part, complete	4,900
Steel car and canvas cover	5,500
Propeller frames	500
Rudder	200
Steel gauze and asbestos	250
Compass binnacle, steering wheel	150
Miscellaneous	500
E N V motor, complete	800
Lorraine-Dietrich motor, complete	1,050
Small motor	250
Air blower	125
Winches and cables	150
Instruments, bedding, kitchen	250
Wireless equipment	300
Electric light	250
Tools, extra parts, etc.	200
Lifeboat, complete, with rig	1,700
Miscellaneous	425
Total	17,500
CONSUMABLE CARGO—	
Gasoline in large reservoir	2,950
Lubricant in the car	450

... six men, spare c

Buoyant force at start . . .

Equilibrator and cable, at

Grand total . . . .

IN THE EQUILIBRATOR—

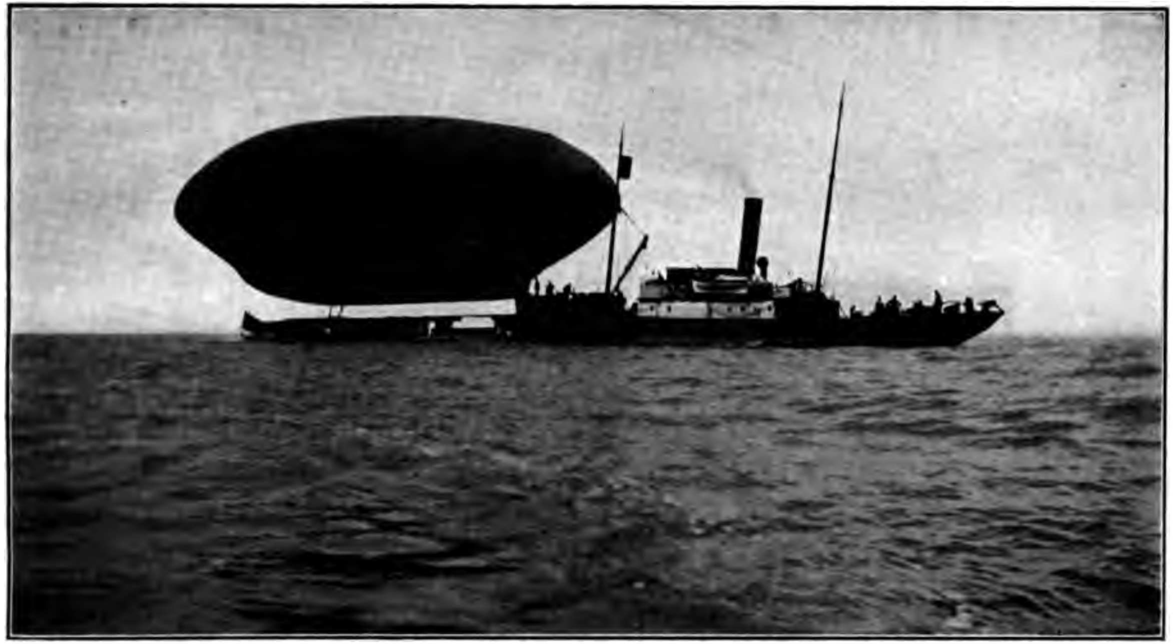
Gasoline . . . .

Weight of tanks and cable.

The total weight of m
equipment as the airship s
was:

The ship and machinery, etc.
Hydrogen in the balloon. . . .
Fuel, lubricant, provisions an
Crew and clothing . . . .
Equilibrator tanks and cable

Grand total . . . .



The Norwegian Steamer Farm rescuing the Airship Crew—1909.

[redacted]

risk to life is apparent. How great this risk must remain an unknown quantity till we have put it to the test. Once well on our way, the danger of fire or explosion will be ever present in our minds. The combination of a ton of inflammable hydrogen, nearly three tons of gasoline, sparking motors, electric light, and wireless, is not one to inspire perfect confidence. We are exercising all possible precautions, with our steel gauze and asbestos around the engines, fire extinguishers at hand, the gas valve placed far aft, and the exhaust from the motors carried well out from the gasoline tank and into the area of air movement from the propellers.

"Lightning may strike the ship and fire the hydrogen. Our equilibrator may not ride well in heavy seas and by its shocks injure the airship. Or, it may possibly foul some ship or fishing vessel. Both engines may break down.

"We go prepared to make all small repairs *en voyage.* It is barely possible a propeller might break and flying parts pierce the gas bag and wreck the ship—such a disaster happened to the French military airship *La Republique* a year ago, and all on board were killed when the craft crashed to earth. But the propellers of *La Republique* were of steel, were turned at 1,100 revolutions per minute, and crystallization doubtless weakened the metal. Our propellers

blow us far out of our course, tow
or the Saragossa Sea. Persisten
may drive us back or exhaust ou
and leave us helpless in midocean.
chances which we take with open ey

"Sudden disaster, like explosion
of the gas bag, might make it impo
to enter and launch the lifeboat. B
life of the airship come to an end w
minutes' warning, the lifeboat is ava
is hung with an instantaneous relea
and is at all times kept fully equipp

"It is true that if the *America* wer
down into a rough sea there would fol
ward scramble to enter and cut aw
boat, but we believe we could manage

"We have not arranged for a
steamer because the chances are we
an escort the first or second night
a westerly or southwesterly bre

steamer lane from New York to the English Channel, and if we should be so fortunate as to be able to keep fairly on the course help would not be far away in case of accident.

"While the plan is to follow the steamer tracks the best we can, we do not aim to make a landing at any particular place, nor even in any particular country. Any spot between Gibraltar and the North Cape will look good to us."

CHAPTER XXXV

THE START—OUT OF THE BALLOON HOUSE

It was at 8 o'clock Saturday morning, October 15, 1910, that the airship *America,* with a crew of six men aboard, set out from Atlantic City over the fog-surrounded ocean, headed for Europe. That she did not cross the ocean, but did make a memorable voyage of three days and nights, beating all records of airship navigation for distance covered and duration of voyage, is now known all over the world.

When we fared forth that foggy morning we six men of the crew—myself as commander, Melvin Vaniman as chief engineer, Louis Loud and Frederick Aubert as assistant engineers, Murray Simon as navigator and Jack Irwin, wireless operator—had very little idea of what was to happen to us or where we were likely to stop.

We knew we were going to try to reach Europe; we knew we had some sort of a chance—how good or poor a chance it was we could not calculate—to do so. We knew we were engaged in a difficult and dangerous scientific experiment and adventure, one which was the more fasci-

[redacted]

nating because it was difficult and dangerous; that it was a thing worth doing for itself and what it might lead to in the progress of the arts; that it was not foolhardy because all possible precautions on a large and engineering basis had been taken to assure success and our own safety —all advancement in aerial navigation is attained at some risk; that it was not merely a sensational feat, because a high and worthy purpose lay behind it; and that like many other achievements marking man's conquest of the elements, we never could know what we could do till we tried.

Despite all the precautions our experience and foresight and study could suggest, we were not unmindful of the risks to be taken, nor of what the world has been kind enough to call the daring of our unique, unprecedented venture. But we were filled with joy to have our chance for whatever it might be worth.

My first thought was one of pride in the gallant men of my crew. Hundreds had volunteered. Letters and cablegrams and telegrams had been sent from all parts of the world by men eager to go in the *America*—aeronauts, engineers, sailors, motor-experts, journalists, men of no vocation or fitness, cooks, scientists, army officers, wireless operators. Applications had come from England, France, Germany, Russia, Cuba, Egypt, South America, a great number from the United States.

But the men who had been chosen were well fitted for their difficult tasks, were personally known to me. Vaniman had been with me in two aerial voyages, Loud in one voyage, and were men tried and true; Aubert, the youngest man in the party, I had known for years, and felt every confidence in him; Simon had come to us from the White Star Steamship Company, where he had been one of the officers of the great steamship *Oceanic,* and his long experience, his character and our personal contact with him told us he was the man we wanted; Jack Irwin, an Australian by birth, a man who had been in the Zulu and Boer wars, of late wireless operator on the steamship *St. Louis,* and the man who had received Jack Binn's famous C. D. Q. call from the sinking *Republic,* had been chosen by the Marconi Wireless Telegraph Company from among a host of volunteers, and we never doubted he would prove to be the right man in the right place.

Glad of spirit but somewhat weary of body were we half dozen men when we took our parting dim glimpse of the gray, mist-strewn Jersey shore. Glad, because we were at last on the way. Weary, because for days and weeks we had all been under nervous and physical strain in the work of preparation, and in the midst of calumny and insult, such as men must once endure to understand. After a brief, fitful sleep, we had been roused that morning long before the dawn.

Hoping the night before to get a chance in the early morning, we had asked Leroy Chamberlain and Fred Aubert to watch the night through at the balloon house. At four o'clock they knocked at my door, reported no wind, a dense fog, a good outlook. A moment later Engineer Vaniman was called; telephones were set ringing all over Atlantic City; messengers were sent scurrying after the other members of our crew; the fire and police departments, which had offered to help, were notified, and in a half hour had a hundred men on the way to the huge structure in which the *America* was housed. Long before the first streaks of light came from the East we were all there, eager to be off upon our voyage.

First, the canvas doors of the balloon house were pulled back out of the way. Then the steel sea serpent, or equilibrator, weighing nearly two tons, were carried on the backs of three-score men and thrown into the sea, a few hundred yards distant. Next the lifeboat, considerably more than a ton with its cargo, was taken out and placed upon the ground in front of the bal-change. General conditions ove

Ocean were reported favorable;
were right; thanks to a little patie
fulness our chance had come to l
ship without danger of accident
out, one of the things which from tl
most feared, for well did we know
ence the hazard of that operation.

Then we took her out. A h
grasped the leading lines placed f
hanging down from the sides of
The 12½ tons of material and gas cc
ship floated in the air upon such an
that one could push the whole mass
with one hand. A few hundred wei
bags were thrown off, the hundred
enough upon their lines to compen
ward thrust of this buoyancy, and
of men walked forward at the word
the huge ship glided gracefull

Taking Instruments, Dogs and Crew from the partly wrecked Airship — 1909.

her great size, her graceful proportions. A small boy cried out: "My, just see how big and long she is!"

In a few moments the lifeboat had been hooked to the steel car—the shackles and fasteners were all ready. One by one we of the crew bade good-bye to families and friends; no tears were shed by anyone, though all of us felt the seriousness of the moment. The cat was placed on board amid the applause of the on-lookers. Engineer Vaniman remained on the ground to superintend the attaching of the cables which hung the equilibrator to the airship. This done, and the last remaining sand bags cut away, he clambered to his place in the engine room, and was cheered by the crowd as he did so.

The *America* was now ready. At the order of "Let go all," the hundred men holding her slipped their lines and she rose in the air, carrying the lifeboat with her, and lifting about one-tenth of the weight of the equilibrator. A line was given to a motor-launch, to tow us out through the bay over the bar to the open sea. In a moment we lost sight of the balloon shed and the people on shore; but we could hear them cheering somewhere back there in the gloom.

Moving slowly out through the mists towed by the launch, my first thought was of the equilibrator down below. It swam easily on the surface of the water. But a pity 'twas, thought we who had laboriously and carefully made the plan of all this, that the design could not have been better carried out and fully one-half of the weight of the serpent be suspended in the air at the very start. At this moment I confess I had my first forebodings of trouble; weights had overrun; the lifeboat was double the stipulated weight; apparently almost everything else had exceeded calculations; thus the ship was overloaded in a desire to carry with us enough fuel to insure a radius of action equal to the tremendous distance which lay ahead.

It was with a keen feeling of disappointment I looked down and saw only one-tenth instead of one-half of the equilibrator lifted from the sea. But there was not even a thought of turning back, nor—if the motors started up right—of converting the start into a trial trip. This weakness of the overload was nothing new; we had struggled against it in vain through the weary weeks; it was fundamental and could not be remedied. A trial trip, and return for alteration, could avail nothing; already we were a month later than our original programme had called for, and with the season so far advanced a return would probably mean no start at all this year. That, of course, could not be endured, no matter what the cost.

If good reason there had been for returning—anything of practical value to be gained—we should have come back. But there was none, and on we went. Here at last was an answer at least to those who had misunderstood and had mingled malice with their ignorance. Just a flash of all this, accompanied by a momentary exultation that we had never turned to the right or the left because of baseless criticism, and also a feeling, "Now that is all over—forgive and forget"—passed rapidly through my mind as we drifted out into the silence of the mist, as vague and uncertain as the fate that lay before us.

Just then attention was directed to that member of our crew destined to be the real hero of the voyage—because real heroes are never self-conscious—are always unconscious of suspicion and slander, of danger, of over-generous praise—and therefore are never two-legged. The young gray cat, taken on board half in jest as a mascot, was howling pitifully amid these strange surroundings. Mr. Vaniman, afraid of having his short sleeps disturbed, insisted that "Kiddo" be left behind. Mr. Simon, sailor-like, vowed it was bad luck to let a cat leave a ship, and with equal energy insisted kitty should stay on board. The momentous question was referred to me. Without any fear of midnight howls on the one hand, and without any superstitions on

the launch had cast loose th
Kiddo was pulled up again,
from losing all his fame. La
right, glad chance had decided
retention of the feline member o

CHAPTER XXXVI

OUT OVER THE ATLANTIC

So off we went to the eastward, the seven of us, including the cat. In a quarter of an hour the eight-cylinder motor was started; the propellers cut the air; the *America* vibrated, responded, moved over the water with her own power. She was a real cruiser of the air. Down below through the fog we could see the equilibrator swimming along, for all the world like a great sea serpent, its head in the air, with a tortuous foamy wake. There was a gentle breeze from the northwest. The ship was making fair headway.

We all felt the exaltation of this moment, and said little but smiled at one another. All were happy, save Kiddo, the cat, and he was still sullen with the strangeness of his garret. A strange garret indeed, perched upon a frame of steel, suspended underneath a mass of silk and cotton and rubber, lifted by a ton of hydrogen, a whirring engine disturbing the silence and moving through gray space—pioneers in navigation of the atmospheric ocean which covers the world's high sea. It was no wonder that for an hour or two Kiddo's eyes stared a trifle wildly.

But we who were conscious of the fact that no man before us had attempted what we were doing—conscious that no matter what and whom we had left behind, or what we were going to, we were the first of humankind to sail these two oceans in one with a great engineered and cunning machine, designed to conquer them both together—we should have been less than human if we had not felt a strange joy, an almost uncanny fascination. Even men of the calm, cold, practical order of minds, who calculate stresses and pressures and densities, who figure and plan and construct and experiment and work logarithms on the one hand and carburettors on the other, may have a little imagination and may be permitted an occasional moment of enthusiasm. All about me were radiant faces—all save Kiddo's, it still a bit sour with strangeness; cats have no imagination, no ken of chemistry and human nature and the history of progress; no vanity in pioneering.

After we had been out two and a half hours, the motor was stopped to try the wireless. Jack Irwin was scrouched down in his corner by his instruments in the lifeboat; the wireless receivers at his ears; over them thick woollen pads to drown out the whirr of the motor and propellers.

Now there is a broad, bright grin underneath the pads. We all lean forward expectantly. He must be hearing something from shore. He waves off interruptions, then seizes paper and pencil and jots down this message from Atlantic City:

"*Wellman, Airship America:*

"We are getting your signals. What news?"

I dictated to Irwin the reply:

"Headed northeast. All well on board. Machinery working well. Good-bye,

"WELLMAN."

And these were the first wireless messages exchanged between a station on shore and an airship navigating the sea. One world's record had at any rate been established; and again we all felt the gladness of pioneering along the path of progress.

More messages followed. Overjoyed with this strange experience of carrying on conversation with friends and families twenty miles away from our aerial perch, I wirelessed the *London Daily Telegraph,* the *New York Times* and the *Chicago Record-Herald* that we were on our way and making good progress. Mindful of

...pn W. Salus:

"Atlantic City did nobly. W
best to repay your loyal support

And in his generous enthusia
replied:

"Wellman, Airship America:

"Great work. One of the achie
century. God speed to you and

"J. V

There was Vaniman, unemotion
native, a good mechanic, and seem
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fact as they. Yet Vaniman con
wards that when he realized we w
to sea and were communicating to t
and forth with Signor Marconi's w
the-wisp whisperings, through the
tears stood in hi

Melvin Vaniman at Spitzbergen.

Now Mr. Percy Bullen, American representative of the *London Daily Telegraph,* asked me from Atlantic City through the Hertzian waves:

"From your experience up to now, do you feel confident of being able to make Europe?"

My reply was: "Just started; too early to judge the outcome."

Frankly, at that moment we had no great degree of confidence, only a hope large enough to cling to and work for. Realizing how weights were overrunning, how the symmetry and balance of the original plan was being overthrown by the exigencies of construction and equipment and the impracticability of getting contracts filled to the letter—such as the life-boat weighing double the stipulation—realizing, too, that the agreed-upon quantity of fuel could not be carried and that the equilibrator was far too much in the sea and too much of a drag upon the ship, for a fortnight or more my hope had sensibly diminished. And now, with almost stunning swiftness, came trouble with the motors; and hence the caution with which my reply to Mr. Bullen was phrased.

Motor troubles came soon enough, heaven knows. Despite all our experience with these engines, all our care and expense in fitting them up and trying them out, with the best experts we could bring over from Paris, and more than two months in which to get them in perfect order, the eight-cylinder motor never gave more than one-half its normal power. Just why, I do not know even now. It worked weakly by fits and starts. The four-cylinder Lorraine-Dietrich did a little better, but during the first ten hours was not up to its mark. My log shows many entries like these: "L.D. worked 12 minutes and stopped 40 minutes. E.N.V. ran 9 minutes and it was two hours before it started again." Engineer Vaniman and his two assistants Loud and Aubert, worked like Trojans. They did the best they could, but that unfortunately was not good enough; motors are proverbially coy and uncertain.

This first day out, with a quiet sea and a gentle wind from the right direction, when we should have been making excellent progress on our course, we had a motor running about four hours altogether, and that at a reduced output of power. And in the afternoon the eight cylinder broke down entirely, Vaniman remarking that "It was no good and could be thrown overboard as ballast." So this day was virtually wasted. By nightfall, nearly ten hours out, we were sighted and reported by the steamer *Coamo,* about eighty miles from Atlantic City, when we should have been two hundred.

It was a discouraging start, and that's the truth. Blame does not fall upon any man, but it does fall upon the pesky machines, which failed us so early, despite the fact that the plan of campaign, from the first, all factors taken into consideration—the time, distance, probable winds, speed of ship, fuel supply, everything—I had expressed in these words of elementary law: "We have two good, well-tried motors; if we can keep one or other of them going all the time, we can cross the Atlantic."

It was particularly maddening, as night came on and the gas in the balloon contracted, and the ship dropped more and more of the equilibrator into the water and came nearer and nearer to the surface of the sea, to find it necessary to throw overboard, for lightening ship, the very gasoline which should have been burned during the day in the engines and converted into so many more miles covered. These were among the unpleasant discoveries of this first day and evening of the voyage; but still there was no thought of turning back—we would fight it out. The plan had been to start with four and one-half tons of fuel, the equilibrator half above the water, to burn half a ton of gasoline per day, thus gaining 500 or 600 pounds of buoyancy over the loss due to gas leakage, gradually lifting the equilibrator until, under normal conditions, only a small bit of the tail would remain in contact with the waves.

It is easy to design, difficult to execute; and we were so unfortunate in our execution that we were compelled to start with less than 6,000 pounds of gasoline, and almost all of the equilibrator upon the sea; on account of the poor working of the motors we were this first night out throwing over gasoline which should have been burned; and the serpent underneath us, instead of being gradually lifted, was getting relatively heavier and heavier, retarding the speed of the ship, and interfering to some extent with the steering.

Still, we kept on. With a lucky run of wind, one good engine and a reduced fuel supply it was still possible to cross the ocean. There was no thought of surrender. As yet the *America* as a power-ship had not given a good account of herself. She had been drifting and dawdling with only 25 per cent. of her normal engine power in use. But this Saturday night we came upon conditions which challenged the engineers and their remaining effective motor to battle. They accepted the challenge and made a struggle which must live long in the annals of aerial navigation.

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CHAPTER XXXVII

PERILS OF FIRE, SHIPWRECK AND COLLISION

This was a night of many perils. Early in the evening a fresh breeze sprang up from the south-southwest. It was blowing us towards the New England Coast. Aware of our danger, Simon and I called for more energetic motor service, and the engineers responded nobly. At 7:00 o'clock Saturday night, they set the L.D. running at about three-quarters normal speed and kept it going hour after hour. Simon threw the helm as far as it would go, tied it there, and thus the battle continued throughout the night, the ship fighting for easting to keep off the land.

And such a night as it was! Soon the exhaust pipe was heated red hot and began to belch sparks—not an occasional flash of fire, but thick showers flying aft along the varnished cotton enclosure of the steel car, up against the under part of the balloon itself, against the canvas rudder, and the ship's colors floating above the helm. Nor were these mere evanescent flashes of filmy flame, but great constellations of living coals, many of them glowing for a few seconds after they had fallen into the sea. It seemed to

...the world to an end.

For some minutes, half sea

I watched these aerial firewo

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explosion, my nerves gave way.

"Vaniman," I cried, "you mus

at once."

He stopped it and called

engine room to me in the lifeb

matter?"

"Nothing but hell fire," I rep

be descriptive, not profane "

this: it's onl

"Nothing."

"Nothing whatever?"

"Nothing except to stop running the motor altogether."

"Then run the motor, but for heaven's sake try to stop those fireworks."

There we sat hour after hour, watching this volcanic eruption against the reservoirs of gas and gasoline, fearing every minute would bring the end. Louis Loud, as brave a man as ever trod the deck of an aerial cruiser, came down from the engine room and sat by me for a time. He looked at the red hot exhaust pipe and the torrents of fire streaming out behind and uttered one short and significant word. A little later he added:

"I don't mind what I can't see, but when I look at those globs of fire, I don't feel good."

Louis sat for a time, fascinated, as we hear men sometimes are by the fire-glint in the eyes of poisonous reptiles, and then went back to the engine room overhead without saying another word. The truth is, words were useless.

I fell into the habit of singling out one particularly large, glowing mass after another, following its course with my eyes and muttering, "That's the one that's going to do the business." Then I took up again my favorite mathematical calculation of chances, and proved the truth of the old saying that you can do anything with figures, especially if you are an optimist—and I guess none but an optimist would try to cross the Atlantic in an airship—for this time, remembering that the balloon and canvas were all damp with the fog, I reduced the odds on eternity to 50 out of 100.

One can get accustomed to almost anything. Comforted by my revised mathematics, I dozed off to sleep. And a few minutes later was awakened by a dream which had set me laughing immoderately. The dream was of Hinky Dink Stover—by the way, Owen Johnson's "The Varmint" was the only book except works of navigation we carried on the airship. Hinky Dink out in centre field, ninth inning, opponents needing three to win, two on bases, a beautiful fly coming right toward him, Dink holding up his paws, admiring the fine, graceful trajectory of the sphere, watching it fall gently into his outstretched hands—and then, forgetting to grip it, seeing it trickle over to the ground for a home run. You remember how Dink's mates chased him to his room and tried to get through the transom to eat him alive. That's where dream laughter awakened me; and I began watching the sparks again, though with only a languid sort of interest in them.

French mechanics working on the Airship at Paris — 1910.

Adventures in the air? Well, we had our share. It was our lot to break another record. Not only the first to navigate the atmospheric and aqueous oceans, the first to send wireless messages from airship to shore, now we were the first to be in imminent danger of collision between a ship of the air and a ship of the sea. About eight o'clock that Saturday night a cry of alarm was raised by one of our crew; dead ahead, ghost-like in the fog, was a four-masted schooner. We were almost upon her. I called to Vaniman to stop the motor, that the *America* might swing round with the wind and cut in behind the vessel. Instead, he ran forward to warn Simon at the wheel, the window at the navigating deck not affording a very clear lookout. But the alert Simon had already seen the schooner. In a moment he threw his helm hard to starboard; the *America* responded quickly, swung round to the northward, and passed astern the stranger. We all breathed more easily as her masts slipped by.

It was a close call. From the lifeboat we looked almost straight down upon the schooner's deck, where we could see men running to and fro, but the noise of our exhaust drowned their voices. If we were astonished, what must have been the feelings of the skipper and his crew when they saw a great dark, whirring,

iman came down to the lifeboat
the skipper and his helmsman w
saying. "I'll wager the men o
dare tell their shipmates down
saw on their watch. And if th
be unmercifully ridiculed for
tipsy yarns about seeing a
Dutchman." And we all laug
iman. But the skipper of the
pened to be on deck, saw the ap
air with his own eyes, and was no
about it when he made port. The
the *Bullard,* bound for Norfork.

"We were running in a thick m
tain Sawyer, "and were tooting
Suddenly a sound like the stead
engine reached our ears, and we
steamer was close upon us. Just
we saw a light, but we thought i
mast of the steamer. W

of my crew ran about shouting and yelling to what they believed was a steamer, hoping that its lookout might see us in time to avoid a collision.

"There was great confusion aboard the *Bullard.* We could plainly hear the steady grind of the machinery and the whirring of the motor, but we could see nothing but the light in the air. It was dark, and there was a thick fog. The light came nearer and nearer, and members of my crew said that they could hear voices. Then out of the darkness and mist shot a big aerial phantom, as we imagined, going east, and headed directly for the *Bullard.* The thing was such a big surprise for all hands that we were knocked off our pins.

"The airship, when almost on us, rose up higher, and shot out to sea. She was probably going fifteen miles an hour. The *America* was less than a hundred feet above the sea, and the topmasts of the *Bullard* are 110 feet. Had the airship hit us, she would undoubtedly have been destroyed and probably those in her would have been killed. The miss was so close that several members of the *Bullard's* crew declare they heard the airship scraping the topmasts as she veered off.

"We could hear the voices on the airship, but were unable to make out what was said.

... there was some
us. I think the surprise on the
great as our own. But the ai
fect steering arrangement. S
almost like the wind, and when
turned suddenly, like a moto
around a corner or a short cu
harmlessly out to sea."

The light the skipper saw upo
was our red hot exhaust pipe!

CHAPTER XXXVIII

A DAY OF STORM AND DANGER

All that Saturday night we kept up the struggle to weather the southern shores of New England and get well out to sea. The four-cylinder motor continued to run, and to spit fire, but as long as we could make easting we were content. Although the wind held fresh, the propellers gave us a course of northeast in the stronger puffs and nearly east when the wind eased off. No one slept that night, though most of us were well-nigh exhausted. It was a night of peril, of strain, of anxiety which cannot be described.

All through the night I stood watch by the compass or steering wheel, watching the wake of the equilibrator and noting its angle by the magnetic needle. Throughout our voyage the actual course of the ship was determined in this manner, and we had no need to use the leeway wire and indicator. We had not been able to get a sight of the sun or a star since leaving Atlantic City, and knew only roughly where we were. But Simon and I calculated that if the

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motor for the way th
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the engine would stop
but at 5:00 o'clock Su
running.

At dawn the pract
and Jack Irwin, wh

this agreed with our rough log. An hour later we reckoned we were free of land. We had escaped the humiliation of pulling up short on the coast of New England. The broad Atlantic was opening before us.

A little later the wind freshened, and seemed to be carrying us more to the north. Alarmed, we called Vaniman—he had been asleep fifteen minutes—and started the motor again to make sure of completing our victory. At eight o'clock we felt sure of having passed well east of Nantucket, and it was high time Engineers Vaniman, Loud and Aubert should have a brief rest from their arduous labors and the red-hot exhaust pipe should get a chance to cool. The big, heavy Lorraine-Dietrich had run altogether about twelve hours with only a few minutes' stoppage, had kept the *America* from 40 to 60 degrees into the wind, and had saved the situation.

The *America* had thus given gallant proof of what she could do as a cruiser. This Sunday we were now entering upon she was to be tested in another and most severe way. Early in the morning heavy gusts from the southwest struck the ship, sending her forward at tremendous speed, causing the submerged equilibrator to pull harder and harder and bearing the *America* almost down to the sea. Once or twice the lifeboat nearly touched the crest of the waves; if it had struck it would have been torn loose from its shackles, those of us in her would have been swamped or set adrift, while the members of the crew in the car overhead would have had no craft left in which to attempt an escape should opportunity offer.

Several times we thought the end had come. So great was the danger that we frequently found it necessary to lighten the ship. More gasoline, a heavy cable and various spare articles were thrown overboard one after another. The most of this day was spent in like manner, a stiff breeze from the west-southwest pushing the *America* rapidly before it, broadside to the wind, after the motor was stopped for good.

Thus we drifted an estimated 140 miles beyond Nantucket, when the wind shifted to the west-northwest, and now we drifted toward the transatlantic steamer lanes, and wondered if we should meet a ship. So great was the hazard that the lifeboat would be torn loose in the heavier gusts we took care to put the cat up in the car, where it would be safer. But it was not a very happy cat. It had little appetite, but was finally induced to eat, and whenever we of the crew could find time to snatch a few minutes' sleep puss had a way of nestling close to the face of one of us under the blanket, there

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ASSEMBLING THE PARTS OF THE GAS APPARATUS, PARIS — 1910.

[redacted]

sleeping soundly. Anticipating a frightful night, and increased danger of being borne down into the sea as the gas contracted with cold and the balloon lost a part of its buoyant force, we began breaking up the E. N. V. motor preparatory to throwing it overboard piecemeal.

All through this day we wondered if the steel car could withstand the strains put upon it by the equilibrator cables as the steel serpent jumped from wave to wave, fifty to eighty feet each leap. Strange to say, there was no sharp jerking, there were no sharp shocks. But the leaping of the equilibrator from wave to wave, first easing up the pull on its cables then drawing them suddenly taut, set up in the airship a swaying or rocking motion which was not at all pleasant to experience because it suggested the dire possibility that the strength of the car would not prove sufficient to endure the strains. The cables which held the floating, bounding and leaping serpent were attached to the forward and aft part of the steel car of the airship. We knew that if one steel-stay or fastener were to give way the structure would be weakened at that point, something else would yield as the strains continued and were repeated, and that once the work of destruction was begun it would not be long before we were down in the boiling sea. And well did we realize that if

Despite the fact that ma

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anxiety he felt. If there was a
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or look.

Late this Sunday afternoon
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away in safety. We were now
atlantic steamer lanes, and if we
the lifeboat the chances were
have long to wait before being
some ship. None of us knew wh
to bring forth. A renewal of th

away while there still seemed to be a chance. I could not agree with him. I was not ready to give up the fight so quickly. At that moment I did not have much hope of being able to cross the Atlantic, it is true, because we had found it necessary to throw over so much fuel that should have been converted into miles to the eastward. But if the wind should happen to change to the west again we might still make a run for the other side. At any rate there was no need to give up the voyage until circumstances absolutely compelled us to do so. Vaniman and I discussed the matter for some time. He still insisted upon leaving the ship; I as strongly opposed it. The other members of the crew said nothing, though they overheard our conversation.

Under the circumstances which existed, the danger which confronted us, the possibility of getting away in safety now, I did not feel that I had the right as commander of the ship to order men still further to imperil their lives. If there had been a real and promising chance to make a success of the main object of the voyage, it would have been different. But if any such chance remained it could at best be said to be only a desperate one. So I determined to give the other men an opportunity to vote upon the question. Their lives were at

. ...

"And so am I," echoed Jac

"And I, too," shouted you from the engine room overhea

Thus the decision was re yielded gracefully, and as usu defatigable in his efforts to sec the ship.

Up to this time we had not or sleep, except a few snatches no we had had no warm food. Or had had a bit of breakfast before ship out of the hangar (or bal Atlantic City Saturday morning Sunday evening, and we had subs time on cold meats and ship biscu sional cup of coffee. Now, at Fred Aubert started up the gaso in the lifeboat, and not only bc cooked the most delicious bacon the lins of ...

CHAPTER XXXIX

WHISPERINGS IN THE AIR

Throughout much of this trying Sunday, and the still more trying night which followed, things wonderful were happening, things comforting, things agonizing. The air was filled with wireless whispers. Almost constantly Irwin could hear "W," "W,"—our signal letter—repeated over and over, from shore stations and ships at sea. At last we began to get an inkling of the generous, sympathetic interest the world was showing in our adventure and fate—though I must admit we did not realize it to the full till after we had reached New York. Irwin heard Cape Cod, Siasconset, Sagonapack, the Brooklyn Navy Yard, a number of ships flashing back and forth the eager, kind query: "Any news of the *America?*" And it was hard indeed to listen to all this magic questioning, and to the replies, repeated over and over: "No news!"—to know how anxious many hearts were for our welfare, and not to be able to tell them we were alive—unable to break our silence because our apparatus could not transmit through the dis-

... at sea, battling
life itself, we heard the Marc
just long-distance telephone
Chalfonte, Atlantic City, that
hard but could get no news c
hoped all was well!

During Sunday we did get c
by way of Cape Cod—one that
25 miles per hour not workin
other, in the dark hours, to th
Telegraph, the *New York Tim*
cago Record-Herald, by our p
that the equilibrator was strain
but that no damage had been
while the outlook was not so fa
keeping up the fight. We rece
to many messages of inquiry and
one of congratulation from *H*
azine, and one from Mr. Van
editor of the *New York Times,*
us news of the ...

build another airship it shall have a similar equipment, though of far larger power and range.

Sunday night was one of almost constant danger. The wind blew strong again, the sea was rough, the airship was borne down almost to the crest of the waves in the heavier gusts, rising high again in the lulls. Again we feared the car would break up under the strain. Every time there was an unusual noise we started up and made anxious inquiry, fearing a steel stay had snapped, that the end was approaching. More gasoline and lubricant overboard, and a goodly part of the beautiful 8-cylinder motor.

Yet we did not lose our composure nor our sense of humor. Once in climbing from the lifeboat up into the car my sheath-knife caught and held me fast, suspended, dangling and kicking, and, I fear, growling savagely. Loud and Aubert pulled me up, and a moment later I saw them convulsed with laughter at my expense. It was funny; and I laughed with them.

But for the most part we wanted nothing so much as sleep. We were exhausted; time and again we slumbered, our last conscious thought being, "When we awake we shall probably be down in the sea, but that isn't so terrible—anything so we may sleep." I do not know what the experience of my comrades was, but my fitful sleep this night was full of dreams—dreams not of the sea, nor the air, nor of impending disaster, broken down motors, a sound and rational plan spoiled by faulty execution, none of these things. Do you play hearts, that game of cards in which the queen of spades is the black beast you are always trying to escape? Well, the queen of spades was always in my hand or always being put upon me. And when we awoke—often with Kiddo's warm fur on our cheeks—it was always with surprise that the *America* still floated above the seas. Thus the night passed—a night not to be forgotten.

We kept close watch upon the only thing there was worth watching—the height of the airship above the sea. Two of us were always down in the lifeboat, looking over the gunwales at the serpent swishing and leaping along down below. In the strong wind and heavy sea the airship was played upon by two forces—one the power of the wind to send it forward, drifting broadside to the direction of the wind; the other, the retardation of the heavy equilibrator as it rushed through the sea, tending to hold the airship back. The component of these forces was of course a downward pull. In the heavier gusts of wind the balloon pulled one way and the serpent the other with increased force, and with the airship going down nearer and nearer to the surface of the waters.

The great hangar of the Airship America, Atlantic City, N. J.

At such moments the watch in the lifeboat would call out—

"Three tanks up—two tanks up—now she's going down! Overboard with something!"

And the men up in the steel car, standing by cans of lubricant, or of gasoline, or parts of the broken-up motor, threw weights over till the danger had temporarily passed.

Whenever a crackling or any unusual sound was heard forward or aft in the car, Loud and Aubert were sent out, one of them one way, one the other, to investigate, to learn if any of the stays or parts had broken. Anxious moments were these for those of us who awaited the report—the report which meant that we had another lease of life or that in a little while we should all be thrown into the ocean as a result of the breaking up of our ship. Great was the relief to call out—

"Anything wrong at your end, Louis?"

And to hear the cheery reply:

"All right here, sir."

"How is it with you, Fred?"

"Nothing wrong out here."

Then we breathed easier; but only to go through the same experience half an hour or an hour later.

Through this dreadful night it became apparent enough to all of us that it was a mistake to try to sail over a stormy ocean with nearly all of our heavy equilibrator floating upon the waves and dragging the airship downward. But it was equally apparent that if the equilibrator had been employed in accordance with the original design, it would have shown itself a successful device. When only half or less than half in the sea its pull upon the airship was not strong enough to lead to any trouble. How we did curse the combination of circumstances which had made it necessary for us to attempt the voyage with so much of the serpent down in the ocean that it was a hindrance instead of a help.

Still, we were not beaten—not quite. After midnight I heard Vaniman order Loud and Aubert to throw over more gasoline—to take an axe and cut a hole in the big steel reservoir and let the precious fuel run out. Against this I protested, pointing out to Vaniman that the wind was fresh from the northwest; that it was driving us toward the Azores; that we had one good motor and some gasoline left, and could probably get more gasoline up from the equilibrator tanks as soon as the sea should become less boisterous; and that it was our duty to hold fast to all the gasoline we had and prepare to make a fight for it with the engine should the conditions change in our favor.

Vaniman made no answer, but recalled the order to jettison more gasoline. I presume he would have obeyed my instructions to start up the motor and make an effort to run to the east-southeast if the weather conditions had held any length of time. But soon the wind shifted more to the north, and then to the north-north-east and northeast, and blew more strongly. In an hour it became necessary to throw over more gasoline in order to prevent the lifeboat being torn away as it struck the waves; and as I saw the gasoline streaming down into the sea I realized that the hope of reaching Europe, or at least the Azores, was practically at an end, though we were still determined to take advantage of any opportunity that might arise for a renewal of the struggle. That opportunity never came.

This was the turning point of the voyage—this shift of the wind into the northeast. And right here I wish to record a few facts: The *America* was a splendid airship. She held gas admirably, and all the predictions that we should fail through rapid loss of hydrogen, were wide of the mark. Her structural strength was superb, as was shown in these severe tests. In all respects save over-weight and lack of buoyancy due to faulty execution of the design, and in part to the poor installation of one of the motors, she was a successful airship. Had we been able to execute the work of construction fairly close to

...ade, the *Americ*
three thousand miles instead

The critics, expert or laym
a mad scheme, impossible, fo
do not know what they are t
do know. Take the *America*
voyage. Avoid the mistakes
ing and the engine breakdow
should have been averted with
and competent handling—and
opinion, have reached the other
tic even under the wind and w
which prevailed after we left A

Under the circumstances wh
motor gone and most of the fu
sea instead of into the engin
holding strong in the northeast
to begin to think in earnest a
lives. All Monday afternoon
about that. The wind was d
Bermuda, and ...

[redacted]

account of the thick weather. But at noon on Monday we got the sun, and with the latitude thus obtained and our dead reckoning, rough as it was, we knew approximately where we were—about four hundred miles east of the Hampton roads.

Our plan was as follows: To hold the one good motor, and all the gasoline we could, in reserve for a final struggle to reach the Bermudas or the Florida coast, meanwhile permitting the ship to drift with the wind.

It should be pointed out that while the *America* did thus drift from Sunday forenoon till the end of the voyage, it is not true that she was all this time at the mercy of the winds. We could have started up the motor at any time and made some headway to the southeast or east-southeast if the conditions had so changed as to warrant the effort with the reduced fuel supply we had at our command. We were never without power, never without gasoline.

It is also proper to mention that the total length of the voyage of the *America* over the Atlantic was approximately equal to the distance from Camp Wellman in Spitzbergen to the North Pole and half way back again.

To get ourselves out of tl
upon the sea in the lifeboa
a simple problem. We stu
carefully, you may be sure.
running an average of from
hour with the wind. She was
on to the course, which mean
boat was launched into the sea
the water headside on. Wh
selves, over and over, was th
craft be instantly capsized and
if she be lucky enough to esca
about the equilibrator, tearing
in the rear? Will it not stri
boat with the force of its two-tc
through the water, act as a b
smash us to pieces?

These were pretty serious
and we

swain's chair, and there, dangling between sea and sky and leaping from wave to wave, with his legs gripping the swaying hawsers, to cut the equilibrator away, thus removing that part of the danger. There is not the slightest doubt in my mind that the brave fellow would have accomplished this daring feat if he had had the chance; but upon reflection we decided it would never do to cut loose the equilibrator, for then the *America* would rise to the clouds, and when she came down again we had little in the way of ballast to lighten her and prevent her going plump into the sea, lifeboat and all.

We had this very day an illustration of the supreme importance of the equilibrator or something else to take its place in principle. The sun came out clear and warm. The gas absorbed heat and expanded rapidly. Tank by tank the serpent was lifted, and finally the entire device was in the air, and the ship rising. At this point a stupid bit of work was done. The only way to prevent a heating balloon or airship rising to a great altitude is to let out gas the moment the aerostat starts upward; for if it be permitted to rise, every yard of ascent means diminished atmospheric pressure, and consequently greater and greater expansion of the gas and more and more altitude.

On this occasion, notwithstanding my order to the contrary, Mr. Vaniman, who was nearest the valve-cords, opened still wider the air-valves instead of the gas-valves. The result was that instead of letting out of the distending balloon, for every thousand cubic feet of expansion, a weight of about 7 lbs. of hydrogen, there was let out a weight of about 80 lbs. of air. Many thousand cubic feet were thus set free. Relieved of this load, the *America* shot upward —up so rapidly that we all suffered pains in our ears, whose membranes are adjusted to normal atmospheric pressure and find it difficult to accommodate themselves quickly to sudden changes, to a rapid ascent or descent. Up we went nearly 3,000 feet as shown upon our barograph. My aneroid dropped 1.8 inches in that needless ascent. Beautiful indeed was the view at that height, the weed-strewn waters of the eastern edge of the gulf stream below us, glistening in the sun, but it was a scenic delight obtained at the sacrifice of about one-seventeenth of our whole volume of gas—too high a price.

And when the airship started down—having found her equilibrium in the lighter air up high —she acquired a great momentum; again the pains in our ears; and but for the two-ton equilibrator dangling below her she would have gone souse into the sea. As it was, the serpent went in almost its full length before the *America* re-

Vaniman, Simon, Wellman, Auburt and Loud.
Copyright by Underwood & Underwood, N. Y.

bounded and rose 200 or 300 feet again like a rubber ball. Gradually she settled down. After that, orders to open the gas-valves the moment the tail crept up out of the water, were obeyed. Lying in the water-tight compartment of the lifeboat, watching the aneroid and the barograph, I could tell the moment the serpent was rising from the sea without looking over the side of the ship.

It was a serious question during this Monday afternoon if we could keep the *America* afloat during the night, as the gas cooled after the sun should set. We decided to try it, hazardous as it was—hazardous because if it should come on to blow during the night, or rain, and thus drag the airship down to the ocean, we should be compelled to launch the lifeboat, no matter what the conditions. With a high wind or rough sea that would mean disaster. And it was with most anxious eyes I watched the barometer; we were approaching the area of the cyclone we had heard by wireless was coming up the coast, and which did strike Florida a few hours later with destructive force; had the glass shown any marked drop we should have taken to the lifeboat at once for fear of running into the edge of the storm.

Irwin told me that day a regular steamer left Bermuda Monday. Taking my chart, reckoning our position and course, and also the course and probable speed of the steamer, my conclusion was we should have at least a chance to pick her up Tuesday forenoon. It is always well to be an optimist. And if we had to launch the lifeboat, and run the risk of foundering and being smashed by the steel serpent, it would be pleasant to have a steamship somewhere in the neighborhood.

This third night out, a bright, full moon brilliantly illumined the waters. Wind from the northeast, about 15 to 18 miles per hour. Warmer, and the gas did not contract as much as we had feared. Not so difficult to keep afloat. Only a little lubricant and remaining parts of the motor thrown overboard. Barring the uncertainty as to how we were to get out of the dilemma, an agreeable experience. Most of the crew slept fairly well—and heaven knows they needed it. I had had more rest, and stood watch most of the night, eyes alert for signs of a ship—which I had a belief we should find. I am not a fatalist, nor superstitious, nor anything of that sort. But I had been in so many tight corners, and always getting out of them with an approximately whole skin, that not for a moment did I doubt we should get out of this one, sometime, somehow.

That Bermuda steamship would be about

right. I looked for her so intently, and at times so drowsily, my eyes began seeing things in the gleaming horizon or the gloomier depths covered by passing clouds. I saw a hundred steamers, some of them full electric lighted from stem to stern; trains of cars, rushing automobiles, tall buildings shining with lights. Then I shook myself, and saw nothing at all, only to drowse again, and have more optical delusions; then rouse, and nibble, and smoke.

We ate at all times, cold ham, ship's biscuits, tinned meats, Horlick's malted milk tablets, drank much water, and not an ounce of spirits was used on the trip. The cat ate, too; now the garret was not so strange. We were all settling down to the strange life.

But we knew, each one of us, this was our last night; we could keep the *America* up during the following day, Tuesday, but when night fell again, and the sun set and the gas cooled, down she must come and into the lifeboat we must go, be the conditions for launching what they might —favorable or fatal. We have not enough ballast left for another night.

How is the barometer? Is the West Indian cyclone anywhere in the neighborhood? Where is that Bermuda steamer? And if we don't see her, what is to become of us?

At four-thirty Tuesday mor saw the lights of a ship; but ceived myself that I looked agai fully, before crying out. This t I called to my mates; told Van some sort of a torch or signal; ro all the others. Vaniman soake with gasoline, lighted it, suspend mass from a wire; the steamer course—they had seen us.

Irwin tried his wireless but go Then he seized the electric "blin Morse dashes and dots in flashe naled to the steamer. Her offic the same fashion. We told the them to stand by, prepared to hel said they would do so. We aske the ship; she was the

[redacted]

freely back and forth by wireless. The *America* kept drifting, and the *Trent* followed us, having about all she could do to keep up at her topmost speed.

Strange chance that brought these two ships together—that gave us the pleasure of establishing another record, the first rescue of an airship by a steamship. If we could not reach Europe with the *America,* it seemed the fates had conspired to make our adventure as thrilling and dramatic as if a Sardou or a Belasco had written it all out for us, and we were merely rehearsing. If the *America* had drifted a few miles faster or slower, or half a point of the compass to the right or left; if the wind had not shifted to the eastward an hour or two earlier in the morning; and if the *Trent* had not on this voyage for the first time visited a Cuban port before starting to New York, thus being out of her regular schedule, the ship of the air and the ship of the sea would not have come together. And in that case what would have become of us? We have not the slightest idea.

Navigator Simon, with the instinct of the brave sailor, soon blurted out that we'd better stick to the *America* and make a run for it. But that was instinct, not reason. We should have been forced to leave our ship within twelve hours at most, and had we run into the cyclone area,

[redacted]

as was not improbable, it might have gone very hard with us. The chance for safety at hand, it would have been madness to go on, with nothing to be gained by the further hazard.

But how to get out of the airship and upon the *Trent?* It was not as easy as it looked. In fact, it was that same big problem we had so often and so anxiously considered. There was the danger that the lifeboat would be swamped or crushed in launching her. But we could find no other way. Vaniman did, indeed, dream of having the *Trent* come up and get a line to us, when we were to be transferred to her deck by life-buoys. An effort was made to attach a line, but it was lucky it was not successful, for if it had been probably the straining of the line would have pulled the steel car of the *America* in pieces and thrown us into the sea. Captain Down came very near us, incurring the danger of collision or of the ignition of the balloon by sparks from his smokestacks, but he handled his ship with great skill and fine judgment. Other plans were suggested and discussed, the *Trent* patiently following, her passengers now all on deck to witness the rare spectacle, and, as they afterward told us, so fearful for our fate that many of them were weeping or praying for our escape.

While we were hesitating and discussing, the

America lost her equilibrium, and was in imminent danger of capsizing, end over end. The air ballonet at one end had not been completely filled with air, the supply pipe having become deranged. Thus that end of the ship was lighter than the other; as this lighter end rose in the air the hydrogen rushed to the elevated part, greatly increasing the buoyancy there, and threatening disaster. None of us would have been surprised if in the next moment the airship had taken a header.

At this crucial juncture it was young Fred Aubert who leaped up into the car, ran forward to the disarranged pipe, put it in order, rushed to the engine room, started the service motor, and kept it going until the *America* was once more upon an even keel—a brave deed by the youngster of our party, of whom we are all proud. Had the *America* turned turtle, as she came very near doing, this is what would have happened, in all probability: The weight of the car would have been thrown upon one end of the balloon; the suspension would have stripped; the car would have been thrown into the sea. We five men in the lifeboat might have had some chance to save ourselves. But how much chance would there have been for the brave boy up aloft?

That is the sort of crew I had with me—every

… go back to our first pr…

chances in the launching of t…
thing was made ready for th…
man passed the gas cord …
and began opening the valve…
gen and causing the airship …
Simon saw that all the boat ta…
trim; we took our places in t…
the plunge.

But stop—the cat! Van…
wanted to leave Kiddo behind,…
puss in the water-tight compar…
have enough fresh air, and i…
asked for time to make an ope…
the moment was, we had to l…
have been enough fresh air in t…
to keep kitty going for at leas…
had to have our joke at Vanima…
if we were to die with it the ne…

[redacted]

Jack Irwin, Wireless operator Airship America.

[redacted]

CHAPTER XLII

THE FATES WERE KIND THIS DAY

Down came the *America* nearer and nearer the sea. We gripped the lashings of the boat, and each of us held fast to a life-preserver. No, Vaniman had none—and called attention to the fact; so Louis Loud and Jack Irwin promptly gave him one of theirs and shared the other between them, though neither is much of a swimmer. Simon and Loud held the lines which were to release the boat at a single pull.

When the water was only four or five feet from us the word was given, snap went the two release-hooks simultaneously, up shot the lightened airship, down into the rough sea plumped our craft. She almost capsized, then righted herself in a twinkling. At that instant the dreaded equilibrator hit us, bruised Irwin and Loud, and stove a hole in the forward compartment of the boat, fortunately above the water-line—probably the kind fates were eager to make sure kitty had enough air—and it was all over. In ten seconds from the pull on the release-hooks we were calmly riding the waves in a staunch, well-provisioned and watered, fully-equipped lifeboat, prepared to sail to land or wait to be picked up by some passing ship. There was some satisfaction in the thought that we had really saved ourselves, as the *Trent* did not put a boat over into the water; which her officers were prepared to do, but could not for this reason: the moment the *Trent* should stop her engines and slacken speed sufficiently to permit of the safe launching of one of her boats, the fast-drifting *America* would have run away from her, and it was doubtful if the steamship would again be able to overtake us. As it was, we were running about as fast as the *Trent* could steam. We had foreseen this possibility, and prepared in case of necessity to start our motor and try to bring the *America* round under her own power so that the steamship might overhaul us. For, to tell the truth, we were glad enough to have the ship somewhere near by when we resorted to the dangerous experiment of launching our lifeboat. Now we were in our boat, the cat and all, and barring accident or hurricane could probably have taken care of ourselves.

But there was the splendid and now famous *Trent,* a ship's length away, her passengers and crew waving welcome to us in their joy that we had escaped the perils which beset us. How

[redacted]

good she looked—one of our men said she appeared to him as big as the Waldorf-Astoria. And how glad we were that we did not have to spend a week or ten days pounding about in the sea in a half open boat trying to reach land or meet a ship in a part of the ocean where ships are but rarely seen.

Still we were not quite out of danger. Almost before we could realize it, before we had time to unship oars and get our somewhat clumsy craft under control, the *Trent* was upon us. Her prow, rising it seemed to us as high as a church, was coming straight for us at a speed of fifteen knots. Were we to be smashed to smithereens here within ten feet of safety and after escaping all these other dangers through which we had passed? Five seconds will tell the story. She is going to smash us! No, her sharp stem hits us a glancing blow on the side, we sheer off, we are running along her port quarter. We are all right. Indeed the fates are good to us this day; thrice within as many minutes they have resolved dubious chances in our favor.

But we are not yet aboard. One more chance at least one of us must run before safety is ours. As we spin along the iron sides of the big ship the sailors on deck throw us a line. Someone on our craft sings out to catch it. We all grab.

..a. a hitch has come into the

is round my right hand; the otl
but I can't. The line winds
draws tighter and tighter, and it
my mind that one of two things is
—my fingers will go with the rc
and what chance shall I have to
sea alive, dragging captive at the
trailing at fifteen knots? Of cour
a flash; for in two seconds it w
and strange to say, neither happer
gers were not torn off—I was not
the sea; only a lacerated and bruis
was all. Such a day for good luck

But this was not quite all. Just
sea was boiling. We were nearin
lers. One of our men cried out
lost. Were we going to be cut to p
rapidly revolving blades of the s
had sent to save us?

[redacted]

the trough of the sea. "That must have been our ninth escape from Davy Jones' locker," quoth sailor Simon; "told you it was a good thing to have a cat along—cats have nine lives!"

At last we were safe on board the *Trent*, where we were received with amazing kindness by Captain Down, his officers and crew, and all the passengers. Soon we were again in wireless communication with the shore, and learned of the more than generous interest and sympathy the people of the whole world had felt for us during our adventurous wandering, and for which my comrades and I feel more grateful than words can tell.

Upon a printed passenger list of the *Trent* there soon appeared this postscript:

Picked up at sea, from the Airship *America*, Oct. 18, 1910:

W. Wellman	M. Vaniman
M. Simon	L. Loud
J. Irwin	F. Aubert

The last we saw of our good airship, which had carried us, under her own power and drifting, a little more than a thousand statute miles over the sea, she was floating about 800 feet high, 375 nautical miles east of Cape Hatteras. A day or two later, in all probability, she dismoistening of the eyes Vanima

bye to the big craft that had b
trouble in this world—droppi
a Spitzbergen glacier, a seco
polar sea, and this third and l
Atlantic.

Good old *America,* farewell.
the noble comrades and rare
have brought me, for the lessons
us. You played your part i
progress. In the years to come
will cross the Atlantic; and you
as the ship that showed the way.

CHAPTER XLIII

NAVIGATOR SIMON'S LOG

One of the most interesting narratives of the voyage of the *America* is the one given in the log kept by F. Murray Simon, the fine young British steamship officer who shared with me the work of steering the airship, keeping the dead reckoning and making astronomical observations. Mr. Simon made his entries hour by hour as we went along, and records his experiences and observations in frank and hearty sailor fashion. I give Mr. Simon's log in full:

SATURDAY, Oct. 5, 8:05 A. M.

The airship *America* is launched at last! It was with joyful hearts that we saw the people on land, policemen and firemen, and citizens, let go the ropes which had held us. We are thankful to get away after the last couple of weeks of deferred hope, and we are all eager for our new experiences in the air.

Wellman, Vaniman, and First Assistant Engineer Loud had been flying before at Spitzbergen. They had been studying airships for

... to a height about 80 feet ...

the big equilibrator weighing
tached to our car and soon we a

"Now," we say to ourselves
those blooming critics eat their o
have been hammering us for
ridiculing our 'worn-out gas-bag
mill for motor,' telling us we sh
sight of land, that the wireless
is a mere bluff, and that all the
work the ship have 'cold feet.'"

I have been rather nettled as
rude remarks in the hangar where
been built, coming from people wh
the difference between an aeropla
ble airship. As to myself and my
confidence in Mr. Wellman and
grew by leaps and bounds as we
own eyes what a fine craft they
It was all very new, very abso
citing.

The eight cylinder E N V Motor in place in the steel car — 1910.

Twice before we got ready at 3 A. M. to sail, but when the conditions off the coast were right they were all wrong along the transatlantic route, and when they were all right on the transatlantic route strong winds blew on the coast. Critics hadn't realized there must be reasonable agreement in local and transatlantic conditions before we could start.

8:10.—Fog is very dense, but it is absolutely calm. An airship can do with the calm, and we must take the bad with the good. The air is like pea soup, and all we can see on the Parade of Atlantic City is the dim outline of a huge building, which gives us an idea of our shore position.

Mr. Vaniman, our Chief Engineer, did not start the engines when the police and firemen let go the ropes at the water's edge, because the racket kicked up by our motors would have drowned our voices, and, being close to land, we wanted absolute silence. Until we reach open waters we depend more upon our ears than upon our eyes for guidance.

My great doubt all along has been: "How should we get away?"—we were so big, and on land, which was not our natural element, we were so clumsy! All of us were so delighted to get aloft for the first time. We think we may have a chance of reaching Europe by the air lanes, and henceforth began to behave himself fairly well.

8:25 A. M.—We start the big motor and commence to forge ahead with our own propellers, making about 15 knots an hour for a start. Everybody as happy as can be! This was the moment we had been anticipating for months. The conditions are not ideal, but we feel it's better to put to sea in half a gale of wind than to stay on land.

Jack Irwin, the wireless operator, has come from the hospital with a wounded leg to take his place in the crew. His foot pains him, but he is so glad that he has not been left behind that he laughs and jokes like a happy schoolboy. Mr. Wellman says to me: "I'm happier now than I have been for the last four months."

My first test of the wheel encourages us. I find the airship steers remarkably well. It is exactly the same as steering a ship in the water, and I enjoy my job. I am sitting down steering, a thing unheard-of in the ordinary ship. My view ahead is obstructed, and so I cut two circular holes in the nacelle of the car.

In this nacelle—a sort of canvas gangway over 156 feet long—we must live and work. We have three windows on either side of the car made of mica, nicely fitted into the canvas-like portholes. In the lifeboat Mr. Wellman seats

[redacted]

himself on the lookout. He is to share with me the work of steering, and I shall relieve him on the lookout. There is a sort of hammock in the nacelle for each of us, but it is very narrow. When we cannot sleep in the lifeboat we will sleep on the floor, which is a sort of wooden rafter over the long gasoline tank forming the keel of our craft. We shall sleep just when and how we can, and the same remark applies to eating.

The worrying and buzzing of the motors prevents much conversation between the car in which the helmsman is stationed and the lifeboat slung below the car in which the lookout and the wireless man are stationed. They have thought of this, and we have two speaking tubes, one from the wheel to the engine room and the other from the wheel to the lookout. Loud, who is a Chicago boy, says he fitted the tube himself and swears it will work what he calls "fine and dandy."

10:20 A. M.—Now we stop the big motor, not because there is any breakdown but to give Jack Irwin a chance to speak to old pals in Atlantic City, for we have pals there as well as critics. They spent $12,000 to build us the hangar in which the airship was constructed, and if the hangar blows down they will build us another.

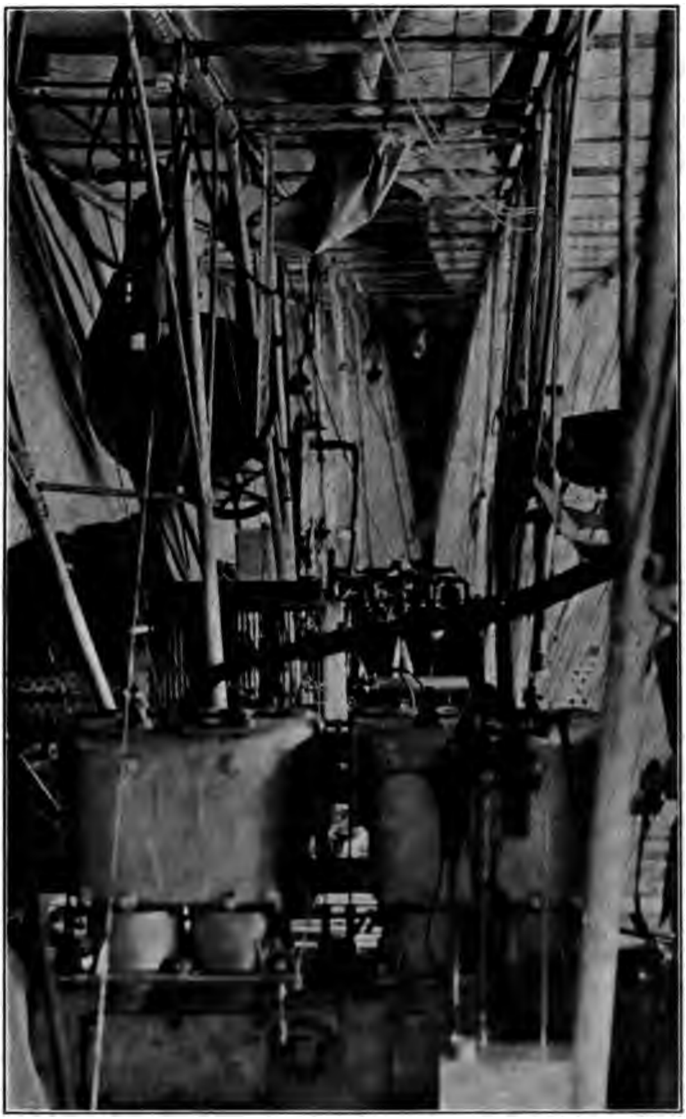
Irwin was able to get in touch with the wireless man on the pier at Atlantic City within one when the wind is against us, will the strength of the engines be sufficient to carry so big a craft along, will the equilibrator tug the life out of us, will the electric lighting prove satisfactory, or will it be so damaged by the vibration as to be useless; shall we have to work by torchlight and run the risk of being blown to bits in a big aerial explosion?"—all these things passed through our minds.

The next few days will tell us everything, and whether we succeed in reaching Europe or whether we fail, we are all buoyed up by the knowledge that we are gaining experience aloft and ere we get back to land again we shall know more about just the kind of craft wanted to cross the Atlantic Ocean by the air lanes.

11:17 A. M.—Stopped big motor, running hot. That sand at the hangar seems to have got in everywhere and apparently our big motor got its share of it. Irwin takes advantage of silent motors to send private messages ashore. We receive congratulations from families of crew. During this interval I am growling like the deuce at the delay. The wind is freshening and we are drifting to the nor'rd like a wisp of hay.

11:38 A. M.—Vaniman started big engine again. We are still making about 15 knots. At noon got out my camera and took several snapshots of the interior of the ship.

[redacted]



ENGINE ROOM OF THE AIRSHIP AMERICA LOOKING AFT.
Copyright by Underwood & Underwood, N. Y.

12:26—Stopped motor again because of more sand in the bearings. I cannot help cursing that sand—it seems doomed to delay us. Irwin again sending messages. Received one from Mr. Salus, President of the Hangar Erection Company, Atlantic City, who says all Atlantic City is excited and talking nothing but airship. Decided to take opportunity of the quiet to have some lunch. This consisted of bread and ham prepared by young Fred Aubert, washed it down by a cool drink of water.

12:45.—After lunch we started again. All the afternoon it was pretty hot and we are gradually going higher and higher until we are lifting thirteen tanks from the water, say about 100 feet above the sea. When we left Atlantic City this morning we were lifting only three tanks, so she has increased in buoyancy, caused by the expansion of the gas. Of course this will be reversed at night when the gas contracts proportionately, and the tendency is to come down, but I think we have enough reserve gas to keep us well afloat without sacrificing any of our gasoline.

Up to this time we have not sighted a single vessel.

4 P. M.—Wind freshening from southwest, and steering not so good. She will not come nearer than 8 points to the wind. This blessed equili-

brator is the cause of that, I think. Luckily the wind is pretty fair for us and I think we will weather Nantucket all right.

5:40 P. M.—It's getting dark and gas is beginning to contract.

6:00 P. M.—Steamer passed. Irwin tried to speak her but she doesn't seem to be fitted with wireless. Now we find, unfortunately, that we are coming down too near the water and we have to part with a little gasoline to counteract the contraction.

8:00.—Now going along through a dense fog and the motors were making deuce of a noise when I heard whistle in the speaking tube from lookout in boat. I answered it and lookout shouted, "Do you see that ship?" Looking ahead I saw through the mist a large four-masted schooner not a hundred yards away. I immediately jammed helm hard a-starboard and just cleared her, our bilge passing over her spanker. It must have given the crew of the schooner a devil of a scare to see us up in the air with the motors spouting fire like some demon. I don't suppose they had heard about us and I would like to hear their remarks now.

9:00 P. M.—Wind holding S.S.E., curse it! This will make it difficult for us to weather Nantucket, but we have got Hobson's choice and we'll just keep going and trust to our luck to keep clear.

This is the longest spell at the wheel I ever remember having, and I have every prospect of being here the remainder of the night. Mr. Wellman, the only man who can relieve me, has his hands full elsewhere, but on occasions like this we must expect long hours on duty.

This is a night I won't forget. Sitting at the helm tired and anxious as we rush into the dense fog, unable to hear anything but the noise of our motors, I realize that this trip is no picnic. Two or three times I dropped off to sleep and pulled myself together with a start. So the night drags on.

CHAPTER XLIV

SIMON'S LOG—THE SECOND DAY OUT

SUNDAY, 4 A. M.—I decided that the danger of getting ashore seems over for the present, and big motor which has been running all night stopped for the time being. How quiet everything seems!

As the motors are stopped the ship turns broadside to the wind and we drift northeast. This is pretty near our course and will not hurt for a while. I was now relieved from duty and lay down alongside wheel, leaving orders to be called if anything was heard or sighted. I soon fell asleep, too tired even to dream. I had done twenty hours at the wheel at one stretch.

5:52 A. M.—I was awakened, greatly refreshed, and feeling fit for another twenty hours, to find wind freshening and sea getting rough. Started motor again and proceeded on our course.

8 A. M.—Met a fisherman and observed strong tide rips, which proved we were in Martha's Vineyard, which is between Nantucket Lightship and the mainland. I told crew our position and they

were delighted and greatly cheered up to hear we have made such a good course.

Young Fred Aubert was now told off to cook breakfast, and he started our stove in the boat, cooking us some ham and eggs and coffee. This was, in my opinion, about the finest breakfast I have had in a long time.

I have discovered by accident what our cat will eat. Irwin happened to drop a piece of biscuit and pussy eagerly pounced on it and devoured it. Apparently airship cats must not be epicures if they want to feel comfortable.

After breakfast wind continues to freshen and the sea is getting rougher. Things commenced to look bad for us. All our hopes of getting across seem vanishing. The acting of the equilibrator and the increasing sea is something fierce, dragging us down until the seas touch the lifeboat at times, pulling and straining at the car until we expect the ship to go to pieces at any moment.

Proceeded to jettison gasoline to keep us above water. It's a pity to see that good fuel going to waste, but we have to do it to save the ship. I would like to have some of those 'longshore "old women" here with us now.

In the midst of all our troubles Irwin hears Atlantic City asking Siasconset for news about us, and we hear Siasconset answering "All's well;

Wind comes away from the northwest and freshens and we are having another lively night of it, drifting to the southward and eastward, making twenty-five knots an hour at times. While drifting, of course, it is not necessary to use the helm or remaining motor, so we have nothing to do but sit up in our aerial perch and wonder how long she will hold together. We all had snatches of sleep, our watches now being two hours on duty and four hours off.

MONDAY, 4 A. M.—Called to keep my watch, and shortly after the wind eased considerably and things began to look joyful again. While I'm on watch everybody else is asleep. As the crew wake up one by one I assure them all is well and there are prospects of a fine day. On hearing this they all turn over again and go to sleep sounder than ever. Being the only sailor on board, I am supposed to know all about weather conditions, and my assurance that we are in for a good day seems to relieve their minds.

It was a beautiful sunrise and I quite enjoyed it. Commenced to feel hungry, so I scrambled down into the boat and kitty and myself had a hearty breakfast.

At 6:30 Mr. Wellman relieved me and told me to get some sleep, but I was too anxious to get observations and waited until the sun was high enough, when I found our position.

[redacted]

Bow view of the Airship America.
Copyright by Underwood & Underwood, N. Y.

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CHAPTER XLV

THE NAVIGATOR'S LOG—THIRD DAY OUT

As I prophesied, this is turning out to be a delightful day. The sun is so strong that the gas expands and we commence to go up, up, up, taking the equilibrator with us. Wellman shouted to Vaniman to open the valve of the gas bag and let her down, which he did, but not until we had attained an altitude of 3,600 feet, after which she commenced to come down.

The vibration in our ears during the ascent and descent is something tremendous. This is caused by the rapid change of air pressure, the ear drums not being able to adapt themselves quickly enough to the different altitudes.

On coming down our equilibrator struck the water and buried itself right up to the head. Then we bounced up like a rubber ball to the height of about 500 feet, and repeated this performance until we had once again attained our balance. It was quite a fine sensation, the White City Scenic Railway being far outclassed.

Got good sights for altitude at noon, and found our position to be 38 degrees 06 minutes north, 66 degrees 21 minutes west longitude.

12:30 P. M.—Irwin hears Siasconset and Cape Cod calling us. They are wireless voices in the far distance. We hear them, but on account of the narrow range of our wireless we cannot reply. They tell us great anxiety exists on land regarding our welfare; they also say that the weather prospects for transatlantic journeys as far as the Banks of Newfoundland are good. We are not much concerned by weather prospects so far afield. We are simply at the mercy of the wind.

It is an ideal day. The shadow of the balloon shows up on the surface of the water. I took a snapshot of the ship. My lunch to-day consists of dry biscuit and smoked ham, after which I had a quiet smoke in the boat. All is serene.

It's a delightful, exhilarating sensation, this floating between sea and sky. We hate to think that we are really at the mercy of the equilibrator, and that with a little rough sea we shall be jerked into various stages of nervous collapse. If the wind holds as at present we will make Bermuda.

We spend most of the time in the lifeboat, and we gaze, not without admiration, at the shapely craft overhead. Some day we think there will be a fleet of aerial craft and we shall have been the pioneers.

The lifeboat is swung about six feet below the long steel car, and is always in the sun's rays. A little rope ladder connects the car with the lifeboat. It is a beautiful prospect this Monday afternoon—a vast expanse of dancing sunlit sea. Overhead there are blue skies flecked with white flurries of passing clouds. We are all as happy as can be. I could do with a couple of months of this job. Apart from the equilibrator this sort of journey pleases me just as much as a jaunt to Brighton or to Margate.

We know the poor old *America* cannot keep afloat more than twenty-four hours at the outside. Our sudden flight aloft this morning cost us an immense amount of gas, and to an airship gas is lifeblood. The *America* airship will die from sheer exhaustion, a sort of bleeding to death, and before the last comes we must take to the boat. No, we shall not reach Europe this time. It's deuced hard lines on Mr. Wellman and the crew.

Vaniman and myself put the finishing touches to the boat in preparation for our departure. It is only a precautionary measure, because we don't intend to get out until we are kicked out. We are content to know that we have learned sufficient to show that the next airship must be larger, more powerful, and must have more reserve force. There must be an equilibrator, but it must be an equilibrator better adapted for the purpose. It seems to us that the lessons we have learnt are well worth the price we have paid.

You must never cross the Atlantic in an airship without a cat. We have found our cat more useful to us than any barometer. He is sitting on the sail of the lifeboat now as I write washing his face in the sun, a pleasant picture of feline content. This cat has always indicated trouble well ahead. Two or three times when we thought we were "all in" he gave most decided indications that he knew we should shortly be getting it in the neck.

We are doubtful at times about being able to keep up all night, but intend to have a good try. Mr. Wellman is here, there, and everywhere supervising. He has a gift for detail and is the best skipper I ever met. We simply await events.

3 P. M.—We secure observations and discover we are making a south-southwest course. When the engines were going the car with the canvas inclosure was warm enough. Now the engines are out of commission it's getting cooler and cooler. We have not tried to reckon our distance by the log and have relied upon the sun.

From noon to 3 to-day we drifted about 36 miles. We could leave the ship with safety this afternoon because conditions are ideal for dodging that blessed equilibrator. We have got the habit of cursing the equilibrator and yet we learned without one of some sort we shall never be able to get to Europe by the air-lanes.

I am looking forward with pleasure to three or four days in the lifeboat. It is well stocked with provisions, water, and tobacco. It contains several sleeping berths, sea anchor, and wireless plant. That lifeboat has always looked good to me. It is the most compact little craft for its size I have even seen and reflects credit upon Saunders of Cowes, who built it. My favorite sport is boating, but whether my longshore shipmates will regard two or three days in an open lifeboat in the Atlantic in the light of sport I do not know. The boat has a lugsail and can go five knots with a decent breeze.

6:00 P. M.—The prospects for the night are fairly good. We are still drifting, drifting, always drifting, and at elevations from the sea which seem to be determined as much by the prevailing breeze as our friend the equilibrator.

We must lighten the airship, and so we throw overboard everything we can spare. Amongst other things I jettisoned a five-pound box of sugar, several jars of bacon and some biscuits. They will be no use to us and we may as well give the sharks a treat.

To our delight we find the ship is floating high enough for the night—about three tanks above the water, say a distance of fifty feet. There is no spray and no chance of getting wet.

We are sure we will be able to keep the *America* going, and the good Lord help us to keep afloat until 8 A. M., by which time we shall have broken all records for airships. We read with glee a statement in a local paper that "Mr. Wellman and his airship will take precious good care never to go out of sight of land." We know now that we can keep afloat until sunrise. That means that we shall be still aloft until sundown, because the sun expands the hydrogen and so increases our lifting strength.

8:00 P. M.—All the crew are in the lifeboat smoking and spinning yarns. It is bright moonlight to-night, millions of stars are twinkling and the water below gleams like silver. Flying fish hover around our strange craft, and below big batches of gulf weed drift lazily by. It's perfectly calm, peaceful, and such a contrast to Sunday night. Aubert said he felt like going to church.

We all feel elated—the reaction, possibly, after tremendous strain during the last two days. We have no fears for our immediate future. The thoughts and conversation of the young members of our crew do not revolve about such matters as the equilibrator, propellers and gasbag, but stimulated by the surroundings they turn to certain fair damsels left behind at Atlantic City. All our friends had stayed up on Friday night to see the airship launched on Saturday and we were certain that wherever we landed in the United States the same faces would greet our return.

10 P. M.—Four of us retired to sleep, the other two remaining to keep watch. Kitty came along to my hammock and nestled snugly beside me, purring as contentedly as if cozily seated by the kitchen fire. Kitty is one of twins. His brother was killed a few weeks ago by a wolfhound in the hangar.

TUESDAY, 4 A. M.—I was awakened at 4 A. M. from a sound sleep by Louie Loud. It is my turn to relieve him. I growled like a demon at being turned out, but got scant sympathy.

Mr. Wellman and myself now watch together. We make ourselves snug in the lifeboat, and yarn and smoke and watch. Mr. Wellman is greatly pleased with the endurance of the gas envelope, the strength of the long steel car, and the tendeurs. He regrets most that there has been no chance of testing the special set of propellers devised by Mr. Vaniman to revolve on the axis in such a manner as to impart an upward or descending motion to the airship. That piece of machinery wasn't able apparently to stand the vibration of the first motors we used, and was soon fit only for the scrap heap.

It is evident that the discovery of some motor which will withstand great vibration is necessary. Already Mr. Wellman and Mr. Vaniman have in their minds the sort of machinery and airship which will solve all difficulties and embody all the practical lessons we have been learning. Mr. Wellman as he chats with me in the lifeboat seems more than ever convinced that the Atlantic can be crossed by an airship, and I believe he'll set to work again if the chance arises.

Mr. Wellman said to me: "As soon as the sun comes out to-day the *America* will go up again well aloft. We will have to let out some more of our gas, which will mean we're about done by sundown." I replied: "Why not draw water and fill one of the tanks as ballast so that we can keep down during the day?" "A good idea," said Mr. Wellman; "we'll try it."

CHAPTER XLVI

NAVIGATOR SIMON'S LOG—THE RESCUE

TUESDAY, 5 A. M.—I'm again on my perch in the car—a nice little nest between the engines —and I hear Mr. Wellman, who is in the lifeboat, sing out, "Why, there's a ship." I replied, "The ship be blowed, we can hang on for another twelve hours. To tell the truth, I don't want to lose my little outing in the lifeboat."

All hands are called and by means of the Morse lamp we talk to the ship, which, we learn, is the *Trent* of the Royal Mail Steamship Company, bound from Bermuda to New York. The question is again discussed whether we shall leave the airship. We know that we can take care of ourselves in the lifeboat in case of necessity, and at first nobody seemed particularly anxious to desert the *America,* but commonsense prevailed and soon our opinions may be summed up in the phrase, "We do love our airship, but O you *Trent!*"

We realize that if we miss this chance there is just the possibility we may not get another. I am annoyed because I must miss my boating trip when I fiendishly hoped to soak my longshoremen shipmates. (It was well, after all, that we did decide to leave the ship, because a little later a big hurricane swept up the coast destroying ship and mariners. F. M. S.)

At first we chat with the *Trent* with the Morse lantern, which has a movable slide and so communicates dots and dashes of light in the Morse code, and afterward exchange messages by wireless. We ask the *Trent* to stand by. We are still drifting fifteen knots per hour and the *Trent* is plugging along at full speed to keep pace. We ask them to follow us.

As soon as I caught sight of the *Trent* I knew she was a British ship by her rig, and I knew therefore that she would not desert us.

A lively debate followed as to the best ways and means of quitting our aerial perch. We were then about eighty feet above the water and the equilibrator was kicking up a lively shine in a moderate sea. I want to let the balloon go down and get away in the boat without delay, but my shipmates seem to favor sliding down a rope onto the *Trent's* deck. I do not think this plan is practicable, and I am afraid that during the few minutes in which I urged my views I used more sailor language than I had used for years past. Finally it was decided to launch the boat.

When everything was ready to lower away I thought "What a fine chance to get a snapshot," and so I took my camera, which was tied up in an oilskin coat, and snapshotted the *Trent* following us.

While in the car I noticed upon the canvas over two of the hammocks two interesting inscriptions. One was "Percy S. Bullen, *London Daily Telegraph*," and the other "Isaac Russell, *New York Times*." "First-class cabins reserved" was the inscription beneath the names. I recalled that they had been written there at the time when it was proposed to make a trial trip from Atlantic City, and the "first-class cabins" had been duly allotted by Mr. Wellman.

I cut the sections of the canvas from the ship with my clasp knife and will hand them to Messrs. Bullen and Russell as soon as I see them. They are the only relics of the ship to be taken away by the crew apart from the lifeboat and its contents. Meanwhile the cat has been taken to the lifeboat and is put in the after chamber and screwed down.

All being ready, Mr. Vaniman opens the gas valve and we begin to descend toward the sea. We came down in a series of gentle glides. I asked Louie Loud to attend to the after releasing gear of the lifeboat while I took the forward. It is a rather ticklish job, but I know Louie is just the right sort of man for the job.

Watching a favorable opportunity I roared to Louie "Let her go." We released our clutches simultaneously and the boat splashed into the water with a mighty splash. The airship, relieved of so much weight, immediately soared skyward. The gas was escaping all the time and long before we got aboard the *Trent* the *America* was sinking toward the water for the last time.

The airship had been drifting at the rate of 15 knots an hour, and we had launched the boat broadside on—the only way possible. I fully expected we would capsize, but as we could all swim that would never have troubled us. On striking the water the boat reeled onto her beam ends, but righted in an instant. The equilibrator then struck her on the port bow, knocking a hole in the forward air chamber and nearly knocking Loud's head off. We all felt delighted to get clear without a ducking.

The *Trent,* which was following close in our wake at full speed, could not stop immediately, and as she swept past we could see all the passengers on deck cheering.

Mr. Wellman got a lifeline thrown from the *Trent,* but it was wrenched from his hand, which was badly torn in an attempt to hold it. Now we decided to sit tight and wait for the *Trent* to pick us up.

Mr. Vaniman here found time to become seasick, and for a few minutes he was busy over the boat's side. I recall Mr. Wellman saying: "The few minutes I have been in the lifeboat persuaded me that I would not like to be in her for a few days." Loud found some cigarettes, which he passed around. I got out my pipe, thankful for a chance to smoke away from the blooming gasoline engines, where there was always a chance of blowing up the whole business.

The *Trent* came back, steamed alongside, threw us lines, which I made fast, and hauled us to the gangway. Passengers cheered. Captain kindly consented to take our lifeboat aboard. I remained in boat making shackles fast to haul her away.

When boat hauled aboard I opened air-chamber and found the cat curled up fast asleep. I took kitty out. You should have seen her eyes open at the strange sight. Started to scratch and tear and howl wonderfully, but soon settled down to a breakfast they brought her.

8. A. M.—All safe aboard the *Trent*. The bath aboard was good. We had hardly washed since last Friday. The breakfast in the passengers' dining saloon was still better. We scarcely

had a square meal since we left Atlantic City. We ate at any old time and we always had good appetites.

To my delight and surprise I meet several old friends aboard—a strange, unexpected meeting here in the center of the broad Atlantic. The officers rigged us out in clothes and could not do enough for us. The passengers were not less kind and kept us busy signing autograph albums.

That night in the smokeroom of the *Trent* will remain my most pleasant day afloat. We exchanged many experiences. Mr. Wellman's record took the biscuit. Twelve months ago he was up in the Arctic and made a trip over the frozen seas. This spring he was up the River Nile to meet Colonel Roosevelt, and now in the autumn of 1910 we find Mr. Wellman and his crew being picked up in mid-Atlantic from the airship *America*. "If that's not living a bit," as he said, "I should like to know what is."

All of us felt gratified by our novel trip and all are fully prepared to take part in another attempt. I think I am right in saying that our appetites have been whetted by this taste of transatlantic travel by the air route, and we are certain that when we try again with an improved airship we shall be successful.

WEDNESDAY, 1 P. M.—Reception which we aboard the *Trent* had from the steamers which

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came out to meet us, including a special steam launch engaged by *The Daily Telegraph* and *The New York Times,* was particularly gratifying.

We left Atlantic City amid the yelping of some ribald writers who were disappointed because we had been unable to supply the visitors with a few sensational trial trips along the coast. We returned to New York in triumph and apparently were to be received on land as well as at sea as heroes.

This reception has been far beyond our deserts, but will encourage Mr. Wellman and his crew to do better next time. We are defeated in our attempt to reach Europe but we are not discredited. We have established a record of which we are proud. We covered 1,008 miles; we were in the air 72 hours; we sacrificed our airship but we saved our lives, and, above all, as Mr. Wellman and Mr. Vaniman will show when they write their technical reports, we have gathered a vast amount of useful knowledge which will help largely in the solution of big problems relating to the navigation of the air. And we also saved the cat!

(Signed) F. MURRAY SIMON.

CHAPTER XLVII

THE MARCONI WIRELESS APPARATUS

The first communication between an airship at sea and stations on land was made by the *America* during this voyage. For the mechanical installation which secured this great success we are indebted to the Marconi Wireless Telegraph Company. The English Company took the initiative and furnished the apparatus. The American Company under the direction of Vice-President Bottomley, installed it, the work being skillfully done by Chief Engineer F. M. Sammis and the operator, J. R. Irwin.

In the *Electrical World* of September 8, 1910, Mr. Sammis thus described the apparatus:

"The dirigible balloon *America,* with Walter Wellman as pilot, that is to attempt the remarkable feat of crossing the Atlantic Ocean during the month of September, is being equipped with a special set of wireless telegraph apparatus by the Marconi Wireless Telegraph Company. In order better to describe this pioneer wireless equipment of an airship, and its method of oper-

THE AMERICA AS SHE WOULD HAVE APPEARED FLYING OVER ATLANTIC CITY.

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ation, perhaps a few words descriptive of the dirigible itself may be helpful.

"The huge cigar-shaped envelope is 230 feet long. It has been constructed from a specially woven fabric of rubber and silk, well adapted for containing the hydrogen gas without leakage. Suspended from the gas bag by means of rope slings and steel guy wires is the car. This car is constructed entirely of steel tubing, braced with steel guy wires, and upon it and the platform which it supports are mounted the main and auxiliary gasoline engines, the former consisting of two 80 horse power units and the latter developing 20 horse power. These engines drive the four propellers that furnish the motive power. A huge gasoline tank, 150 feet long and 2 feet in diameter, is also supported by the main car body. Suspended directly underneath the steel car is an indestructible and unsinkable lifeboat. In a locker in the forward end of this little craft is located the wireless equipment.

"Attached to the underneath side of the steel car, but insulated from it by special rope insulators, is the steel drag rope. The device, while common to the ordinary balloon, has a unique feature worth mentioning. It will, of course, be understood that the function of this drag rope is to equalize the variation in lifting power of the hydrogen gas, owing to the expansion and contraction due to heat and cold. In order to combine a large amount of equalizing weight with increased storage capacity for gasoline, a number of special steel tanks have been constructed, each having a capacity of about one barrel. These tanks are made with hollow centers so that they may be slipped over the steel drag rope, one above the other; thus they can be drawn up into the car and their contents used should occasion require.

"In designing the special wireless telegraph equipment for the *America* two requirements were of great importance; first, minimum weight, and second, freedom from danger in operation. In consequence of the importance of these considerations the set was constructed with an exceptionally loose coupling, and operates on energy furnished by a small storage battery which in turn is charged with a miniature gasoline engine generating set used for lighting. This little generating set is a model of compactness.

"The ground end of the secondary winding of the oscillation transformer is connected to the steel cable or drag rope, the aerial end being connected to the steel body of the car.

"In arranging the coupling of the transmitter it was necessary to give careful attention to the fact that the steel drag rope which forms part of the oscillating circuit, would be continually varying in length, dependent upon the lifting power of the hydrogen gas, thus causing a corresponding variation in its natural periodicity. A very loose coupling was finally determined upon in order to nullify as far as possible the effect of the open circuit upon the closed. The actual power used is approximately 250 watts, a standard Marconi 10-inch induction coil being used to charge the condenser. With this small amount of power the danger of troublesome sparking is negligible, while actual tests with this set demonstrated the practicability of working from 50 to 75 miles without difficulty."

It is proper for me to add that in view of the great success of this experiment, it is clear that future airships may be fitted with much more powerful wireless apparatus, able to maintain communication through several hundred miles. The Marconi Company did not feel like assuming the responsibility, in this first experiment, of introducing an intensity of electric power which might produce dangerous sparking, and we also felt it better to be on the safe side. But we now know that much more powerful apparatus may be prudently employed, and this is one of the many valuable lessons learned by our voyage.

CHAPTER XLVIII

JACK IRWIN'S WIRELESS LOG

[From the New York Times.]

Jack Irwin, the young wireless operator of Wellman's airship *America,* which sailed 1,008 miles in its attempt to reach Europe under the auspices of *The New York Times, The London Daily Telegraph,* and *The Chicago Record-Herald,* is treasuring as his curio of the eventful attempt to cross the Atlantic some eight pages of dingy paper, scribbled over with lead pencil, that is already beginning to blur.

These bits of paper make up his diary of the voyage. They were kept with the wireless instruments, where he could jot down a running story of his experiences from the operator's point of view, and as a formal record a carbon copy has been handed to the Marconi Wireless Telegraph Company of America. It is the operator's report to his office of the voyage of the first air craft ever equipped with a wireless outfit.

The diary is written in the lingo of his profession, and Irwin took it all in a very business-like and unemotional manner. Only once or twice did he allow his feelings to creep in and disturb the regularity of his record.

"Sensation very fine. All happy," he wrote in the early afternoon of his first day out from Atlantic City.

"It's all up," was his brief comment in the middle of the afternoon when the gale struck the *America,* and it looked as though they must take to the lifeboat immediately. And later, in noting down the events of the early morning on which the *Trent* picked them up, he wrote:

"Unable to reach Cape Cod, but heard him working. It sounded very much like home."

Irwin's great trouble came from the lack of power in his sending apparatus. Much of the time he could hear, but he could not make himself heard. He would get the messages distinctly from the land stations, but there was not enough voltage at his command for him to be able to answer.

"We were in touch with the Siasconset Station until about 1 P. M. Sunday, when I sent the message that all was well and we were running northeast," he writes in his own account of the trip. "On account of the low power of the sender I was not able to raise Siasconset after Sunday noon, but I picked up messages from Siasconset Monday. We received several messages for Mr. Wellman but I could not tell Siasconset that we had them. I got them very distinctly, and could also hear Siasconset calling various steamships and asking for news of the *America.*

"It was rather funny," he said in a laconic mood, after it was all over, "sitting in the lifeboat under the balloon and hearing inquiries being made for us and not being able to answer."

But at other times his account of these hours, when the land stations and ships were sweeping the seas for the *America,* suggests that it was anything but "funny." Rather was it like some dreadful nightmare, such as sometimes besets a man, filling him with a great helplessness when he strains and strains to speak and cannot utter a sound, when shouts and calls reach his distorted senses and he cannot speak so much as a single word. So it seemed to Irwin, sitting beside his receiving instrument in the little lifeboat, hearing Cape Sable and Sable Island asking for news of the dirigible and himself unable to call for help or give any hint of the *America's* whereabouts.

That was the fate which met a message to Mr. Wellman from *The New York Times* congratulating him on his success that far, and sending him the news from Washington as to the weather probabilities. The message went from New York to the Nova Scotia coast, whence it was sent out to Sable Island with instructions that the station there should pass it on to the *America.* Sable Island reported back that all efforts to get into communication with the aircraft had been unsuccessful and that the message would go undelivered.

Yet that very message had been carefully copied by Irwin and handed to Mr. Wellman. He had picked it up as it left the Nova Scotia coast for Sable Island. It is duly noted in his diary for Oct. 17.

"Now hear Cape Sable sending a message to some ship. It is from *The New York Times* and is about the weather."

Irwin tried to send his messages in the secret code arranged with *The Times,* which would reveal their contents only to the initiated in *The Times* office. So unfamiliar were the words he had to send that the receiving operators kept thinking they must have heard incorrectly, so that they interrupted again and again, asking for a repetition, and so exhausting his precious voltage that he was obliged to abandon the code altogether.

Irwin's regular diary was cut short with the darkness on Monday evening, when he wrote:

"Hear wireless stations working from Cape Sable to the Southern States."

He did not write again till he was on board the rescuing *Trent*, filling out the back hours from memory and with the aid of the notes taken by the *Trent's* operator. As the rapid-fire conversation between the *Trent* and the *America* began, Irwin did not stop to copy them, merely reading aloud the messages from the *Trent* as they reached his receiving instrument.

The diary is the last word in abbreviation. Here is a sample:

"11 A. M.—Msc wkg msk gives him our 'All Well' & Sk gives it to Ax. Sc & Sk ex sgs re 'W.' "

All of which means:

"Siasconset working Sagapontag. Gives him our 'All Well' and Sagapontag gives it to Atlantic City. Siasconset and Sagapontag exchange signals about the *America*."

Here is the diary translated in full:

Marconi Wireless Telegraph Company of America. Airship *America* Station.

Oct. 15. 1910.

8:05 A. M.—Leave Atlantic City.

9:30 A. M.—Unable to do anything until they fix the equilibrator.

10 A. M.—Tuning up. Call Atlantic City and all stations. Nothing doing. Hear steamship

Cleveland, steamship *Philadelphia,* and Sagaponack, L. I. An Italian ship is calling Sagaponack. Steamship *Philadelphia* is working with Seagate. Jamming bad.

10:30 A. M.—In communication with Atlantic City.

11:05 A. M.—Send eight messages to Atlantic City.

12:25 P. M.—Received two messages from Atlantic City.

1:30 P. M.—Received one message and sent two more to Atlantic City. Everything going fine. Sensation very fine. All happy.

2:10 P. M.—Received two messages from Atlantic City regarding the weather.

2:45 P. M.—Signaled Atlantic City. Nothing doing. Dynamo not working. Now going easy on batteries, as we are unable to say whether the dynamos will be put in order.

3:30 P. M.—Received one message from Atlantic City from *The London Daily Telegraph* man while the motor stopped. Tried to get reply off, but Atlantic City jammed continually. Motors now started. Am unable to say whether Atlantic City got it, as it is impossible to hear any signals while the engines are running.

8 P. M.—Nothing doing. Unable to hear, owing to the engines running. Have passed one

steamer and two sailing ships. The last sailer was within fifty yards of us.

Oct. 16.

5:05 A. M.—Hear Siasconset working ships. Also heard the S. S. *Caledonia* calling Seagate and the S. S. *Arabic* calling S. S. *Canopic*. The navy station at Brooklyn is calling me. Engines now stopped. Call all stations. Nothing doing. Dense fog throughout the night.

7:30 A. M.—Hear Sagaponack and Siasconset working. Sagaponack tells Siasconset that we were sixty miles southeast of Scotland Light Vessel at 6:50 P. M. last night. That was when we passed that steamer.

8 A. M.—Siasconset now strong, but there is no answer to my repeated calls. S. S. *La Gascogne* calling Siasconset.

8:10 A. M.—Newport tells Nantucket that we started yesterday and to report any news of us.

9:45 A. M.—Unable to raise Siasconset, who is now strong.

10:35 A. M.—Send two messages to Siasconset.

11 A. M.—Siasconset working Sagaponack. Gives him "All well," and Sagapontag gives it to Atlantic City. Siasconset and Sagapontag exchange signals about the *America*.

Noon.—Heard Cape Sable call stations.

2:30 P. M.—Messages to Siasconset.

4:45 P. M.—It's all up. Arranging to take boat. Serious problem. Calling C. Q. D. S. S. *Main* seems strong.

Oct. 17

7 A. M.—All ready during the night to leave in the boat, but the breeze was too strong for launching. Listened in and got S. S. *Main* very strong. Now hear Cape Sable sending a message to some ship for us. Copy it. It is from *The New York Times* and is about the weather.

7:10 A. M.—Hear Cape Cod giving signals. Calling Siasconset with message.

7:20 A. M.—Navigator just got a sight for longitude. We are 210 miles east of Nantucket (approximately). Longitude 65.51 west. Hear Siasconset and Cape Cod. Heard Cape Cod send a message to us from *Hampton's Magazine,* but only got last three words, as tail keeps coming out of the water. [This means the tail of the equilibrator, the cable of which was the "ground" connection of the wireless apparatus.]

8 A. M.—Drifting due southwest.

9 A. M.—Went up 2,600 feet, now down again. This is the second time this morning we have been in the clouds.

9:20 A. M.—Hear Cape Cod and Siasconset talking and working. Siasconset gives S. S. *Ryndam* "Go ahead with communication."

1 P. M.—Nothing doing. Have slept and eaten.

2:40 P. M.—Still drifting along. Getting ready to make a getaway in the boat. The question of launching has been discussed for hours. The danger lies in the tail hitting the boat when we are launched.

2:45 P. M.—Hear New York calling a Bermuda line vessel. Weak.

3:10 P. M.—Siasconset sounds strong. A Panama Line ship calls Atlantic City. Very weak.

3:11 P. M.—Siasconset gives S. S. *Main* "Go ahead." Then calls S. S. *Kronprinz Wilhelm*. *Kronprinz Wilhelm* calling the *America*.

7 P. M.—Hear wireless stations working from Cape Sable to the Southern States.

Oct. 18.—Notes made after arrival on board S. S. *Trent*. Made from memory and the notes of the *Trent's* operator.

Remained on watch until 3 A. M. listening to various wireless stations working. Static resistance very bad. Unable to read Cape Cod, but heard him working. It sounded very much like home. I turned in at 3 A. M. and was awakened about an hour later by calls of a ship in sight.

Descended into the lifeboat and called C. Q. D. Nothing doing. Then got small electric torch and commenced calling in Morse lamp fashion. Was eventually answered by the *Trent* and signaled him that we were in trouble and

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required help. Also convey to him that we were equipped with wireless.

The *Trent's* operator was awakened, and he called, and as I had my fones on all the time, I answered him, and instant communication was established. I am indebted to Mr. Ginsberg for the copies of the following messages which were copied by him. I did not do so, merely reading out his messages to Mr. Wellman as he sent them.

To the *America*—Do you want our assistance?

To the *Trent*—Yes. Come at once. In distress. We are drifting. Not under control.

To the *America*—What do you want us to do?

To the *Trent*—Come ahead full speed, but keep astern, as we have heavy tail dragging.

To the *America*—O. K. Am standing by the wireless in case of trouble.

To the *Trent*—You will pick us up at daylight. You will be better able to see us then.

To the *America*—O. K.

To the *Trent*—Come in close and put the bow of your ship under us. We will drop you a line, but do not stop your ship, as you will capsize us.

To the *America*—O. K.

To the *Trent*—Who are you and where bound?

To the *America*—S. S. *Trent,* bound for New York.

To the *Trent*—Have one of your boats ready to launch, as we will probably capsize when we launch.

To the *America*—O. K. Boat manned.

To the *America*—Shall we stop for you?

To the *Trent*—Yes; we are getting ready to launch.

To the *America*—Shall we stop for you?

To the *Trent*—Don't stop; we will drop you a sea anchor and try to stop our ship.

To the *Trent*—We have a motor going above. We can't hear your signals now. Will say when I can. We are pumping air into the airship ready to bring her down to the level.

To the *America*—We are going full speed waiting for your orders.

To the *Trent*—We are going to launch the boat. Stand by to pick us up. (Wireless then closed.)

I then cut aerial and earth wires, put water-tight doors on the openings of the wireless cupboard, and stood by. The boat was successfully launched, a most dangerous operation. We were going fifteen knots an hour, with the boat swinging beam on to the sea, and behind the ton and a half trailer, composed of heavy tanks of gasoline.

At the signal "Let go" both clutches holding the boat were jerked. They acted beautifully. The boat fell into the water, lurched gunwale under, then righted. The equilibrator hit Mr. Loud, the first assistant engineer and myself, and stove a small hole in the wireless compartment of the boat, but it did not injure either of us nor impair the stability of our boat.

The greatest danger of the whole eventful three days now occurred. The *Trent* was following full speed, right in our wake, and she bore right down on our lifeboat for a few seconds, which seemed hours. It appeared we were to be cut in two. I prepared to jump overboard and swim clear of the propellers of the big ship, but fortunately at the instant I thought to do so, the *Trent* cleared us and we grazed along her side.

After two or three attempts to row to the ship with two small oars we waited, wallowing in a heavy sea, for the ship to come about. This she did and ranged at slow speed alongside us. Lines were thrown, but although we tried to hang on, the speed was too great for us, and again we were left astern. Once more this maneuver was executed, and we got near enough to the ship to catch a line. We came alongside and climbed aboard by a rope ladder. All wireless gear saved.

J. R. Irwin, Operator.

CHAPTER XLIX

THE FUTURE OF AERIAL NAVIGATION

We may now say with truth that man has at last realized his centuries-old aspiration. He has conquered the air. He has successfully navigated the ocean of atmosphere which surrounds our earth. With persistence, ingenuity, courage, sacrifice, heroism, devotion, loss of life and fortune, man has kept at his task, advancing little by little, step by step, toward the ultimate triumph.

To-day the greatest fact in the progress of mankind toward the full realization of his mechanical possibilities is this: Man flies; man soars in the air; he converts himself into a great bird; he spreads his wings, sets in motion his motor-muscles, rises from the earth, sets out determined to reach a given destination a long ways off, flies straight toward it, reaches it, descends. This is aerial navigation; it is conquest of the air. It is one of man's most wonderful achievements. And in my opinion the triumph of it in nowise depends upon man's ability to make general commercial application of his new-found art, his latest victory over the elements.

The Airship as seen at some distance from the Trent.

And yet the question is everywhere asked: Now that man has achieved aerial navigation, how much practical use is he going to be able to make of it in the world's work? No other question is to-day more discussed throughout christendom. No other rouses more curiosity or develops wider range of opinion. We may say, looking at the matter broadly, that the foremost engineering and mechanical problem of to-day is: Can aerial navigation be commercialized? If so, how, by what method, with which type of machine?

It is my purpose to attempt an answer to this question in these pages. If the answer cannot be made as complete and definite as we should like, we may still be able to throw valuable light upon the subject.

First, to clear away all doubts, let me state my firm belief that aerial navigation is as yet in an experimental stage. We are virtually in the infancy of the art. We have only begun to demonstrate its possibilities. It is only within the past four or five years that the motor-balloon has been developed into a practical and fairly dependable instrument of air travel. It is only within the past three years that mechanical flight has been demonstrated in such practical fashion and upon such a scale as to convince the world that aerial travel is here at last.

The ingenuity, skill and courage that can accomplish all this in such a short time must be regarded as the forerunner of much greater things to come. At the present moment the precise method of attaining the vastly larger and more important results may not be in sight. We cannot say that it is. Moreover, so far as any existing type of machine is concerned, certain limitations of the art of aerial navigation, set by physical conditions, may be regarded as interposing almost if not quite insuperable obstacles to further important development—development which would carry the art to the general commercial application so much discussed and desired.

While it is true that these limitations are sharp and apparently insuperable, it must be remembered we are considering them only as they apply to present types of machines, both lighter and heavier than air. There is every reason to hope that new types are to be developed which will rise superior to the limitations. All over the world men are studying aerial navigation. They are experimenting with new apparatus, building, testing, tearing down, reconstructing, keeping at it. Perhaps it is safe to say that throughout the world fifty thousand men are to-day giving all or most of their time and energies to this fascinating problem. Many of these, it is true, are mere mechanics, whose point of view is restricted largely to details and to experiments therewith. From such workers as these improvement of the existing types of machines may be expected, perhaps nothing revolutionary, but a gradual progress toward perfection.

Not only mechanics, but men of science and engineering are at work upon the problem—men who take the broad view, who study everything from the beginning, who take into consideration all the laws of physics and aerodynamics involved, and who seek, not mere perfection of details or improvement of present types, but the creation of new types which shall revolutionize the art and bring about another epoch in air travel. The Lilienthals, the Langleys, the Wrights, the Julliots, the Zeppelins, the Chanutes, the Montgomerys, the Bleriots, the Santos-Dumonts, are not all dead, nor all inactive or worked out, nor giving their energies to the commercialization of the sporting and gate-taking aspects of the art to the neglect of its future.

Men of this class are of every country, every nationality. They are delving deep. I pin my faith to them. From one of them may come at any moment an invention, a discovery, or a combination, which will revolutionize the art; something that will go so far beyond a *Zeppelin,* a *Lebaudy* or an *America,* so far beyond the performances of the mechanical flight machines of to-day, that people will be wondering how they could ever have given so much attention and admiration to the crude contrivances of 1910.

My faith is strong that having demonstrated the practicability of air travel man will go on till he has developed flight into a state of perfection and usefulness not even indicated by the apparatus of to-day.

Whether or not full commercial utilization of aerial navigation is coming, soon or late, is a question which no one can now adequately or confidently answer. It may come, it may not. My own impression, rather than conviction, is that in the next half century we shall have limited rather than universal commercial application of the art. But within those limitations will be found much that is highly beneficial to humanity.

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CHAPTER L

POSSIBILITIES OF THE MOTOR-BALLOON

As is well known, the art of aerial navigation is practised with two types of machines—the dirigible or motor-balloon, and the mechanical flight apparatus, generally known as the aeroplane. The differences between the two types are obvious. A motor-balloon gains its power to rise in the air and to lift not only itself but a considerable cargo of motors, crew, fuel, etc., by means of the buoyant force of hydrogen, which is simply the difference between the weight of the air displaced and the lighter hydrogen gas substituted for it within the balloon or reservoir. Once in the air, the motor-balloon is driven forward by propellers operated by engines, usually of the inner-explosion type, burning gasoline for fuel.

The mechanical flight machine, on the other hand, has no buoyant force of its own. No hydrogen or other gas is used. The machine is lifted in the air by the push of its wings or surfaces against the air as it is driven rapidly forward by its propellers worked by motors.

The motor-balloon, having inherent buoyancy, remains in the air regardless of whether its engines and propellers are working or not. The mechanical flight machine is maintained in the air solely by the push exerted by its propellers, and if these stop working it must descend to the earth, though instead of falling vertically it glides downward, still pushing against the air by virtue of the momentum of its descent, just as like forces kept it aloft whilst the motors and propellers were in operation.

It is possible to build a motor-balloon de-signed to carry a limited number of passengers across the Atlantic Ocean, at high speed, and with complete immunity from seasickness. But if such ships are employed regularly for this purpose, and the venture be conducted on purely commercial lines, the passengers must pay high fares for their speedy and comfortable voyages, else the enterprise could not earn profits.

Later I shall give the outlines of an airship which, in my opinion, could cross the ocean from America to Europe, or vice versa, at high speed, and with a minimum of risk to the ship itself or its passengers, though I am not prepared to go so far as to say such a venture could be made commercially profitable, or that the risk involved would be as small as that which one incurs when he entrusts his life to a great modern transat-

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lantic liner. Hence it is not for me to predict that airships of this type will ever supplant or seriously compete with steamships. But it is not at all improbable, certainly not impossible, that in time we shall have a special aerial transatlantic service for the accommodation of a small share of the swarms of transocean travelers.

Other possibilities of the motor-balloon are in war and exploration. As to the value of the airship in war I shall write a special chapter. As to its use in exploration, if there remains a part of the earth's surface worth exploration, and the difficulty of doing that by the ordinary means of travel is so great as to involve practical difficulties, the motor-balloon is available for the purpose. For example, if it were considered worth while for anyone to endeavor to revisit the North Pole since its discovery by Peary, a motor-balloon would serve very well as the vehicle of travel. If Peary had not reached the Pole when he did it is highly probable, almost certain, that an airship would have performed the feat in a year or two.

It may be that there are other parts of the Arctic regions, or of the Antarctic, or of Australia or Africa, now unknown, and in the exploration of which a motor-balloon could be used to advantage. Prof. Hergesell, of Berlin, of whom I spoke in connection with his valuable exploration of the upper air by means of *ballons sonde,* has indeed brought forward a project to attempt such exploration in the Arctics by means of an airship of the *Zeppelin* type, and he further imitates our recent enterprise by considering Spitzbergen as a base of operations.

It should be borne in mind that the use of a motor-balloon in the work of exploration does not necessarily mean that the ship of the air must be depended upon to make the round trip, carrying the expeditionary party both into and out of the region to be explored. One of the best features of the use of airships of large lifting capacity in such work as this is found in their ability to carry not only the explorers but their instruments, provisions, accouterments of all sorts, to the extent of several tons, over a great distance and regardless of the difficulty of the road considered for surface travel, in a short space of time. If it then becomes necessary to abandon the airship and finish the work of exploration by travel on foot, employing dogs or ponies or horses as draft animals, or perhaps motor sledges or motor-traction vehicles, according to the characteristics of the region, all these may be carried far within the unknown country, along with ample supplies, and wherever the airship is caused to descend a great depot may be established as a base of further activities on the part of the expeditionary party.

In the autumn of 1909 I worked out such a plan for an expedition to the South Pole, and came very near embarking in the enterprise, desisting only because of certain physical and meteorological difficulties which were found in the way. The Arctic and Antarctic regions are not at all similar. In the far north we have an ocean covered with a sheet of ice, more or less broken up, rarely still, and its surface quite rough. The winds are not very strong, and are exceedingly variable in direction. The cold is not an obstacle to the employment of an airship, the summer temperature closely approximating the freezing point in the shade.

But in the Antarctic regions conditions are quite dissimilar. There is found a great continent, presumably millions of miles in area. This continent is glaciated, like Greenland and other Arctic lands. That is, it is covered by huge masses of eternal ice, the mountains being sheathed with it and the valleys filled with glaciers. The cold is greater in the Antarctic than in the Arctic, on account of the presence of this great glaciated continent, and the altitude above the sea. The South Pole, we know from Shackleton's admirable journey, is situated upon a great ice-plateau eight to ten thousand feet above

CHAPTER LI

OBSTACLES TO COMMERCIAL USE

So great are the obstacles in the way of general commercial use of the motor-balloon over land that we must frankly express a doubt if they can be overcome, though reserving the statement already made that for special commercial purposes where the circumstances are unusually favorable, and in certain ocean traffic, these craft may be employed. Commercial aerial navigation, like any other navigation, means operation for a profit in competition with railways and steamships. Involved in operation for a profit are certain requirements well understood but which it will be well to state. First, there must be a high degree of safety of operation, and reduction to a small minimum of the risk of accident to the ship itself and its passengers and cargo. Without this high degree of safety, ships and their cargoes cannot be insured at practicable premiums, owners cannot afford to carry their own insurance (since the inevitable losses must be made up in some way), passengers will not offer themselves for voyages, and goods will not be tendered for transportation without insurance.

Next, ships of an aerial transportation line, like steamships, and railway trains, must be fairly sure of setting out on a given schedule, and of accomplishing the voyage in a reasonably close approximation to the time advertised beforehand. It is clear that great uncertainty of departure and of time of arrival would constitute a handicap against the enterprise in competition with more stable modes of transportation.

These objections, sure to hold in the long run, might not apply sharply to an aerial line as long as the novelty remained. For the unusual experience of a trip in the air passengers might offer themselves and be willing to pay much higher rates of fare than they would have to pay upon competing lines. Some business of this character has been done in Germany, where the *Zeppelin* airship has carried a considerable number of passengers on short voyages at rates of fare which must be regarded as fanciful from the purely commercial standpoint.

One great obstacle to the commercial employment of a motor-balloon is the impossibility of taking a large ship of this character out of her shelter house without incurring serious risk of disaster, if the maneuver be attempted at any other time than in a period of light winds or calm. It is axiomatic for obvious reasons that the larger the ship the more likely is she to give a good account of herself in the air. In a ship of great size there is opportunity to instal powerful and heavy engines and to carry a reserve of fuel and ballast sufficient to meet many emergencies. This is true because the weight of an airship—the balloon, the car, the suspension, the motors and permanent equipment—does not increase as rapidly as the displacement and the lifting power. Double the size of a well-built and well-equipped airship of the dirigible type and you approximately quadruple the amount of lifting force which can be devoted to fuel and ballast and cargo.

But, the larger the ship the more difficult it is to handle while not in the air under her own power. It must be taken out of the shelter house by means of guiding lines held in the hands of men, and with a large craft, if a considerable wind is blowing, this is a most difficult task. It is well nigh impossible to utilize enough men to make sure that the huge craft, when caught by the wind, shall not acquire momentum and bring on the danger of escape or of injuring itself. When such a ship is partly out of a hangar or balloon shed, and the wind catches it broadside, the risk is great that it may be thrown against the walls of the house and be damaged or destroyed, despite the efforts of the personnel to control it.

It is true that much may be done toward minimizing this difficulty by equipping a balloon or shelter house with specially arranged netting to help control the craft whilst she is in the process of emerging from or entering the structure. Also, by having a large and well-trained crew of men to handle the leading lines. By such means it is probable airships, even those of great size, may be prudently managed in winds blowing up to ten or possibly fifteen miles per hour, which means, counting the average winds of the Atlantic seaboard of the United States, that such a craft could set out upon a voyage in little more than one-half of the hours. But we do not yet see the method by which such a ship could be assured of starting at any appointed hour, regardless of wind and weather, as steamships do in 99 cases out of 100.

But the greatest obstacle to the commercial employment of airships of the gas type, save in special circumstances, is the uncertainty which must cling about their arrival at their predetermined destination. Here the hazard is not so great as to preclude their use for sport, or exploration, or for the purposes of war. In all of these fields a certain amount of risk is inevitable, acceptable, a part of the game. But it is a doubtful question whether or not the hazards are too great to admit of actual commercial work, voyages for a profit.

It is unfortunately true that it is impossible to build a motor-balloon, no matter how great its size and power, or how advanced its engineering and equipment, which can attain the same high degree of safety upon a voyage of considerable length as that which is common to steamships. The reasons for this are important, and should be given with care.

In considering this phase of the problem we shall eliminate airships of relatively small dimensions and meager equipment, built for sport or exhibition or advertising purposes, and deal only with what we may call the advanced and highly engineered airships—the ships of the future, if, indeed, the art has a certain future of development and growth. We shall reckon only upon craft which have engines powerful enough to give them very high speeds, and capacity great enough to enable them to carry large reserve supplies of fuel to meet serious emergencies. Such ships may or may not be built for commercial purposes, but in the future it is quite sure we shall have them as parts of the navies and military establishments of the advanced and scientific powers.

Photograph of the America taken from the Trent.

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CHAPTER LII

LIMITATIONS OF AERIAL CRAFT

The first striking discovery we make in our analysis is the radical difference of principle which exists between the navigation of a steamship, a battleship or cruiser, over the ocean, and the navigation of a ship of the air, whether over the sea or over the land. If a steamship encounters a gale blowing forty miles per hour, as a rule the progress of the ship is not interrupted. It may be necessary to reduce the speed one-quarter or one-half, on account of the roughness of the sea, but generally the ship proceeds on her way. If the storm be unusually violent, and the sea runs very high, the worst that usually happens is that the ship must lie to for a few hours till the storm's center shall have passed and better conditions obtain, when the voyage is resumed.

The steamship during such circumstances drifts but a few miles out of her course; she lies to without expenditure of more than enough fuel to keep low fires under her boilers. It makes little difference from which point of the compass the storm blows, and no very serious difference how long it continues. The explanation is obvious: the steamship is affected in its movement and course only to a very small extent by the winds, say one or two or perhaps five per cent., of the force of the wind, regardless of whether the wind is ahead or astern or broadside on. The craft is sailing in the water, not in the air.

But it is altogether different with the ship of the air. She is navigating the air alone, is a part of the air, and currents in the air exert upon her, not merely one or two or perhaps five per cent. of their force, but all of it, one hundred per cent. Thus we find that while the wind means little to the master of a steamship of high power, and considerably more to the mariner of a sailing vessel, to the skipper of a ship of the air it is everything.

Let us assume that an airship sets out upon a voyage from New York to Chicago, a distance of about one thousand statute miles. The normal speed of the ship, in still air, is between twenty-five and thirty-five miles per hour, according to the engine power kept in operation. But she is equipped in such a way, with reserve engine power for emergencies, that at will her commander may increase her speed up to fifty miles per hour. In calm weather, at normal speed, the ship would make the voyage from

New York to Chicago in thirty-five or forty hours.

But suppose that after having reached the neighborhood of Lake Erie a nor'wester blowing at forty miles per hour should be encountered. What would then happen? For the sake of illustration, and to make the matter quite clear, assume that the engines have been stopped. In that case of course the ship simply drifts with the wind. It flies to the southeast with the velocity of the storm, and it is only a question of time when it will pass out over the Atlantic somewhere in the neighborhood of Chesapeake Bay.

To avert this undesirable and perhaps dangerous drift the master of the ship must set his engine running. He must fight the storm. If the engine give the ship a movement of forty miles per hour—just equal to the average force of the wind—the ship will stand still. If the engine yield a speed of only thirty miles per hour the craft will drift ten miles per hour with the wind. If the engine produces fifty miles per hour the ship will make ten miles per hour on her course.

Thus we see at once that when an airship encounters a wind blowing contrary to the course the ultimate safety of the craft depends upon engine power, then upon the intensity and duration of the storm, and finally, in the last analysis, upon the endurance of the ship—that is, the quantity of fuel carried in her bunkers, her ability to keep up the struggle till she shall have won the victory or the weather conditions change for the better.

Hence the importance of large airships, with great carrying power, and ample stores of reserve fuel to meet emergencies. Whereas a marine vessel may find a greater measure of safety by reducing engine output, or stopping the engines altogether in a storm, an airship must not only keep her motors running all the time, but to make sure of not losing headway must increase the output of power and in consequence the consumption of the precious fuel.

High speed is costly. Theoretically a speed of fifty miles per hour costs four times as much energy as a speed of twenty-five miles per hour, measured in time, and in practice probably a trifle more. With an airship involved in a storm, the first fear of her master would be of a breakdown of his engines, though in the ship of the future, which we are now considering, there will be no more danger of engine failure than in a modern steamship. His second fear will be that his stock of fuel shall become exhausted before he has weathered the storm and made port.

It is true that with a highly-developed airship, able to remain a long time in the air, advantage may be taken of the fact that sea-room, so to speak, is virtually unlimited. There being no danger of running upon the rocks, or a lee coast, the ship may be permitted to drift with an adverse wind. Or, an economical part of the engine power may be employed to hold the craft into the wind, losing headway but not so rapidly as with no engine running, waiting for the storm to subside and prepared to regain the lost ground when the conditions should improve. This would enable the master of the craft to conserve his store of fuel and be the more sure of his ability to ride out the gale and ultimately reach port.

For example, in the case which we have just considered, the ship might be kept against the wind at a speed of thirty miles per hour, losing ten miles per hour on the course. At the end of twenty-four hours, assuming the storm to have blown itself out by then, a total of 240 miles would have been lost. Eight hours would be required to recover the lost ground, at normal speed; but the stock of fuel would not be so nearly exhausted as would have been the case if the ship were kept going all the time at her top speed and most costly output of power.

If the wind should now turn to the east or southeast, the lost miles would be very rapidly regained, because the force of the wind would be added to the energy of the motors. We thus see again that the wind is the prime factor in a voyage by airship. An aerial cruiser, no matter how great its engine power and speed, must be prepared to struggle against winds and storms. It is largely a question of endurance, and endurance means large ships. Though an airship has this advantage over a marine vessel, that with a wind blowing directly in line with the desired course it gains one hundred per cent. benefit from the atmospheric movement, this is counterbalanced by the fact that in unfavorable winds it suffers losses to the extent of one hundred per cent. And the equation is thrown altogether out of balance, unfavorably to the aircraft, when we remember that the ship of the air may get into almost if not quite as serious difficulties with a favorable wind as with one blowing in the adverse direction. Assume, again, that we are traveling through the air from New York, bound for Chicago. While over Lake Erie we are overtaken by a storm of forty miles per hour, this time coming from the east. It is moving directly toward Chicago, and in a few hours, by adding the help of the winds to the power of our motors, we shall be at or near our destination.

Now the great problem which the master of the vessel has to decide is how he can make a safe landing in a forty-mile wind. It is clearly impossible to bring her down to earth in any open field or clear space without incurring the danger, almost the certainty, that she will be wrecked by the gale after reaching the ground, the ship being seriously damaged or destroyed even if the passengers and crew escape with their lives. In order to make a safe landing in such a wind it is necessary to reach a specially built shelter house or landing field where there is a wind-wall or other guard behind which the craft may be brought gently to the ground.

In other words, a ship of the air running to port out of a storm, must have a harbor to take refuge in, just as the ship of the sea must have a roadstead or other safe anchorage to make for —one of nature's creation or made by man's cunning, like a breakwater or artificial harbor behind a sea-wall. The difference between the two craft, under such circumstances, is, however, a great one. The ship of the sea can in ninety-nine cases out of one hundred make the roadstead or harbor and effect a safe anchorage. But any man who has handled a great airship understands very well the difficulty of steering and handling such a craft in a strong wind and getting safely within the shelter provided for its reception. It is not impossible, but it is difficult; there would be at least a certain percentage of risk of disaster, and this hazard must be taken into account by all who project aerial transportation systems.

If the master of the air vessel found it im-

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CHAPTER LIII

THE FUTURE TRANSATLANTIC AIRSHIP

That the Atlantic Ocean can be crossed by an airship of the motor-balloon type there is no doubt whatever. The feat could be accomplished, simply as a demonstration of its feasibility, with an airship much like the recent *America,* only a little larger and more highly powered and better equipped. The value of such a demonstration, apart from the general information derived from it, would be as the forerunner of an application of the method to military operations or to a regular aerial service for the public convenience.

The practicability of carrying passengers across the ocean, in quick time, and with immunity from seasickness, is a sound and rational engineering and aeronautic proposition. That is, it can be done; whether or not it would pay as a purely commercial venture is a problem which no one is now able to decide and which the future will have to determine.

An air-craft to traverse the three thousand knots or sea-miles which lie between New York

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and London must be of great size. Neither time nor money must be spared in her construction and equipment. The engineering must be sound and comprehensive, and the work of the constructor must adhere strictly to plans and specifications. No second rate talent, no haphazard methods, will suffice. The engine-equipment must yield great power, and must be so planned and installed that the operation of the motors shall be as sure and certain as in a modern steamship. The fuel-carrying capacity of the ship must be very large, and her reserve of buoyancy and energy ample to provide a prudent margin against unfavorable conditions of wind and weather.

In the following pages is given the outline of an airship designed to make the voyage from New York to London, or vice versa, in four days, with neutral winds; in two and one-half or three days with favorable air currents; in five or six days with some adverse winds. This is a much larger and more powerful and costly ship than would be required merely to make a demonstration. It is such a ship as would at least have a chance to carry demonstration and experiment forward into the field of actual commercial and regular service, since it is a craft designed to carry fifty or sixty passengers each voyage, in addition to the crew.

The reader may be somewhat astonished at the great size of this proposed ship, at the enormous lifting and carrying capacity. He may be inclined to look upon it all as a dream, a work of fiction. But I wish to assure him everything planned here is within the limits of aeronautic engineering and construction. To create such a ship is merely a matter of demand and capital. If it can once be demonstrated, as it may be, that there is a commercial future for such craft, the capital will be forthcoming, and the engineering and construction are already within the limits of the art. The ship of which we are writing, and which may some day be actually put in service between New York and London, is only about thrice as large as the latest *Zeppelin*, and about five and one-half times larger than the late *America.*

The greatest diameter of the balloon part of our suggested airship is 20 meters, or 65.6 feet. This diameter is carried nearly the whole length, giving the body of the ship a cylindrical shape, rounded and pointed at the ends. The balloon is given a length ten times the diameter, 200 meters, or 656 feet. The total surface of the balloon or gas-reservoir is 12,000 square meters, or 128,880 square feet, equivalent to about three acres. The total volume of the balloon is 60,000 meters cube, or 2,118,800 cubic feet. Assuming the temperature of the air to be 60 Fahrenheit, and the atmospheric pressure normal at 29.92 inches, or 760 millimeters of mercury, the weight of the air displaced from the interior of this balloon is 73,500 kilogrammes, or 162,000 pounds.

Filled with hydrogen of a high but practicable degree of purity, weighing about 100 grammes per meter cube (.00624 pounds per cubic foot), the gas will weigh 6000 kilogrammes, or 13,225 pounds, and the buoyancy or lifting force of the balloon will of course equal the difference between the weight of the air taken out and the weight of the gas put in its place, which is 67,500 kilogrammes or 148,675 pounds. Thus the total lifting force available is nearly 75 American tons.

To hold this great volume of hydrogen, with ample tensile strength in the envelope to resist the upward thrust of the gas and to make sure of sufficient tightness to prevent the escape of more than about one per cent. per twenty-four hours, it is necessary to make the balloon of the best procurable material, and of considerable weight. In all parts above the equatorial line of the balloon the cloth must be three thicknesses of the strongest cotton, each fabric heavily coated with an emulsion of rubber, and having a weight of 600 grammes per meter square (approximately two ounces per square foot).

The parts below the equatorial line, not being subjected to so much strain, may be of lighter material. Here we use two strong cottons, both rubbered, with a weight of 400 grammes per meter square. The average weight of the fabric of the whole balloon, therefore, is 500 grammes per meter square, making the total weight of the envelope 6,000 kilogrammes. To this must be added about ten per cent. for the lappings of the seams, the thread, and the extra rubber cement used to stop all needle holes. The inner reservoirs for containing air will weigh 600 kilogrammes, and the valves, air-ducts, relingues or points of attach, and the system of steel suspension cables, 500 kilogrammes.

About the whole upper half of the balloon we throw a chemise or outer covering of rubbered cotton, leaving a space between the balloon proper and this outside sheet. It is a ventilating space, and is to be used in the following manner: Air will always be kept circulating through this space, and as it absorbs the radiant heat of the sun the warmer air will rise to the top and escape through automatic valves; as this air takes up the heat of the sun's rays and passes it off as the warmed air is replaced by cool air (arrangements are made to artificially cool the supply), the absorption of heat by the hydrogen within is almost entirely prevented.

In this way we overcome one of the greatest difficulties in the management of a gas airship, namely, the large and rapid gain or loss of lifting force due to the alternate expansion and contraction of the air due to temperature changes and the coming and going of the sun. Arrangements are made not only to supply artificially cooled air to the ventilation chamber, but to the inner balloons as well whenever occasion demands. Moreover, as lower temperature threatens to contract the gas and cause undue loss of lifting force, it is arranged that hot air can be thrown into the ballonets. The exhaust heat from the motors is utilized for this purpose. By these means the temperature of the contents of the aerostat may be kept very nearly at a constant value.

The weight of this outer jacket is about 2300 kilogrammes, bringing the total weight of the balloon and its direct appurtenances up to an even 10,000 kilogrammes, or 22,046 pounds—eleven American tons of cotton and rubber in the huge envelope or hull of our ship. But as the total lifting force is 67,500 kilogrammes, or 148,-675 pounds, we still have 57,500 kilogrammes or over 126,000 pounds available for other purposes.

CHAPTER LIV

POWER AND EQUIPMENT OF THE GREAT AIRSHIP

Underneath the balloon, suspended by hundreds of steel cables, we place the car or nacelle of the airship. This is a structure of metal framing, being built of steel-aluminum alloy tubing and steel wires of finest quality. Instead of one solid and continuous structure from end to end, we divide the car or nacelle into six sections of fifty feet each, leaving a space between also fifty feet in length, and connecting the platforms with light galleries strong enough to serve as a promenade deck for passengers and crew.

The reasons for this subdivision are: It is highly desirable, in fact necessary, to carry the nacelle well forward and aft, so that it may support horizontal planes for steadying the ship as she moves with great rapidity through the air—for this is to be an aerial greyhound—and such planes are most effective when placed at the extreme ends of the system. The rudder must also be carried well aft. Again, it is necessary to distribute weights fairly evenly throughout, and this can best be done with the platforms running almost

Just before the launching of the life boat — photographed from the Trent.

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to the extreme ends of the ship. But if the car be made full size and strength throughout several thousand pounds more weight is put into it than will be necessary if we divide it into sections and connect the platforms with light galleries, somewhat after the method followed in the *Zeppelin*. In fact, this plan is a combination of the continuous metal nacelle of the late *America* and the platforms at intervals found in the *Zeppelin*.

These platforms carry the enclosed cabins for passengers and crew, the engines, the propellers, all the machinery and appliances, the instruments and tools, wireless outfit and electric light, and the backbone of the platforms is composed of metal reservoirs for containing the large stock of gasoline to be carried upon the ship.

The cabins are provided with light beds, all conveniences, electric light, telephones, dining-room, kitchen, baths, music-room, smoking-room, etc.

Underneath the platforms are suspended two large lifeboats, of capacity great enough to accommodate all the passengers and the crew. These boats are furnished with motors and sails, and are kept constantly supplied with provisions, fuel, water, instruments, etc., ready for instantaneous use in case of accident. Moreover, their davits are so arranged that at the moment of launching, no matter whether the airship be running under her own power, or drifting broadside to the wind after the engines have stopped, the boats may be launched stem on to the course which the ship is making over the water, averting the great hazard of capsizing and swamping which we had to incur when we launched the lifeboat broadside in a rough sea from the *America.*

This transatlantic airship is equipped with engines and propellers designed to give her a maximum speed of 45 knots (50.7 statute miles) per hour. The speed of an airship, of course, is measured as in calm air.

The formula is that R—resistance, equals the product of K—the coefficient, .01685; D^2—the greatest diameter of the airship in meters; and V^2—(vitesse) the speed in still air in meters per second; the resistance thus found being expressed in kilogrammes.

Using this formula, we have for our 20 meters of diameter $K - D = 6.74$. One meter equals 3.280833 feet, and as there are 3600 seconds in an hour one meter per second equals 2.237 statute miles of 5,280 feet, or 1.9426 knots or sea-miles of 6,080 feet, per hour.

From this data we compute the following table, in which the last two columns represent the thrust required by the propellers, in kilogrammes and also in pounds, to produce the speeds indicated in the first three columns:

Meters per second	Statute miles per hour	Knots per hour	Thrust required in Kilos	Thrust required in Pounds
10	22.37	19.42	675	1,486
12	26.85	23.30	970	2,140
14	31.32	27.18	1,320	2,910
16	35.80	31.07	1,725	3,805
18	40.27	34.95	2,185	4,817
20	44.75	38.84	2,696	5,945
22	49.22	42.72	3,262	7,192
24	53.70	46.60	3,882	8,558
26	58.17	50.48	4,556	10,045

With a good installation of motors, effective driving gear, and the efficient modern propellers, a thrust of from four to five kilogrammes per brake horse power is practicable. If we take this value at the lower figure, four kilos per horse power, we shall arrive at the amount of engine output required to drive our ship at various speeds through the air. Experience has shown that the weight of gasoline, lubricant and water for replenishing the supply in the cylinder-cooling circulation system averages about 300 grammes per horse power hour (approximately .7 pound) for good engines. We are thus able to compute not only the amount of engine output required, but to measure the cost of various speeds in pounds per knot or sea-mile made:

Knots per hour	H. P. required	Fuel, etc. per knot, pounds
19.5	170	6.1
23.3	245	7.2
27.2	330	8.4
31.0	430	9.6
35.0	550	10.9
38.8	680	12.2
42.7	825	13.5
46.6	980	14.8
50.5	1,170	16.2

In other words, if content with about 23 knots per hour, the speed of the fastest steamships now plying between America and Europe, excepting only the *Mauretania* and *Lusitania,* one 250 horse-power motor would be sufficient, and the motor-supplies would amount to 7.2 pounds per mile made, while a total of about eleven tons of fuel, lubricant and cooling-water would be required for crossing the Atlantic. But if we aim to double the speed and make 46 knots per hour, we must have four times as much power in the engines, and the fuel supply must be about double, or 45,000 pounds.

Hence it is important to learn how much fuel we can carry in our airship, and how large engines we can afford to instal and operate. We have already seen that of our total lifting force of 148,675 pounds, 22,000 pounds are taken up by the weight of the balloon, leaving 126,000 pounds still available. We call this an even 125,000 pounds, and proceed to ascertain the weights of the remainder of the ship and its equipment and cargo.

The six metal platforms or cars, with their cabins, gasoline storage reservoirs, connecting decks or galleries, the horizontal planes, the rudder and steering gear, we compute at a total of 20,000 pounds, or ten tons. The two motor lifeboats, their motors, provisions and fuel, will weigh 4,000 pounds each, or the two together four tons. Instruments, kitchen, bedding, various furnishings, will bring this total up to 30,000 pounds. There is still available 95,000 pounds.

We decide to equip the ship with four 250 horse power motors, each engine having its own pair of twin propellers and forming a complete and independent propulsive unit, the whole so arranged that at will one, two, three, or all four engines may be worked. We put in also two small motors of 15 horse power each, as service engines, being used to start the large motors, to run the electric light and the wireless, pump air, and to work the refrigerating plant for cooling the ventilating chamber. Excellent and re-liable motors are now made in large units at from four to eight pounds per horse power, complete with cooling reservoirs and all appurtenances. At the intermediate figure of six pounds per horse-power our battery of four 250 horse motors will weigh 6,000 pounds. Four thousand pounds more suffice for air-blowers, dynamo, cooling apparatus, heating plant, propellers and propeller frames, machine shop, wireless apparatus, tools, repair materials, etc. We still have left a lifting force of 85,000 pounds.

A crew of twelve men is sufficient to manage this ship—two navigators, four men in the engine room, and six servants and general helpers. The weight of the crew and their spare clothing, etc., is 2,000 pounds. The ship is to be fitted to carry fifty passengers, and their weight, with light baggage is assumed at 10,000 pounds. Provisions and fresh water for ten days for all hands, 2,000 pounds. Miscellaneous and contingent, 3,000 pounds. For the mails (letter mail only) 3,000 pounds. Total in this paragraph—20,000 pounds. Still available, 65,000 pounds.

Five thousand pounds of this we propose to devote to a small equilibrator, for use only in an emergency, and there is left for gasoline and other motor supplies a total of 60,000 pounds.

CHAPTER LV

TWO NIGHTS FROM NEW YORK TO LONDON

We shall now consider some of the possibilities of such an airship plying between New York and London, or, rather, of a line of such craft, for it is assumed that if aerial ocean transportation ever becomes a reality its promoters will aim at regularity of service maintained by means of a fleet of ships. We will regard the distance from New York to London at 3,000 sea-miles, though there is no good reason why the aerial service, if installed, should not have Halifax as its western terminal, thus saving more than one-quarter of the length of each voyage, and increasing the safety of the ships in even greater measure.

It is noteworthy that if the master of the aerial greyhound were to keep two of his propulsive units in operation throughout the voyage, he would make about 32 knots per hour, which is twenty-five per cent. greater speed than that of the *Mauretania* and *Lusitania*. Considering the winds as neutral, that is, helping as much as they hindered, the airship should make the voyage from New York to London, with two motors constantly working, in four days. The consumption of fuel would amount to 33,000 pounds, and the voyage would be completed with 27,000 pounds, or nearly one-half of the original supply, still on hand.

If the circumstances were such that the commander of the airship deemed it prudent to run three motors constantly throughout the voyage, the speed would be forty knots per hour, and the crossing would be effected in 75 hours, a trifle more than three days. This would be done at the cost of 40,000 pounds of gasoline, and there would still be ten tons of fuel in the bunkers.

Still assuming that the net effect of the winds is neutral, if the conditions favored running all four propulsive units throughout the voyage a crossing could be made at the rate of 45 knots, or in 67 hours, less than three days. But this fast trip would be accomplished by the expenditure of 47,000 pounds of fuel, leaving a margin of only 13,000 pounds still on hand; and it is therefore obvious that the master of the vessel would not care to run so close to the end of his store of fuel unless the conditions were unusually favorable.

One of the striking possibilities of this aerial express route is that on rare occasions a voyage might be made in which the winds were favorable throughout most or even all of the trip. Assume that throughout a voyage the wind was astern at an average of fifteen miles per hour. With the full engine power in operation the speed of the ship would be sixty knots (seventy statute miles) per hour, and the entire voyage would be over in fifty hours. Only two days and nights between New York and London!

If ships of this type, or even larger and more powerful, are ever put in operation between the metropolis of the new world and the metropolis of the old (and he would be a bold man who asserted that they will or that they will not), voyages made in two, two and a half or three days, will not be so very uncommon, and while regarded at first as among the wonders of the world will soon cease to rouse comment. It is quite within the range of the possible (we dare not as yet say the probable) that within twenty years it will be practicable for a traveler to leave New York by the air-line on Saturday, have a day or two in London, and be back in New York again the following Saturday night.

Of course the less favorable side of the picture is presented when we consider voyages in which the prevailing winds are contrary to the course. We may assume at the outset that when this aerial transocean line is put in operation its promoters will confine their voyages almost entirely to the summer season, when the tide of travel is heaviest and, fortunately, the winds are lightest and the weather best. In the summer months the average wind movement over the North Atlantic is only about fifteen miles per hour, and as a rule is somewhat variable, with a trend of movement from west to east. During those months eastward airship voyages could be made with facility and a high degree of safety. Westward voyages as a rule would be a little slower, and now and then one might be accomplished only with some difficulty.

On rare occasions it might be necessary to seek a landing in Newfoundland, or Nova Scotia, and the managers of the line should certainly equip landing stations in all these countries, as well as in Ireland and upon the French littoral, to be used in case of emergencies.

With the development of aerial ocean navigation will also come a like wonderful development of the science of meteorology. Here again we are assuredly upon the eve of great things. The United States Weather Bureau, under the able and energetic management of Prof. Willis L. Moore, now gathers meteorological data for the whole of the northern hemisphere, particularly the barometric pressures. The winds for several days in advance can be confidently predicted from thorough knowledge of the barometric gradients extending over wide areas. With land stations covering all the continents, steamships and airships sailing in profusion all the seas, and every one equipped with Marconi wireless, it is wholly practicable to collect each day data so complete as to enable the meteorologist to forecast the winds for the North Atlantic two, three or four days in advance, and to do so with a high degree of scientific certainty.

The commander of an aerial transoceanic liner would receive this information almost hourly by his wireless equipment. He could at once judge the conditions—whether or not in a given circumstance it were prudent to continue his voyage, return to the port of departure, or seek another port. In not a few instances he might advantageously change his route, running more to the south or to the north, seeking there the area of favorable, or at least of less unfavorable winds, which his information would justify him in expecting. All of this means simply progress, development of the agencies and instruments and organizations which man has already summoned to his aid in his persistent and successful struggle to master the elements and make them all subservient to his wants and needs.

The navigation of airships will develop new principles and methods. It will soon be found that it will not do in all cases to follow the precedents set by marine navigation. With the master of an aerial liner it is even more important than to the skipper of a steamship to make sure of having always at command an ample reserve of fuel. The usual and ordinary head wind conditions he is able to struggle against and overcome. But he must maintain a reserve to meet unexpectedly severe and persistent adverse conditions.

With strong and continuous head winds his situation is not as desperate as we might think it at first glance. For instance, if he is in mid-ocean, and finds strong head winds, and his meteorological information gives little hope of an early change for the better, this much is certain: He may find safety in running with the wind. The wind cannot be unfavorable for reaching both coasts—it cannot blow from both east and west at the same time. It may be a disappointment to owners and passengers to be compelled to turn back, but taking advantage of the very wind that made this retreat imperative he can quickly make his return trip.

To illustrate, an airship is voyaging westward. In mid-ocean it meets a westerly gale of 35 to 40 miles an hour. Wireless advices indicate that it is likely to continue for some time. Deciding not to continue the battle, the skipper turns and runs for Europe. With the wind alone his ship makes 35 to 40 miles per hour. Adding his entire motor service, he could make 80 or 85 miles per hour. At that rate it will not take long to cover the 1400 or 1500 miles which separate mid-ocean from the British coast.

Even with the most unfavorable conditions, there need be small risk of disaster. These airships are planned to remain a long time in the air. They are fitted, as we have pointed out, with means to overcome one of the greatest obstacles to aerial navigation by ships of this type, namely, the alternating expansion and contraction of the gas due to temperature changes. Being able to stay a long time afloat, they need fear neither rocks nor lee coasts. They can in case of emergency sail over land as well as over seas. Strong winds, storms, soon blow themselves out. Conditions change. The air skipper in command of a ship like this is able to weather the gale and keep a reserve of fuel for making a port after the condition shall have become more favorable.

It is true that an aerial transatlantic service could not be made quite as safe, and certainly not as regular and dependable, as that afforded by steamships. By the air route the traveling public must be prepared for occasional surprises. Now and then a voyage, particularly east bound, would be made in an unusually short time with favorable winds. Now and then with head winds a voyage would be disappointingly slow, and in rare cases it might be necessary to make a landing, at least temporarily, in some other port or country than the one called for by the schedule.

Such an airship as the one we have under consideration would carry a fair reserve of energy and radius of action with which to meet emergencies. With 60,000 pounds of fuel in her bunkers she could overcome all ordinary adverse conditions. To show graphically her capabilities I have prepared the subjoined table giving approximately various values relating to the energy, endurance and motoring radius:

Motors in	lbs. fuel	radius	radius	to cross the Atlantic	
operation	per hour	hours	miles	hours	lbs. fuel
1	175	340	7,820	130	23,000
2	350	170	5,440	94	33,000
3	525	114	4,560	75	40,000
4	700	86	3,850	67	47,000

Even larger airships than the one designed here can be built, able to carry still larger equipment of engines and greater stores of fuel. In fact, there is no reasonable limit to the dimensions such ships may take on in the future. Metal balloons or gas reservoirs are practicable on a large scale. Engines totaling five or even ten thousand horse power are not impossible.

Surprising indeed are the possibilities of size development in ships of this type. If we were to build an airship with a diameter twice the one we have been considering, or of forty meters (132 feet) and give it a length of ten times the diameter, its total lifting power would be 1,200,000 pounds, or 600 American tons. Such a ship could probably carry two or three hundred passengers besides her crew, her engines and enough fuel to run her across the ocean at high speed, despite the fact that the engine-power would have to total 12,000 horse-power to give her a speed of fifty knots per hour.

A monster airship like this would cost a million dollars to build and equip. But even at that figure it is not improbable she could carry a greater number of passengers in proportion to her construction and operation cost than a modern steamship costing six or seven millions of dollars.

CHAPTER LVI

THE FUTURE OF MECHANICAL FLIGHT

At the present time the world apparently has much more confidence in the future of mechanical flight than in the future of the motor-balloon. This is not surprising. Motor-balloons have met with many accidents, and have so far failed to perform much real or regular service; while so much that is spectacular and astonishing has been done with aeroplanes, it is only natural that the public should lose more or less faith in the one and build greater and greater hopes upon the future of the other.

For the future of mechanical flight, as for all forms of conquest of the air, we all entertain ardent hope. We are naturally optimistic. And our faith in the ingenuity, skill and persistency of man is great. It is a common thought that the construction and operation of the aeroplane—using that word generally for all mechanical flight apparatus—is an art now only in its infancy, and that in the natural course of things it must be developed as far beyond its present stage as the steamship and the automo-

Crew of the America in the Life Boat after leaving the Airship.

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bile and the railway have been developed from crude beginnings. It does not seem to any of us that having achieved so much—having really conquered the air so far as demonstration is concerned—man shall suddenly find himself stopped from going further, compelled to admit that there are limitations which he cannot overcome, and that his beautiful and wonderful apparatus, which he has developed with so much patience and sacrifice, must remain a mere toy, used almost exclusively for sport and exhibition.

It is an easy task to sit down and imagine the wonderful achievements of the future—artificial birds as thick as blackberries, every man who wishes being the owner of one, huge mechanical airships carrying passengers and freight across continents and oceans, aerial transportation largely taking the place of railways and steamships.

Though all of us, in our sanguine moments, dare to hope all of this may some day come, the present state of the art does not warrant great optimism. The men who are most experienced in the manipulation of mechanical flight apparatus are not the men who predict the marvels of which we read so much in the press. They realize that there are limitations to the art, limitations set by physical laws, mechanical principles and the nature of materials.

Hundreds of men and machines fly in the air. Some fly a little better or higher or through longer distances than others. Much depends upon the man driving the machine. All of the machines are in principle the same. All are small. All are limited in carrying power and radius of movement. All seem subject to the same restrictions.

The aeroplane of to-day is an air motor-cycle, which can carry one, two, perhaps three, possibly four men over short distances. The greater the load the shorter the flight. It is not a machine which any or all persons can drive. It is not as easily mastered as the bicycle. For this and many other reasons it is not likely to come into general use. To learn to drive it requires time, patience and courage, and also special aptitude. The men who make the greatest success with it possess this aptitude. They are not unlike the professional bicycle riders, men whose skill enables them to perform marvelous feats upon that machine. To-day aeroplane driving is much like aerial trick bicycle riding. It is only for the practised, the skillful, the daring, those with aptitude.

If the aeroplane were as simple as the bicycle, if it were as easily mastered, if use of it were no more dangerous, it might have a future as a useful vehicle, small as it is, and costly as it is.

[redacted]

But it is not simple; it is not easy; it is hazardous. And in its present form there is little reason to hope for its adoption even as a limited social vehicle—for tours in the country, for excursions, for going to and from town, for messengers, doctors, errands, visits. In other words, it does not bid fair in any sort of degree to take the place of the bicycle. We cannot say this is absolutely impossible, but at the present moment it is highly improbable.

The future of the aeroplane would be assured if it gave any promise of development into an air automobile. As every one knows, the motor-car is now one of the institutions of civilization. We wonder how we got along without it before it came. Not only has the motor-car come to stay, but it will be made better, cheaper, more perfect, more convenient, more useful. Any one can learn to drive it. It is not extra hazardous. It is capable of any sort of development or modification. It can be built of any size, for almost any purpose. No limitations hedge it in.

The aeroplane in its present form cannot be developed into a safe and convenient, and therefore common, family-carrying air motor-car because of the same limitations which prevent its being developed into something like the locomotive or the steamship.

The locomotive, the steamship, the motor-car are capable of almost infinite development. In this respect they are like the motor-balloon. We have just seen that the motor-balloon may be greatly developed in size and perfection. Moreover, the larger and heavier it is, other things being equal, the safer, the more likely to be of service to mankind, the more it can carry of engine power, fuel and cargo, the wider its radius of action, the greater its endurance and reserve for meeting emergencies.

Strangely enough, it is precisely this sort of development in size, capacity, power and usefulness that the aeroplane in its present form is apparently incapable of. I say apparently, for I do not believe the last word has been said. But taking the mechanical flight apparatus in all its forms as we find it to-day, and we seem to be justified in declaring that it is subject to this law of limitation:

Beyond a certain point in size, weight and capacity, any additions thereto are made with loss and not with gain of net efficiency.

A motor-balloon, for example, may be developed in all three dimensions—length, breadth, thickness. Double the quantity of materials used and you quadruple the volume or capacity.

The mechanical flight machine, in which capacity depends not upon the volume, but upon surface, is developable in only two dimensions, length and breadth. In principle, thickness is an absent dimension.

It appears to be impracticable to develop the two dimensions of length and breadth beyond a certain stage without doing one of two things, fatally reducing structural strength, or fatally adding excessive weight in order to get the strength. The larger the structure the greater must be the weight in proportion to the lifting surface. In development of size there thus comes a point, due to mechanical principles and the nature of materials, which cannot be passed. And this is the law of limitation which applies to the present aeroplane.

Great is the ingenuity with which constructors have striven to get the greatest possible lifting surface with the least possible weight. They have searched the world for light and strong materials, and have exhausted the art of mechanics in their employment. They use silk or cotton for surfaces, modern metal alloys, bamboo, or artificial bamboo-tube cleverly built up in segments and wound, the best of the woods and metals, the highest grade wires and appliances in their struggle for lightness and strength. They do the same with their equipment of motors, propellers, rudders and all accessories. It does not seem possible for them to go much further in this direction.

Moreover, when they build the largest and heaviest aeroplanes, able to carry the largest motors, they find these the most difficult and dangerous to handle. In fact, the tendency now is toward smaller rather than larger apparatus, easier and safer to manage, capable of higher speeds. In other words, aerial trick bicycle riding—and a most beautiful and admirable game of skill and courage it is—demands small, handy machines.

Thus the tendency of practice is away from and not toward the larger apparatus with greater carrying capacity in power, fuel, passengers, cargo, and ability to cover longer distances, which must come if the art is to have true progress. How can this be done with one dimension lacking—when enlargement of length and breadth alone results in loss of net carrying power instead of gain?

The great problem is to evolve a mechanical flight machine that can take on this missing dimension and thus acquire the true character of development. Can this be done? There is reason to hope; the last word has not yet been spoken. There is hope for the evolution of a new type, a new principle that will revolutionize the art and give to the world a really great and serviceable ship of the air.

Now human flight is much like the flight of birds—beautiful, graceful, fascinating as a spectacle, but on a relatively insignificant scale. Even if they were trained to do so, birds could perform no useful work. They have the power to carry only themselves, a worm or two, a bit of prey, a fragment of material for their nest-building. That is all the bird needs for himself. It serves his purpose. But this is not the sort of flight which serves or satisfies man. He must be able to fly, not only with the confidence, precision and safety of the bird, but he must have the power to carry cargo, passengers, mails, goods.

At the same time, it is obvious the aeroplane of to-day, like the present motor-balloon, may be used in certain favorable circumstances for limited commercial work or social convenience. In France an aeroplane has been driven 360 miles in a single flight in eight hours. One was driven 167 miles without stopping, carrying one passenger. It is probable that with perfection of the existing types even these fine records may be excelled. And such performances unmistakably indicate use of the mechanical bird for carrying light mails and messages between points where better and more certain and cheaper means of communication are not available: For example, between mountain towns, or from islands to mainland, or over rugged country where the building of railways is too difficult or costly. In new countries, or along the frontiers of civilization, aeroplanes may perform valuable service.

Despite their limitations, both the motor-balloon and the artificial flight apparatus, as we now know them, seem to have a certain field of usefulness in the service of society in a limited way. And of the two, it is probable the mechanical bird will be more generally employed. It is cheaply built and operated. It is in small units. No expensive plant or gas apparatus or shelter house is needed for it. And when the new type of machine comes—as we feel sure it will come—with greatly enlarged power and capacity, wider radius of action, and probably with greater safety and certainty of operation, its commercial and social uses will rapidly broaden.

Once in flight, aeroplane efficiency increases with speed. The machine of the future will probably develop speeds above 100 miles per hour; and crossing the ocean from New York to London in a little more than 24 hours is a dream which may easily come true during the next generation.

Both types of aerial craft—lighter and heavier than air—are already available for the purposes of scientific warfare.

CHAPTER LVII

AERIAL NAVIGATION IN TIME OF WAR

We have fully and frankly pointed out the difficulties which stand in the way of the commercial utilization of aerial navigation—difficulties which are not insuperable and which may yet be removed. The chief difficulty is largely one of the hazard inevitably involved in the navigation of such craft—hazards which capital will be slow to incur. But no such obstacle stands in the way of the utilization of aerial navigation for the purposes of war. Commerce may or may not be able to afford the risk; war certainly can afford it. For war is of its very essence hazard—hazard to life, to property. There are no risks, either of life or property, involved in aerial navigation which are beyond the normal scope of war operations. In fact, when submitted to close analysis, we shall find they are far below the normal. The only question remaining to be answered, therefore, is as to the usefulness of aerial craft in the practice of the military art.

As these pages go to press I am submitting to the Congress of the United States a proposal that our government take an advanced step toward utilization of aerial navigation in time of war. It would not be proper for me to state here all that I am suggesting to the government. There are certain details which for the present at least must be withheld. In case the government should adopt my suggestions, there are plans and ideas which it would not be wise or patriotic to make public at this juncture.

It is proper for me to add that the proposal which I am submitting to the government involves no business contract or profits of any sort for myself. If out of my experience, somewhat extensive, in designing, building, assembling and navigating large motor-balloons, and in studying the art of aerial navigation as a whole, there has come anything which is of value to the country, the country is welcome to it without price.

The plan which I submit to the government at Washington is bold and far reaching. If it is based upon sound and rational theory, as I believe it is, and it is adopted and put into force, I believe it will to a considerable extent revolutionize important branches of the art of war. I further believe it will introduce an epoch in military operations, and ultimately contribute materially, by making war far more scientific and more destructive, to the great movement which is now so strong among all the advanced peoples toward the era of universal peace.

Ten years ago my late friend and sponsor before the French Academy of Sciences, Prof. Janssen, director of the Astrophysical Observatory at Meudon, said to the International Aeronautic Congress at Paris, of which he was president:

"It was Themistocles who declared that 'he who shall make himself master of the sea is destined to become master of the land.' Now if the ocean has given this power to the nation which was wise enough to seize it, how much greater will be the coming mistress of the air? While the sea separates and renders passage of even a narrow channel difficult in the face of a hostile force, the air unites all nations and offers a route from any point on the earth's surface to any other, which can be traversed with impunity, no matter how vigilant the patrol. Political or natural frontiers will no longer form barriers between states when aerial fleets can sail over them."

The suggestion which I offer the United States government does not comprise plans for operating aerial fleets over land, though that phase of aerial warfare will come for the nations which have need of it. The United States has no such need. For geographical and political reasons we are virtually an isolated power. Our policy is one of peace. We are not likely to cross the seas to attack an enemy. The only thing we have to fear is that some enemy may cross one or other of the oceans which lie beyond our borders and attack us. Hence coast defense is peculiarly important to the people of the United States, and is to-day the only feature of our military establishment which gives any serious concern to the authorities and the strategists.

What I propose is that the United States shall take up the art of aerial navigation and make serious effort to utilize it for the national defense by creating a comprehensive and well-supported Aerial Military Establishment, and proceed to the construction of air fighting and scouting ships and machines.

The plan comprises:

First—Creation of an Aerial Coast Defense Fleet composed of both motor-balloons and mechanical flight apparatus, a fleet of such craft to be stationed along both the Atlantic and Pacific seaboards.

Second—The creation of a fleet of aerial scouting ships which may revolutionize the art of securing naval and military information in time of war.

Third—The creation of a fleet of aerial battleships and battleship destroyers, composed primarily of motor-balloons but with many aeroplanes fitted to the combination and to serve as advanced scouts and aerial torpedoes—a fleet designed and prepared to take the offensive, to meet an approaching enemy and destroy or damage him.

Fourth—This aerial fleet to constitute the first or outer line of national defense, leaving our navy in all its branches—battleships, cruisers, destroyers—to constitute the second line, and the distinctive coast defense vessels and the coast mines and land fortifications the third and fourth lines.

It is my belief I shall be able to show that this first or aerial line of defense will be worth far more than its cost in scouting alone; far more than its cost as a means of striking the first blow alone; far more than its cost in its moral effect upon an enemy alone; and in all its fields of usefulness worth a hundred times its cost, because at a relatively small outlay for construction and maintenance it will double the effectiveness of our naval and coast defense system.

In time of war, when a great nation, its cities and commerce, are liable to be struck by the approaching fleet of a powerful enemy, the value of early and accurate information as to the enemy's movements is incalculable. Early and trustworthy information gives the home government opportunity to mobilize its naval and military forces, perhaps to change the whole plan of campaign previously determined upon, to strike when and where least expected. As many battles are won by information as by valor.

We propose that each American seaboard shall be patroled by fleets of fast air scouts, able to cruise from a thousand to fifteen hundred miles from our shores, pick up the enemy and report him by wireless telegraphy. These motor-balloon cruisers would possess the invaluable ability to sight the enemy without the enemy knowing he was discovered; and within a few minutes the home authorities would be fully advised of the foe's force, dispositions, course, and apparent destination.

Observers upon the decks of a scouting airship have enormous advantage over those confined to altitudes but little above the sea level. At the heights to which an airship may rise her officers have a sweep of the seas for many miles and may observe without being observed, as their ship forms but a tiny speck in the skies.

In case of coming into close contact with an enemy the scout-ships might be able to inflict as much damage as they received. But in general they would seek safety in their altitude, above the reach of guns, and in their high speed, which would enable them to run away from the fastest torpedo boat or destroyer on the seas. If in the accidents of war and weather a ship were lost now and then, the loss would be a trifling one compared with the service which it might be able to render. Such a ship would represent a first cost of less than a quarter of a million dollars, and her maintenance would be a bagatelle. The value of a few aeroplanes is relatively nothing at all. Even if ships were lost, their crews would have excellent chances of escape by means of their lifeboats.

For the second line of defense, the fleet of aerial battleships and battleship destroyers, I propose larger air-craft, with a total lifting force of sixty to seventy tons, able to carry large stores of fuel and with a cruising radius great enough to enable them to cross the Atlantic, equipped with powerful wireless, carrying explosives and means of using them against the enemy which cannot be here disclosed.

In case of war it must be expected that now and then an aerial battleship will be lost or wrecked, destroyed by the enemy in battle or drifted away in storms. But these craft cost only a half million dollars each. They are manned by twenty or twenty-five men all told. And they are attacking and perhaps destroying dreadnoughts which cost ten millions and whose crews number eight hundred or a thousand souls.

If ten air battleships should be lost in destroying one of the enemy's dreadnoughts the ad-

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