

MY ZEPPELINS



HUGO ECKENER

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DR. ECKENER'S name, like that of his predecessor, Count Zeppelin, is synonymous with airships — those majestic, cigar-shaped dirigibles that were a familiar sight in the decade before the war, sailing through the skies.

This is Dr. Eckener's own account of his ships, particularly the two *Graf Zeppelins* and the *Hindenburg*, and the history-making flights that he made in them across the Atlantic to New York, Rio de Janeiro, around the world, and on Arctic exploration.

After his first, rather reluctant, meeting with Count Zeppelin, Eckener's life became one of high adventure and struggle—high adventure in successfully pioneering commercial airship flights — struggle in the early years in trying to raise funds for his then fantastic idea, and with the politicians for hangar accommodation.

Flights frequently included tense moments when, for instance, the fin of the first *Graf Zeppelin* was rent in a mid-Atlantic squall, and his son volunteered to crawl out on to its bare framework to free the fluttering tatters of fabric so that the elevator would not jam. Or when torrential rain, followed by hail and icing, battered the *Graf Zeppelin* down to less than 200 feet from the ground in a deep mountain valley. With her engines straining Eckener finally coaxed his ship upwards to safety.

The many photographs have been especially selected for this book, and several of them have never been published before.

Hugo Eckener's son, Knut, has added a technical chapter on the development of airships, which puts Eckener's ships in their correct perspective and explains the theory and practice of lighter-than-air flight.

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Beringer & Pampaluchi, Zurich*

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The first *Graf Zeppelin* soars past the 14,000 foot Finsteraarnhorn in the Swiss Alps, 1929.

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By HUGO ECKENER

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With a technical chapter by
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CONTENTS

INTRODUCTION	11
I. THE FLIGHT OF THE <i>ZR III</i> (<i>LOS ANGELES</i>)	19
II. THE FIRST FLIGHTS OF THE <i>GRAF ZEPPELIN</i>	32
III. A SENTIMENTAL JOURNEY TO EGYPT	57
IV. THE FLIGHT AROUND THE WORLD	67
V. THE SOUTH AMERICAN SERVICE, 1930-37	95
VI. THE ARCTIC FLIGHT OF 1931	119
VII. THE VICTORY OF THE ZEPPELIN CON- CEPT 1931-37	140
VIII. THE <i>HINDENBURG</i>	155
IX. HELIUM TROUBLES AND A GLOOMY ENDING	174
A NOTE ON THE TECHNOLOGY AND DEVELOPMENT OF THE ZEPPELIN AIRSHIP	185

ILLUSTRATIONS

- | | |
|--|----------------------------|
| <p>The <i>Graf Zeppelin</i> over the Alps (Photo: Beringer & Pampaluchi, Zürich)</p> | <p><i>frontispiece</i></p> |
| <p>1. The <i>Hindenburg</i> nears completion (photo: Friedrich Moch)</p> | <p>32</p> |
| <p>2. Dr. Eckener and Count Zeppelin (photo: Friedrich Moch)</p> <p style="padding-left: 20px;">The Zeppelin <i>Schwaben</i> (photo: Friedrich Moch)</p> | <p></p> <p>33</p> |
| <p>3. The "Reparations Ship" LZ 126, <i>Los Angeles</i> (photo: Friedrich Moch)</p> | <p>48</p> |
| <p>4. The <i>Graf Zeppelin</i> on Lake Constance, 1931 (photo: Friedrich Moch)</p> | <p>49</p> |
| <p>5. Control room of the <i>Graf Zeppelin</i> (photo: Associated Press)</p> <p style="padding-left: 20px;">Salon of the <i>Graf Zeppelin</i> (photo: Associated Press)</p> | <p></p> <p>128</p> |
| <p>6. The damaged <i>Graf Zeppelin</i> fin (photo: Pacific & Atlantic)</p> <p style="padding-left: 20px;">The <i>Graf Zeppelin</i> ready for Mid-West Flight (photo: Acme)</p> | <p></p> <p>129</p> |
| <p>7. The <i>Hindenburg</i> over New York, 1936 (photo: Friedrich Moch)</p> | <p>144</p> |
| <p>8. The <i>Graf Zeppelin II</i> on her maiden flight, 1938 (photo: Douglas Robinson)</p> | <p>145</p> |

MY ZEPPELINS

INTRODUCTION

How DID I fall under the spell of Count Zeppelin and his ideas—I, a “philosopher” and political economist, and least of all an aeronaut and technician? I have read all sorts of stories about this, out of curiosity or a wish to learn more about myself; they were more or less correct, sometimes I was amused, sometimes annoyed; so I feel I should tell the story myself.

In September, 1900, the editors of the *Frankfurter Zeitung*, to which I had occasionally sent short articles, inquired whether I would care to “report on Count Zeppelin’s future experimental flights”, which according to report were scheduled for the near future. The paper had sent one of its own reporters for the trial flight in July, but “did not consider it worth the trouble to send someone again to Lake Constance”. I had not been in Friedrichshafen at the time of the July flights, but, since I was not really interested in Count Zeppelin’s experiments, I had been vacationing on a yachting cruise in the Baltic. The newspaper reports that I read then about the first trial flights in July, 1900, had convinced me that the solution of a significant as well as a difficult problem was being pursued above the surface of Lake Constance. Therefore I accepted the commission of the *Frankfurter Zeitung*. So I actually reported the ascent which took place in October, but I adopted a rather cool and critical tone in my story.

It is not correct, as was stated later about me, that I was at first an “opponent” of Count Zeppelin, and later was “converted like Saul into Paul”. I merely asserted that the heavy ship with her metal framework had actually risen into the air and had attained a certain speed, naturally showing herself to be controllable also, but that the speed of 13–16 miles per hour which she had attained was much too slow for her to withstand even a moderate wind, or to advance against it. This observation, which Count Zeppelin contested, was undoubtedly correct, for no higher speed could have been developed with the two engines of 16 horsepower each with

which the ship was equipped. The experts were not convinced. The Count was forced to dissolve his "Joint Stock Company for Promotion of Airship Flight", and it seemed that that would be the end of the matter. But everyone underestimated the old gentleman's determination.

He was not in the least discouraged and presently completed a new ship, built largely with his own funds, which had engines of 85 horsepower each. In the late autumn of 1905 the ship made her first and only flight. A catastrophe resulted. Although the flight started off well, a stiff west wind sprang up and drove the ship helplessly into the Allgäu, where she was wrecked near Wangen, about 20 miles from the take-off point. The fate of the Zeppelin airship seemed finally and definitely sealed. It was a general laughing-stock, and the experts, who had always insisted that it would be impossible to land an airship with a fragile rigid framework, seemed to be vindicated by the wrecked ship lying across the field. Count Zeppelin, heartbroken and discouraged, declared in fact that he would build no more airships.

I had been a spectator of the whole event and drove quickly by car to the field where the ship had stranded. There I found the old Count quietly and calmly standing beside the badly damaged hull and giving orders for it to be dismantled. I described my observations in a report for the *Frankfurter Zeitung*, emphasizing that the controls seemed inadequate, particularly in the vertical plane, as the ship flew much of the time at a marked angle of slope and apparently could not be brought to an even keel.

But now for the sequel: a few weeks later, as I was working in the garden, our maid came to me, quite excited, to say that Count Zeppelin was ringing the doorbell. I told her to invite the Count inside and show him into the living-room, where I would join him immediately. I pulled off my working-smock, tried to make myself presentable for the prominent visitor, and went into the room. Here I found the old gentleman in meticulously correct morning clothes, with silk hat and yellow gloves, the courteous and distinguished aristocrat which he was at all times. I was curious to know what had caused him to call on me. He drew a copy of the *Frankfurter Zeitung* from his coat pocket, pointed to an article signed "Dr. E.", and asked if I had written it. I said I had, whereupon he said he wanted to thank me for the friendly tone in

which I had written about him personally, but that he wished to discuss further with me some inaccurate statements included in my article. He then explained to me in the course of a long conversation that the only design error in the otherwise successful ship was that she had no stabilizing fins at the stern, no "empenage", which an arrow, for instance, must possess if it is to fly straight through the air rather than sideways. He was determined to continue his efforts, but the next ship would have to have stabilizing surfaces, in order to keep her on a steady course. His statements convinced me. And when he extended a very friendly invitation to me to call on him whenever I might want information on any kind of question, I accepted gladly, perhaps more from a human interest in the personality of the Count himself than from any real interest in his ideas on airship construction.

When he invited me to dinner a few days later, I went with a faint and not entirely agreeable premonition that the visit might lead to a relationship that could influence my future life and work to a large extent. The result was much more far-reaching than I ever suspected. The description of his situation, which the Count gave me, revealed all too clearly the fixed, almost malignant, hostility to his ideas among all governmental officials and agencies that were involved in promoting such projects and others of a similar nature. The Prussian airship battalion, which was most directly involved in the matter, was developing its own ship, a so-called semi-rigid, and was particularly bitter in its opposition. And the technicians, scientists, and industrialists who had previously been interested in the Count's efforts and had encouraged them, had been disillusioned by the catastrophic ending in the Allgäu and wanted nothing more to do with the matter. It was obvious that only a steady and unremitting educational and publicity campaign could revive this interest. Clearly the Count's appealing personality, which aroused respect and admiration, would be an important factor in this publicity effort.

I told the Count that in view of the great progress with internal-combustion engines, I believed in the practicality of his ideas and that, in my own way, I would try to publicize his cause. He accepted my offer with thanks, though perhaps with some scepticism. Personally I was rather more optimistic, as my calling had shown me the great influence of public opinion. I realized that

henceforth I would have little time for my previous intellectual pursuits, and would have to devote most of my life to the Zeppelin project. And the changing fortunes of the Zeppelin during the next three years brought me to the point where I was obliged to demonstrate the worth and capabilities of the rigid airship not only with the pen, but eventually also with the steering-wheel, in my hand. Thus the "philosopher" and economist was turned into an airship man, but one who, I would like to think, endeavoured constantly and with success to combine his moral and political ideals with the purely technical approach.

I cannot go into details concerning the first years of my work with the Zeppelin enterprise, with its constant series of successes and failures, today soaring through the clouds, tomorrow plunged in the depths of despair. These have already been presented in my commemorative book on the hundredth anniversary of Count Zeppelin's birth. I would minimize this period, as I was more of an astonished spectator of these events rather than an active participant. These were not merely my own experiences, but those of the entire German people. They were so exciting and tumultuous that they could be described without exaggeration as a portion of the great history of the German people. Their hero-worship for the old Count and enthusiasm for his airship were amazing. The most tangible manifestation of this feeling was without doubt the popular contribution of more than one and a half million dollars, which was accumulated in a few days after the Count lost his airship in a thunderstorm at Echterdingen. It was amazing. When the Count returned dejectedly to Friedrichshafen the next day, and was met at the station by a silent, bareheaded crowd, I greeted him with the words, "My congratulations, Your Excellency!" He looked at me in amazement when I told him that already during the night several hundred thousand dollars had come in as a fund for a new ship.

Yes, it was a miracle! The catastrophe, which according to all human expectations should have marked the end of the Zeppelin dream, instead set Zeppelin's work on a firmer financial basis than it had ever possessed before.

However it happened, the very significant fact remained that the people had offered Count Zeppelin a gift of more than one and a half million dollars, with which he immediately built a construc-

tion shed and a new airship. But what to do next? The army airship troop was not yet interested enough for the factory to be able to count on many orders from this source. The misfortune at Echterdingen had actually merely vindicated and reinforced the scepticism of official circles. In this situation the energetic business manager of the Zeppelin Company, whom the Count had discovered in the person of Herr Colsman, had the brilliant idea of exploiting the general enthusiasm by founding a "German Airship Transportation Company", *Deutsche Luftschiffahrts-Aktien-Gesellschaft*, called the DELAG for short. This Company would have the task of ordering airships and placing them in service and testing their capabilities in practical operations. This last seemed particularly necessary in view of the many disasters which had overtaken the ships.

It is astonishing that this enterprise succeeded, and succeeded easily, with a capital of \$750,000. The mayors of most of the large cities were so eager to join the Board of Directors of the DELAG that this finally had more than twenty members, with each mayor endeavouring to arrange the building of an airship hangar for his city. For it was taken for granted that a Zeppelin air line would promptly be set up between the larger cities. Frankfurt, Cologne, Düsseldorf, Baden-Baden, Munich, Leipzig, Dresden, and Hamburg were the first subscribers for airship bases. They all gradually achieved their aim, but suffered many disappointments on the way, for it turned out that the difficulties were greater than had been expected. And, unfortunately, I must admit that I bore a large share of the guilt, for the mayors' optimism was a result of the publicity I had carried on for the last four years. But "all crimes must be paid for in the end", and thus it presently came about that I personally had to assume the difficult task of proving the capabilities of the Zeppelin airships. This caused me many sleepless nights, and tortured hours, before success was achieved.

The first DELAG ship, the *Deutschland*, was wrecked in the Teutoberg Forest on one of her first flights out of Düsseldorf. She proved to be too slow to hold her own against a stiff west wind that blew up, particularly after one engine failed. A replacement ship was put in service; but who would fly it, since the *Deutschland's* commander had been dismissed as unsuitable after his piece of bad luck? Herr Colsman asked me if I would take a chance on

it. Naturally I had to accept, since I had always championed the usefulness of the Zeppelin airships. Thus I became "Director of Flight Operations" and airship captain with the DELAG.

There were three main problems to be solved. Firstly, the difficulties and dangers involved in bringing the airships in and out of their sheds in a cross-wind had to be resolved. Secondly, capable steersmen had to be trained to land the fragile ships. Thirdly, a worth-while weather service had to be set up capable of judging the weather accurately. I believe that we succeeded in solving all three problems, but I will never forget the heavy burden on my conscience whenever I had to decide in a critical situation whether I dared to take the ship out of the hangar in a strong cross-wind, or to take off in the face of a threatening weather front; while the passengers gathered around the ship and waited impatiently for the word to go on board. A refusal would make us ridiculous and damage the enterprise; while an irresponsible decision to take off could endanger the ship. How many times in such circumstances have I cursed the fate that made me an airship captain!

Once, right at the beginning of my service as an airship captain, the presence of a large crowd of spectators and a cabin full of influential and important guests tempted me to risk taking the ship out of the hangar with the wind from an unfavourable direction. I paid for my weak-kneed decision by damaging the ship so badly that she had to be almost completely rebuilt, and thereafter was cured of such impulsive acts.

More and more we learned to overcome our difficulties by making proper arrangements and developing a sure skill. Thus we made more than two thousand flights, carrying tens of thousands of passengers, in the four ships *Schwaben*, *Viktoria Luise*, *Hansa*, and *Sachsen*, between the years 1910 and 1914. But it was nothing less than an "air line" that we were running. We made local flights of about two hours' duration, during which our enthusiastic guests enjoyed the charms of flying, the realization of man's dreams of conquering the air. Nevertheless, the DELAG fulfilled its main purpose, which was to train a nucleus of qualified commanders and steersmen, and, above all, to develop a familiarity with the elements in which the aircraft had to fly in the ocean of the air, with all its dangerous tricks.

The DELAG, therefore, became the university of airship flight, and the armed forces presently detailed groups, generally consisting of an officer and three or four non-commissioned officers, to participate in our flights. Especially significant was the participation of the Imperial Navy in these assignments, for we held the opinion that the Zeppelin would perform much better service for scouting at sea than could cruisers and other such surface vessels. It was a real satisfaction and joy for me when the Navy in the year 1914 decided to set up a "Naval Airship Division" with the intention of employing the Zeppelin airship as an aerial cruiser. When the war broke out, I reported to the Admiralty as a "volunteer airship captain", with the hope of being assigned to command a naval airship.

The Admiralty accepted the offer of my services and ordered me to duty as "instructor" to train naval airship commanders. As such, I gave theoretical courses and conducted practical instruction on training flights. Now and then these training flights involved us in combat service, for a corner of the North Sea would be assigned to the training-ship as a scouting area. I was on a footing of close friendship with the extraordinarily capable and energetic "Leader of Naval Airships", Captain Strasser, and was able to advise him in many ways in his efforts to make naval airships larger and thereby more serviceable. Strasser did not have the fear of big ships which prevailed in the Army Airship Battalion and which had prevented the building of more efficient Zeppelins. He clearly recognized that this fear of size had to be overcome in order to achieve really worth-while airship performance in combat. If a man like Strasser had arrived at his post two or three years earlier, at the outbreak of war we would have had naval airships of outstanding performance. When Strasser's goal was finally attained in the year 1917, the enemy's defences had meanwhile become so strong, with the ground anti-aircraft and improved aeroplanes, that nothing more could be done with airships.

At the same time the Zeppelins had performed very valuable service in the first two or three years of the war. Brilliantly commanded by highly qualified, selected naval officers, they kept a constant scouting watch over the entire North Sea, and thereby relieved the cruiser squadrons to a very great extent. At the Battle of Jutland, although hampered at first by thick weather, they were

able to send a message to the Commander-in-Chief of the Fleet at a time of vital decisions which very probably saved the German Navy from severe losses. They reported the approach of a strong enemy squadron. The air raids on London in the first years of the war could have had an effect hardly to be overestimated if they had been made by bigger ships operating safely at higher altitudes. As it was, they were no more than pin-pricks, painful, but still pin-pricks. It was a tragedy of lost opportunity!

When the Seamen's Revolt broke out, I returned home in November, 1918. I had become thoroughly familiar from close range with an interesting chapter of the war and had been able to follow the progressive development of the airship towards a worthwhile commercial vehicle. The transoceanic ship was here! But the conditions of peace at first forbade us to build and fly it. What more could we do? Was the Zeppelin idea dead, at the very moment when its realization was possible? The task now before me was to try to overcome the restraints. The following pages will tell how this came about.

I

THE FLIGHT OF THE ZR III (LOS ANGELES)

THE RIGID airship, the "Zeppelin", had been not without a certain military value in the first World War, both as a scouting craft and an attack weapon. This seems all the more astonishing when one considers the Zeppelin's relatively low performance, particularly those in service at the beginning of the war. At first they had a gas capacity of only about 700,000 cubic feet, a maximum ceiling of 6,500 feet, and a speed of 46 to 50 miles per hour. But they encountered practically no opposition. Aeroplanes were still in their infancy, and an effective and well organized anti-aircraft defence was not in existence. This changed rapidly. The defences became more effective. But the airships were also improved: they were enlarged to 1,100,000, 1,200,000, 2,000,000 cubic feet, with a ceiling that gradually rose to 16,000 feet, and a speed which increased to 72-75 miles per hour, and thereby enabled the ships to be flown in strong winds. It was a race between the attack and defence, which continued until the end of the war. But already in 1916, when phosphorus incendiary ammunition had come into use and simultaneously the climbing performance of aircraft was greatly increased, the Army gave up employing airships. Only the German Navy continued to use them, for occasional bombing raids, particularly on London, and for scouting flights in the North Sea. The ships increased in size to 2,500,000 cubic feet, the ceiling was raised to 23,000 feet, and what the Zeppelins achieved, and what they could have achieved in these respects up to the end of the war, was so valuable militarily that very large Zeppelins were characterized as dangerous and effective war machines. Hence the so-called London Protocol prohibited Germany from building Zeppelins of more than 1,100,000 cubic feet capacity.

This was the situation in the year 1920, when discussions began

between the Zeppelin Company and the American Military Commission in Berlin on the question of whether the Zeppelin Company should build an airship for the American Navy Department. At the end of the war, four of the latest Zeppelins had been seized and later divided up among the Allied Powers. These ships were out of commission and hung up by tackles at a naval airship base under the care and supervision of their naval crews. But when the surrendered German Fleet was scuttled by its own crews at Scapa Flow, this deed inspired the airship crews. They let the ships fall on the hangar floors and destroyed them. The Allies ordered compensation to be paid to the respective Powers and set America's share at \$800,000. This was the beginning of the negotiations with the Zeppelin Company: we proposed to pay the compensation, not with gold, but with a replacement ship. We did not handle this proposal through the appropriate Government department, the Treasury, but direct with the American Military Commission.

The American Military Commission was immediately interested in our proposal, and prolonged negotiations with the Navy Department led to the result that America showed its willingness to accept a new replacement ship in place of the \$800,000 due to it, with the stipulation that the airship be delivered in good condition in America. The delivery flight would then prove the ship's airworthiness. The Zeppelin Company accepted this condition, but the transaction was not complete; for we had to admit to ourselves, and could easily demonstrate, that a ship required to cross the Atlantic Ocean must have a volume of at least 2,500,000 cubic feet—the same size as the last wartime ships. But the conditions of the London Protocol forbade us to build ships of more than 1,100,000 cubic feet. Furthermore, we could prove that such a ship could not be built for \$800,000, but would cost at least \$900,000. The Navy Department therefore had to arrange for the relevant condition of the London Protocol to be set aside in this case, and had to provide the additional sum of \$100,000 from its own funds.

The contracts between the Government, the American Government, and the Zeppelin Company were all signed simultaneously on the same day. It was the day on which Secretary Rathenau was assassinated—the man who had consistently recommended the signing of the contract.

The building of the ship began in the same year. She was a ship

of 2,542,320 cubic feet capacity, with five Maybach engines of 350 horsepower. A small staff of three American Navy engineering officers came to Friedrichshafen to supervise her construction and to discuss details with the engineers of the Zeppelin Company. This led to a delightfully harmonious co-operative effort. By the end of September, 1924, the ship was completed and made a first short trial flight over Lake Constance, during which we were fortunate, if I may say so, to fly through a very rough line squall which put the ship through a severe test of strength. After a further and more extended trial flight, which revealed no defects, the start of the transatlantic flight was set for October 12.

I looked forward to the flight with complete confidence. This did not prevent me from undertaking it in great earnestness and with some of the feelings of a gambler; for it was clear that not only the lives of the participants, but also the fate of the Zeppelin idea, would depend on our success. A failure would, in these circumstances, have meant the end of the Company in Friedrichshafen and with it the only place where the rigid airship tradition and the belief in its future were still alive. A failure would certainly discourage from further efforts countries like England and America, which were rather hesitantly building replicas of the Zeppelins.

But failure to use the opportunity offered to us, to demonstrate the capabilities of the rigid airship, would in my opinion have also meant the death of the Zeppelin idea, for who would carry it on if its present advocates should disappear along with their entire carefully-built-up organization? Thus we had to risk the gamble! For it is always a gamble, no matter how much conviction and confidence one may have. One always needs some luck, if not in the sense that especially favourable circumstances should help, but in the sense that no especially unfavourable circumstances should interfere. And when can one be sure? I had to tell myself: we already knew that Zeppelins had shown their ability to survive severe line squalls—but what were such line squalls like over the North Atlantic? We knew of course that line squalls over land were especially turbulent because of heating of the air over the ground, but also a storm's horizontal velocity was much greater over the sea and could perhaps lead to increased turbulence in the squalls. There certainly was a gap in our knowledge in this respect,

which could only be filled by practical experience. Above all, I had to remind myself that the ship had no excess of lift and that we had to be economical with the fuel, which would only last for about eighty hours for all engines. If very unfavourable wind conditions should develop over the North Atlantic, where fresh west winds usually prevail, we would be in danger of running out of petrol.

This consideration led me on the day planned for our departure to a decision which caused something of a sensation, and even some complaints among the crew. Early on the morning of October 12 the ship lay in the hangar ready to take off. The crew and the American Navy acceptance commission were on board, petrol and water ballast had been loaded in the amount which we believed we could carry with the prevailing weather conditions, and which we believed to be sufficient for the flight. The ground crew were holding the handling lines, ready to walk the ship out, and the crowd of spectators waited excitedly for the signal to start. But it did not come! The engineer in charge of taking her out came to the control car to report that the ship was now no longer "weighed off", but had instead become heavy.

I released several hundred pounds of water ballast, but the ship remained heavy, and in fact became steadily heavier, so that it seemed necessary to release further ballast. The cause of this situation was that fog with warmer air temperatures had begun to flow in, while it had up to then been cool and clear. Warm air provides less lift than cold air. It did not seem advisable to sacrifice more water ballast, for we had already limited the amount to the least necessary. Then we would have to sacrifice petrol! But since this would involve a matter of 900-1,100 pounds, and since the air grew steadily warmer, I promptly decided to put off the flight till next morning.

The waiting crowd jeered, and people could be heard saying that we had "lost our nerve". The newspaper reporters raced off to tell their papers the news, and the public, who had waited with great excitement for the news of the take-off and who had expected the whole enterprise to proceed according to schedule with a certainty born of confidence in us, and from their wish for a sensation, were visibly disappointed. I naturally expected such a reaction from public opinion and hesitated long before finding the

courage to say the words, "The flight is postponed!" Few decisions in my life have been harder than this one. But even today I am glad that I found the courage to make it.

Next morning we were ready again, but an hour earlier, in order to escape any warm morning fog. And this time we succeeded in taking off with the whole load.

The start went wonderfully well. We broke through the overcast at 650 feet and were floating above a shimmering ocean of mist lit by the rising sun, while the chain of the Swiss Alps rose through the mist to the south. We were happy that the "great day", for which we had hoped so long, was here at last. The Zeppelin was going to show what it could do! We headed for Basle above the sea of mist. Then it cleared off, and France lay below us in bright sunshine.

After carefully examining the weather map, we had chosen a course somewhat to the south of the normal steamer route. For the northern part of the North Atlantic was dominated by low-pressure areas which had produced very strong westerly winds down to a line from Newfoundland to southern England. It would have been foolhardy to have headed into them. So we steered a course that would take us over southern France and Cape Finisterre to the Azores, beyond which we should await further developments in the weather. This way was about 400 miles longer than the steamer route, but the flight time could be expected to be shorter. Airship navigation must always be "meteorological", if it is to produce the best results. Modern planes, because of their great speed, can normally fly the shortest distance regardless of the wind.

France lay like a garden beneath us. We looked down with a sort of sensual pleasure on the stony hills where the vineyards of Burgundy grow, and later came to the region where the Bordeaux grapes stretch across level fields in the soft sea air. How different did we find both the country and the flavour! We reached the sea coast at the mouth of the Gironde shortly after noon, and saw the foaming surf stretching out of sight to right and left like a bright, sharp dividing line between land and sea. We crossed with feelings of tense expectation, perhaps with inner jubilation. Before us lay the boundless plain on which we were to gain our first evidence to decide the question whether airships could safely be

navigated across it. Our dreams and our hopes were on the verge of fulfilment.

Now the plain lay relatively calm below us. Only a long, high swell from the west showed that far away, stormy winds had been blowing or were blowing now.

We continued our steady, comfortable flight to Cape Ortegal on the north-west coast of Spain. The sun sank gradually to the horizon, and it became steadily darker and more mysterious on the wide waters, whence many fishermen and seamen looked up in amazement at the wandering star passing over their heads. Towards midnight we reached the lighthouse on Cape Ortegal. Far off in the south-west blazed the powerful light on Cape Finisterre, which has been the guide and salvation of many thousands of mariners blown on to the dangerous north-west coast of Spain on stormy nights. For us it provided a last greeting from Europe as well as the fixed point of departure for our journey across the trackless sea, which we had to cross to reach a goal 4,000 miles distant. Could we be sure of finding that point?

We had developed our navigational procedures from the means then available. To navigate safely and accurately in the ocean of the air, one must be able to estimate accurately the "set of the current", to borrow a nautical expression, in order to set the course to be followed by compass. This current setting naturally exceeds that encountered in surface vessels to the degree that wind velocities exceed those of ocean currents. How are the strength and direction of wind currents to be estimated? They constantly fluctuate within short intervals of space and time.

At that time we used an acetylene-filled "smoke bomb" which was dropped from the ship and which gave off smoke and flame on striking the water. Then, by taking bearings, it was easy to find in what direction and at what angle the ship was drifting. But to measure the ship's speed over the surface of the ocean, one had to know not only the drift angle, but also the direction and force of the wind, and it is clear that winds of quite different strength and direction can produce identical drift angles. Thus it was necessary to make "wind determinations" by measuring the drift while steering on two different courses, after which a simple graphic plot gave both the wind strength and direction. With this, both the

desired course as well as the speed over the ground could be graphically represented.

We had worked out this simple method theoretically a long time before; but now we had to try it out in practice. We had to determine whether the drift measurements were accurate and reliable enough to be sure of reaching our intended destination. It would be superfluous to go into details. It will suffice to say that our method proved reliable enough to navigate the ship across thousands of miles of ocean safely and on schedule to her destination. I recall, for example, that we were once flying from Madeira direct to Recife, without touching the Cape Verde Islands, and when, after twenty-five hours in the air, a passenger asked where we were, I answered, "In half an hour you will be able to see the island of Fernando Noronha one and a half points on the port bow." In twenty minutes the highest point of the island in fact appeared at the precise spot on the horizon.

Nowadays the method of navigation with smoke-bombs has been made obsolete, partly by marvellous telescopic sights from which drift and speed can be read off directly, partly by a very extensively developed system of radio direction-finders and signals which provide the pilot with his position. But at that time we had to be satisfied with our complicated method and put it into practice, and thus we soared out over the dark sea, with the mixed feelings of pride and accomplishment appropriate to a pioneer attempt at navigating an aircraft across the ocean. The weather was fine. Light variable winds at times pushed us a little ahead, at times delayed us a little, but these head winds were generally so weak that we were able to save our fuel, running the engines at reduced speed.

Shortly after noon of the following day there came in sight to the south the island of San Miguel, in the Azores group. We had now been about thirty-two hours on our way and had covered about half the distance from Friedrichshafen to New York, provided we could continue straight ahead on our course. We had reeled off 2,100 miles, and had 2,350 miles to go. Our fuel supply would last 50 hours more on all engines. Thus we were in a very optimistic frame of mind and gave ourselves up to the hearty enjoyment of the beautiful scene spread out beneath us. A low-lying cloud-ceiling covered the greater part of the ocean, but rising

above it in magnificent splendour was the tremendous 7,500-foot peak of Mount Pico, on the island of the same name, along whose flanks we were gliding. A strange spectacle, this fantastic mountain isle apparently floating in the air in the midst of the ocean! Finally it vanished in the distance, and the sea beneath us was again visible. But what we now saw was less pleasant. Apparently a west wind had sprung up which was so strong that it was driving white-capped waves ahead of it. It grew stronger, and a wind measurement showed that it was a south-west wind with a velocity of 22 miles per hour. At sunset it had freshened to 31 miles per hour. This meant that about half our speed was being eaten up by the head wind. We were now making only 31 miles per hour over the ocean, and would take more than seventy hours at this speed to reach New York! Naturally we would not expect this wind to persist all the way to the American coast, but it could increase further and was a little disturbing.

The American Navy had sent out two cruisers with orders to assist us if necessary. One was stationed near 40 degrees north latitude, about 250 sea-miles south of Halifax. The other was near 45 degrees north latitude, about 150 sea-miles south-east of the Newfoundland coast. We now tried to get in touch with these ships to obtain wind measurements from them. After long and fruitless effort we succeeded around midnight, at which time we determined that we were making only 25 miles per hour over the sea. The southernmost ship reported a fresh west wind, the northern one a light south-east wind. And so we could calculate that a low-pressure area lay south of Newfoundland. I decided to go around it to the north, and we set a north-west course for Cape Race, the southernmost tip of Newfoundland.

The stiff south-west wind now blew on our beam and did not seriously slow us down, and gradually it dropped. Towards noon it was quite calm, a sign that we were approaching the centre of the low-pressure area, and after an hour more a light east wind began to assist our progress. We were now about up to the 44th parallel of north latitude, south-east of Cape Race, five degrees north of the point where we had turned on to the north-west course.

Now we steered a westerly course direct for Boston. The ship was travelling at 78 miles per hour. Towards four o'clock we ran into thick fog, which lay on the water. The cold north-east wind

currents were striking the warm waters of the Gulf Stream, above which we were cruising. We were flying above the fog in clear air, but it rose higher and higher, until finally we were going up to 5,000 feet to stay above it. It was beautiful, flying above the clouds; but eventually it became unpleasant, because we had no way of knowing where the ship was drifting to. So I did something which I would not do today and which, thanks to the present radio direction-finding system, would not now be necessary. I went down to try to get a look at the surface of the sea. I was well aware of the risk of going down, for somewhere below us might be the mountains of Nova Scotia shrouded in fog. But the heavy fog and cloud formations had already convinced me that we must be over the Gulf Stream south of Nova Scotia.

After going down to an altitude of 500 feet by our barometer, I stopped our descent, because our barometric reading might be inaccurate, since we had run into the low-pressure area, and we might have crashed into the sea because of a false reading. It was a disagreeable situation, because the temperature had gone down almost to freezing. But after two hours it began slowly to clear, and towards 10 p.m. we saw the lights of Halifax twinkling far away to the north. With this, the flight was as good as over from the navigational point of view. For the portion ahead of us, the 550 miles to New York, was child's play in the clear, fine weather we were now running into. In the early morning hours we arrived over Boston. The city was sound asleep, but it awakened for us. Sirens and steam whistles began howling while we were still far off; but they gave us some idea of what was in store for us.

At daybreak we were off Sandy Hook, seventy-seven hours after our take-off from Friedrichshafen. The bay and the low shore were shrouded in a light morning mist, but the fantastic shapes of the skyscrapers towered above it and gleamed in the rising sun. The imposing picture, celebrated in all languages, which this overpowering giant metropolis of daring and enterprising spirit offers to the arriving stranger, appeared to us with a double beauty, a fairy-tale city to which we had abruptly come out of the dark, empty sea.

We gave the New Yorkers the pleasure of watching us cruise a long time over the city, while we slowly spiralled up to an altitude of 10,500 feet. Then we steered for the nearby airfield at

Lakehurst, where we arrived towards 9 a.m. A tremendous crowd of people, who had come down from New York by car and in thirty special trains, were awaiting us. Their welcome was overwhelmingly noisy and enthusiastic. As in a triumphal procession, the ship was carried into the hangar and secured. A torrent of newspaper reporters and photographers descended on us, and there followed an hour of being pushed around and embarrassed, until we were rescued by friendly naval officers and led away to the quarters set aside for us.

The flight across the ocean brought us valuable experience. We had found that certain weather conditions could be used to our advantage to make our journey faster and safer. The weather map we saw after our arrival in Lakehurst clearly showed that if we had held to a due west course from the Azores to New York, we would have taken at least ten hours more for the journey than we required for our detour around the low-pressure area south of Newfoundland. This was an important piece of knowledge for flying over the sea! Furthermore, we had seen that the atmospheric turbulence in the line squalls ahead of the advancing cold air masses which we had had to fly through had not been in the least dangerous to our ship. This was an important discovery, which we found confirmed in later flights. Thus we were highly satisfied with our flight from the navigational aspect, and we shared the enthusiasm which had developed in America over the ship's performance.

Towards the middle of November I returned to Germany by ocean liner, full of joy and satisfaction, and proud of what the flight of the *ZR III* had contributed to the improvement of relations between the two peoples. I was curious to see what effects this flight had had on the German people.

Our next task was to develop the Zeppelin airship further and employ it as a transport craft across the ocean. For this, however, I needed Government backing, and I could hope for this only if the Minister responsible for our aviation policy, and Government officials of all kinds, were favourably disposed. Thus, it was very disappointing and painful for me to discover that the circles concerned were interested only in aeroplanes, not in airships. The aeroplane was the object of the most solicitous attention by all the governments of the world, and even in the country which had

created the Zeppelin, the Zeppelin type, in spite of all its accomplishments, was considered a mistaken idea, at least in the circle of aviation experts.

Count Zeppelin had had to combat this attitude from the beginning, and, as I found out, there had been little change since. Now perhaps they were right when they said that aeroplanes would soon be developed to the point where they could fly the oceans, and I myself had never doubted this; but the error in this attitude was that in favouring the better means that was expected in the future, they were neglecting the good that was already here. How much advantage could have been derived from this available method during the interval? I will not hesitate to assert that we would have enjoyed the success inherent in the Zeppelins ten years earlier, and therefore for that many years more, if, immediately after the flight to America, the lessons of this experiment had been put to use. But we had to wait until 1934, when the decision was taken to build the *Hindenburg* and Government money was made available.

When it became clear that a generous contribution from the Government could not be counted on, at least in the beginning, the idea occurred to me to exploit the enthusiasm of the German people for the Zeppelin, and to promote a "People's Subscription" similar to that which they had contributed to Count Zeppelin in the so-called "Echterdingen Subscription" of 1908. I was aware that this would be a somewhat doubtful undertaking, for the subscription in 1908 had developed spontaneously, when the old Count was seen to be helpless and broken after one of his ships had been destroyed in a thunderstorm. As a tragic figure he had appealed to the sentiments of the people, in whom he had inspired love and admiration. At the present moment there had been no such tragic incident, and a whole people are not likely to enthuse a second time over one and the same cause. But there was nothing left for me but to make the attempt, hoping for the enthusiasm which might be aroused by success rather than by disaster. So a business office was organized to conduct a drive for the "Zeppelin-Eckener Subscription", as we felt we had to call it.

The campaign was carried on particularly through lectures by myself and some of my co-workers, such as Captains Flemming, von Schiller, Wittemann, and Pruss, concerning the flight to America and its technical consequences. It was a fatiguing task.

I myself gave about a hundred lectures in the years 1925 and 1926, and was obliged to recognize at the conclusion of these that I had reached the end of my strength, both physically and mentally. It was perhaps the most exhausting work I have ever done in my life. But it turned out successfully, and again aroused enthusiasm for the Zeppelin, and a readiness to make sacrifices for it, which extended throughout the entire nation.

But it was soon apparent that even the most strenuous lecturing campaign by myself and my assistants would not suffice to raise the money needed for a new airship. The sum needed amounted to about a million dollars, this being required for an airship big enough and having a sufficient useful load to operate safely and regularly across the Atlantic Ocean. I had to discard right at the start the idea of a really high-performance ship like the later *Hindenburg*. But it was all the more urgently necessary to raise money for the "Zeppelin-Eckener Subscription" in some other way than by giving lectures. Ultimately we succeeded through the "Zeppelin-Eckener Subscription" in collecting about \$750,000 for building a new airship, and construction could be started. To complete her the Government finally made a donation of rather more than \$250,000.

The ship as conceived in the beginning had to meet a number of requirements. She was to be the first aircraft ever capable of operating on a transatlantic service with mail, air freight, and passengers. She was to be an airship in which one would not merely fly, but would also be able to *voyage*. For these purposes she was to have a capacity of 3,707,550 cubic feet instead of the 2,471,700-cubic-foot content of the *ZR III*, with a length of 775 feet and a maximum diameter of 100 feet. She was to have five engines with a maximum output of 530 horsepower each, which were expected to produce a speed of $79\frac{1}{2}$ –81 miles per hour. A long gondola was attached under the nose, containing the control and navigation-room, the radio-room, and a proper kitchen, and in the rear was a large lounge and dining-room, as well as ten state-rooms with two berths each. For the time being it was a barely adequate arrangement for passenger traffic, but there was not enough money for a larger ship. She was of the smallest possible size for safe commerce across the Atlantic Ocean.

It was not until eight years later that we could progress to the

construction of an economical and aerodynamically satisfactory ship, the *Hindenburg*, which was almost twice as large. Perhaps these enforced limitations also had their advantages; for we had to confess that while we were convinced that the Zeppelin could operate in any kind of weather, we lacked experience of how matters would go in the air above the ocean. Thus the *Graf Zeppelin* became a training-ship with a pioneering mission, not only for airships but also for all kinds of flight above the oceans. This was especially true of navigation, which was still in its infancy.

Early in July the ship was essentially complete, and on July 8, the birthday of the old Count, she was christened with the name *Graf Zeppelin* by his daughter, the Countess von Brandenstein-Zeppelin. I had chosen this name in order to connect the final decision concerning the value and significance of the builder and his airship concept with their confirmation in this ship fated by destiny. The result would be either victory and fame, or final downfall and the end of a defective concept. The short trial flights, undertaken soon afterwards, were satisfactory in every respect. The useful lift of the ship was somewhat higher than anticipated, the manœuvrability was good, and the speed of about 81 miles per hour at full power corresponded to our expectations. Not even minor defects in the ship's structure came to light. Thus we looked forward confidently to the day when the *Graf Zeppelin* would undertake her first flight across the ocean. October 12, Columbus Day, the anniversary of the discovery of America, was once again planned for this.

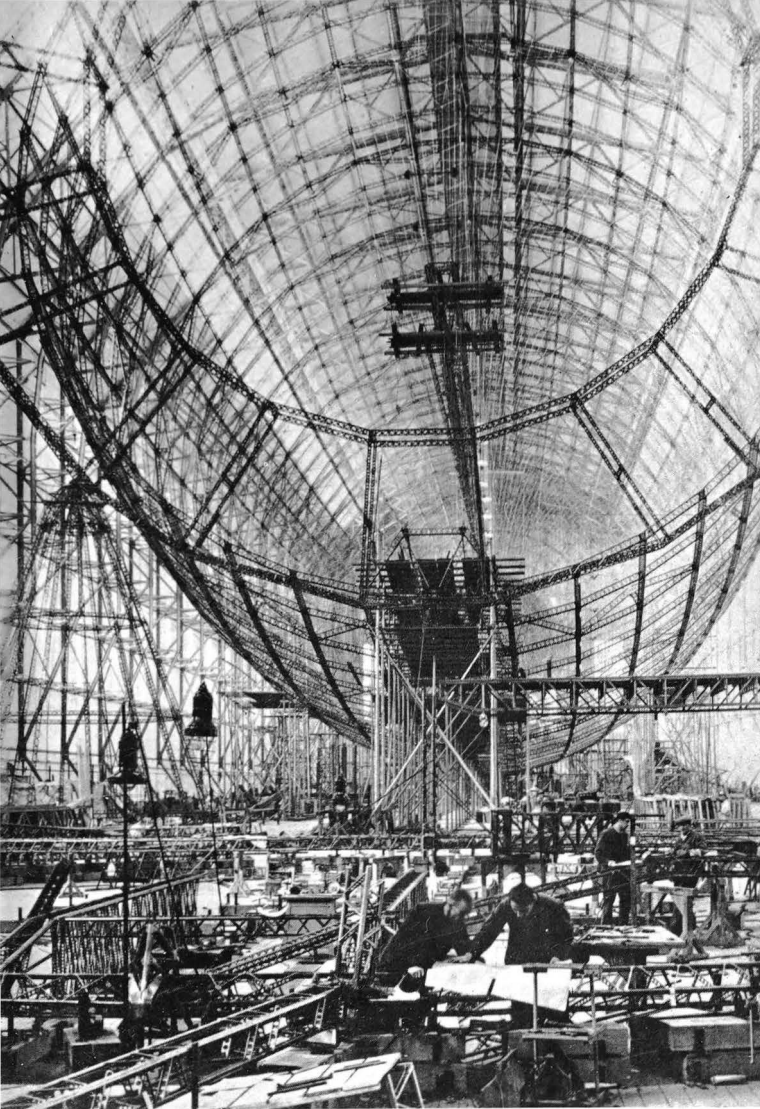
II

THE FIRST FLIGHTS OF THE *GRAF ZEPPELIN*

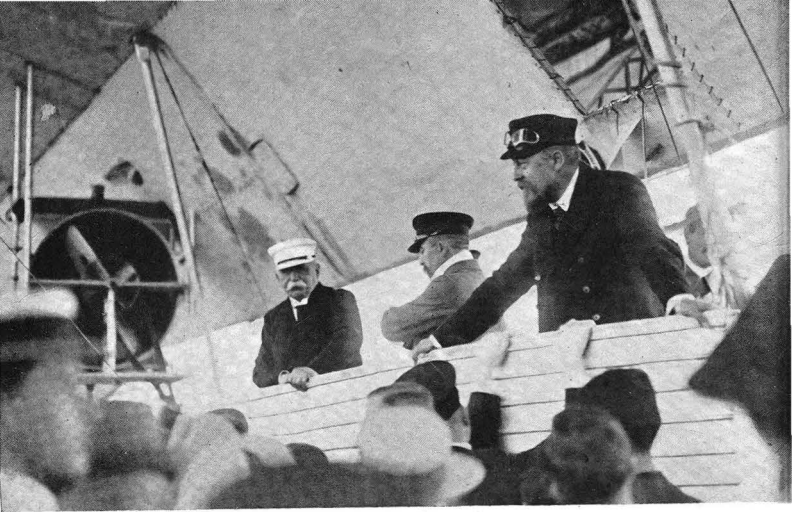
I DECIDED TO arrange the usual thirty-six-hour endurance flight to test the engines so as to pass over a whole series of large cities. This endurance flight was set for September 18, 1928. On this day we took off at 8 a.m. and, after briefly circling over Lake Constance, set a course for Nuremberg. I then intended to go on by way of Leipzig and Dresden to Berlin, and from there over Hamburg to the North Sea, where we could spend the night cruising about. Then we would return home over Düsseldorf, Cologne, and Frankfurt. This route was announced in advance and naturally aroused lively anticipation in the cities named. But it turned out otherwise.

While we were still between Ulm and Nuremberg the weather report received on board announced that a low cloud-ceiling with rain was covering Leipzig and Berlin, so that the ship could not be seen there from the ground. I therefore decided to proceed differently. We headed west, to reach the Rhine via Frankfurt and Mainz, and then steer down the Rhine valley to the North Sea. The flight turned into a triumphal progress over these heavily populated areas. The farther we went, the more intense became the excitement, for our arrival was apparently announced in advance. Cologne and Düsseldorf were gay with flags, and thousands of people were standing on the Rhine bridges. Something similar had occurred in the year 1908 when the *LZ IV* had made her flight through the middle Rhine valley that abruptly ended at Echterdingen and brought about the Zeppelin Subscription. Yes, the Zeppelin frenzy was here again, and apparently stronger than ever!

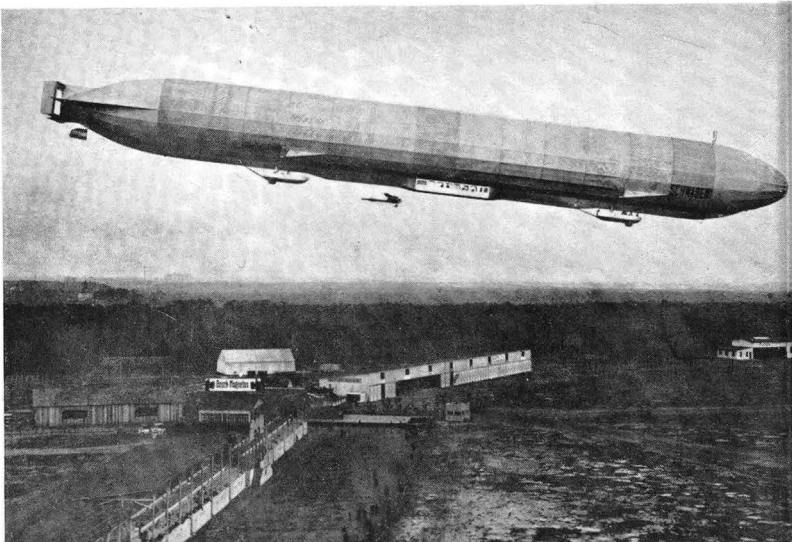
Towards evening we reached the Dutch border, and I decided to go by way of the Hook of Holland out over the North Sea, in



The *Hindenburg* nears completion at Friedrichshafen. The main hull framework, seen from aft, towers up into the hangar; the tail cone stands vertically at the left, and on the floor in the foreground is the growing skeleton of the cruciform girders that form the rudder posts.



Captain of the *Deutschland II*: Dr. Eckener (right) with Count Zeppelin (left) when Dr. Eckener was examined for qualification as an airship pilot, spring 1911.



The world's first successful passenger aircraft, the Zeppelin *Schwaben*, commanded by Dr. Eckener, landing at Johannisthal near Berlin. A Taube monoplane is flying below her.

order to spend the night cruising around, and then to fly over Bremen in daylight. I informed the passengers, among whom were a number of Government representatives and journalists, that the course would be by way of Nijmegen over Amsterdam to the sea, and then we would go in the direction of Harwich to the English coast. In fact I followed this route at first. Presently I altered my plan and decided to set a course for Vlissingen, in order, since the weather was very thick, to get a definite point of departure from the coast from the very powerful Vlissingen lighthouse. Thence we could plot a course for Harwich.

In Hamburg, Kiel, Berlin, and the other large cities which we visited in the course of the next day the joy and enthusiasm were as great as on the preceding day. Once more the people had a Zeppelin and believed in it as a technical masterpiece and expected wonderful feats of it as an envoy of the German people for peace and international reconciliation. Public expectation and tension were immense when on October 10 the *Graf Zeppelin* lay ready to start her flight to America.

The ship had proven herself in every detail on the big test flight, we had fuel for 100 hours on board, and, in addition, twenty passengers and newspaper reporters. What the ship was to demonstrate was—one can say this without exaggeration—of epochal significance. She was to prove that passengers could now be carried across the Atlantic Ocean by air in speed and safety, and with all the comfort and pleasure which the modern traveller demands. Up till then this had been a wishful dream, which other types of aircraft had not fulfilled so far, and, we believed then, would not soon be able to fulfil. But we were sure that we could do it, and we hoped furthermore that our flight would strengthen and improve the moral and political success that had resulted from the *ZR III*'s ocean crossing. I never dreamed that we would be placed in the most mortal peril *en route* and that we would spend several hours in which I would have to bear the heaviest anxieties for the ship's fate.

My worries began already on the day before our planned take-off when I examined the weather map. The weather seemed about as unfavourable as it could possibly be. One severe depression followed another across the Atlantic Ocean, with westerly storms of wind strength 9 and 10. Numerous steamships were described

as being in distress, and the great ocean liners were twenty-four hours late on their voyages to New York. A flight via the steamer routes would have been sheer folly in these circumstances, for we would have needed sixty hours or more to get even to the Azores—less than half the distance—while fighting a wind of 45–55 miles per hour at our flight altitudes. I considered a flight extending far to the south by way of Gibraltar, Madeira, and Bermuda, but I could not be satisfied with this extremely long route of about 6,000 sea-miles; for the speed of an air line is its most important advantage, and how could one emphasize speed by taking the longest route?

In the other direction I was attracted by the alternative, a flight by the shortest and most northerly route, over North Scotland and close by the south coast of Iceland. I would choose this route today, but at that time our still primitive navigational methods made this risky. In my mind's eye I saw a disturbing picture of the ship groping her way through the fogs and low-lying clouds of the late autumn season along the high rocky ridges of Scotland and Iceland, with no possibility of fixing our position accurately. No, the twenty passengers, who had confidently and trustingly offered themselves as "guinea-pigs" for this first passenger flight across the ocean, should not be subjected to such a risky experiment! That would be betting too much on the first throw of the dice! Thus I vacillated, discouraged and uncertain, between the Scylla of a long southern route I did not care for, and the Charybdis of a northern route decidedly dangerous in the circumstances.

In this dilemma I abruptly decided to postpone the departure planned for October 10, and put it off until the 11th in the feeble hope that weather conditions would improve, and if this did not happen I would take the southern route; for it would discredit the airship if I hesitated longer. Naturally the postponement of even *one* day had an unfavourable effect on the attitude of the thousands of people who had come to see the take-off, and for whom the hotels and other accommodations of Friedrichshafen were entirely inadequate. Many of them could be heard saying, "Just look at what they mean by the regularity and punctuality of airship travel!" and part of them left, angry and resentful. A wise man will not concern himself with the opinions of the easily swayed masses, but an even wiser man realizes clearly that this opinion

carries great weight today. The demagogues know how to employ and manipulate it, until they have seated themselves in the saddle. And actually the pennies of the common people had to a great extent made possible the building of the *Graf Zeppelin*!

And so quite reluctantly I postponed the flight. But I had a stroke of good luck. On October 10 a frightful storm with torrential rain passed over Friedrichshafen. Everyone realized that the ship could hardly take off in such weather, and they complimented me on being an expert meteorologist who had correctly foreseen the foul weather; for it is a common experience that the lay public believes that the weather conditions at the take-off point, which hardly concern me, extend over the whole long route of the flight.

But we could not have taken off in such weather even if we had wanted to, for a stiff wind blew across the shed exit and made it impossible to take the ship out. The question now was, would the situation be the same the next morning? All day it continued bad, and when I went to bed that night the wind was howling past my bedroom and the rain beat against the panes. I have hardly ever passed such a restless night. I spent it listening to the constant whistling of the wind in the shingles and the splash of rain against the window. I got up every hour to look out and went back to bed cursing that the Lord in His wrath had made me an airship pilot. Finally, around 5 a.m., the storm began to lessen. Unfortunately sleep was now out of the question. I dressed, and when I stepped out in the garden found to my delight that it was almost calm and dry.

When I reached the airship field towards 6 a.m. everyone was already very busy. Baggage and mail were arriving to be stowed in the ship, and the ship herself was being made ready for departure. In the large, echoing hangar the engines thundered an overture for the ears of the experts, and the gas-bags received a final filling till they were bulging full. But I was most interested in the question of whether we would really have to follow the long route via Gibraltar. In a conference with Captains Flemming and Schiller we quickly decided to follow this route, which at the time seemed shorter than that by way of the Azores. Privately, however, I made the reservation that we would decide from the weather situation whether we might steer from Lyons in the Rhone valley

to the Bay of Biscay. But when the moment arrived we had to choose the route through the Mediterranean.

From now on everything moved quickly and quietly forward. At 7.30 the passengers were on board with their luggage. Among them were four representatives of the Air Ministry, ten paying passengers, and six representatives of the great newspapers. Among the latter were two representatives of the American Hearst Press, Mr. von Wiegand and Lady Hay, who later participated in all the great flights and became enthusiastic friends and supporters of the Zeppelin airships.

At 8 o'clock sharp we were in the air and the engines started up. The charming landscape began to unroll beneath us like a moving panorama, and the passengers, sitting in comfortable chairs before the big windows, discovered with amazement and enthusiasm how comfortable and enjoyable it was to voyage in a Zeppelin airship. One of the chief purposes of the flight was to acquaint the public with this experience: in an airship one does not fly, one voyages, with all the splendid meaning that one associates with the word "to voyage".

At top speed we flew down the Rhine, over castles and medieval towns, along the south side of the Black Forest to Basle, which we crossed, flying low, after less than one and a half hour's flight. An expectant crowd was standing outside on the bridges and in the squares, waving to us with sympathetic wishes for a good journey. On we went down the Saone valley. On our right we looked down on the vineyards where the famous Burgundy grape is gathered by industrious vintners. To the left reared the snow-covered chain of the Alps, with the giant massifs of Mont Blanc and Mont Peloux drawing the eye in fascination. Historic towns, like Avignon, and the ruins of ancient Roman buildings, followed next and captivated the mind and the eye in the same degree. And so, shortly after noon, we arrived at the Mediterranean, and unforgettable attractions of a new kind again stimulated our senses. It was as if we were softly gliding through an infinity of surrounding misty blue. Air and sea merged imperceptibly into each other. We flew on, as if set free from hard, rough material things, in a world of fragrance and soft light. As in a dream, the passengers sat at prettily decorated coffee-tables and, in a mood of wordless ecstasy, enjoyed good Friedrichshafen pastry together with the fabulous

panorama of the sea. Yes, an airship voyage is wonderful! "A calm sea and pleasant journey" was the word for this flight over the Mediterranean, and for the whole of the next day over the Atlantic.

Night gradually came. Black and mysterious loomed the steep, rocky cliffs of the Spanish coast close on our right. The blazing sea of light that was Barcelona, with its glaring advertisement signs, was like a tonic. We flew a circle low over the city and harbour and dropped a mail-bag which the industrious journalists and the postcard-writing passengers had meanwhile filled. Valencia we saw as a weak glow on the far horizon, we rounded Cape Palos towards midnight, and then Cape de Gata, the south-east corner of Spain, whence we headed in a westerly direction for Gibraltar. An hour later we sighted the brightly burning lighthouses of Ceuta and Gibraltar ahead, and with the early dawn we passed over the straits and out above the Atlantic Ocean. Once more there lay below us the arena in which we were to prove our capabilities! Memories of our eventful crossing with the *ZR III* exactly four years before came back vividly. What surprises would we find this time in the broad expanses of the spiteful and incalculable North Atlantic?

The flight across the ocean progressed so wonderfully that we developed the happiest expectations of a smooth and fast crossing by our southerly route. While we had had to contend with westerly head winds of sometimes considerable strength over almost the entire route from Friedrichshafen to the Mediterranean coast and then over the Mediterranean, the wind became increasingly favourable the farther we flew out to sea. An hour beyond Gibraltar the ocean surface was ruffled by a light north-north-east breeze coming down the coast of Portugal, the famous Portuguese "norther". Presently the wind veered more and more to the east, and three hours beyond Gibraltar we were being pushed along by a fresh north-easter which gave us a ground speed of 75-80 knots. A cloudless sky extended around us over a bright blue sea, and the occasional whitecaps crowning the waves delighted us all the more as they were moving with us. We really had escaped from the realm of the strong westerly winds.

I set a course for Madeira, hoping that this route, which would lead us far to the south, would keep us as long as possible in the

region of easterly air-currents, and so by speeding our flight would compensate us for the length of the route. Already at 1 p.m. local time we saw the mountains of Madeira rising out of the haze, and soon the gorgeous island paradise, with its green vineyards, its white villas, and its grotesque jagged cliffs and gorges, lay beneath us in bright sunshine. We crossed the harbour of Funchal, in which, like a stirred-up ants' nest, people ran out of their houses, cheering and waving wildly, to stare at the miraculous bird overhead. That this fabulous craft, which they had read about in the papers, should appear to them without warning! Through the years they were to see the *Graf Zeppelin* on many occasions as she made regular flights to South America. Here we dropped more mail, for the newspaper reporters and passengers had still been writing industriously.

We went on for eight to ten hours in the same favourable manner, and by late evening were about 250 sea-miles south of the island of Terceira in the Azores. We made contact with the radio station on the islands, in order to get information on the weather. What we received was not so pleasant: a squall-front, a southerly extension of a deep Atlantic depression, was approaching the islands, and we had to expect bad weather. An hour later the station broke off its communication with us because of a severe thunderstorm. Actually we could see vivid lightning in the night sky far to the north, and it steadily increased. Towards midnight the entire northern heavens were aflame with almost incessant lightning. It was a grandiose spectacle, but at the same time rather disturbing. Apparently an influx of cold air was extending far to the south, and we had to expect that it would reach us. Our local observations confirmed this: the easterly wind, whose favourable influence we had previously enjoyed, diminished and veered to the south. Obviously a disturbance lay before us, doubtless a squall-front extending from the northern cyclonic storm, and we had to anticipate that in the warm, humid air which lay above this southerly sea, marked turbulence and squall activity would result.

I must admit that I experienced a feeling, not really of anxiety, but of great tension over what the next hours would bring; for I was already fully convinced that the ship could survive even very bad weather structurally intact, and also that squalls over the sea were not as violent as above overheated land. But this was still

only a theory, and had to be proven by practical experience, which we still lacked. For one or two hours more we flew on in calm weather. The storm to the north remained generally behind us, but the atmosphere was sultry and the south wind steadily increased. It was very disagreeable, for something *had* to happen, unless all meteorological indications should prove deceptive. And in fact, towards six in the morning we saw lying ahead of us a blue-black wall of cloud of very threatening aspect. It was advancing towards us at great speed from the north-west, and we approached it with the onrushing *Graf Zeppelin's* full speed of around 75 knots. It was clear that a strenuous test of the *Graf Zeppelin's* structure lay ahead, and I sent for our most experienced elevator man, Herr Samt, to ask him to take over the elevator controls from the less experienced man who was handling them.

But before the elevator men could exchange places, the ship put her nose way down, only a moment later to raise it suddenly upwards, so that she took an up angle of more than 15 degrees. This angle of slope, which was enough to send us sliding down the deck, was accompanied by a horrible racket. The place settings already laid on the breakfast tables slid off with a crash, and in the kitchen pots, pans, and kettles fell with a clatter from the stove and cupboards on to the deck and against the door. Amidst the noise, which was increased by the crash of thunder, it was impossible to tell if the hull structure was breaking up. Mutely we looked inquiringly at each other, wondering what was coming next. But nothing happened. We had to fly through two or three more squall-clouds, in which the ship bounced and pitched heavily, but we had her well under control, and she was soon going calmly ahead at reduced speed with the engines throttled down to half power.

I was very well satisfied. Out here, over the warm ocean, we had managed to overcome a squall which probably ranked as the most severe the North Atlantic could produce. I considered that the main reason for the ship rearing up was that the inexperienced elevator man had not immediately applied down elevator when the nose started to rise. Thus, he had reinforced the upward movement of the nose.

We still had to get through the cloudburst which commenced as the ship reared up and which continued undiminished for an

hour more. It soaked the ship so thoroughly that it finally leaked through the ceiling into the cabin, and we in the control car were standing with our feet in water and had to remove our shoes and socks. But this was merely a small temporary discomfort, which we accepted calmly, for even at reduced speed the *Gräf Zeppelin* could easily carry the six and a half to nine ton load of rain-water. At full speed she could walk away with an overload of thirteen tons.

We seemed to have survived the worst, when the Flight Chief, Grötzing, whose eyes were everywhere, came to me in the control car to report that the bottom fabric covering of the left stabilizing fin had torn and its tattered remnants threatened to jam the space between the elevator and the fin. This was a very serious matter! Would the endangered *upper* cover of the fin hold fast, and would the ship still be controllable if this gave way? I considered the seriousness of the situation and came to the very difficult conclusion that I would have to send a radio message to the American Navy Department to ask them to send a small, fast vessel (perhaps a destroyer) to our position. I had to do this on account of our passengers, without considering prestige. It would take at least three days for the vessel to reach us, for we were almost exactly in the middle of the ocean between the Spanish and North American coasts, and about 2,100 miles from each, but there was no immediate danger. We could if necessary keep the unsteerable ship hovering stationary in the air. The next step was to send a group of men, immune to vertigo, out into the stabilizing surfaces, to investigate the damage and to attempt to repair it, or at least limit its extent. Meanwhile we flew on towards our goal at low speed, in order to spare the damaged fin.

Next I visited the passengers, to see how they had stood up to the harrowing experience, and to inform them about the situation. It appeared that some of them were quite depressed and frightened, while others were full of confidence. Foremost among the latter was brave little Lady Hay, the reporter for the Hearst Press. She greeted me with a gay smile and remarked, looking at the broken china on the floor, "The good Count has been in a surprising and expensive mood! Well, if we have to, we can get along without cups and saucers." Later I heard that at the moment the crockery tumbled from the table she calmly called out to her friend and

colleague, Mr. von Wiegand, "Karl, run quickly to my cabin and see that my typewriter doesn't fall on the floor"! Such coolness, particularly in a woman, could well have prevented the development of a spreading panic.

I gave the passengers a full explanation, without trying to conceal its seriousness, but in such a way that they would calmly and collectedly await further developments. "If worst comes to worst, a destroyer will certainly pick us up; but I hope we can limit the damage. A repair gang is already hard at work."

The repair group had actually determined that luckily the forward quarter or third of the fabric cover of the fin had remained intact and the upper covering was still holding quite well. The first thing to do was to get rid of the fluttering tatters of fabric so that they would not jam the movement of the elevator, and then to reinforce the remainder of the covering so that it would be preserved. This was not easy or without danger, for the crew had to work in the slipstream of 45-55 miles per hour created by the forward motion of the ship herself. It was not possible to reduce her speed more, because the deluge of rain weighed her down to an unusual degree. As soon as we slowed down, the ship fell, and again had to be brought up to altitude by increasing the speed. It was a very disagreeable game to play, increasing and decreasing the ship's speed, enabling the men to work during the period of reduced speed. Thus we were constantly varying our altitude between 1,600 and 3,300 feet above the white-foamed surface of the sea. But gradually the job was done. In an hour and a half emergency repairs were complete, and we could go ahead at 40-45 knots, without over-taxing the stabilizing fin. During the next three or four hours the job was so well completed that it could be relied on to hold unless the weather turned squally again.

The men who had volunteered to climb around in the framework of the stabilizing fin, heaving violently up and down, and blasted by the stormy slipstream, deserved the highest praise. Chief among them were the steersmen Eckener, Ladwig, and Samt, as well as our "cell inspector", Knorr, whom we were used to seeing climbing around in the framework like a squirrel to check on the gas-cells. I must admit that I felt some parental pride that my son had been one of these volunteers, and not the last one either.

We flew steadily on now in constantly improving weather with reduced speed, and I felt justified in sending a second dispatch to the American Navy Department announcing that assistance was no longer necessary. I was not completely relaxed, for the incoming weather forecasts indicated one deep depression following another across the North Atlantic. How readily a squall-front could extend down to our southerly route! How would we come out of it with a ship already damaged? Particularly on our first flight with the new "passenger ship", which was to provide a convincing demonstration of the practical usefulness of the airship in commerce over the ocean, why did this same ocean have to play its autumn tricks with such malice? I was very upset about this, even though I kept up a calm appearance for the sake of the passengers.

During the following night and the greater part of the next day we made relatively good progress. Towards evening, however, as we approached the Bermuda group, the west wind freshened and from the appearance of the sky it seemed that we were once more facing a threatening change in the weather. Ahead of us apparently lay a sizeable disturbance, which certainly would bring heavy squalls with it. What to do? Turn aside farther south to Florida? I could not make up my mind to do it, for that would involve a detour of ten or twelve hours more and put the capabilities of the Zeppelin in an unconvincing light. Then should we plunge into the squall-front with a crippled ship?

I called for the flight engineer and asked him whether in his opinion the fin-covering was equal to the stresses of severe pitching up and down in a squall. He was dubious. The decision I now made was the most difficult and critical of the whole flight: I decided to go through the squall. Towards midnight we were in the heart of it. The ship bounced and bucked severely, and an uncomfortable, heavy rain mixed with hail lashed and rattled against the cabin walls and windows. But the fin-covering had been magnificently secured! It held fast, except for a small tear, which we discovered later at daybreak. The battle with the wildly raging elements lasted about an hour, then we were in calmer air, even though there was a stormy air current of 27-34 miles per hour. The temperature in the squall-zone had dropped from 73 to 46 degrees. Those who understand the significance of such

meteorological data can derive an estimate of the extraordinary turbulence which must prevail in such violently contrasting masses of mingling air. At last we came through victorious. What we found from there to Cape Hatteras could be logged as "calm sea and pleasant journey". About 10 a.m. on October 15 we crossed the coast at the mouth of Chesapeake Bay and steered across it on our way to Washington.

In America they had followed our flight from the start with great interest. This naturally progressed to extreme tension and excitement as the news spread of our damage and the radiogram to the Navy Department. From the bombardment of radio messages we received, we could form an idea of the degree to which public opinion was concerned for us and for the ship. As we found later after the landing, the most outrageous rumours were circulating, prevailing for hours without denial, because for the duration of our repairs and for a while thereafter we could not send messages owing to our reduced speed. Our generator for providing current was driven by a propeller turned by the air-stream. It only required our fortunate conquest of the danger to replace the extreme tension with a feeling of great relief and deliverance, which brought the enthusiasm to a climax. The performance of the "crippled" ship was valued all the more highly since everyone had expected a catastrophe. And so our misfortune had a happy ending.

We were able to observe for ourselves the almost ecstatic enthusiasm which our appearance created as we flew low over Washington and on above Baltimore to Philadelphia and New York. For I thought it a good idea before we landed at Lakehurst to show to everybody the ship half given up for lost. Darkness had fallen as we finally landed at Lakehurst, which lay about 60 miles south of New York. Twenty to thirty thousand people were still there, patiently awaiting us, and our reception was stormy and enthusiastic. The loud shouts of welcome, cheers and yells as we sank earthwards were like the roaring of a hurricane, and the crowds of people which pressed round the ship, despite heavy police cordons, as soon as she lay on the ground, surrounded her like a wildly tossing sea. In a moment we were hemmed in and neither we nor the ship could move.

Luckily it was almost dead calm, and the ship lay comparatively

quiet, otherwise the presence of the closely packed crowd, which included many women and children, could have led to a serious accident. The enthusiasm was such that the normally well-disciplined American public was completely out of hand. In spite of the great and solemn significance of the moment in which the pioneer airship touched her bumpers to American soil after her eventful voyage, I had to smile as I looked down on the excited crowd.

A whole series of invitations from great and small figures came in and went merrily on, demanding considerable powers of endurance; but more and more often and urgently we were invited to visit the Middle West with the *Graf Zeppelin*. Finally I promised that after the fin was repaired, if at all possible, we would make a flight to the Middle West. Immediately several dozen people appeared who wished to make the flight as passengers, and the newspapers proclaimed that all the big cities in the West were eagerly awaiting the ship's appearance. Unfortunately they were disappointed. The fin repair dragged on for a good twelve days, and it was now almost November. The weather became so unpredictable that bringing the ship out of the shed on to the very exposed Lakehurst field became an increasingly uncertain manoeuvre. Thus I abruptly decided to cancel the Middle West flight and set our departure for home for the late evening of October 28.

Would the weather then be favourable for the departure? We had to expect a great crowd of spectators, before whom we did not want to have any accidents! At noon I travelled by motor-boat across the bay between New York and Long Island to visit a friend at his beautiful estate on Long Island. A mean, cold north-west wind whistled about my ears, promising trouble for the take-off, for cold winds are not likely to stop blowing with evening. When I returned during the afternoon it had become even worse, and I drove to Lakehurst without delay to examine the situation on the spot.

In the hangar, the crew and some passengers were standing around the ship, mail and luggage were stowed aboard, and everyone was waiting for a definite decision as to when we should take the ship out. It did not look good, for a wind of 18-22 miles per hour, considerably stronger in gusts, was blowing across the shed

and making it impossible to take the long ship out of the hangar. Hoping that the wind might drop by then, I postponed the take-off, which had been planned for 8 p.m., to midnight. This tried the patience of the passengers, but had the beneficial result that the public, except for a few hundred diehards, gradually went home.

Now I had enough time to study the evening weather map in detail. When the meteorologist on duty brought it to me, he seemed very pleased and satisfied, as if he were bringing me a valuable present. "It looks very good out over the ocean," he said. In fact, as soon as I saw the map, I thought I had hardly ever seen a more favourable picture of weather conditions over the North Atlantic. From Lakehurst to Newfoundland strong north-west winds prevailed, which would scarcely affect our speed, and from Newfoundland on there extended a large high-pressure area across almost the entire ocean to Ireland. So after a somewhat bumpy flight to Newfoundland in the cold north-west wind, it looked as if we would be flying for most of the journey in fine weather. Also the route via Newfoundland would be the shortest, for it would follow the Great Circle course.

I realized, however, that the area before and to the south of Newfoundland would be something of an unknown quantity, for only *one* ship had reported from there. The cold north-west wind striking here could and must announce its presence with squally weather. On the other hand, it was not very attractive to steer directly east from Lakehurst on the normal steamer route, for the cold north-west wind would certainly be causing thunderstorms and turbulence above the Gulf Stream, through which this route led. It seemed as though a low-pressure trough with such disturbances was developing all the way down to Bermuda. That could lead to the same weather formations which we had encountered, to our sorrow, on our approach via Bermuda. A burned child dreads the fire! Therefore I decided on the Great Circle course, with the intention of remaining as far as possible over the cold water between the Continent and the Gulf Stream. None of us, as we discussed the weather map, could have remotely imagined the shocking surprise awaiting us at the point of uncertainty which I mentioned above.

At midnight the wind unfortunately had not yet dropped enough

for us to dare to try to walk the airship out of the hangar. Things were turning out rather disagreeably, as we asked ourselves if the weather would really improve during the night. Such situations are exactly the ones which throughout my whole career as an airship captain were most likely to make me nervous if I were not left alone. And thus I roamed about, in a bad temper, up and down in front of the hangar, listening to the whistle of the wind rising and falling in the girders of the shed. Even today I have lively recollections of my restless pacing about in bright moonlight in front of the hangar doors, for it was a really important matter. A few dozen reporters were waiting impatiently for the take-off. They were telephoning their papers that we could not get out on account of a ridiculous cross wind of 13-18 miles per hour, and that twenty-five increasingly impatient passengers were being kept waiting. A fine commercial vehicle!

Towards 1 a.m., however, it became calmer. We quickly got the passengers on board, opened the doors, and walked the long hull out into the open. By 2 a.m. we were in the air and flying towards new adventures, of which for the time being we could know nothing.

At first we headed for New York, which the passengers very much wanted to see by night. At our flight altitude a gusty north-west wind was blowing at 38 miles per hour, against which we made slow progress on our northerly course. Towards 3 a.m. we were over the city. We were rewarded for our trouble: a limitless sea of lights stretched in all directions, and we asked ourselves in amazement if light cost nothing at all in this blessed land. Everywhere, as far as the eye could see, lights twinkled and gleamed, as if the whole coast up to Boston were a continuous city. In spite of the early hour, a number of steamers in the harbour could not resist giving us a farewell send-off with sirens and whistles. Whether the New Yorkers were edified thereby, I do not know, but the passengers were very pleased with this "happy journey". Now we headed out over the dark ocean, above which a sharp, chilly breeze was blowing.

Throughout the rest of the night until dawn we flew on beneath a clear, starlit sky with a cold, gusty wind that nearly equalled our own speed. Then the skies began to be overcast. Heavy clouds rose on the horizon ahead. It was apparent that we were approach-

ing the area where the cold north wind was impinging on the low-pressure trough which extended down to Bermuda. This naturally would produce severe disturbances and vertical currents, for on the eastern edge of the trough warm Gulf Stream air-masses were pouring into the trough and mixing with the cold air. Towards midday an amazingly sharply defined squall-front lay close ahead of us, blue-black and threatening. The wind freshened suddenly, and it became very turbulent. We dived into the black wall, were severely shaken up, and frequently carried up several hundred feet. But presently things went considerably more smoothly, and the ship flew on steadily and well under control of the steersmen.

While we were traversing this zone the temperature rose only about $3\frac{1}{2}$ degrees—to 48 or 50 degrees, a sign that we were still barely on the edge of the mingling air-masses. After a brief hour came a second zone of heavier squalls. In these were several showers of rain that we had to fly through, and the temperature jumped abruptly to almost 57 degrees. But this still was not the zone in which the first definite contact occurred between the northern air-mass and the warm southerly one. This had yet to come, and we were already concerned about how this would turn out. Shortly after 2 p.m. a very sinister-appearing belt of extensive squall-clouds lay ahead of the ship, and we knew: this is it! The ship was thrust upward by the elemental force of a rising air-mass, which was followed by a violent downward current.

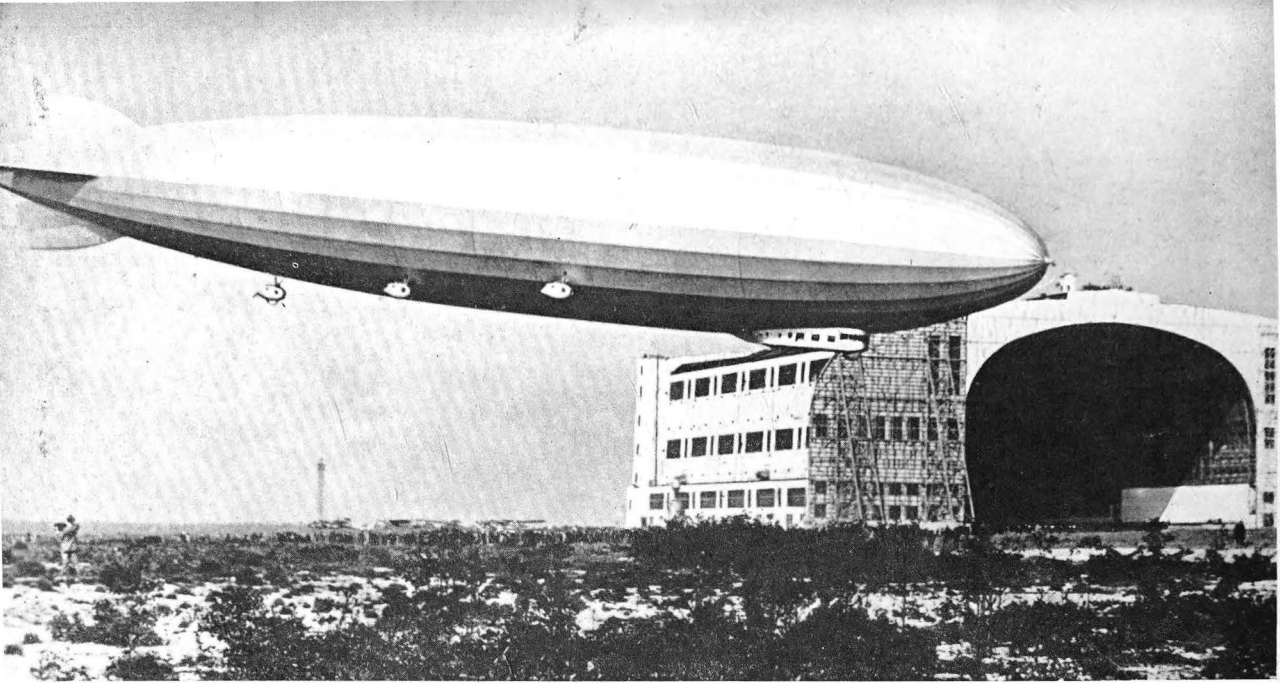
We had learned in such situations to let the ship go along with the direction of the air-masses rather than to resist the motion with great movements of the elevators, for they would be useless and would only result in putting an extra strain on the ship. On the contrary, I prefer to reduce speed, to minimize the stresses. This is what I did on this occasion, and the ship remained comparatively stable and quiet, without violent shaking. It is like a switch-back ride at the fair, and has none of the disagreeable bumps and blows and those sudden rises and drops which one has to put up with in going through a squall-front in an aeroplane. The length and mass of the airship prevents such violent motion. In this last echelon of squalls a cloudburst mixed with hail beat down on the ship, and the racket might have done more to terrify the fearful than the motion of the ship. But, for the detached observer, it was an incomparable demonstration of the atmospheric conditions in a

squall-cloud as they could only be experienced inside the cloud itself.

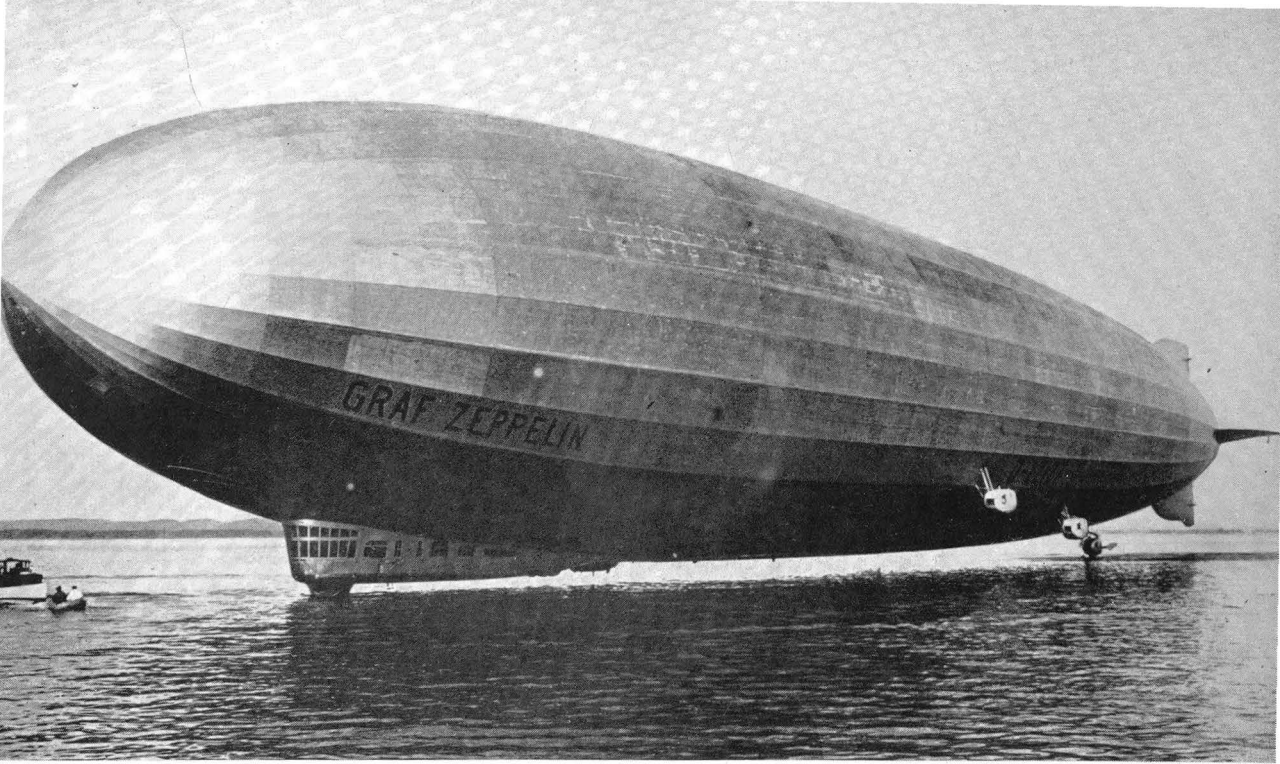
In the space of only a few minutes we came out on the other side, and found that the temperature had risen to 62 degrees. The wind had shifted to south-west and steadily freshened to 34 miles per hour. The overall picture had changed completely. We were sailing along under a friendly, bright sky which presently cleared up to a radiant blue. We were on the far side of the low-pressure trough, and we flattered ourselves that we would now be going steadily farther into the high-pressure area which had looked so tempting on the weather map the night before. We were all the more certain that our hopes would come true when we took in during the morning a weather forecast from Cape Race, at the south-east tip of Newfoundland, which read, "Weather clear, fair, south-east". That meant that there were no stormy winds on the south coast of Newfoundland. So we flew on over the blue sea in the best of humour, making more than 80 knots with the aid of the south-west wind. But man proposes, and the god of weather disposes.

At 4 p.m. we found ourselves around 43 degrees north latitude and 56 degrees west longitude, and entered the fog zone, which, with such weather conditions, is often found extending a long way south of Newfoundland. At first the fog lay as a solid cloud-ceiling at an altitude of 700-1,000 feet, and we were able to fly under it. Presently, however, it lowered to the surface of the sea, and we had to climb over it. But the fog quickly rose higher and higher, and at 4.30 had already reached 2,300 feet and soon afterwards 3,000 feet. I did not want to go any higher, as we were beginning to valve gas at this altitude, and it did not seem advisable to make the ship heavy by blowing off gas at the start of the ocean flight. So we went on in thick fog.

Our last observation, around 4 o'clock, had established that a wind of 34 miles per hour was blowing from the south, and we expected to come out of the fog into clear weather towards 6 p.m. about 170 miles south of Cape Race. As long as we were flying in fog, we naturally did not know where we were going. It was rather unpleasant, and we waited impatiently either for a sight of the sea or of clearing heavens. There was really no danger associated with this "blind flying", for we flew high enough to be at a safe



The "Reparations Ship" which saved a dying industry: The *LZ 126*, after a successful Atlantic crossing, glides down to land at the U.S. Naval Air Station, Lakehurst, New Jersey, October 15, 1924. As the *Los Angeles* she remained in service until 1933 when she was scrapped.



The *Graf Zeppelin* in a water landing on Lake Constance, practising for the Arctic journey. Summer 1931.

altitude above the low mountains of Newfoundland, which we furthermore estimated to lie a good 170-230 miles to the north of us. But after we had flown calmly and without movement of the ship for an hour in the fog, suddenly the *Graf Zeppelin* began to pitch and roll. The motion grew continually more violent. The ship shook and creaked in all her joints, and I felt obliged to reduce the engines to half speed. The motion of the ship steadily became more wild than I had ever experienced, and I worried over how long she could stand it.

What had happened? What was wrong? We had apparently run into a very violent storm, but that did not explain the severe pitching of the ship. We must be over land, and, specifically, above the cliffs of Newfoundland, where the fierce storm would be shattered in a wild maelstrom of turbulent gusts. But how was this possible? With the wind conditions we had accurately determined at 4 o'clock and with the favourable weather forecast we had received in the morning from Cape Race, how could we have been blown at least 170 miles out of our course to the north in a space of less than three hours? We kept looking down to see if the cloud layer would open somewhere. Towards 6.30, after putting up for half an hour with the severe pitching and rolling of the ship, the cloud ceiling below us suddenly opened for a moment. I glimpsed through the hole in the cloud some shapes which, in the dim light of the low moon, could not at first be recognized. I suspected, however, that they were cliffs, and ordered specially sharp-eyed men to the control car to take turns standing lookout. At first they reported low-lying shreds of cloud, sheets of mist, and foaming waves. After a short period of consultation and uncertainty, we saw clearly through a wide hole in the clouds that we were actually over a rocky land. We recognized at the same time that we were driving in a northerly direction at extraordinary speed, and that we could hardly be said to be advancing in an easterly direction, although we had been steering due east since 4 o'clock.

Soon it became clearer, and we could make an estimate of the wind by the safe and simple method of heading the ship directly into the wind, so that we drifted neither to the right nor left over the ground. We determined that the storm was blowing from south by east with a velocity of 74-76 miles per hour. With reduced

speed, we were making 56 miles per hour, and were therefore travelling stern first at a speed of 18–20 miles per hour.

This was a valuable discovery, but we still had no idea where we were over Newfoundland. How long had we been driven northwards by the southerly gale? We had been able to make our last wind measurement at 4 o'clock, which, as already mentioned, showed a south wind of 34 miles per hour. Perhaps—and it was very probable—we had then risen to greater altitudes in the fog and had encountered the storm of 76 miles per hour. That had been about two and a half hours ago. If we proceeded on this assumption, then we must have been set about 210 miles to the north, and would find ourselves over the south coast of Newfoundland. In accordance with the wind measurements, we altered our compass heading, which had previously been due east, to south-east, and with a drift angle of 90 degrees we followed a due north-east course over the ground. We were then making a speed of no more than 35 miles per hour with engines at full power, as we were now able to run the engines wide open.

Gradually it became clearer, and by the light of the rising full moon we could slowly see more of the ground. We were flying over a row of small wooded islands; we crossed stretches of open water and finally came to a broad bay. To the south-east flashed the beam of a lighthouse, but none of the lighthouses on the south coast showed such a signal. We saw no further land, and we assumed that we had come across either Conception or Trinity Bay, since both these bays are open to the north-east. After our return we read a newspaper report from Newfoundland according to which, on the evening of October 29, some fishermen saw a giant airship in the clouds over Trinity Bay. If one examines the track we had followed between 4 p.m., when we entered the fog, and around 8 p.m., when we flew over Trinity Bay, it will be apparent that we had been set to the north nearly 300 miles by the southerly gale. The wind during this whole time must in fact have been blowing with an average velocity of 67 miles per hour, which corresponds to strength 10 to 11 on the Beaufort scale.

This flight was discussed several times in the papers by meteorologists, and a Danish professor of meteorology insisted that the weather had not really been so bad and that we had been guilty of gross exaggeration in our reports of the flight. The Monday

morning weather map, and even that of Tuesday morning, had indicated no storm off Cape Race. But our personal and accurate wind measurements over Newfoundland and our amazing drift while steering an easterly course showed irrefutably that in fact we had been seized by a storm of hurricane force in the evening hours of Monday. On that same night we had taken in a radio message, sent with friendly intentions by an English steamer, located 150 miles south-east of Cape Race, transmitting her position and adding laconically, "Here heavy south-east gale." We could only answer, "Thank you; we have gale, too." We had stumbled into an amazing adventure. But from it we derived two valuable lessons. Firstly, that in the region off Newfoundland, where the cold Labrador Current and the warm Gulf Stream meet and mingle, particularly violent and sudden weather changes and storms may occur with certain wind conditions, and, secondly, that our *Graf Zeppelin* was equal to such situations. Not a single bracing wire had broken despite the extraordinary stresses! Full of confidence, we went on to possible future adventures.

Uncertain of our exact position, we assumed that the mouth of Conception Bay was the place where we had oriented ourselves towards 9 p.m. About seven hours later a passing steamer, whose position we received, proved that our assumption was fairly accurate. We found we were at 52 degrees north and 48 degrees west. We continued on a north-east course, in order to escape as quickly as possible from the realm of the still-stormy south wind. If we steered into the wind on a south-south-east course, we hardly moved from the spot, so that the north-east course offered the only possibility of getting away from the place.

The flight continued uneventfully and, despite the high wind, smoothly and quietly, compared with our experiences over Newfoundland. The temperature, considering the season and the north latitude we were in, was very mild, and reached nearly 50 degrees. In especially marked contrast was the picture to be seen below, which fascinated us: huge icebergs and cakes of ice drove by constantly underneath, being carried south in tremendous numbers by the Labrador Current. It was almost like a landscape on the coast of Greenland.

Towards 9 a.m. the wind began to drop to 45-55 miles per hour, and around noon was blowing only 38 miles per hour. We were

now making nearly 50 miles per hour over the ground, and two hours later entered a zone where we found only a moderate breeze with a slight westerly component. We had come northward to the 54th parallel of north latitude and now headed on a south-east course straight for the mouth of the English Channel, with a speed of about 70 knots. And so, towards midnight, we reached 20 degrees west longitude and deluded ourselves with the hope of completing the remaining distance of about 1,400 miles by the following evening. We had been encouraged in this hope by a weather report from the naval observatory informing us that a low-pressure area lay west of Scotland and appeared to be moving in a north-easterly direction. If this were true, it would bring fresh west to north-west winds, which would enable us to reach a speed of at least 80 knots. But unfortunately this did not happen, as we found on the following morning. On the return flight, also, we were not favoured by good luck in any respect.

As I looked out at the sky on the following dawn, which was Wednesday morning, I was forced to realize that we did not have a westerly, but a hard northerly wind of 50 miles per hour, while around us appeared threatening clouds and squall formations. Especially to the east, towards the Channel entrance between the Lizard and Brest, which was still 250 miles distant, the sky looked particularly wicked. Apparently the storm was not moving to the north-east, but instead had sent at least an extension to the south. The naval observatory weather report, received towards 7 a.m., actually informed us that "a low-pressure trough has developed from the Irish Sea to the Bay of Biscay", and "on its western margin squall-fronts have developed with winds of about 45 miles per hour". We saw for ourselves that this was true, and I had to smile at the thought that we were apparently getting back our own weather report, which we had sent in to the observatory at 6 a.m. Another "low-pressure trough"!

We had become familiar with these troughs as far back as the American coast, where, as the reader knows, one had developed all the way from Nova Scotia to Bermuda. What this formation meant we did not know. On the American coast it produced a decidedly disagreeable squall-front on the western side, which we crossed with violent pitching and rolling, and then came a fierce southerly gale on the eastern side which set us off our course as

far as Trinity Bay in Newfoundland! No! A clearly circumscribed storm area is for me far preferable to these incalculable troughs, encountered in the process of their development, which are mostly extensions of honest low-pressure storms!

And so I felt no desire to take the chance of entering the squall area at the mouth of the Channel, and instead ran on a more southerly course along the squall-front towards the Bay of Biscay. From the navigational point of view this front appeared extremely threatening, but from the artistic and æsthetic point of view it was all the more attractive. I therefore sent for the painter, Dettmann, who was flying with us again, to come to the control car, and he now proceeded to make a number of sketches of the truly grand cloud-formations, the airy mountains, imposing turrets and "Matterhorn" peaks which loomed up in extraordinary shapes and colours in the rising sun. It was like an indescribably beautiful endless panorama, which unfolded before our astonished gaze to port during the next two or three hours. But gradually I had my fill of this theatrical spectacle, and had to turn my attention again to real living with its actual problems.

Towards noon, having progressed in our southerly detour to the latitude of the mouth of the Loire in the Bay of Biscay, I decided to end the game and to force a way through to the east. It was increasingly possible to do this, as well as necessary, because the sky appeared generally better and the wind had backed again to north-west, a sign that we had practically arrived at the southern limit of the disturbance lying off the entrance to the Channel. We flew through an extended zone of squalls with no particular difficulty and then entered calm air, dominated by a moderate west-north-west wind of 16-18 miles per hour. As we approached the coast towards 5 p.m., the heavens exploded in unforgettably beautiful fireworks, as if in farewell, and the painter, Dettmann, made several sketches with his deft crayons. Towards 6 p.m. we crossed the coastline at the mouth of the Loire. We had crossed the Atlantic Ocean.

From the passenger quarters we heard cheers and shouts of joy as we crossed the coast. The pleasure of the passengers was understandable, for we had become acquainted with the disagreeable side of the November North Atlantic, and had had to follow a roundabout way because of its treacherous moods. But

apparently only a few of those in the cabins had any idea that a very difficult part of the journey lay ahead, considering the circumstances, which we would need all our luck to get through unscathed. We had to cross the whole of France to Basle at night, in the November season when, even in good weather, night-time fogs generally obscure the ground, and in bad weather, deep clouds and rainstorms conceal the higher elevations. If one flies for an hour or less in such low-lying clouds, and does not have an extremely accurate idea of his position, he is obliged to ascend high enough to be certain of flying over any elevations which he could possibly encounter in drifting off course. Consequently it is practically impossible to get a sight of the ground, since only with a very accurate knowledge of his position would one dare to go down through the clouds; for at that time there were no radio direction-finders and no airway beacons, such as make it easy to determine one's position today.

I decided to attempt to reach Basle via Nantes, Tours, and Dijon, and calculated that we could find the ground again on the lee side of the mountains in the highlands of Burgundy, even if we should previously have lost contact with it.

We were favoured here by good luck. We set a direct course for Dijon and were able to follow it easily in fine and clear weather. Occasional ground mist in the Loire valley caused no trouble, and, after the long flight across the empty ocean, it was a pleasure to see once more the lights of inhabited towns and villages under us. A little beyond Tours we had to climb, as the country was now higher, and we entered a low overcast. At first we tried to fly under it, in order not to lose sight of the ground. But this forced us to fly so low that our antenna, hanging down 300 feet, was torn off. So we went up into the clouds—just as we did off Newfoundland! But here matters were not so critical, for only a light, steady west wind was blowing. After we had flown about an hour and a half in the clouds, they dissolved suddenly and Dijon lay beneath us. Actually the clouds had broken up on the leeward side of the Cote d'Or, as I had expected.

Now we continued on our way towards Basle, over comparatively open country and with good visibility, and I went to bed leaving orders to awaken me if fog should be found again in the Rhine valley, as was to be expected. For there it could be critical,

as we would have to steer through a deep gorge between the Black Forest on the left and the Jura Mountains of Switzerland on the right, in order to reach Lake Constance. I lay dozing for a while, then fell into a deep sleep, of which I had had little enough during the preceding three nights. Suddenly I was shaken awake. Before me stood Dr. Lehmann, who was in charge of the watch, telling me we had entered a very thick fog reaching up to 3,000 feet. I said I would come to the control car immediately, but must have gone sound asleep again at once; for when I arrived in the control car half an hour had already passed since I had been awakened.

We were now flying at an altitude of 3,000 feet in thick fog and had to climb out of it quickly, for the Black Forest lay only a short distance ahead. To our surprise, we found this rather difficult to do, but the reason for this was soon clear. Above us lay a very warm layer of air of at least 54 degrees Fahrenheit, while up till then we had been flying in a layer of about 36 degrees. The ship would not rise into this warm layer. But finally she climbed, and we rose out of the fog at 3,600 feet. We saw ahead of us the highest peaks of the Black Forest floating like islands on the white sea of fog. A short distance north of us was the Blauen, and farther ahead the summit of the 5,000-foot-high Feldberg. It was now easy to orient ourselves. We were able to recognize Hohen-schwand underneath us and set a course for Friedrichshafen, still 60 miles away. We hoped to be able to see the ground beneath us over Lake Constance, but first we floated along over the uniform white surface extending ahead of us like the sea. And it scarcely seemed possible that we would catch a glimpse of our home base during the next few hours. But we were remarkably lucky.

Suddenly there was a hole in the clouds, and we recognized beneath us the western corner of Lake Überling and the village of Sipplingen. We quickly descended through this hole, and a few minutes later found ourselves over the surface of Lake Constance. It was a good thing that we used this favourable opportunity, for the fog rapidly closed down again over and around us. We had to travel the 12 miles to Friedrichshafen through fog, and saw nothing of land or water, and it was amazing when the curtain suddenly parted and, as by a stroke of magic, the brightly lit airship shed greeted us. It was 4 a.m.; ten hours had passed since

our crossing of the French coast, and sixty-eight hours since our departure from Lakehurst.

We cruised about for two hours more until, with dawn beginning to break over the lake, the ground crew assembled on the field. We then made the surprising discovery that the whole of Lake Constance, with the sole exception of Friedrichshafen, was entirely hidden in fog. Extraordinary! As an old "sea dog" I had never seen anything like it, and it was more amazing as the area around Friedrichshafen was a favourite site for fog in the early autumn. It was as if a Higher Power were helping the *Graf Zeppelin* at her home port after the varied and difficult ocean crossing. By 7 a.m. the ship lay safe and sound in the shed in which she had been created.

Could I be satisfied with the results of the flight? I believe so. True, we had not been able to put on a fast crossing of forty-eight hours or so in favourable weather, but instead had needed eighty-one hours to go from Gibraltar to Washington, and fifty-eight hours from New York to the mouth of the Loire. But we had been able to show that the Zeppelin airship, even in the most unfavourable weather conditions and with a failure of one of her important structural features, could safely cross the ocean. The ship had to be faster! This was the first goal to be attained. And we ourselves had to get to know the ocean still better. But this could be done, and we had already learned a great deal on the two journeys.

III

A SENTIMENTAL JOURNEY TO EGYPT

THE GREAT success, beyond all expectations, which had been achieved by the flight of the *Graf Zeppelin* could at first glance have led to the agreeable conviction that we had been delivered from all troubles and difficulties, and could now count on the Zeppelin Company being generously supported by public officials. But we promptly found that nothing of the kind was happening. What we needed was to raise the capital to build a better ship with improved performance, and we also needed operating funds to continue with the flights of the *Graf*, as the world called the ship. Compliments are very fine, but they cannot be eaten, and popular enthusiasm is elevating and bestows on effort and hard work a moral uplift and exaltation, but these cannot take the place of lifting gas, with which the airship's cells have to be filled. At that time, in the winter of 1928-29, I had not yet comprehended the degree to which the interest of great newspaper enterprises and of stamp collectors could be exploited to supplement the receipts from carrying passengers.

We had to raise operating funds somehow. Where were they to be found? Theoretically, we could imagine a capitalistic enterprise seeking to develop a business out of commercial Zeppelin transportation. But at this time they seemed to lack courage and confidence. There might still be eager groups in the population, enthusiastic about the Zeppelin, who would contribute to a subscription. But how could I dare to direct another appeal to the German people? And so there remained only the State, the Government itself, to help us out of our difficulties with subsidies. Yet the agencies most important in this respect, in spite of taking an unmistakably more friendly attitude, were still very noncommittal, since there were yet more important tasks, in their opinion.

Finally I struck on the idea of inviting a number of important Government officials and influential party politicians on a fairly long flight, to give them an opportunity to learn from their own experience the safety and comfort of voyaging in a Zeppelin, which they only knew in theory. This flight would naturally have to be a specially attractive one, and I decided, for three reasons, to plan one to the Eastern Mediterranean with a landing in Egypt. Firstly, such a voyage would provide an easy opportunity to solve a number of navigational problems which would also be interesting to our passengers; secondly, it would lead through a region which scenically, as well as being the site of many historical events from antiquity to most modern times, would be extraordinary and rich in associations; and, thirdly, it would be an effective publicity flight, both for the people whose cities we would fly over, as well as for the German politicians who would observe from on board the extraordinary impression which the Zeppelin airship aroused in the world generally.

I had intended to prepare for our very influential guests, who perhaps would be the ones to decide whether a Zeppelin air line was to be or not to be, a beautiful journey in an even greater sense than that mentioned above. It was the severe winter of 1928-29, and in Germany since the beginning of January we had had temperatures hovering around zero. I had planned the take-off for February 24, in order to meet early spring on the Riviera and full spring in the Eastern Mediterranean. But on February 20 we registered 11 below zero in Friedrichshafen, and the masses of snow covering the whole of Western Europe and Russia made it seem certain that we would have to wait weeks longer for milder weather.

So I postponed the journey a full four weeks, and set it for the 21st of March, the beginning of spring, according to the calendar. And even then it was still so cold over Central and Southern Germany that the passengers in our cabins, which were then unheated, did not take off their winter coats until we reached Crete. Most of the palm trees along the Riviera had frozen in this, the severest winter for the past fifty years. It was a wonderful experience, therefore, for our passengers, after a rather chilly midnight take-off from Friedrichshafen and a night journey across France, to find warm sunshine beaming down on them at Marseilles, on the first morning of spring.

In the next hour and a half we flew along the Riviera to San Remo at such a low and comfortable altitude that all the beauties of this attractive stretch of coast could be taken in at our ease. We then turned off to the south, and soon saw to our right the imposing mass of the mountains of Corsica, where Napoleon was born, and to our left little Elba, where he spent some months as a prisoner, a potent reminder of the changes of fate which even the great experience.

We swung over ancient Ostia, rich in memories, on our way to Rome, the "eternal city", which for so many centuries determined the fate and course of the world for good or evil. We looked down on the ruins of antiquity, on the gardens of the Vatican, the ruler of the Middle Ages, and on the teeming streets and squares of modern Italy. And we decided it would be a good idea to send Mussolini a telegram of greetings. It read: "Filled with admiration as we look down on Eternal Rome with its timeless remembrance of a glorious past, and its lively activity as a flourishing modern metropolis, we respectfully offer our greetings and our good wishes to the genius of this splendid city." As I handed this message to the radio operator, I remarked rather maliciously, "I can't help wondering whether Mussolini will assume that he himself is the genius of the city." Mussolini's answer read, "Many thanks for your friendly greeting! I wish you a happy journey. Mussolini." I don't dare to guess what Mussolini really meant.

We continued our journey along the coast and entered the Bay of Naples, where the city itself, Vesuvius, Capri, Sorrento, and Amalfi competed for the prize of beauty. "See Naples and die!" "Yes, indeed!" we thought, "but from on board a Zeppelin!" With approaching darkness we came to the toe of the Italian boot, left behind on our right hand the already-darkened Straits of Messina, and went up over the toe from the Tyrrhenian to the Ionian Sea. For the first time there was nothing to see outside, and our guests seated themselves around "the candle's friendly flame" at the attractively decorated tables. We had: Turtle soup, ham with asparagus, roast beef with vegetables and salad, celery with Roquefort cheese, and an excellent nut cake from Friedrichshafen, together with wine in abundance. The passengers, who were able to enjoy this meal in completely steady flight across the dark sea, were, we liked to think, pleased with our offering.

On the following morning they looked out on the coast of Crete as they sat down to breakfast. During the night I had deviated somewhat to the north from our flight course on account of a very strong south-east wind, which had greatly retarded our progress, hoping that this south-east wind would not prevail on the northern side of the long island that was traversed by high mountains. And such was the case. In calm and peaceful flight we ran along the north coast, giving our classical scholars on board much to see and to remember. Similarly we quickly passed the island of Cyprus, lying somewhat to the north of our course, where so many Romans, Turks, Venetians, and Crusaders had contended for its strategically important territory.

We now steered for Haifa, and crossed this busy harbour in its beautiful, protected bay. Then we flew along the coast and over Tel Aviv towards Jerusalem. Below us was the stage on which so many acts of world history had been played, as ancient and legendary as that of Crete, but how different in the emotions aroused! There antiquity and ancient Greek culture, here Biblical and Christian associations, but both fundamental for our still-valid spiritual standards.

I now had the idea of offering the guests on our publicity flight a sensation of a quite extraordinary kind. The surface of the Dead Sea lies almost 1,300 feet below sea level. We were irresistibly tempted by the opportunity to fly our Zeppelin at an altitude well below sea level. Jerusalem lies at an altitude of about 2,600 feet, and within a quarter of an hour we were at the edge of the high plateau from which there is a sheer drop into the gorge at the bottom of which lies the Dead Sea. It was evening, and the barely risen full moon shone still with little power, so that the great lake lay reflected in semi-darkness, as mysterious as the nether world. We slowly sank down, carefully feeling our way lower and lower, until we hovered a few hundred feet over the surface of the water. We looked up to the heights towering around us as if from a cellar. It was a strange sensation to be in a ship which ordinarily soars high above the sea level, now flying some 1,000 feet below it. We opened a couple of bottles of Rhine wine and celebrated the occasion, which each of us found unique, with a gay round of drinks. Later I had a chance to use it in playing a simple but astonishing joke.

I had been invited by a young friend, a U-boat commander, to a celebration of the commissioning of his new boat. I was supposed to say a few words to the crew at the dinner, and remarked, "You know that my calling usually has me flying *over* the surface of the sea, and often we have also floated with the gondolas of our ship *on* the surface of the sea. But it will be news to you that we, just like you, have journeyed *below* the sea's surface. And I believe that we have hung up a record in our ship that you cannot equal in your U-boat. On one occasion we went down 1,000 feet below the surface of the sea." Great astonishment and disbelief were reflected on the faces of the young U-boat crew, but this vanished in loud laughter as they heard the subsequent explanation.

After a short sojourn in our defile we slowly rose again and flew low over the fissured precipices which rise on the west side of the sea towards the plateau of Jerusalem. The full moon meanwhile had risen higher, flooding the cleft and rocky landscape with a ghostly light, and disclosed to us an intricate, confused labyrinth of crevices and hiding-places in which robber bands of all kinds could conceal themselves. Was some such game being played there now? We paid a short farewell visit to Jerusalem and then faced the question: "What now?"

The pyramids of Egypt lay only three hours by air to the south of us, and a visit to them should have been the high point of the journey. But the Foreign Office had forbidden us to fly over Egypt! Yet we were not forbidden to fly along the coast of the Land of the Pharaohs. And I decided to do this, as we wished to arrive in daylight, not earlier than the following morning, in Greece, and had considerable time to spare. We therefore took our departure from Jerusalem on a southward course. Under us lay, in bright full moonlight, the broad caravan route which, since ancient times, has communicated with the Land of the Pyramids. There, almost 3,000 years before, had traded the sons of the Patriarch Jacob, to buy grain from their brother Joseph, the greatest and luckiest grain speculator of all time. In that period there were apparently no boundary difficulties, as in our enlightened age.

As we approached the border we turned out to sea, on a direct course for the lighthouse of Port Said. From there we would

travel at the prescribed six-mile distance from the coast towards the site of the famed ancient lighthouse of Pharos, which had provided illumination for Antony and Cleopatra.

From here we continued our flight, which had already provided us in such an agreeable way with a geographical object lesson on significant sites of importance in the history of European culture, in a happy and expectant frame of mind. The impressions which the day just past had brought were overwhelming. We were completely satisfied at being able to sleep quietly and comfortably for a few hours, while the ship flew, vibrating gently, across the waters of the Levant, gleaming like a mirror in the silvery rays of the full moon, with her bow turned north towards Athens; for we could expect that the next day would bring us many scenes and experiences in the region of the ancient Greek world, for which we should have to be properly rested.

At 6 a.m. we aroused the Athenians from their morning slumbers with the thunder of our motors as we flew over the city and circled the Acropolis, and we were already far on our way by the time they had wrapped themselves in their togas and collected in the streets and squares. Soon we came to high Olympus, where dwelt the gods of ancient Greece. Its slopes were still covered with snow, but the summit, where the gods were wont to seat themselves, was unfortunately hidden by a black cloud. Here we turned back. Our intention had been to fly over the famous monastery of Athos and Homer's ancient Troy to Constantinople, and then return in the general direction of home by way of the Rumanian oil-fields and Vienna. But the incoming weather reports informed us that the whole Balkan area was covered in deep clouds. We could not therefore expect much on this route. And so we turned, in order to fly by way of the Gulf of Corinth to the Adriatic, whose islands and coasts promised a rich and interesting feast for our eyes all the way up to Trieste. Athens, which we reached again at 9 o'clock, had meanwhile awakened, and here we were enthusiastically received, particularly, I suspect, by those who had slept through our first visit and had been teased about it by their neighbours.

We traversed the Isthmus of Corinth and from a low altitude looked down on the canal, which is particularly significant, in my opinion, as the ancient Greeks lacked the means and the energy

to dig it. Now it has filled up so as to be hardly wide enough for small craft, and it looked from 500 feet like a passage for row-boats. We flew along the north coast of the Gulf of Corinth at about 1,000 feet, and could see far into the land of fantasy and legend.

Ithaca, a small island which we, from on board our ship, could encompass in a glance, was set miraculously in a cobalt-blue sea, through which its chalk foundations shimmered like silver. We left this poetic spot of land only after some delay, to fly along the Adriatic coast. We gazed on the beauty of Corfu and many other picturesque islands, looked on quaint little towns like Ragusa and Sebenico, and everywhere encountered reminders of the eventful history of these shores.

The sun set at last as we reached the most northerly point of our Adriatic journey at Spalato. Our philosophical pleasure flight in light and sunshine, which we had offered for three days to our rigorous Board of Examiners—if I may so describe them—was practically ended. The remainder was a trial of the navigational capacities and the airworthiness of the Zeppelin; for the weather north of the Alps, according to the forecast, was still foul and wintry in this severe winter which seemed to have no end. We were trapped, so to speak, in the giant horseshoe of the Alps, which we had to surmount if we were to reach Friedrichshafen.

There were three routes we could follow: we could cross the Brenner Pass, following the valley of the Adige; we could traverse Lombardy to the Riviera and the mouth of the Rhone and thence retrace our outward route; thirdly, we could fly over the outer ranges of the Dinaric Alps to Pressburg and Vienna. The first route was impossible, for it presupposed daylight and completely clear, fine weather to find our way between the towering Alpine ranges. The second way was not very attractive, for it was very long. There remained the third. But this was not so desirable either, for we also needed clear weather for it if we were not to get into unpleasant, not to say dangerous, situations. We would in fact have to rise to an altitude of 4,600 feet to fly over a high plateau, and then would have to go through a narrow pass between two mountains, which were almost 6,500 feet high. If this pass should be hidden in cloud, we should have no choice but to climb to 6,500 feet in order to be safe. But that would be very

undesirable, for we would have to blow off a great deal of gas while climbing, and the ship as a result would be about 11 tons heavier. If we should later, with our heavy ship, have to fly through rain or even snow-squalls, we would not only have to drop the last of our slender supply of ballast water, but would probably have to drop several tanks of fuel also, in order to keep the ship in the air.

In a considerable state of excitement we started our flight over the high passes. At first it was all we could wish for. It was clear with good visibility, although the moon had not yet risen. We came to the highest pass, and could see the two mountains which flanked the passage looming up ahead of us. Within ten or fifteen minutes more we would have them on our right and left, and it seemed almost dead calm, so that we then would be able to steer by compass out of the maze of peaks. But suddenly we noticed that clouds were gathering on the sides of the peaks. There were only a few wisps; but we knew how quickly everything can be hidden in the mountains. We later found that a stiff east wind was blowing on the windward side of the whole mountain chain, causing the usual cloud-formation on that side, while we on the lee side had had up till then the prevailing gentle south wind. The tension in these last few minutes was absolutely unbearable, and every minute I was sure I would have to give the order to climb to 6,500 feet. But our luck held: we still had sufficient visibility on reaching the point where the mountain walls soared upward to right and left. A great load was removed from my mind as the ground began to fall away below us and we were "through". The passengers had been watching anxiously while the ship ran past the dark walls in the narrow passage, which looked like a ravine. Apparently they were feeling more tense than I did; for the pilot naturally knows a lot more about the situation and realizes, if he is a prudent person, what has to be done to meet the threatening danger. But the Minister of Commerce, who was on board, came afterwards into the control car and said, "Thank God we got out of that hole!" And I was glad that we had succeeded without having to climb.

Next we entered some really bad weather. Above the Plattensee the wind was blowing so violently out of the pass, where the Danube debouches between Vienna and Pressburg, that we ad-

vanced very slowly over the ground and did not reach Vienna till midnight, in a beginning blizzard.

In Vienna they had been waiting for the ship since 11 p.m., and the radio audience had been promised a speech from on board her while she cruised over the city; for the people of Vienna had also given their mite to build the ship and had a right to a show of gratitude. I had volunteered to give this speech myself. But when the time came I was busy with navigational problems. After the tensions of the preceding day, and particularly of the last few hours, I had so little inclination to say anything that the good Viennese might have wanted to hear that I did not care to keep my promise. So I asked the President of the Reichstag, Herr Loebe, who was on board, to speak in my place. He was kind enough to take over for me, and certainly did it much better than I could have done. I heard later that the people of Vienna were very well satisfied with his speech, and I believe that he was too.

The blizzard had meanwhile increased greatly, and it was quite like winter. Not only were there "delicate grains of ice brushed across the green plain", as Goethe describes it in *Faust*, but it was genuine winter, which would not let up. The passengers who were still out of bed had once more wrapped themselves in their heavy coats, and even the staunchest patriots agreed that the German climate was nothing to boast about. The wet snow froze on the panes of the windows of the control car and formed an ice layer a quarter of an inch thick, through which we could not see. Navigation on a dark night was hazardous in such circumstances. It was difficult to hold the ship on her course over the Danube valley, between the great heights on both sides. But I was privately not nearly so angry over this situation as I pretended to be, as we could show our Board of Examiners how safely the airship could find her way even under such unfavourable conditions. In case of need we might have turned off to the north at greater altitudes. But we were quite happy when we got out of the Danube valley at Passau, and had ahead of us only the final stretch, which posed no difficulties.

The weather had cleared when we reached Ulm, and towards 8 o'clock our shed came in sight, and half an hour later we had landed, after a flight of eighty-one hours. We were sure, and we

heard it from our passengers in words of enthusiastic thanks, that this flight—perhaps the most splendid that one could make in Europe—had created a great impression on every one of them. We were sure that henceforth they would be true friends of the Zeppelin airship. And so it proved.

IV

THE FLIGHT AROUND THE WORLD

THE FLIGHT to Egypt would certainly have aroused the dullest mind. The entire crew of the airship, down to the youngest machinist, had been inspired by it. They had seen many beautiful sights and had had many experiences, and had acquired a taste for this kind of voyaging; it was therefore not surprising that they had developed a certain adventurous, romantic frame of mind which yearned for far-away places. They began to dream and talk of a flight around the world, for they were convinced that the airship could do anything.

The idea of such a flight was not strange to me either. It was the task of the commercial department of the Zeppelin Company to demonstrate the usefulness of the Zeppelin under all conditions throughout the world and to obtain experience in all its zones. How better could this be done than in a flight around the world? At the same time this would provide a brilliant testimonial of the endurance and operational radius of the ship, and would promote propaganda for the cause throughout the world. And the flight seemed technically feasible, for if necessary we could use two intermediate bases: the airship hangars at Lakehurst and at Kasumigaura near Tokyo. The shed in Japan had been expropriated from us after the first World War and set up again at this distant spot, surely not with the intention of serving a German airship on a world cruise, though seemingly intended for this by a mischievous destiny. Therefore I was not unsympathetic towards the current talk about a world flight. But it was not easy to make up my mind about it, and for two reasons. The first question was, *who would pay for this flight?* The second was, *what route could we take?*

The cost of the journey would have to be estimated at a quarter of a million dollars at least, of which the provision of additional gas

and fuel for the ship in Tokyo would require the major portion; for we needed to drive the motors on a special fuel gas, of which at least 883,000 cubic feet would have to be shipped out to Japan and there stored properly by engineers sent out for the purpose. How were these expenses to be met? Little was to be expected from the German Government, which still at that time had a very reserved attitude towards the Zeppelin airship. We would chiefly have to help ourselves, and that seemed rather difficult, for we had not even yet realized to what degree the stamp collectors throughout the world were interested in Zeppelin cancellations. How were we going to make out?

From this embarrassment we were rescued by a surprise offer from the generous American newspaper magnate, William Randolph Hearst. In return for a world-wide monopoly of reporting from on board the ship, he offered to pay \$150,000. This would have covered about two-thirds of the estimated cost, and I would gladly have accepted the offer. Unfortunately I had to recognize that this was not possible. The German newspapers would have pilloried me and would have given the undertaking a hostile reception if I had excluded them from the list of correspondents on board. Perhaps not without justice, for the Zeppelin had been a German boast for many years, and the German newspaper proprietors had done everything possible to help me—or, at least, believed they had. And so I replied to Hearst's offer that the European continent (not England) must be excluded from the monopoly rights and that these reporting rights must be left to German publishers if they thought it worth while. Hearst then reduced his offer to \$100,000. The German publishers would then have to pay \$50,000 if I were not to suffer injury, or if the whole flight were not to become out of the question.

In this dilemma I went to the Minister of Commerce to get his views. On questioning Herr von Guerard I received an astonishing piece of advice. He thought I should give the German Information Bureau (Wolff's Telegraph Agency) the reporting rights for the Continent, and that in return I should only request a single passenger fare, which had been set at \$2,500! This would have cost me \$50,000, less \$2,500, or about \$47,500. And there was no question of compensation from Government funds!

Naturally I did not agree to the Minister's proposal, but instead

contracted with three German publishing firms for a group payment of \$12,500. A great West German newspaper, to which I had promised a berth, replied that they would not even pay \$1,250 for it. Were they foolish? I think so. At least, according to a well-informed source who told me, Hearst's sales of papers came up to his expectations, quite apart from the prestige that he obtained for his enterprise. I should also add that the reporting by the Hearst representatives, Karl von Wiegand and Lady Drummond Hay, carried on under precarious conditions on board, was really extraordinary.

This took care of half the expenses. The other half was generously met by the stamp collectors, who took an extraordinary interest in the flight. Also a not inconsiderable sum was received from the passengers, whom we carried in addition to the numerous Press representatives. And so it came about that the flight could be made with a profit of \$40,000.

During the negotiations with the publishers and officials we had been exploring the other question which was no less important: what route the airship would have to follow, and, particularly, whether the journey could be carried out in safety. There seemed two routes to consider: one through the Mediterranean and on to the Indian Ocean and the China Sea; and the other north of the high mountain chains of Central Asia, across Lake Baikal, through the Amur valley to Manchuria, and across North China to Japan. A more central, so-called direct route, was ruled out by the tremendous ranges of mountains lying between Northern India and Lake Baikal. At first we gave much thought to flying the first route across the Indian Ocean. But this course is very long, amounting to nearly 9,000 miles. This might not have been in excess of the *Graf Zeppelin's* range in calm weather, provided economical speed was maintained, but weather conditions in the China Sea are very unpredictable, and, given unfavourable wind conditions—for example, on the fringe of a typhoon—we might possibly run out of fuel.

And so we turned our attention to the second route, via Lake Baikal and the Amur valley. With a length of only about 6,000 miles, it was considerably shorter, and the altitude conditions would not cause trouble—in clear weather! But exactly this was the critical feature! If low clouds or fog should prevent us from

getting our bearings in the central Amur valley, navigation could be very difficult in avoiding the great heights on the south and north sides of the river. The flight might even end in disaster. Particularly in July, when the flight was planned, typhoons frequently drive in over land from the China Sea and shroud the whole of North-east China and Manchuria in heavy rain-clouds.

Therefore I decided to follow still another route, namely that across Central Russia and Siberia to Yakutsk, in order to cross the 6,500-foot Stanovoi Mountains at Fort Ajan and reach the Sea of Okhotsk. Thereafter there was a final 1,900-mile stretch in a generally southerly direction, between the elongated island of Sakhalin and the Asiatic mainland to Tokyo. At first glance this seemed a somewhat peculiar route to follow: from South Germany diagonally across Central Russia and Siberia nearly up to the Polar Circle, to a point lying 1,900 miles north of Tokyo, and then running this 1,900 miles to the south! But only at first sight did this appear strange; for about three-fourths of the distance—to the Sea of Okhotsk—approximated a so-called Great Circle course, the shortest distance between two points on the globe, and thus it happened that this route of about 7,000 miles was hardly longer than the course through the Amur valley with its full 6,000 miles. And this route was safer! This flight over the inaccessible and almost unknown interior of Siberia appeared so very interesting and exciting that we fancied ourselves as bold discoverers. So this route was chosen.

The point of departure for this voyage around the world was not Friedrichshafen, but Lakehurst. It happened in this way. Mr. Randolph Hearst, as a condition of his willingness to support the voyage—indeed, by making it possible through his generous agreement with us—had demanded that the world flight should begin at Lakehurst—and likewise end there. This would brand the flight really as an American, not to say Hearstian enterprise. Although this condition at first seemed somewhat disagreeable, I was not so unsympathetic when I considered it further; for, to begin with, the engines, after having been completely overhauled in regard to clutch and vibration problems, would have a thorough trial during the ocean flight to Lakehurst before starting the journey around the globe. Secondly, it was consistent with my general efforts to

develop close, friendly connections and co-operation with America through the Zeppelin flights. How could this ideal be better served than if America should embrace the German Zeppelin idea so publicly? Thus it came about that two world flights were to be made in one: the Americans thought of the flight from Lakehurst to Lakehurst; the Germans, of the flight from Friedrichshafen to Friedrichshafen. Later the Americans found to their great satisfaction that the "American" flight set a record that was twelve hours shorter, because the first crossing from Lakehurst to Friedrichshafen was made in twelve hours' less time than the final crossing at the end of the "German" world flight. Such finely drawn calculations serve to provide the "philosophers" with a good laugh, and laughter is healthy.

The journey to Lakehurst started on August 1, 1929. It lasted all of ninety-five hours, because we had to buck stormy west winds over part of the distance. This made it all the more worth while as a test of our engines, which proved themselves splendidly. At Lakehurst we found that, thanks to the Hearst publicity, there was a tremendous demand for berths on the ship.

Before an assemblage of 10,000 sightseers the take-off for the world flight occurred late in the evening of August 7. We flew a farewell turn over New York, with its millions of lights gleaming up at us and captivating the senses. Then we were swallowed up in the darkness of a quite misty night. Wine was served, and in the comfortable little cabin we drank a glass all round to the success of our journey, before we went to bed. But the reporters' typewriters clattered almost the whole night through, a sound which for days was constantly in our ears. What we had to put up with!

The flight across the Atlantic brought no real surprises. Yet the navigator and the pilot always find lessons to re-learn. At first we encountered variable winds and weather, as several disturbances lay south of Newfoundland. Then we held somewhat more to the south and came to the south side of an extensive low-pressure area which stretched from east of Newfoundland all the way to the English Channel. Now we had a tail wind shoving us along. Beneath us the sea was foaming with waves running in our direction. And so in no more than forty-five hours we were off the entrance to the Channel, and around midnight, Central European

time, were over the coast of France. At this moment a couple of passengers entered the control car with glasses of champagne to offer their congratulations. It was the start of my birthday, which I had forgotten about! I must admit that on this occasion I attached a real significance to the customary birthday greetings, for I was engaged in a really significant enterprise at the start of a new year of my life.

We flew across Paris in the early dawn and looked down with interest on the countless carts and wagons converging on the market-places. Yes, the people of Paris dine richly and well. Shortly before noon we landed in Friedrichshafen, after a flight of fifty-five hours. A good beginning for a journey of which fully 12,500 miles, depending on the route we chose, still lay ahead. Roughly 4,500 miles was behind us.

We stayed five days in Friedrichshafen, partly to make some alterations to the ship which had appeared desirable during the flight to and from Lakehurst, partly to await the arrival of some of our passengers, who were to join the ship at Friedrichshafen, and partly to check the ship and engines thoroughly once more before the great journey. Chief among the passengers boarding in Friedrichshafen were the German Press representatives, who naturally wished to participate in the "German" world flight from Friedrichshafen to Friedrichshafen. Also there were representatives of the Russian Government, who were to accompany us during the journey over Russian territory, and who, as I later discovered, were to cause us some trouble. A representative of the American Navy Department, Commander Rosendahl, had naturally come aboard in Lakehurst. Altogether there were twenty passengers and a forty-one-man crew on board as we rose into the air early in the morning for the "flight around the world".

The weather was fine and calm. The flight went by way of Ulm, Nuremberg, and Leipzig to Berlin, where shortly before 11 o'clock we were above the Unter den Linden. We naturally felt obligated to the people of the nation's capital to show ourselves on our departure and also, so to speak, to carry thence their greetings to the people of the Japanese capital. The Berliners understood this thoroughly and waved enthusiastic greetings to the ship flying low and slow down the Unter den Linden. I was struck by curious thoughts as to how the times change, for Japan had been our

enemy in the war and had driven us from our Chinese possessions. The world forgets quickly, but in foreign policy this is a good thing, otherwise old feuds never would be settled.

We set our course towards Stettin, to give our Captain Fleming a chance to drop a farewell message to his old mother, who lived there. Then we steered along the Baltic coast by way of Danzig, Königsberg, and Tilsit, aiming to cross the Russian border around 6 p.m. How would we go from there?

The direct route led to Moscow by way of Ekaterinburg, where I intended to cross the Ural Mountains. The Russian representative on board came to me in the control car to emphasize the absolute necessity of flying over Moscow. He apparently was instructed to demand this; for in Moscow, as he said, "hundreds of thousands were awaiting expectantly the appearance of the world-famous Zeppelin", as the Government had led them to expect. I still hesitated to give a definite promise, for I first wanted to look at the evening weather report, since the morning report indicated uncertain weather conditions over southern Russia. When the evening report was received, it showed that a low-pressure area had developed north of the Caspian Sea, causing strong easterly winds as far north as Moscow. We would have to be prepared for head winds if we flew by way of the capital, while I had every right to expect calm air or even favourable westerly winds on a route laid out more to the north. What to do?

It was clear to me that it would be "politically" desirable not to vex and disappoint the Muscovites. On the other hand, navigational considerations obliged me to use the weather situation to the best advantage, for the journey was long and our fuel supply limited. We had loaded fuel for 100 hours at Friedrichshafen, which should have sufficed for the distance of about 7,000 miles in still air. Naturally a decrease of speed would provide a certain reserve, which we could obtain by increasing the flight time to 130 or 140 hours, if we did not encounter too strong head winds. But our safety and our reserves could best be assured by the right use of wind conditions and by taking advantage of tail winds if they could be found. It was a fundamental principle with me to take navigational considerations into account first of all, even if political or other disadvantages might ensue. Therefore I decided to steer to the north and to leave Moscow on our right. The Russian

Government representative was furious and almost threatening, but it availed him nothing.

While the inhabitants of Moscow were vainly keeping watch on their roofs for our ship, the latter was continuing her progress in steady flight to the north-east. In the process we came more and more under the influence of a low-pressure area covering Northern Europe, and made good headway with the assistance of freshening south-west winds. We ran on with only four motors, throttled down, and even so we were going 68 miles per hour over the ground. This meant that we were effecting a marked saving in fuel. We went up almost to the latitude of Leningrad, to the city of Vologda. Here for the first time we changed to a direct easterly course, towards the city of Perm, located at the foot of the Ural Mountains, where we could cross at the lowest possible altitude.

We flew at an average height of only 2,000–2,300 feet, and had an excellent view of this country, which was new to us, particularly as there were only two or three hours of real darkness in these northern latitudes. What enormous open spaces, what tremendous areas of forest and field as soon as we crossed the border—so sparsely interspersed with villages and farm-houses, according to our ideas—increasingly sparsely as we followed this parallel into Central and Eastern Russia! How drearily isolated seemed so many of the small villages, lying quiet and peaceful amidst miles of endless forest or on the banks of small rivers. We asked ourselves what could ever disturb the patriarchal, self-sufficient, isolated existence of these people down below us. “The Czar is wide, and the heavens are high!” This Russian saying was brought home to our awareness in its most literal meaning. But it applies only to the times and peoples of the past. Today, when all citizens can be reached so easily by radio and telegraph, a mobilization of all resources is no longer so difficult even in the most remote forest or distant land.

Shortly after midnight we approached the Urals, somewhat north of Perm, and slowly climbed to an altitude of 3,300 feet. The mountain range lay below us like a level, immense woodland, like a gently rolling, hilly region in which only isolated elevations appeared more prominent. But we were impressed and amazed to find that for long distances this area was covered by thick smoke. We counted a good dozen large forest fires, and for half an hour

flew through smoke so thick that it was impossible to see more than 100 feet forward or aft. We were told that this was a quite normal occurrence. Wood-cutters, hunters, and tramps of all kinds were constantly causing conflagrations by their carelessness in starting fires which spread during the dry midsummer season. At one time during our crossing of the Urals we saw an area of more than 60 miles in length and breadth lying under thick smoke.

We passed out of the smoke and found ourselves over the border between Europe and Asia, about 30 miles north of Ekaterinburg, where the Trans-Siberian Railway begins. We had come about 2,000 miles from Berlin and had covered this distance in twenty-nine hours with engines throttled down. We could afford to be very well pleased. The wind was blowing from a due westerly direction, and we remained in this favouring air current, which we had reached by following a north-east course, for a good twenty-four hours.

Now we went ahead on our north-east course in the direction of the confluence of the Irtysh with the mighty Ob, to have a fixed and accurate point of departure for the monotonous, trackless, and treeless waste which would soon lie beneath us. The landscape became steadily more lonely and, in its desolation, appeared, I might say, even frightening and terrifying; for it was gradually changing to the swampy region, called "*taiga*", which stretches for immense distances on both sides of the Ob. Probably no man previously had seen this terrible waste land in its full extent and most desolate portions; for in summer it is inaccessible, and in winter, when it lies beneath ice and snow, the gay-coloured, pretty picture which in summer it presents to the eye is concealed by a covering of white. Like an extraordinary, decorative carpet it blazed up at us in all its colours—green, yellow, blue, red, and orange—horribly beautiful when we thought we might have to land on this carpet and be trapped helpless and lost amid the swamps and countless criss-crossing little streams.

These thoughts disturbed one of our passengers so much that, as he said to me, he lost his appetite for supper, which for the rest of us was increased by the splendid radiance of the sun hastening towards its setting. It was true. We could land anywhere except in the swampy "*taiga*"! But there was really no justification for being disturbed by such thoughts. In calm and stately flight the

ship went on her way at a 1,000-foot altitude across the vast area. Towards midnight, after crossing the Irtysh and the Ob, we were over the endless swamp and forest country between the Ob and the Yenisei, following a steady north-east course towards the point where the so-called Lower Tunguska empties into the Yenisei. Our intention was to follow from there the course of the Tunguska in the general direction of Yakutsk, since a more southerly route would bring us over higher land. Also the northerly route was now the shortest to the Sea of Okhotsk.

It was quite difficult to steer an accurate course in the dark night over the monotonous, roadless, and trackless area between the Ob and the Yenisei, as long as the ground could not be seen. And so, when we arrived at dawn at the broad expanse of the Yenisei, we did not know if the little river-port of Imbatsk, for which we were looking, lay to the north or south of us. We could not discover it from where we were. After some reflection we decided to seek it to the north, for the wind during the night could have sent us perhaps a little to the south. So we headed north above the majestic river, and presently within a brief quarter of an hour we saw the place just ahead of us. It was a wretched little village of perhaps twenty-five or thirty huts, but we were acquainted with it, for at the same time it was a weather-station—the only one on the lower portion of the Yenisei.

Though Imbatsk had twenty-five huts when we arrived, it had only twenty-three after we left; for we saw the following drama take place as we flew overhead. Apparently our arrival was a complete surprise. Who would ever have thought that we would be steering straight for this little hole in the midst of the immeasurable green wilderness of Siberia, merely to fix our position accurately in the lower Tunguska valley? We were approaching at a low altitude above the river; then we turned a corner, and suddenly we were over the houses. Doors and windows opened and people curiously stuck their heads out to look for the cause of the thunder they had never before heard from the heavens, but most of them quickly drew back, apparently frightened by the sight of the giant heavenly chariot. A heavy two-wheeled cart was slowly plodding down the narrow street between the low huts, and the driver was lazily leaning back on the sacks and dozing. Suddenly he jerked upright, saw the monster close overhead, and

jumped off, vanishing into the nearest hut. The horse pulling the cart apparently took fright also and raced off terrified, dragging the vehicle. At the next corner he turned so abruptly down a side street, that it turned over, knocking down the shabby hut and destroying the next one also. We could not follow what happened next; but, though somewhat anxious, we told each other jokingly, "We'll have to pay plenty for wilful damage to a peaceful village!" The little adventure was certainly interesting, in that we saw once more what we had observed previously: that primitive people living in simple surroundings became panicky and terrified on seeing the giant ship. Religious or superstitious beliefs could play a part in this.

We now turned off to the east and, after flying about an hour, struck the Tunguska at a point where it follows a generally east-to-west direction, and we then followed its course in an easterly direction, which was supposed to bring us to Yakutsk. We had gone up to the 64th parallel of north latitude, and as a result were now crossing the meridians of longitude so rapidly that every seven hours we had to advance the clock an hour. This caused a certain amount of disturbance to our customary routine, for the meal-times came closer and closer together, so that even our passengers, ordinarily blessed with a good appetite, almost threatened to go on strike if they had to eat or drink coffee "already again". Luckily this mutiny never broke out, and next day the danger passed as we turned to the south.

But another problem was really causing us some concern. We knew that somewhere in this area a few years previously a giant meteorite had landed, blasting a huge crater in the ground and knocking down the forest round about with the wind of its flight. We would very much have liked to observe and photograph this crater from the air. Unfortunately we had neglected to determine its exact position. None of the gentlemen on board knew it precisely, and likewise the still-resentful representative of the Russian Government could give us no information. Therefore, to our deep regret, we had to give up the idea of taking what would certainly have been some interesting photographs.

The lower Tunguska winds and twists through endless forests and partly swampy lowlands, seeking its way through the dismal monotony of Northern Siberia. We saw no life on it, though we

flew directly above it for long distances. Only once did we see people. There were five of them, standing on a raft and fishing. Quite possibly there were many fur-hunters hidden in the deep, primeval forest, who probably could see us, though we could not see them. There was no trace of cultivation or forestry along the river. These Siberian rivers have the unwelcome idiosyncrasy of emptying their waters into the Arctic Ocean. Hence the vast resources of the endless forests remain unused. Flying over this green wilderness brought a feeling of regret that everything lying and decaying here was of no use to the world and seemed to be longing to be included in the living world of commerce. Perhaps this may come in time.

Some variation in our steady flight was caused by a squall-cloud of fearfully threatening aspect, which appeared directly in our path around noon. It lay extending for miles on either side, coal black, reaching down to within 500 feet of the ground, and it looked as if we were entering a new weather zone, after having put the westerly winds to good use. We were concerned over the turbulence we might encounter while steering beneath this black, darkly threatening barrier. But it was quite tame, causing only a little pitching and bumping.

On the other side of the squall-cloud lay an air-mass some 11 degrees warmer, into which our cooler west wind was blowing and causing the squall-front. But the atmosphere was too dry for more severe disturbances, like thunderstorm fronts, to develop. "Its bark was much worse than its bite," we told each other, as we passed through the sinister-looking squall-line with only a slight pitching motion. On the west coast of Europe this would have involved a very disagreeable meteorological disturbance with stormy winds, hail, and vertical gusts. But now it was warmer, as I have said. The temperature at 3,300 feet rose to 57 degrees, corresponding to a sea-level temperature of more than 68 degrees. This is how pleasantly warm the air was in 64 degrees north latitude in the Siberian summer! But only in summer, as we saw presently with our own eyes, for we soon left the upper Tunguska valley for a steppe-like plateau on the watershed between the Yenisei and the Lena basins.

Here we saw scattered colonies of people—the Yakuts. They very rarely live in real houses, but rather in underground sod

huts, before whose underground entrances we saw people lying about, "baking" comfortably in the sun. In winter, actually, the temperatures in this latitude fall to 76-94 degrees below zero, so it is a good idea to store up a little heat during the summer months!

Man, that adaptable mammal, can live wherever he finds something to eat, and he manages, whether it is in the steppe-like area of Northern Siberia between the Yenisei and the Lena, or on the ice of the Polar seas. Speaking for ourselves, however, we declined to live here, and flew steadily eastward in an almost calm, windless atmosphere, through a gorgeous sunset which flooded the empty plain with golden light.

During the brief night hours a full moon rose, or at least attempted to rise, for it remained low above the horizon to the south, where it rolled slowly along on its brief course like a huge yellow ball. In the north the brightly glowing sky showed that the sun was only a few degrees below the horizon. An American passenger was so fascinated by these theatrical lighting effects that towards 11 p.m., when everyone else had gone to bed for a brief rest, he called for two bottles of wine and spent the night watching the moon and the twilit heavens. I kept him company for a while, for the wine we were carrying on board was not bad at all, and the celestial spectacle was quite extraordinary.

With first daylight, as the sun rose blazing in the north-northeast, we came to the valley of the Vilyui, a considerable tributary of the mighty Lena. We were still roughly 350 miles distant from Yakutsk, which we naturally intended to cross for a variety of reasons, for Yakutsk was, for us western Europeans, one of those cities lying in the almost mystic vastness of farthest Siberia, where are measured practically the lowest temperatures on earth, and where nonetheless so many men live side by side, where above all tens of thousands (or is it hundreds of thousands?) of exiles had been sent by the Czarist regime as common or political prisoners to get them out of harm's way. A place from which, if they survived endless toil and hardship, an escape would be practically impossible. How difficult it would be to get away we had seen demonstrated on the thirty-hour flight over swamps and forests. Furthermore, compatriots of ours, German prisoners from the first World War, lay buried there, and we wished to drop a wreath on their graves.

Towards 6 a.m. we saw Yakutsk a short distance ahead in the broad valley of the Lena. It appeared as a scattered large settlement with several solid and well-built streets and squares surrounded by wooden dwellings and huts. With astonishment we saw tremendous wood-yards on the shores of the broad river and asked ourselves where this timber was to be shipped. Down the Lena to the Polar Sea? Hardly likely! This quantity of timber suggested preparations for an extremely cold winter, in which people would have to burn a lot of wood for heating.

We dropped our wreath over a modest little cemetery at the edge of the city and steered on, now making for the south-east towards the mouth of a pass through the Stanovoi Mountains which we intended to cross by following the valley. The mountains were not yet visible, for their peaks were still nearly 200 miles away. We passed over an uninhabited and empty land, which, however, was not without charm and became even more picturesque as we approached the mountains. After a two-hour flight we crossed the Aldan, a sizeable tributary of the Lena, which runs its course parallel to the mountains at their base. And now we began slowly climbing in the valley, whence a tiny brook emptied into the Aldan, up into the broad mountains lying on either side, which stretch for 500-600 miles, rising steeply from the water, and extending down the eastern shore of the entire Sea of Okhotsk. We had flown over Yakutsk at an altitude of about 1,600 feet, and had traversed the broad Lena valley and the distance to the Aldan at a height not much greater.

Now we rose first to 3,300, then 4,000, feet, and the magnificent mountains were revealed in bold peaks and gently descending ridges which extended ever higher before us as far as the eye could see. How high did they go? The geographical manuals described the ridges as averaging a good 6,500 feet, with the top of the pass leading to Port Ayan on the Sea of Okhotsk being about 5,000 feet. But the entire cartographic representation of the mountain area was rather indefinite, and we were tense with anxiety as we watched the valley steadily narrowing and the peaks on either side rising higher and higher. Towards noon we seemed to be approaching the crest, for higher peaks could not be seen ahead. But we were already 5,500 feet up, and the top of the pass still appeared higher than we were. A rather gusty north-west wind had sprung up in

the valley, and we had to be careful not to get too close to the rock walls. We climbed to about 6,000 feet and hoped that this would take us over the pass. Of course, we could have driven the ship 2,300–2,600 feet higher, but that would have caused large quantities of gas to blow off and the ship would have been made heavy. This was to be prevented as far as possible, for we did not know when the ship might be loaded down by rain during the flight.

Tensely we looked out ahead as the crest of the pass came steadily nearer. It looked as if we might make it—and we did! With about 150 feet to spare we slid easily over the threshold. “*Thalassa! thalassa!*” we cried excitedly, for before us, almost directly under us, lay the Sea of Okhotsk, a vivid blue which it rarely shows to charm the eye. The journey through hostile Siberia was over. The beautiful blue ocean beckoned to us with the fascination of which we never tired, and we expected soon to be once more over friendly coastlines and cities. We gradually descended. Shortly after two o’clock our engines thundered above the heads of the fishermen of Port Ayan, who probably had watched with amazement the strange bird “coming down from the mountain-tops”, although they did not creep anxiously into their huts. Seamen and fishermen travel far, and would not be likely to take a peaceful Zeppelin for a raving prophet mounting to Heaven in a fiery chariot.

We had flown the course from Berlin to the Pacific Coast in barely sixty-nine hours and had covered a distance of 4,700 miles. Since we had made very economical use of our fuel, we still had enough for fifty hours in our tanks, and I must admit that a bold idea occurred to me: could we not fly onwards directly to Los Angeles, and thereby set a record for flying from Berlin to San Francisco non-stop, which would take about 120–125 hours? Via the Great Circle course, leading generally over Kamchatka and Unalaska, the distance would be only 3,700 miles, and the weather reports indicated we could count on following winds almost all the way. So our fuel would certainly last. But what would the Japanese say? They would be even more resentful than the people of Moscow over our avoiding their city. On this occasion my political instincts triumphed over my Zeppelin passion, and I gave orders to steer south towards Nikolaievsk and Japan.

Next came a navigationally very interesting part of the journey.

While *en route* over the lower Tunguska we had received a weather report advising us that a severe typhoon, centred over the China Sea, was moving towards the Sea of Japan. We were not worried about running into it, for it should have passed us by the time we expected to arrive in the Sea of Japan. But by then the typhoon might have moved so far to the north-east that we would no longer be able to make use of the north and north-east winds in its wake.

It turned out differently, however. Until we reached Nikolaievsk, which lay off the bow at 10 p.m., we had quite clear weather with light south to south-east winds. Then clouds formed with a north-east wind. Soon it became so thick that we were completely shrouded in cloud and could no longer see the surface of the sea. The situation was rather unpleasant, for we were flying in a narrow strait between the island of Sakhalin and the Siberian mainland, with high mountains on both sides. Some meteorological reasoning might help us.

We apparently stood north-west of the typhoon, which was moving east, consequently the wind should be gradually backing more northerly, since we would be flying south into the rear of the typhoon. Therefore I gave orders to steer a point more to the west, in order not to blow the ship on to the mountains of Sakhalin. If we should approach the mainland, we could count on having clear visibility, due to the "Föhn" effect. And so we flew on for two or three hours in thick cloud. Then it gradually cleared somewhat, and we could see that we were being helped by a north wind of 34-36 miles per hour.

Our calculations had been correct, for at dawn we stood on the west side of the Japanese island of Hokkaido, and towards 6 a.m. flew over the lighthouse of Kamoi on the south-east corner of the island. From here we flew in a shower of rain towards the big lighthouse of Hakodate and now, with clear weather, had a straight run ahead of us along the Japanese main island of Honshu. The task of overcoming the longest and most difficult portion of the flight around the world had been successfully completed. Still ahead of us were the hardly less difficult social and political obligations!

Next came Kasumigaura, our landing-place, whose great hangar we saw shining from far off. Here was extraordinary activity! Hundreds of thousands of people had streamed out to see the ship.

Later we heard that thousands had waited for the ship all night—men and women, coming from long distances, with their babies on their backs. They hoped to witness an event of historic significance. From distant Berlin, in the west, an airship had come in less than four days, a distance requiring almost a month by fast steamer and more than fourteen days on the Trans-Siberian Railway! The distant Orient cheek by jowl with Central Europe, whence came these mysterious, dangerous men who, during the past few decades, had been coming in increasing numbers, despite meeting with hostility! Now they were coming so fast through the air!

We naturally had to demonstrate this astounding fact to the people of Tokyo, and so first we flew over the Japanese capital and its seaport, Yokohama, where a large number of passenger steamers from all over the world lay at anchor. I will not attempt to describe the excitement and wild enthusiasm on the streets and squares of both cities. Only a poet, finding himself amid the mass of people, could manage to portray the intense feelings that seized the crowd.

After an excursion lasting one and a half hours, we landed towards evening on the field at Kasumigaura. The ship was quickly walked into the hangar by the skilful and well-disciplined Japanese sailors, and came under the protection of the Navy. We stayed a full six days in Tokyo, as an extensive programme of entertainments and receptions had been planned for us, culminating in an afternoon tea at the German Embassy, at which the entire German colony appeared.

We had set the take-off for the following morning. Unfortunately, this came to naught: while the ship was being walked out of the hangar, one of the trolleys to which she was made fast jammed, and the jolt tore out one of the girders of the hull's framework. This caused a sensation among the numerous high naval officers present. "How could this happen to us?"

The unfortunate officer who, with his men, was bringing the ship out, was overwhelmed with shame and expected to be cashiered on the spot. I took his part and assured the admiral, who demanded an explanation, that such accidents often happened when the temperamental trolley tilted, or a stone or some other small object got wedged in the track.

Nobody was very happy with this explanation, and with good reason, for it is a standing order that the trolleys should be run out for a test beforehand. But at least they were pleased that we had tried to protect the officer, and that we had spoken to the Press in the same fashion, for the whole of Japan was watching.

For the rest of that day we were hammering and patching, and towards midnight the damage was repaired. We intended to leave the following morning. But the weather god raised objections! The previous afternoon a dirty, typhoon-like storm had blown up, and the next morning such a stiff wind was blowing across the shed that we could not take the ship out. We would have to wait!

Once more the crowd of officers and dignitaries had to depart. I sat down on a chair in front of the hangar and waited, resolved to take the ship out as soon as the wind dropped, and then take right off without getting everyone out again. And so it turned out. Towards 3 p.m. it happened, and we took off. But a great crowd was "unofficially" present, and gave us a friendly send-off that came from the heart.

We had fuel on board for about a hundred hours for all engines. The distance to cover to Los Angeles was about 6,200 miles, so we could undertake the flight across the vast distances of the Pacific with complete confidence. And navigationally the flight promised to be very interesting. At first we were interested in the typhoon which had passed over Tokyo the day before and which had moved off to the north-east. Where would we overtake this typhoon, and could we possibly make use of it? For the centre of a typhoon does not progress as fast as an airship flies.

We therefore set our course at first in an easterly direction. The weather was fair and almost calm. But within less than three hours we got into an increasingly stiff north wind—a sign that we were approaching the rear of the typhoon. Towards the east we saw a dark cloud-bank towering, with heavy thunderstorm formations extending far to the south, directly across our course. The sun was setting and illuminated the tremendous cloud-peaks with red-and-gold light. It was an unforgettable picture. From the appearance of the barrier ahead of us, the centre of the typhoon seemed to be at least 50 or 60 miles north of us; but we had to find a way through the squall-front extending to the south. We turned

somewhat to the south and soon found a gap between two thunderstorms, and slid through.

Things happened fast now, as we had hoped they would. The stiff north wind suddenly dropped away, and then came a moderate but steadily increasing south-west wind, which promised us a fast flight on the south side of the typhoon disturbance. Our speed over the surface of the sea, which had dropped to 50 knots, rose gradually to 85 knots, and so continued during the next four or five hours. Thereafter we were beyond the influence of the typhoon disturbance and came into calm weather.

We now had to look for favourable wind currents. In Tokyo I had been told by a Japanese admiral that at this season of the year we would always have to expect thick fog along the shortest route, which was the Great Circle course. That could only mean that along this route cool west to north-west winds would be blowing into the area of the great warm equatorial currents, leading to a condensation of water-vapour. We had to seek these westerly winds, which naturally seemed all the more desirable as at the same time we would find them on the shortest route. And so, soon after we passed the thunder-squall front, we headed on an east-north-east course, instead of the due east course we had been following up to then. We continued with variable winds, mostly from a south-easterly direction, from the 35th parallel of north latitude past the 36th, 37th, and finally up to the 46th. At 44 degrees north latitude and 175 degrees east longitude, which was a good third of our flight across the Pacific, we entered the zone of westerly winds, and these stayed faithfully with us almost to the end of the flight.

We had taken twenty-nine hours for this first third of the flight, at an average speed of $71\frac{1}{2}$ miles per hour. For the last two-thirds we needed only thirty-eight hours, and averaged 87 miles per hour. Actually we had to fly through thick fog or deep, solid clouds during at least half of this final two-thirds of the distance, and it was quite impossible to determine our position accurately. Thus we had to conclude from temperature changes that we were running along with westerly winds above the clouds or fog-banks. The temperature went down gradually, from 64 degrees when we headed on the north-east course to 50-52 degrees, and stayed there until we passed through a squall-front while approaching the

American coast. But when we spoke a Japanese steamer at this time and requested our position, we found that we had run some 170 miles farther than we had determined from careful plotting. And so, during the twenty-four hours we had flown in the fog, the west wind had blown an average of seven miles per hour faster than we had calculated. The error was a pleasant surprise.

Flying for a whole day in fog or clouds, with nothing more than a chance glimpse of the surface of the ocean, is hardly a pleasure. The passengers realized how much they could see and enjoy when they could look from the big windows at the sea for vast distances to the far horizon, delighting in the play of colours on the surface, not to mention the meetings with ships which we overhauled or met, with excited, waving crowds of people on board.

To voyage in an airship high over the ocean is never monotonous, and is always delightful, because the picturesque scene of sea and cloud is always rapidly changing, in complete contrast to the comparatively slow progress of the steamer on the wide, empty ocean. But one must have a clear field of vision such as the airship offers. Flying in the fog, we lost this fascinating exhibition, and had to pass the time with social activities. This is not hard to do in an airship, as there is sufficient space and freedom to move about, so that groups of people can play games or engage in conversation. For many of them it was a minor sensation when, during the night, we crossed the 180th meridian of east longitude, the International Date Line, and on the morning of the next day found it was 8 o'clock in the morning of August 24, after they had gone to bed at 11 o'clock on the night of August 24. Even though this is a simple proposition, some of the people could not get it straight in their minds.

At 4 p.m. on August 25 the American coast came in sight. Shortly after 5 o'clock we flew over the "Golden Gate" in San Francisco Bay after a flight of sixty-seven hours from coast to coast. We had set a record we could be proud of.

The beauties of San Francisco Bay have been sung in all languages. The "Golden Gate" has not been given this name without reason. As we steered inland at 1,600 feet and viewed the fabulous scene, we were deeply affected and even moved to tears. The setting sun flooded sea and land and the surrounding mountains with warm, golden light and painted an extraordinary

picture. And the reception which this beautiful city had prepared for us was no less magnificent. Squadrons of planes flew out to meet us and escorted us past the entrance. The vessels lying in the harbour and at the docks had dressed ship, their whistles sounded a greeting, accompanied by the tooting of thousands of motor car horns on the streets. We needed both eyes and ears to appreciate the enthusiasm of our welcome. Many times had we experienced such receptions, but this one, after our long and monotonous flight above clouds and fog, has remained unforgettable in my mind for its warmth and beauty.

We cruised for only a quarter of an hour above the city, and then continued our flight, for our goal was Los Angeles, which lay some 450 miles to the south. We had steered for San Francisco only to set a record over the most significant distance across the Pacific. If we had headed straight for Los Angeles, we would have taken only an hour longer and would have been able to land there towards 7 p.m. Now we had to cruise half the night to get there.

The coastal landscape out there, down which we were slowly flying with throttled motors, is charming, but after two hours it lay in darkness beneath us. Towards 11 p.m. we neared the place where the promoter of our flight, Mr. William Randolph Hearst, has a large estate. We looked, but to our surprise everything was enveloped in deep darkness. Nobody seemed to be awake. But suddenly hundreds of lights went on, flooding with brilliant light the large mansion and the many small cottages on the estate. It was a special and memorable surprise, for which we thanked Mr. Hearst in a wireless message.

Shortly after 1 a.m. we were over Los Angeles, but we had an understanding with the naval authorities that we would not land before dawn, about 5 a.m. And so we idled in circles for three or four hours, and let the passengers and crew sleep. The landing at 5 a.m. was decidedly unsatisfactory, for the following reason: the layer of air above the ground had cooled off markedly during the night, partly because of radiation from the ground, partly because cold air had flowed down from the mountains. This is a phenomenon both agreeable and commonplace for the people of Los Angeles. Flying at 1,600 feet, we had a temperature of 77 degrees, while on the ground it was only 66 degrees. For an airship of our size, the cooling of the air by *one degree* increased

our lift by about 660 pounds, so that we became around 4,000 pounds. "lighter" when we descended into this cold ground-layer. By flying low we attempted to reduce our gas temperature to that of the ground-layer, but this proceeded so slowly that we would have needed several hours to bring the gas and air to the same temperature. So we had to make up our minds to release more than 35,000 cubic feet of gas through the manœuvring valves, before the ground crew was able to pull the ship down to earth. This, as we shall see, resulted in our experiencing severe difficulties when we took off again late that evening.

But the ship, skilfully guided by the nimble hands of the Navy ground crew, was walked to the mooring-mast and there made fast, while everyone disembarked to visit the world-famed movie metropolis. Only a duty section remained in the ship, to assist the Navy personnel in preparing for the next part of the flight. We had to fill up with gas and fuel, for we had used about three-fourths of our gaseous fuel and a quarter of our petrol in the flight across the Pacific. The fuel still on board would have lasted for thirty-five hours of flight, which would not have been enough for the distance from Los Angeles to Lakehurst, which we estimated would take fifty hours. In an emergency, with engines operating at low speed, we could probably have flown on to Lakehurst on this amount of fuel, but it would have been a gamble and fuel lay ready as planned at Los Angeles.

A dinner, given by Mr. Hearst, went off in a pleasant atmosphere, and as usual gave an opportunity for many pretty speeches about the advances of technology and commerce uniting nations. It was really a great experience for the people of the Californian coast to see us arrive in three days from distant Japan across the vast Pacific.

I could not really relax, however, and soon went out to the ship to see how matters were going, for our experiences in landing had made me worried. I found my friend, Captain Flemming, the officer of the watch on duty, quite concerned, saying, "Doctor, the ship is too heavy and she won't rise!" I calculated the amount of hydrogen and petrol that had come on board, and concluded that the gas-cells, heated by the sun during the day, must have blown off too much gas, although the refilling with gas had not been started until afternoon. The gas cylinders at the airfield were now

empty, so a further refilling was impossible. We had to leave behind part of the crew to go on to Lakehurst by rail, and had to reduce the fuel and water ballast to the barest minimum. Thus the ship was made to "weigh off". But we then found that she floated only in the markedly cool ground-layer of air, and at once became heavy as soon as her hull rose into the overlying warmer air. We had to try a risky manœuvre: "All engines flank speed!" and run along just above, or rather on, the ground, in order gradually to rise into the warmer air.

We tried, and it seemed to go all right. But while we were running along with the after gondola about 15 feet above the ground, there suddenly loomed up in front of us high-tension wires running diagonally across the field at a height of at least 65 feet! We had to go over them! We were forced to apply more elevator to obtain more altitude. In doing this, however, the after end of the ship, with the lower fin, touched the ground. But we could not allow that to worry us, since we certainly could not fly into the high-tension wires. Once more the stern hit the ground, and then we were high enough and flew over the wires with 3 feet to spare. After feeling a tremendous strain I finally could relax, but for a long time my limbs felt like lead. For just imagine what might have happened!

The next thing was to check to see if the fin had sustained any significant damage. The engineer who inspected it came back with the report that "nothing else had happened", and only an unimportant girder had been bent, so we could continue the flight without concerning ourselves further over this matter.

I must admit, however, that I began this flight across the American continent with qualms such as I had never before experienced. Would I be able to overcome all the difficulties that might occur? The beginning of the journey had nearly been fatal because we had had no water ballast in the ship. Now we had to make the whole flight without ballast, or practically without ballast, and with a minimum of fuel. I thought of the unpredictable weather in this region, with tropical heat in the deserts of Arizona and Texas, with sudden cold fronts and thunderstorm fronts from the north-west, with tornadoes and hurricanes which at this season are likely to roar inland from the Caribbean. I was not yet familiar with continental summer weather conditions, for our flight across

Siberia had taken place at such a high northern latitude that it was hardly comparable. We had to have plenty of luck if we were to arrive at Lakehurst, now that the ship was incapable of her best performance.

That was what I thought at the time, and I certainly had some reason for doing so. Since then, however, I have learned from personal observation that flying across America is not half as bad as it is generally considered to be. To be sure, weather phenomena of almost inconceivable violence and severity are to be found there, particularly the dreaded tornadoes; but these disturbances are so limited in their extent that one can easily avoid them. The extensive thunderstorm fronts are not accompanied by atmospheric conditions any more severe or intense than the similar disturbances in European fronts. On the contrary, I have gained the impression that their vertical gusts are even less turbulent. I attribute this to the fact that there is generally a continental, or relatively dry, air-mass, overlying the States, shielded by the tremendous range of the Rocky Mountains from the air of the Pacific; while off the west coast of Europe lies the very moist air of the Gulf Stream.

We were soon to experience what a continental atmosphere could produce. The opposite of the stable atmosphere which we had experienced on the flight across the broad Pacific, it was most decidedly unpleasant. Through the night we flew on down to San Diego, as we had to go round the southern end of the Rocky Mountains, and thence steer at a low altitude for Yuma, on the Arizona border. From here we would proceed across Arizona and New Mexico to El Paso. At dawn we were over the edge of Arizona. It was a gorgeously clear day, and to the south we could see far down into the Gulf of California and into Mexico, where a thunderstorm seemed to be developing. The uncommonly clear air ahead of us above the Arizona desert was entirely stable during the cool of early morning, and it was very pleasant to go sailing along in this calm atmosphere. We could see great distances, particularly to the north, where the mighty Colorado River pours out of the mountain gorges. In imagination we could follow its course back to the Grand Canyon, but this marvel of scenic beauty unfortunately remained concealed from us.

The sun, gradually climbing, did its work and heated the air

above the ground. It rose, and the ship began to toss about. At first it was hardly noticeable, but towards noon it became so intense that the crockery on the luncheon-tables began to jump about and we had to raise fiddle-boards just as on board an ocean liner in a heavy sea. The ship was lifted 600-1,000 feet at a time by the rising air-masses, and then drawn down an equal distance by down-draughts.

It was not at all pleasant, and I recalled that when a naval airship was sent south during the World War, a good half of the crew, made up of sailors used to rough weather, became seasick on the flight across the Sahara Desert. I did not actually become seasick, but I made up my mind to avoid if possible flying over the desert in the summer by day, or at least to get across the desert as quickly as possible.

Towards evening we reached the border city of El Paso, and with this there ended our galloping horseback ride and our swing to the south. We had left the last spur of the mountains behind us and could now steer free on a north-east course over Texas, Oklahoma, and Kansas for Chicago, which we had promised to cross.

The night was calm and beautiful, and the ship flew steadily on her way, undisturbed by unfavourable weather conditions. In the early morning we crossed the Arkansas River in the neighbourhood of Tulsa, and went on towards the other mighty tributary of the Mississippi, the Missouri, which we expected to cross at Kansas City. The night relieved us of the heat of Arizona and New Mexico and, with decidedly cooler air, the weather picture was favourable, and we could now be sure we would not run out of fuel.

Whoever would have a dramatic impression of the size, the activity, and the many-sidedness of the United States of America should cross it non-stop by air. He should fly at a considerable altitude, to be able to see a good part of the terrain, but not so high that he cannot see the interesting details of the small towns, the villages, and the open country. He would do best to fly over it in an airship, from whose big windows he could get a free view all around. For me, our flight from the extreme south-west coast of California diagonally across the entire continent to New York was one of the most impressive experiences of my life. What a variety of scenic views, and what a variety of regions from the buttes and

deserts of Arizona, and the view of the towering Rocky Mountains, to the farmlands of the Middle West and the industrial cities of the East! And what immense distances we travelled in our astounding day in the air!

In Oklahoma, in Kansas City, in Davenport, Rock Island—everywhere, to our pleasure and surprise, we could see how much excitement was caused by the world flight of our ship and her appearance overhead. But what we experienced in Chicago exceeded all our expectations and fantasies. A year before, a citizen of Chicago, to whom I had described the *Graf Zeppelin's* arrival in New York, remarked, "If you ever come to Chicago we will make the reception you had in New York look like two cents!" I had to smile at the marvellous American way of speech as well as its bold exaggeration. I could not imagine how the spectacle put on by seven million New Yorkers with all their might and main could be surpassed by the three million inhabitants of Chicago. But the Middle Westerner is cast from a sterner and more ambitious mould. What the Chicagoans produced in the way of noise-making and other signs of enthusiasm on our appearance probably set a record that can never be beaten. The big parks on the shores of Lake Michigan were jammed with hundreds of thousands of people, and every one of them was doing his best to drown out the others with sirens, whistles, horns, and saluting guns.

We had now been forty hours on our way, and the sun was about to set. As over San Francisco, we were favoured by a sunset illumination which bathed everything in bright golden light.

We now flew across the lake, to cross the Ford plant in Detroit and then, further on, Cleveland on Lake Erie. Shortly after midnight we were over Akron, where we offered our greetings to our friend Litchfield, the president of the American Goodyear-Zeppelin Company. In the early morning we landed at Lakehurst, and the "American" part of the world flight was happily and successfully ended.

The stresses and strains connected with this flight were by no means over. There is always a concluding act to such special Zeppelin flights, and that is the reception at the goal. We knew that this reception in New York would be especially stormy. Everyone knows this who is acquainted with New Yorkers in this

respect, and we ourselves had experienced this the previous year. Even while we were still between Chicago and Detroit, wireless messages were coming in from the Police Commissioner of New York, Grover Whalen, requesting the passengers and crew to prepare for a triumphal entry into New York. Presently we were advised of the programme: immediately after our arrival we would drive down lower Broadway to City Hall, to be welcomed by the Mayor of New York, "Jimmy" Walker. Being concerned over the fatigued state of the crew, I was not particularly pleased by the idea, and would have preferred to postpone the ceremony to the following day. I replied that the crew had received similar honours a year before, and I did not think a repetition was required. But the reply was that the ceremonial reception was absolutely necessary. So I had to agree, and so it turned out. I believe the enthusiasm this time was even greater than two years before, and the number of telephone-books ripped up for confetti was greater than ever before and broke all records.

At City Hall there was a short speech of welcome. A lady with a wonderful voice sang the American national anthem, and then Jimmy Walker managed to relieve the intense feelings of the moment with a joke. He began his speech by saying, "Ladies and gentlemen, I feel that I have something in common with Dr. Eckener. I too know what it means to be kept up in the air by William Randolph Hearst, so I feel I am the right person to make this speech." Everyone knew what he meant, and laughed. When Mr. Walker had announced his candidacy for the office of mayor of New York, the Hearst Press had been very cool and reserved towards his candidacy, and Mr. Walker had been "kept up in the air", as the American slang expression goes. This, in reference to the Hearst Press, had been an unpleasant experience.

I was glad for the lessening of the excessive "heroics" to the level of average human achievement, for in the grip of a mass enthusiasm, such as the New Yorkers love, it is easy to overdo a good thing. But the enthusiasm of the New Yorkers matched the general attitude of the American people. I realized this on the following day, when President Hoover honoured me by an invitation to visit him at the White House. As I was presented to him, he remarked, "I thought that the day of the great adventurers, like Columbus, Vasco da Gama, and Magellan, was in the past. Now

such an adventurer is in my presence. I am happy, Dr. Eckener, that the American people have greeted you so warmly, and today would like to extend my personal good wishes for your enterprise."

The "world flight" could be evaluated as a very significant feat in the sense of "progress and civilization", which the Americans considered it to be, for the time in the air for the "American" world flight was only twelve days—less time than it took then for the sea voyage from San Francisco to Tokyo.

V

THE SOUTH AMERICAN SERVICE

1930-37

AS FAR back as 1920, even before we had built the *ZR III* and had flown her to America in 1924, a German merchant in Bilbao named Wilhelm Pasch and a Basque living in the same city named Thomas Rementeria had got in touch with me to propose organizing an airship line between Spain and Argentina. Rementeria had had the idea of creating a fast and purely Spanish-organized air line between Spain and Argentina, realizing correctly that such a connection would be very useful for the plans of his Government. He was thinking particularly of an airship line, for he had been very greatly impressed by the performance of the Zeppelins. He was an old sea captain and as such had accumulated a considerable fortune, and he was convinced, and sought me out to convince me, that "no area in the world was more suitable for an airship line than the area from the Spanish coast, starting from Seville, through the trade winds and the belt of calms on the Equator to Argentina". In general, I had to agree with him; but I believed that I should first have a look at the calm belt with its thunderstorms and heavy cloudbursts. Rementeria declared himself ready to finance a research expedition to this area, and I agreed. On this journey I took with me a meteorological expert of the Zeppelin Company, Dr. Lempertz.

We started out in the first days of July, 1921, in the hottest year in decades. I have few pleasant memories of the long railway journey to Seville. We left in a temperature of more than 86 degrees, had 95 in Paris, and in Andalusia, the "frying-pan" of Spain, as we arrived towards noon on the night train from Madrid, nearly 104 degrees in the shade.

Seville, where we waited for two days, is a charming city with many sights worth seeing in the way of art and architecture—but

not in July in an unusually hot year. We were happy to leave on the following day for Cadiz, where the *Reina Christina* of the Spanish Steamship Company was due to arrive from Barcelona.

I had plenty of time on this lengthy voyage to study the wind and weather. At first the north-east trade zone: a following wind to the 10th or 15th parallel of north latitude (depending on the season), which meant moderate to fresh head winds on the return, yet this was always free of squalls and thunderstorms. Next came the area where the cool trade wind entered the belt of calms! While we ran through this zone for a full day, I had a chance to see squall-fronts and black cumulus formations which towered up to the height of Mont Blanc—fascinating subjects for the artist or the meteorologist, but hardly attractive to the airship pilot. The quantities of rain pouring down at times from these cloud-masses were like a deluge. Aeronautical experts had felt certain that it would be impossible to fly a Zeppelin through these cloudbursts. But who were the Zeppelin experts? At any rate, I determined to my satisfaction that strong winds did not prevail in these rain-squalls. After a long stretch in the calm belt, where the weather was very pleasant, there followed a similar squall-front at the southern edge, where the south-east trade winds impinged, also a hardly ideal region for air travel. The last portion in the south-east trades, which extended on to the mouth of the River Plate, was again very favourable—except when a *pampero* bursts forth from the Argentine.

Generally speaking, I was very well satisfied and considered the area suitable for flying, although at that time I had had no practical experience of how well a Zeppelin could handle herself even in heavy squalls over the sea.

During a six weeks' visit in Argentina I completed my studies of meteorological conditions and could inform Señor Rementeria and the Argentinian President Irrogoyen that I considered a Zeppelin airline between Seville and Buenos Aires quite feasible, and that the flight time would be about four days. Irrogoyen showed great interest in such a connection.

But at that time these plans came to nothing. Irrogoyen, friendly to Germany and Spain, was overthrown and replaced by the very cautious President Alvear. And Spain was so preoccupied with the Riff campaign in Morocco that King Alfonso and his Prime

Minister, Primo de Rivera, had neither the time nor the money to build an airship hangar in Seville. Eight years later, however, negotiations were resumed to obtain the participation of Spanish interests, and Señor Rementeria again played a prominent role in them.

I travelled again to Buenos Aires, this time going from Hamburg in the German liner *Cap Polonio*, accompanied by Captain Flemming. In Buenos Aires we had an appointment with the Spanish ex-Minister Goicoechea, who was to arrange negotiations with the Argentinian President. I was able to amplify my studies of the weather conditions along the route on a third journey across the Equator, and arrived at the definite conclusion that it was very suitable for a regularly scheduled airship line. In Buenos Aires we did not meet Minister Goicoechea. He had taken himself to Uruguay, to work there for Spanish interests. And so we had to negotiate the matter ourselves, and this was not difficult, for meanwhile influential people in Argentinian society had begun to take an interest, and they were particularly eager for expert advice.

In this social atmosphere, where wealth was spent in a lavish manner, one might have expected that it would not be difficult to raise the necessary funds for the enterprise, which seemed politically very desirable. Actually the conversations with the interested Government officials proceeded very hopefully, and we next looked for a location where an airship hangar could be erected, for we absolutely had to have a hangar at the terminal, as it was so distant from our European base. But no definite decision was reached in raising the needed sum, which I estimated at roughly three million pesos. Thus I departed with very few expectations, but with the spiritual satisfaction of having had at least a fleeting glimpse of a self-confident and in their own way magnificent people. Is it the same in Argentina today?

I next travelled in a small steamer of the Hamburg-South America Line to Rio de Janeiro, in order to become acquainted with several harbours at which she touched—namely Rio Grande do Sul, Florianopolis, and Santos. In Rio I intended to again board the *Cap Polonio*, which had made an excursion in the meantime to Tierra del Fuego. And so I had a week to spend in Rio, and decided to use it to make contact with the Brazilian Government, for I had been advised many times that there was much interest in Brazil in a Zeppelin airline to Europe. No wonder! For

Argentina and Brazil had been rivals for many years for the leading role in South America in cultural and political matters.

In Rio I had a fairly long interview with the Minister of Commerce, Victor Kondor, who, of South German ancestry, proved to be an enthusiastic friend of the Zeppelin concept. But he was somewhat doubtful when I said that an absolute pre-requisite for a regular Zeppelin service to Rio was the construction of an airship hangar. Brazil is, or at least was at that time, rather weak financially, and for its trade development was very dependent on foreign assistance, particularly that of the United States. I soon realized that a Zeppelin airline to Rio might be difficult to achieve.

Where should I begin? A fortunate idea struck me: my own observations had taught me that in the real trade-wind zone, which, with small seasonal variations, covers the area between the 25th to 15th parallel of north latitude and the 15th to 25th parallel of south latitude, the weather conditions are so uniform and almost entirely free of major disturbances that one could manage without an airship shed and could leave the ship out at a mooring-mast. Therefore we might choose Recife de Pernambuco as a permanent terminal and thence make the short journey on to Rio with only a brief landing there. I naturally expected that safe and regular flights to Pernambuco would arouse irresistible demands in Rio to make it, the gleaming capital of the nation, the final terminal of the air line to South America.

So I approached the Governor of the State of Pernambuco with a proposal to build a landing-field with a mooring mast and gas-cylinder depot for refilling the airship. The Governor was happy to agree, for Recife, the comparatively little-known seaport, would be placed in the spotlight of public attention if the first transatlantic air line should have its southern base there. Possibly for the same reasons, the city of Seville was ready to provide a similar landing-field. And Seville would be very valuable as a sort of auxiliary base to which we might go to refuel if we should meet too strong an opposing trade wind on our return from Recife and be obliged to replenish our fuel on the south coast of Spain. Naturally we would also land at Seville if we had at least two passengers booked for there.

At last, after almost nine years of sometimes very apathetic negotiations, the foundation was laid for a transatlantic Zeppelin

service which was destined to be truly epoch-making in the history of aviation. It would certainly still be flourishing today in improved form if it had not been throttled by the second World War, and if, at the same time, vast sums of money, which only wartime requirements could have made available, had not finally developed the ocean-spanning aeroplane instead.

I was completely confident of being able to create an epoch-making commercial enterprise with flights to South America, for the journeys to gain first-hand knowledge, which we had assembled since I had first travelled by ship in 1921 through the thunderstorm-packed squall-fronts of the calm zone, had fully convinced me that the route to South America could in fact be flown with safety by a Zeppelin airship. And I intended to make the first flight a convincing demonstration in the eyes of the world by making it a "triangular flight", as we called it, from Seville to Recife and on to Rio, from Rio via Recife to Lakehurst, and from Lakehurst back to Seville.

Shortly after 5 p.m. on May 18, 1930, the *Graf Zeppelin* started on her journey to the southern hemisphere. The first part of the nearly 7,000-mile total to Rio de Janeiro—namely, the distance to Gibraltar—was no novelty to us, but it was, as always, a new source of pleasure. It is perhaps the prettiest for a journey in an airship, from which one can comfortably look out at the panorama beneath—over broad Lake Constance, with the range of the Alps to the south, to beautifully situated Konstanz; then through the deep valley between the Black Forest and the Swiss Juras, with the Rhine flowing beneath and "with its waves washing the mossy ruins of so many ancient castles", along the cliffs of the densely settled Black Forest. Further on were the friendly towns of Schaffhausen, Waldshut, Sackingen, etc., like a string of pearls created by human hands, interspersed by the natural splendour of the falls of the Rhine and the rapids at Laufen. The receptive eye revels in wonderful scenes, and the retentive mind has many historical and cultural objects to recall. From the large city of Basle, waving enthusiastic greetings, we leaped over the green hills of Burgundy to the deeply gorged Rhone valley, on the right the rocky cliffs of the Cevennes and to the left the glaciers of the Mont Peloux massif, towering 13,000 feet. Ancient Roman culture greeted us from the towns of Vienne, Orange, and Avignon, and at

the end of the line appeared great Marseilles, presenting a fair picture of lively activity. Now we were over the blue Mediterranean, above the "Gulf of Lions", whose claws, in the shape of white combers, so often snatch at seamen in small sailing-craft. It is seldom calm here. Either the cold mistral is roaring down from the foothills of the Alps through the funnel of the narrow Rhone valley, or strong winds rise over the Pyrenees from the Bay of Biscay and burst violently into the Gulf of Lions.

The east coast of Spain offers an unbroken succession of beautiful scenes to the traveller flying down it by day. But as we had arrived at the Mediterranean at nightfall, we chose the route across the Balearic and Pythian Islands, since the air is more stable over the open sea. The passengers slept well, and at 7 a.m., when they were seating themselves at the breakfast tables in the dining-saloon, we were steering for Cartagena. We now flew a short distance over land, in order to cut off the south-west corner of Spain at Cape de Gata and to show the passengers an example of ancient Moorish agriculture. Today this tip of land is dry and sterile, but one can still see the old irrigation ditches which once made the hillside fertile. Behind Almeria we rose so high over the coastline that for an hour we were fascinated by the snow-covered peaks of the Sierra Nevada. Malaga and its famed vineyards, where the heavy grapes ripen in the hot sun, we crossed towards ten o'clock. The whole population raced out on the piers, gesticulating wildly. Ahead of us rose from the sea the steep cliffs of Gibraltar, the sentry at the entrance to the Mediterranean. We were practically at our goal.

Since we had advised that we would land at 5 p.m., we made a side trip to the African coast and looked down on the very different face of the Mohammedan world of Tetuan and Tangier. After a glance at Cape Trafalgar, where Nelson made his name immortal, we crossed the harbour of Cadiz, which perhaps viewed the new rival of its South American line with mixed feelings, and then crossed the mouth of the Guadalquivir to Huelva. We wanted a look at the harbour of Palos, from which the discoverer of America started his voyage almost four and a half centuries ago. The Columbus statue at the mouth of the harbour looked up at us, we imagined, with shocked disbelief. He actually spent more days on his journey than we would spend hours. A new world of techno-

logy had arrived! Towards 5 p.m. we landed in the midst of a tremendous crowd at the Seville flying-field. I told the passengers, "This is what the first quarter of a flight to South America is like. Are you pleased?" They were.

Wherever the members of the crew appeared in the city they were greeted and feted with warmth tempered by an almost reverent attitude, and they had to acknowledge many greetings of "Long live Germany!" Unfortunately—or fortunately—this test of character, which many could not have undergone without damage to their equilibrium, did not last too long, for, as we were to leave the following morning, they had to return to the ship to load our additional fuel supply. As the elevation of Seville is almost 1,300 feet less than that of Friedrichshafen, we could fill up with about 140,000 cubic feet more of gas, which meant we could carry nearly 9,000 pounds more of petrol, besides replenishing the fuel we had already used. The ship therefore took off next day with sufficient fuel for a flight of more than 110 hours, using all engines.

We flew down the broad valley of the Guadalquivir above the green meadows of Andalusia. We saw thousands of cattle grazing, the famous temperamental fighting bulls, which are so highly prized in the land of the *corrida*. As on the previous day, we flew over the Columbus monument at the mouth of the Rio Tinto, and we suspected that we were experiencing the same feelings as the man down there did as he steered out to sea in his caravels on his own adventure four hundred and twenty-eight years before. We were now over the blue ocean, and the ship flew on as softly and quietly as she always did over water, unless a squall-front was blowing up. As far as the eye could see, a clear heaven spanned the sea, whose dark-blue surface was relieved by white flecks. It was typical of conditions here, and we had seen it like this two years before when we had taken this course to North America in the *Graf Zeppelin*. Only now the wind was rather fresher and more southerly, and therefore I did not steer due south for Casablanca, but south-west towards Madeira, in order to make more speed over the ground.

We cruised on for nine hours and made the fairly satisfactory speed of 70 miles per hour. Then the south wind veered round to west-south-west, and I set the course for the island of Teneriffe

in the Canary group. It was midnight before the light of Santa Cruz de Teneriffe came in sight. Now we were awaiting the big sensation, the north-east trade wind, which, like a helpful spirit of the elements, was to take us in his arms and bear us at great speed to the south across 20 degrees of latitude—a good 1,600 miles—in constantly fair weather. But the trade wind did not come at first. It was setting in more to the south. Next morning at 7 a.m., when the passengers, after a quiet night flight, were sitting down to breakfast, they found that we were being helped along by a weak trade wind of only 11–13 miles per hour. It was quite weak, as it often is, considering that on other days it blows up to 45 miles per hour. But we were advancing at a speed of 60–70 knots. At 3 p.m. we reached the Cape Verdes, and at 5 p.m. we dropped a mail-bag over Porto Praia on the island of Santiago. Here the Dornier DO-X seaplane had recently been at anchor for several months, since a heavy sea and lack of lifting power had prevented it from flying on to South America. We flew proudly on with, as we calculated, enough fuel still on board for seventy-five hours for all engines.

Maintaining the same fast speed, we flew on at an altitude of 1,000 feet until 3 o'clock the next morning. We then found ourselves at about the 5th parallel of north latitude, and in the last twenty hours had put a good 1,500 miles behind us in the trade winds. But now came the critical zone, where the cool trade wind, which had kept the air temperature uniformly at only 62 degrees, impinging on the warm, moist air of the calm zone, whose temperature was about 75 degrees at the surface of the sea. This condition produced a constant stationary front of heavy thunderstorms and rain-squalls. This was the zone where, according to airship experts and meteorologists, we could never pass through in a Zeppelin. We were extremely concerned as to how our ship would overcome it, although our experience, gained on the first flight to North America, made our self-confidence practically complete. But were rain-squalls in the equatorial zone actually more terrible than those in the temperate zone?

At 4 a.m., flying in total darkness which prevented us from distinguishing any clouds in the heavens, we plunged into a rain-cloud. We could see nothing; we could only hear the rain lashing at the windows, and the elevator-man noticed the ship becoming

heavy. After two or three minutes it became quieter, and we had apparently passed through the first barrier. Then in a short time we ran into a new barrier. The rain drummed down once more, and by the ship's lights we saw grey tatters of cloud swirling past the windows. This time it lasted longer: there seemed no end to it. The water drove through the chinks and crevices of the windows and soon lay inches deep on the deck of the control car. Then from inside the ship it began to pour down through the canvas-covered ceiling. She became heavier and heavier, and I glanced anxiously at the elevator man to see if he could hold her at her altitude. But we were in no danger for the time being, for the ship held up well at an angle of 4 or 5 degrees.

After eight or ten minutes, which corresponded to a distance forward of $7\frac{1}{2}$ or 8 miles, we came out of the cloud. It had given us some idea of the quantities of water which a tropical rain-squall could contain. But we had found that the ship could sustain the load of rain with little more than half of her dynamic lifting force. Since the full dynamic lift amounted to more than 13 tons, we calculated that about 8 tons of rain-water had accumulated on the ship. Later we found by experience that even in a lengthy and steady downpour only half our dynamic lift was needed to carry the load of rain. This was a crucial discovery which lifted a great weight from our minds. We did not have to be afraid of tropical cloudbursts. To be sure, matters could be more critical in a hail-storm.

Furthermore, it was extremely significant that the gusts and turbulence in the atmosphere of this calm zone had been very moderate. We had hardly noticed any strong vertical currents. The thunderstorm activity had been relatively mild. This seemed due to the north-east trade wind having been comparatively weak. On later flights we found that a fresh trade wind could cause very disturbed squall-fronts at the edge of the calm zone, which we tried to avoid if we could. But the most important thing for us was that, charging blindly in the moonless night into a rain-filled squall-cloud, we had easily carried the additional load, and, furthermore, we had ballast water to spare which we could have dropped in case of need. If we navigated prudently, as we usually did, we could be sure of getting through the squall-zone safely. We actually did it more than a hundred times in the course of the next seven years,

and it was always a fascinating experience from the æsthetic and meteorological point of view. And so also was our further flight through the calm zone.

"Rosy-fingered Eros," the god of the dawn, arrived to reveal to us a cloud landscape of magnificent splendour. Tremendous cumulus formations towered like huge mountains over an almost motionless sea and were mirrored therein with fascinating clarity. The dark-blue waters were completely clear and enabled us to look down to great depths. In the light southerly breeze, which here and there ruffled the surface, it shimmered with a hundred colours, like mother-of-pearl. Flying-fish were constantly sailing away beneath the ship, and, whenever her shadow fell on a swarm of them, they leaped in terror in all directions on short-distance gliding flights.

At 8.30 a.m., exactly two days after our departure from Seville, we crossed the equator. We celebrated this event according to the old sea-going custom with an initiation ceremony, but in a somewhat less crude manner. The ladies were sprayed lightly with eau-de-cologne and the gentlemen with soda-water, while each had to recite a humorous little poem for their baptismal ceremony.

Around 3 p.m. there arose out of the sea ahead the picturesque, strangely shaped rocky island of Fernando de Noronha with its "Finger of God", a tall pinnacle of rock with smooth, vertical walls. One is always excited on reaching a bit of land after ploughing the monotonous sea for even one day, even if this is colourful and pretty, like the ocean at the equator when viewed from above. Imagine the effect on us of this spectacle of uniquely formed rock architecture! The passengers' excitement was understandable as we crossed the island to afford them picturesque, constantly changing scenes for their astonished eyes. Fernando de Noronha is a Brazilian penal colony, and we could see how its involuntary inhabitants stared up at the huge silver bird, shouting and waving with mass enthusiasm. Unexpectedly we had intruded on their isolation from the world like a supernatural miracle. With longing eyes they must have followed our flight until we vanished beneath the horizon, an experience which perhaps for many weeks gave a poignancy to their imprisonment.

The south-east trade wind, which we picked up at Fernando de Noronha, reduced our speed a little, and so it was pitch

dark before we reached Recife. In these circumstances we had to proceed very carefully in landing on a field which was completely unknown to us. But nonetheless everything went smoothly and safely, and by 8 p.m. we were lying at the mooring-mast.

The ship's safe arrival at Recife was naturally the occasion of tremendous excitement among the inhabitants, who, in spite of the late hour, had come out in tens of thousands to the landing-ground, while the Government of Pernambuco greeted it as an "epochal" event. We, too, were highly pleased that the practicability of a South American service seemed demonstrated by our experiences on this flight, and we saw it as a decisive step forward in the process of making the Zeppelin an ocean-crossing commercial vehicle.

The next day we took off to carry our propaganda activity on to Rio de Janeiro. After the ship had been topped up with fuel during the day, we cast off from the mast in the late evening at 11 and, towards midnight, started on our journey. We took off so late because we wanted to land in Rio in the early morning of the second day following and wanted to hold several hours in reserve for the twenty-four-hour flight in case of unfavourable winds. The flight along the lengthy coastline south of Recife is one of the pleasantest, and at the same time most attractive, which one can enjoy from on board a low-flying airship. It is perhaps the finest part of an airship journey to South America.

We flew close to the white beach over a tremendous surf, which the fresh south-east trade wind kicked up a long way off the coast, crashing in and running out, in ceaseless rise and fall, constantly altering in form and showing a kaleidoscope of changing colours—black, bright green, blue, and white. Beyond the white beach the eye feasted on a variegated forest, which we examined curiously from a low height of 700–1,000 feet.

We went on over pretty bays and charming river-mouths, like the mighty Rio San Francisco; over picturesque towns and big cities, like lively Bahia, built magnificently on rising terraces, and charming Victoria, until we turned sharply west at Cape Frio, presently to see the fabulous Bay of Rio opening before us, "the loveliest bay in the world".

On our first flight we had not been favoured by good weather

conditions. The northern extension of a *pampero* had lashed the coastline of southern Brazil as far north as Bahia, causing extensive destruction to tobacco, cotton, and corn crops. A stiff south-east to south wind held us back and brought with it, during the entire night and almost the whole of the next day, frequent downpours of rain. But towards midnight, exactly twenty-four hours after our departure from Recife, we reached our goal, and the glamorous sea of light that was Rio de Janeiro, the most extravagantly illuminated city on earth, dazzled us. But naturally we could not fly at night into the Bay of Rio, unknown to us and surrounded by steep mountains.

And so we had to stand off with engines running at low speed, waiting for daylight. The passengers slept on undisturbed while the ship moved on completely steadily and almost noiselessly. This was in their own best interest. For when the sun rose towards 6 a.m. it flooded with its golden-red rays a landscape of such unprecedented beauty that we were silent with wonder.

Rio Bay and its surroundings are famous, and have already charmed millions, but anyone who has not seen the picturesque view from an altitude of 1,000-1,300 feet has not become acquainted with all its beauty. Certain landscapes in the high mountains of the Dolomites are fascinating and grand, but a bay with blue water, which is part of the scenery here, doubles its charm. And the mighty, beautifully laid-out city of Rio, stretching its arms out into the valleys and estuaries, produces a comforting impression of industrious and successful human effort.

We were able to stay for only an hour in Rio, for the sun, as it climbed, rapidly heated our gas and gave the ship too much lift, which we could not counteract by taking on water ballast, as the arrangements were not available for this. After exchanging the usual greetings, therefore, we rose into the air once more to return to the mast in Pernambuco. One might have expected that the return would go considerably faster than the flight down, since the stiff head wind which we had formerly had to fight would now be favourable. But that was not the case. The atmospheric disturbance had meanwhile passed off to the north and now we found, over half the distance, north-east and northerly winds which held us back. But then we overhauled the low-pressure area and once again had south-east winds, a good demonstration of how slowly

low-pressure areas advance and how an aircraft can make use of them in certain circumstances to hasten its journey.

Towards 8 o'clock the next morning we again made fast to the mast at Pernambuco and remained there for two days, while preparing for our journey to Lakehurst. I made use of this time to discuss with the officials all possible measures to improve the base and its arrangements. In particular, a gas-generating plant had to be built, as well as a concrete-covered circle around the mooring-mast, on which the airship's after-gondola could ride around as the wind shifted. The city was also ready to create a better connection with the field by extending a tram line to the entrance. Though these improvements were expensive, I could accept them with a good conscience, for Recife would certainly have to continue to be our main base for a few years, until Rio should finally make up its mind to build an airship hangar.

Within two days, despite the inadequacy of the facilities then existing at Recife, the *Graf Zeppelin* was fully replenished with fuel, and at 11 a.m. on May 28 we took off on our return flight. This was to be by way of Lakehurst. As I related previously, the "world flight" of the previous year had made a great and convincing impression in the United States. We had circumnavigated the globe within a belt of the temperate zone, through all kinds of weather, and had overcome all of them. Now our next journey would prove that we were also equal to tropical cloudbursts. I had further planned for the next year a flight into the Polar regions, to test the capabilities of the airship in this zone also.

We flew along the coast to Cape San Roque, enjoying in splendid weather the beautiful and variegated coastal landscape. We circled over Natal, the capital of Rio Grande do Norte, and dropped a bouquet of flowers to honour the pioneer airship inventor, Santos-Dumont, buried here in his native country. Then we set our course direct for Barbados and left the land behind in a blue distant haze. Presently we ran into bad weather with strong rain-squalls and realized that perhaps the northward-moving disturbance, which we had passed four days previously between Recife and Rio, might be making its presence felt this far north.

We intended, in case of good weather, to steer for the island of Cuba and make a brief landing there. But our hopes were frustrated. *En route* we received repeated radio messages from the

experts we had sent ahead to direct a possible landing manœuvre, urgently advising against a landing. A mass of cold air had forced its way down from Canada into the Caribbean Sea, and was causing violent thunderstorms and squalls. The disturbances were especially severe over Cuba. So I decided against what might have been a very interesting visit to the island and steered direct for Lakehurst.

The irruption of cold wintry air from Canada had caused a tremendous squall-front over the whole distance from the Great Lakes to the Caribbean Sea, and this front was advancing towards the Atlantic Ocean. But somehow we had to break through this front to reach the mainland at Lakehurst. We tensely awaited this break-through.

Towards midnight we flew past the west side of Barbados, passed several small islands in the Antilles during the night, and at 6 o'clock the next morning arrived at the Atlantic Ocean at San Juan, on the eastern corner of Puerto Rico. Here we changed course rather more to the north, direct for Cape Hatteras. The approach of the squall-front became more and more noticeable. The wind, which during the early morning had been blowing from east to south-east, gradually veered to south and then to south-west with a velocity of 18-22 miles per hour. The air was still clear and cloudless, and we were making 70-80 miles per hour. A splendid flight over blue seas!

But shortly after noon the wind freshened to between 27 and 34 miles per hour, and to the west we saw a blue-black wall of cloud towering above the horizon. We turned now to a due northerly course and, with a velocity of 90 miles per hour, pushed along by a due southerly wind of 38 miles per hour, we ran along the black wall, looking for an inviting place where we could force our way through to the west. From the weather bureau in Washington and from Lakehurst came urgent warnings of this squall-front, which hardly encouraged me to attempt the break-through. It extended as far up as the 35th parallel, a distance from San Juan of more than 15 degrees of latitude and 1,150 miles, which we had covered in thirteen hours. We were now due east of Cape Hatteras, and we could hardly expect the situation to improve if we continued on a northerly course. So I plunged into the front.

What happened next still stands out clearly in my memory in every detail. The airship was suddenly thrust upward so violently that we felt as if we were being forced to our knees. Immediately the bow plunged downward so fast that it felt as if the gondola floor was being jerked out from under our feet. At the same time the ship trembled in every part, and we wondered if the framework could stand the enormous stress. As soon as she started pitching, I set the engine telegraphs at half speed to decrease the forces acting on the ship; but the situation was still critical. And so it continued for ten minutes—no longer—during which, in a raging turmoil of conflicting air-masses, we were driven up and down, back and forth. Then it was calmer, and now we could look down and see that the wind had shifted from south to north.

We measured its force as soon as possible, and found that it had a velocity of 45 miles per hour, while a quarter of an hour before we had measured a south wind of 38 miles per hour. At the same time the temperature dropped from 72 to 57 degrees, and in the next two hours fell even further to 42 degrees. It had been an extremely pronounced "cold front".

The correspondent of the Hearst Press, Mr. von Wiegand, had asked me for my impressions of this event immediately after we had surmounted this violent disturbance. I remarked, "This was the wickedest squall I have ever experienced, and I don't believe there could be a worse one. But you can see how the ship came through in splendid fashion. We can now fly into *any* kind of weather with complete confidence."

The stiff north wind dropped gradually in the next few hours to 34 miles per hour, so that it took us eight hours more to reach the 40th parallel, as far north as Lakehurst. By 7 p.m. the ship was in the shed. An important and interesting journey had come to an end. My plan to organize a regular Zeppelin service to South America could and would, I was now entirely certain, be carried out as soon as some necessary arrangements and improvements had been made in the base at Recife. I discussed the matter in New York with the gentlemen who, the year before, following the world flight, had shown an interest in founding a "German-American Zeppelin Airline Company". To my satisfaction, I found that confidence and interest in such an organization had been increased

by our flight. And so, after a two-day layover in Lakehurst, I headed for home very well satisfied.

According to our plan, we had to fly next to Seville to disembark our Spanish guests. Several more passengers boarded in Lakehurst, as space was now free for them. Among them was Mr. Harpham, a member of the Board of Directors of the Goodyear Tire and Rubber Company, which, as I have related, had a friendly connection with the Zeppelin Company. Furthermore, we had a very well known and interesting gentleman on board in the person of Sir Hubert Wilkins, who had got himself talked about by a daring flight from Alaska across the North Pole to Spitzbergen, where he had landed in a snowstorm and had barely escaped a catastrophe. Sir Hubert brought with him a fantastic and exciting new idea, and for this reason wished to obtain a first-hand acquaintance with airships. I will describe his plans and their execution in the next chapter.

At 10 p.m. we took off and first made an excursion to New York, which, with some reason, felt entitled to a visit from the airship on her arrival or departure. The city and harbour gave us their usual greeting with much howling of sirens and waving of searchlights.

Exactly at midnight we passed Sandy Hook and set a course for Fayal in the Azores, which lay directly on our route. The flight progressed very favourably, but brought us no new knowledge of importance concerning Atlantic weather. A squall-front lay ahead, which was to be expected on almost every crossing of the cold Atlantic and which was no longer of any significance to us. But we made a very agreeable discovery: by practising and by improving our drift meters, we had refined our method of navigating by wind and drift measurements to the point where, after thirty-three hours of flight over the open sea, we saw the south-west corner of Fayal rising ahead of us at the calculated time and in the predicted direction. Considering the constant changes in wind direction and velocity over the ocean, and the rain-squalls we continually had to fly through, this was a reassuring demonstration of the efficiency, and of the perpetually careful performance of duty, of the navigating officers. We were almost as certain of our calculations of position and courses to be steered as an ocean steamer, which navigates on the surface of the sea comparatively free from currents

and in more assured circumstances, for we could determine the "set of the current", which a surface vessel generally cannot do.

We paid a brief surprise visit to beautifully situated Horta and set off the wildest enthusiasm among the inhabitants. We then cruised past majestic Pico, of which we had seen only the summit above the clouds when we had come that way with the *ZR III* six years before. An hour and a half later we left the picturesque Azores group at the island of Terceira and set our course for Lisbon. We had, as I said, taken only thirty-three hours to reach Fayal.

Beyond Terceira the weather and wind conditions were less favourable. The wind blew at times with considerable force from the north-east, and we had to fly through numerous rain-squalls. And so we needed almost twenty hours to reach the Portuguese coast, which meant that our speed over the ground was reduced to half of what we had made on the way to the Azores, a drop from our previously attained 70-75 knots to an average of 40 knots. But at 9 a.m. on June 5 we were already over Cape di Roca, fifty-four hours after we had passed Sandy Hook. We passed the beautiful capital of Portugal at a distance on our way to Cape St. Vincent, turned here on an easterly course, and came to Huelva, where the Columbus monument once more greeted us and seemed to offer admiring congratulations. Thence we went by way of Cadiz, where we felt we had to show ourselves, to Seville, where we arrived at 4 o'clock.

Here a huge crowd and the highest officials had been impatiently awaiting us. A short, warm speech by the Mayor followed, and we were invited to a banquet to be held that evening to celebrate the occasion. But we declined with thanks, for the vile weather prevailing did not seem safe enough for us to leave the ship overnight at the short mooring-mast. Twenty minutes after our landing we were once more in the air and heading for our home port. It is only fair to add that after three weeks of constant tension we were tired and longing to sleep in our own beds, free of every possible concern about the ship.

The weather was very bad for southern Spain. A stiff southeasterly wind was blowing at 22-27 miles per hour, and the Sierra Nevada and Sierra Morena were hidden by low clouds. So I preferred not to steer for Valencia by the shortest route over land and

mountainous country, but to go down the Guadalquivir to the sea again and cruise through the Straits of Gibraltar. Slowly we made our way back to the sea against strong south winds and rain and by sunset were in the Straits; then it became better and we could make a good and fairly fast flight up the Mediterranean. Towards 10 a.m. we entered the Rhone valley at Marseilles; towards noon we were over Lyons, and counted on landing at our home base in four or five hours.

But then we encountered a terribly dangerous situation, which I look back on with horror even after many years, and which came within a hair's breadth of being fatal for the ship and for all on board her. A short distance beyond Lyons we had entered scattered clouds which seemed quite harmless, although the radio man reported strong atmospheric disturbances and electrical discharges. Undoubtedly a thunderstorm lay ahead of us in the Saône valley, but it was hemmed in between the high mountains to the right and left, and we could not see it developing, as we were flying blind in the clouds. There was nothing to do but to fly on through, unless we were to turn back and wait for the weather to improve. But how long could that go on here among the mountains?

So we flew on across the Saône and into a cloud formation whose previous developmental processes and present make-up were unknown to us—a thoroughly disagreeable sensation and—I admit it—a foolish thing to do. The atmosphere soon became more turbulent and unstable, and the ship began to pitch and bump. But these were preliminaries which we were familiar with and which did not alarm me. Also the repeated electrical discharges close to or on the ship herself were not unusual.

Suddenly, however, an unprecedented cloudburst poured down on the ship, more and more violently from second to second. Even in the rain-squalls of the belt of calms we had never experienced anything of the kind. And then the huge rain-drops began to change to hail, with pieces of ice the size of walnuts! They drummed on the taut outer cover of the ship as on a drum. It was more than the ship could carry! She began to sink in spite of the elevator man's energetic efforts to hold her at the flight altitude. From 1,000 feet above the valley floor we fell to 650, to 500, to a

bare 300 feet. At times the valley gleamed faintly below, covered with a white mantle of hail, and it drew closer and closer, although the ship, flying at a 12-degree up angle, was developing her maximum dynamic lift.

Captain Flemming, who had the watch, called out in horror, "Doctor, shouldn't we stop the engines?" "No!" I cried. "We need them now more than ever! Set them on flank speed! If we pile up, it will be all the same whether we crash into the ground at 50 or 65 miles per hour." This was done, but the altimeter showed we were still slowly falling. We were perhaps no more than 160 or 200 feet above the ground, and I was just about to tell Flemming that he might drop the last two precious bags of ballast—though their 900 pounds weight would hardly make any difference since we were at least 22,000 pounds heavy. But just then the elevator man called out, "You don't have to; I can hold the ship up!"

It was true. The ship held her height and then slowly climbed higher. Perhaps it happened because we had pulled a few hundred horsepower more out of the engines, perhaps also because we had flown out of the hailstorm, which is never very extensive. In any case, we had escaped with only a black eye, and as I looked back at the thunder-squall from the front, I remarked, "I never would have flown into that if I could have foreseen what was going to happen!" When we later checked over the ship in Friedrichshafen, we found that the hailstones had made more than fifty holes in the outer cover. Undoubtedly the impact of the ice-particles as well as the weight of the rain had caused the ship to sink. Not far from us, in this same weather, a plane crashed between Geneva and Lyons.

During the ten minutes it took us to fly through the hail-zone the passengers sat silent and anxious in their cabins and listened to the drum-fire against the fabric. They were upset and noticed that something unusual was going on; but they certainly did not know what extreme danger they were in. Only Sir Hubert Wilkins seemed to suspect it. During the critical moments, as I looked aft from the control car to see how the engines were running, I met his earnestly questioning glance as he looked forward from the cabin. I nodded slightly to him, and he understood.

After our adventure, which had ended fortunately, I arranged to cheer up the passengers by flying a pretty route through Switzerland by way of Neuchâtel, Berne, Lucerne, and Zürich instead of Basle. But I felt so exhausted myself by the unbearable tension of the two or three minutes that made the difference between life and death that when the Countess von Brandenstein-Zeppelin congratulated me happily three hours later after our landing in Friedrichshafen, I answered quietly and seriously, "Yes, we have come back, but we came within a hair's breadth of ending everything, and would have if we luckily had not kept our nerve." Actually I can say that of all the critical and dangerous situations which I have experienced in the course of my Zeppelin career—and there have been a lot of them—none of them affected my nerves like this one in the hail-squall in the Saône valley, for there were sixty-two people on board, and the Zeppelin enterprise would have come to an end.

The experimental and exploring flights to Recife and Rio had convinced me that the equatorial area with its thunderstorms and rain-squalls was practicable for Zeppelins, and indeed, as our friend Rementeria believed, was especially favourable. Such violent atmospheric developments as we had become acquainted with off Cape Hatteras and in the Rhone valley are hardly to be expected here. We were ready, therefore, to proceed in setting up a systematic organization for a South American service. This required the development of the landing-ground at Recife and, in the interest of the Spaniards, of the intermediate base at Seville; also the organization of an energetic agency to make propaganda in Brazil and to deal with Brazilian officials, particularly the post-office and Customs officials, for we had to support ourselves to a considerable extent from mail and cargo payments, if the service was to be financially practicable. All this needed time, and we were also so very much occupied with other flights and tasks that we had to decline at first to make any more journeys to Brazil.

But in August of the next year, 1931, after our return from the Polar flight, we felt we were free to make further journeys to South America. We made a flight there in each of the months of August, September, and October, which went off well and assured us that the excellently laid-out intermediate station at Recife could

guarantee a safe and regular service. The confidence of the public and their enthusiasm for the airship began to increase, so that in the year 1932 we made nine flights, which were invariably sold out, and carried a steadily increasing quantity of mail and freight. In the spring we made four of these new journeys and then, after an interval required for other flights in Europe, we made five journeys in the autumn at regular intervals of fourteen days. We continued the last three journeys as far as Rio, to heighten the interest of the Brazilian Government in a regular air line to the capital. For we *had* to have a shed in Rio de Janeiro.

For 1933 we had again planned nine flights to South America, and after the first flight I stayed behind in Rio to try to persuade the State Government of the city of Rio de Janeiro to build an airship hangar. I succeeded in arranging a contract with the Minister of Commerce, according to which the State Government would put at my disposal the sum of 10,000 Contes de Reis (about \$750,000 at the rate of exchange of the milreis) for building a shed on a site chosen by me. The contract was very generous. It permitted us to build the hangar and special facilities to our specifications and set only one condition, that we were obligated to make at least twenty flights to Rio each year and to pay \$1,200 for each use of the hangar as "docking fees", which would amortize the cost of the hangar in thirty years.

Construction of the hangar was started the next year by the German firm of Philipp Holzmann & Co. on a large Government reservation near Santa Cruz, about 40 miles south of Rio, in whose hilly surroundings an area of sufficient dimensions could not be found. At the end of 1935 it was finished. Simultaneously the airship *Hindenburg* was completed, and now for the first time it was possible to schedule regular flights every fortnight to South America, since the *Graf Zeppelin* had to make short flights at times in Germany and Europe which the crew somewhat scornfully labelled "circus flights", though they were very worth while for publicity purposes and financially profitable.

The number of flights to South America progressed in the year 1933 to nine, in the year 1934 to twelve, in 1935 to sixteen, and in 1936, when the *Hindenburg* started in service with seven flights, to a total of nineteen. The volume of mail rose from an average of about 450 pounds to around 800 pounds per trip out and back,

thus amounting to over 50,000 pieces, as the weight of each piece averaged only a quarter of an ounce. Also express and parcel post were carried to the same amount. Altogether the total amount of freight and mail carried by the *Graf Zeppelin* in the year 1934 amounted to about 24,000 pounds, including about 750,000 letters; in 1935, 31,000 pounds, including 900,000 letters. The number of passengers booked to and from Brazil climbed in the same years from about 400, through 500 to 720, and in the year 1936, when the *Hindenburg* was also flying, they increased to 1,500. This indicated a brilliant development which came to an abrupt end with the loss of the *Hindenburg* in May, 1937, and would certainly have been revived except that Hitler's policies made it impossible.

From Rio we made other flights which did not return direct to Friedrichshafen. For example, in October, 1933, we flew to the United States, as I reported in the previous chapter, and in June, 1934, to Buenos Aires. Our successfully established South American service had originated from suggestions by Spanish and Argentine sources, and, for the time being, amounted only to a connection between Germany and Brazil; but I still hoped it would be possible to extend it to Buenos Aires, and was therefore glad to accept the invitation to visit this city. This was for two reasons. On the one hand I considered it a good idea to maintain interest in Argentina and to reinforce it by showing off the airship. On the other hand I desired to extend systematically our meteorological exploration flights in order to become better acquainted with the weather conditions south of Rio.

The trade-wind zone from the Canary Islands to the vicinity of Bahia or Rio was quite familiar to us, with its atmospheric phenomena and occurrences. But what was it like on the stretch between Rio and Buenos Aires? In seafaring circles, the so-called *pampero*, which frequently roars out to sea from the Argentine pampas and can dismast a large sailing-ship in a few seconds, has the reputation of being a dangerous tempest, almost as dreaded as the typhoon or the Caribbean hurricane. Its effects are felt over the maritime region from south of the mouth of the River Plate as far north as Santos or Rio. I myself had experienced two or three such storms in Argentina in 1921, and in 1929 had experienced the northerly continuation of one in Rio and had become ac-

quainted with its violence at first hand. But that had been over land. What would a *pampero* front be like over the sea? If we were lucky we might perhaps encounter a *pampero* on the way to Buenos Aires. I half feared and half wished it at the same time. But as we had already surmounted extremely turbulent squall-fronts off Cape Hatteras and over Newfoundland without damage, we were justifiably confident.

And we *were* lucky! On the evening of June 28 we left Rio, and next morning found ourselves facing an extended squall-front approximately off Florianopolis. It looked very threatening, and later we heard that in Buenos Aires the day before a very fierce *pampero* had been raging there. The sea was white and the wall of storm-cloud overhanging it was black as pitch, splendid from the artistic point of view, but navigationally very unpleasant. We ran out to sea for a while, expecting that it would be better there, and so it proved. The break-through was accompanied by the usual pitching and rolling of the ship, but it was not particularly severe. On the other side of the clouds we entered a south-west gale of 56-67 miles per hour, and we were glad not to be adrift with split sails on the sea below. After an hour the storm diminished to 27-34 miles per hour, and we made fairly good time over Porto Alegre and Rio Grande do Sul to Montevideo, which we reached towards midnight.

We had now learned all about the secret tricks of weather formations—typhoons over Japan, violent wind-shifts over Newfoundland and on the coast of the United States, cascades of hail in the Alps and, for good measure, a *pampero* off the coast of southern Brazil—and we had conquered each of them. All we lacked in our collection, so to speak, was a Caribbean hurricane. But I would rather not meet that! And it would not be necessary, because it can easily be avoided, for its centre and its path are very narrow. Nonetheless, like the tornadoes, it packs unbelievable destructive force in its narrow diameter.

We spent the last hours of the night cruising over the mouth of the River Plate, and at 6 a.m. appeared over Buenos Aires to awaken its inhabitants. But we found, to our astonishment, that the population, which otherwise would have used this hour with a clear conscience for burying their heads in the pillow, were already up and about. At 8 a.m. we landed on the Campo Mayo in the

midst of a huge crowd of people who offered to the silvery ship of peace the usual stormy greetings.

I would add, as a matter of interest, that beyond Rio we again overtook the *pampero* which we had passed through south of Santos. It had lost some of its force, but still brought us back to Pernambuco in record time.

VI

THE ARCTIC FLIGHT OF 1931

FRIDTJOF NANSEN, famous both as a Polar explorer and as a tirelessly busy friend of humanity, the pride and glory of little Norway, revered by so many outstanding men—this Fridtjof Nansen, in the year 1926, had founded an organization bearing the name “International Association for Exploring the Arctic by Means of Airships”, called “Aeroarctic” for short. To this organization belonged many notable geographers of many countries, and its purpose was, as the name indicates, to promote Arctic exploration by employing airships. Through the secretary of the Association, a former airship commander named Walter Bruns, Nansen got in touch with me to request the use of the *Graf Zeppelin* for a journey of exploration in the Arctic. I had a long conversation with Nansen. And together—he on the basis of his vast knowledge of weather conditions in the Polar regions; I on the basis of my judgment of the Zeppelin airship’s capabilities—we came to the conclusion that there was actually no better vehicle for voyaging and geographical investigation in the icy seas of the far north than such a ship.

At that time (1928) I could not see my way clear to putting such a flight immediately on my programme, for I believed that other urgent matters, which have been described in the previous chapters, were more important. Then, in 1929, Nansen suddenly died. Next, the Board of Directors of “Aeroarctic” offered me the position of president of the Association. I hesitated to accept this office, regardless of the honour it appeared to confer on me, for it was clear that as president of “Aeroarctic” I would be under a moral obligation to employ the airship, which was at my disposal, as soon as possible for the purposes of the Association, and that my acceptance of the presidency would mean nothing less than a declaration of my willingness to do this. Apart from this

consideration, I was also aware of the difficult problem of how to finance a flight to the Polar seas, which certainly would require no small expense. So I decided to ask the German Government, directly—in fact, the Chancellor—what I should do. I had an interview with him and laid the situation before him. After some reflection he declared, firstly, that it was desirable that I should succeed Nansen in the International Association, and, secondly, that it was desirable on grounds of prestige for a German Zeppelin to be employed on an Arctic flight. But the Government could provide no financial support for carrying out this flight!

In this situation help came from another direction, in fact once more from William Randolph Hearst, but in a quite fantastic form. Mr. Hearst had at first answered in the negative when approached with an inquiry as to whether he was interested in a Polar voyage and would contribute his support. A Zeppelin feature article would not be impressive enough for him, particularly as the Nobile adventure had provided an unsurpassed Polar sensation. But then a man appeared who was to put an entirely new aspect on the whole matter, the well-known Polar explorer Sir Hubert Wilkins.

Wilkins had already got himself repeatedly talked about through bold expeditions undertaken from Alaska, and especially for a daring flight from northern Alaska to Spitzbergen. He now put forward the astonishing proposal that he should go to the North Pole by submarine and, like a mole, gnaw his way up through the ice to the surface by means of an ingenious ice-auger. Wilkins came to me and proposed that we should meet each other at the North Pole! I replied calmly, "Why not? Provided you make it to the North Pole and really can bore your way up!"

So Wilkins went to William Randolph Hearst and explained his plan to him. A really magnificent and fantastic story for a newspaperman! Hearst agreed to it, I believe, with amusement and incredulity, and the contract he offered me took account of all my doubts and, furthermore, provided a sensational story for the newspaper reader. It read: "If the airship and the submarine succeed in meeting at the North Pole and in exchanging passengers and mail, the Hearst Corporation will pay \$150,000 for reporting rights on board the airship. If the airship and the submarine merely succeed in meeting at the North Pole, the Hearst Corporation will pay \$100,000. On the other hand, if there is merely a

meeting somewhere in the Arctic, the corporation will merely pay \$30,000." So read the agreement with me. I do not know what was offered to Sir Hubert Wilkins.

I freely admit that I had little confidence in this agreement even with respect to the third contingency, but I signed it, for it gave our flight tremendous advance publicity, and this had an effect on the sale of stamps to collectors. And so I was able to finance the flight, at least to a large extent. I accepted the office of president of "Aeroarctic" and agreed to carry out a flight to the Polar seas.

I will anticipate the outcome of Wilkins's plans. He obtained an obsolete submarine from the American Navy, but it did not appear to be in very good condition. After Wilkins had experienced breakdowns in American coastal waters, he crossed very slowly to Norway and tied up in Trondheim harbour to make repairs to his boat. This took so long that I, even though I had delayed, had to depart without him, as visibility conditions in the Arctic deteriorate with advancing summer, and I could not wait any longer for him. Wilkins did not attempt the journey at all, and there were people who considered the whole matter a publicity stunt on his part. I do not believe this, for I had long ago learned that Wilkins was a daring and uncommonly determined man. He had a rock-like conviction of the practicability of his idea.

The Hearst-Wilkins plan of a meeting of airship and surface ship in the Polar seas had not been conceived in vain, but was, altered to one between airship and icebreaker. The large Russian icebreaker *Malygin* was due to depart at the beginning of July for a scientific expedition to Franz Josef Land. We got in touch with the Russian Government to arrange a meeting near Franz Josef Land of the *Graf Zeppelin* and *Malygin*, with an exchange of mail. This was publicized, and stamp collectors all over the world were excited. We received altogether 650 pounds of mail from collectors, which we handed over to the *Malygin* off Franz Josef Land, receiving in return 270 pounds from the *Malygin*. With this, the major expenses of the flight were largely covered for us, for the average weight of the letters and cards was only about a quarter of an ounce, so we had more than 50,000 pieces of mail in all to carry.

Our intention of making an Arctic flight was considered a great risk by many people, including meteorologists and airship experts,

and probably would still be considered such today. There were two main reasons for their attitude. Firstly, they believed that fog, clouds, and snow would greatly hamper and endanger navigation over the Polar seas. Secondly, they considered that the danger of "icing up" of the airship was a very serious threat. Both opinions are wrong. Concerning the alleged navigational difficulties, the testimony of Polar experts, such as Nansen, Amundsen, and Wilkins, with whom I discussed this question, was that the Polar region generally is less covered by low cloud and fog than, for example, Central Europe and North America in autumn and winter. Certainly fog and snowstorms are prevalent in the Polar regions in the autumn and winter, extending into early summer, but only in limited areas. Contrary to general belief, during the winter and entire spring the Polar regions have more clear weather and good visibility than more southerly latitudes, and only beginning with midsummer do widespread fog-banks form over large areas of the Arctic seas. But one can fly without danger for hours through fog or cloud, without having to fear collision, if one is careful to stay over the open sea, and one can stand off island groups like Spitzbergen and Franz Josef Land until it clears. A good airship, carefully handled, will always have a reserve of fuel, which will enable her to stay in the air for two or three days with engines turning at low speed.

The danger of "icing" is greatly exaggerated, in my opinion, in the case of airships. An airship does not "ice up" very fast. Admittedly, metal parts in the open—for example struts, wire cables, and the leading edges of fins and rudders—can be quickly and heavily coated with clear ice in fog or very damp air at the freezing point, or in super-cooled rain, but this is not true of the entire outer cover of the ship. Here the icing process goes on very slowly. The reason for this, in my opinion, is that the outer cover, in contrast to the metal struts, is a poor conductor of heat. Therefore one always has time to rise into colder layers or to descend into warmer ones, thereby avoiding the layers of air around freezing which are always the most dangerous. In the Polar regions the temperature of fog and cloud-masses in autumn and spring naturally approximates that of areas in North and Central Europe in winter. But I know of no case where Zeppelins during the first World War were endangered by icing, although very often during

winter cruises thick, clear ice would form on braces, struts and wires. One Zeppelin was lost in the winter of 1916 on the Russian Baltic coast through being weighted down by snow during a snow-storm. But in this case the commander had tried for a long time to find his hangar in a blizzard, and finally the ship was so heavily loaded with snow that she became too weighty, and sank to the ground. Had she gone a few hundred feet higher, where the snow was drier and would have been blown away by the slipstream, the ship could have been kept in the air and, when the weather cleared, could have found her hangar.

Aside from other small considerations advanced against using the airship in the Polar regions, further objections have been made that in this region neither magnetic nor gyro compasses can be used for navigation. Actually, on our Arctic flight, though we went beyond the 81st parallel of latitude, we were in fact able to make use of the gyro compass, to a greater extent anyway, than the magnetic compass. Furthermore, today there are radio bearings which make it possible to fix the ship's position, and there is also the so-called sun compass.

In summary, I should like to express my opinion that from the navigational and meteorological aspects the use of airships over the Arctic Ocean is not so difficult as in many regions of the southern seas or in the tropical zone, where the Zeppelin had already demonstrated its capabilities in several hundred flights and in the most severe weather conditions. One can be even more emphatic in this opinion since there is now a network of radio stations around the Arctic Ocean and extending deep into its heart. Our Arctic flight may be taken as proof of this opinion. People said it was made under unusually favourable conditions. Who knows? After our return I described our flight as favoured by good weather, for I never cared to talk about "battling the elements". But we shall see what we actually had to go through.

An important matter, naturally, was to provide the crew and ship with clothing, food, and equipment in case of a forced landing on the Polar journey. This Polar equipment, chosen according to the advice of the experts, finally amounted in weight to 11,200 pounds, or 240 pounds for each of the forty-six people taking part in the expedition. Sleeping-bags and sledges were no more forgotten than emergency rations, hunting and fishing gear, and a

number of cooking-stoves. And so everything seemed ready for any eventuality, and on July 24, 1931, we took off from Friedrichshafen.

We first flew just to Berlin, partly to add a few items to our equipment, but particularly to load more fuel, since the ship had about 9,000 pounds more lift in Berlin than in Friedrichshafen, which has an altitude of 1,200 feet. We flew several circles over Berlin, whose population naturally viewed the "adventure" of the Arctic flight with great excitement, particularly as there were still lively memories of the catastrophic ending of Nobile's flight. "What went wrong with Nobile? He didn't run into bad weather!"

I was asked by an acquaintance about 7 p.m. as we lay moored at the Staaken base and were loading gas and fuel, while tens of thousands crowded around the ship: "Aren't you afraid that something will go wrong with you, too, over the Arctic Ocean?"

I was happily eating a plate of soup which they had hospitably set out for us, and replied, "No, because he is a 'skittish colt', as we put it. Such people should stay away from aviation! According to Amundsen's report on the Polar flight, which he made with him and Risser Larsen across the Pole to Nome in Alaska, Nobile was jumpy and almost dangerously panicky. According to Amundsen's statement, 'the ship would have flown into an iceberg if Risser Larsen hadn't torn the elevator wheel out of the hands of the weeping and hand-wringing Nobile'. And apparently he became equally excited when, shortly before reaching Spitzbergen, his ship began to get heavy. But she was becoming heavy for obvious reasons: They had a little trouble with the rudders and had to stop the engines to repair the damage. The ship was very 'light' and rose like a free balloon, after the engines were stopped, up through the low cloud-ceiling and up to pressure height, where she blew off gas through the automatic valves. The gas continued to blow off, because with the ship stationary it quickly heated up in the warm sunshine above the clouds, resulting in a loss of about 70,000 cubic feet. After repairs were completed they went down below the cloud-ceiling again, the gas gradually cooled, and the ship naturally became rapidly heavier. I doubt that she actually became so heavy that she could not be held in the air. They could simply have dropped ballast. The suddenness of the crash indicates much

more strongly that, becoming panicky over the increasing heaviness of the ship, they handled the elevators incorrectly. So you will see, my friend, that this catastrophe of the Italian ship can provide no argument against the use of airships in the Arctic and that the apprehensions about the matter which prevail in such widespread circles are without foundation."

Shortly after 4 a.m. on the following day we continued our journey. Our day's goal was Leningrad, where we intended to replenish the ship in order to start the real Arctic flight with the greatest possible load of fuel from a point as far north as possible. The flight was fine and interesting. We cruised over Stettin on the Baltic and then along the Swedish coast, over old cities of the Hanseatic League to the Aaland Islands, above the Gulf of Finland, to Helsinki, and finally by way of Narva to Leningrad, where we landed shortly after 6 p.m. All the way from Narva we had been escorted by Russian planes which led us on a course avoiding the Russian fortifications, so that we would not be permitted to see too much of them.

On the flying-field there was a great crowd of Russian military officials and scientists waiting to welcome us. The Russian Government had not only arranged to refuel us, but, wishing to meet us more than half way, they contributed to our store of provisions. Early the following morning not only were a lot of hams delivered to the ship, but also large amounts of packed caviar as a special Russian gift to the ship's galley.

Towards 9 on the morning of July 26—rather late because of a prolonged celebration the night before—the fully loaded ship took off on her journey amid enthusiastic shouts and cheers from a large crowd. She carried fuel for roughly 105 hours for all five engines, including petrol for twenty-one hours. With that amount one could stretch it to 130 hours by flying on four engines. When we finally landed in Berlin after a flight of 105 hours, we still had actually enough fuel for twenty hours on board.

The journey over North-west Russia was by way of Lake Ladoga, then over Lake Onega in the general direction of the mouth of the Onega river, and was interesting to a degree, as it unrolled before our eyes an empire of forests and timber exports. The lower course of the Onega was almost choked with floating logs, and Onega Bay was covered with them for miles. We need

hardly add that it is the same in Archangel, where the broad Dvina empties itself.

The weather was also interesting: the whole of North-west Russia, almost up to Archangel on the Polar Circle, had a temperature of 68 to 77 degrees at a flight altitude of about 1,000 feet, so that it was hardly noticeable that we were approaching the "frigid zone". Many of the passengers, who on leaving Leningrad had foresightedly pulled on thick Polar sweaters, took them off again when they found midsummer weather prevailing still at 65 degrees north latitude. But the incoming weather reports indicated that it would soon be different. From the icebreaker *Malygin* off Franz Josef Land we received the news that a nasty snowstorm had been raging for the past two days, and the reports coming in from the most northerly part of Russia and the few stations in and on the Arctic Ocean indicated that an Arctic low-pressure area with stormy north winds was stretching from south of Spitzbergen and Franz Josef Land across Novaya Zemlya into the Kara Sea, and was apparently advancing eastward into the Arctic Ocean.

We would have to be prepared for bad weather, and above all would have to decide which route we would choose. We had previously put off a decision in order to make it according to the weather. Now it was clearly apparent that we would undoubtedly find ourselves in very thick weather and would probably spend one or two days in it if we steered from Archangel north-east towards the still unknown Severnaya Zemlya, which, like the northern tip of Novaya Zemlya, whence we could steer east to Franz Josef Land, was meant to be one of our main subjects of investigation. This "left-about" route, which provided the only opportunity on our voyage of exploration to enter the Siberian Arctic Ocean, was not very promising. The other possibility remained: to fly "right about", first to Franz Josef Land and thence eastward to Severnaya Zemlya, and from there westward to the northern tip of Novaya Zemlya. We could hope that the weather to the westward of Novaya Zemlya would have improved when we arrived there one and a half to two days later. Naturally we would first have to fly through the bad weather north of Archangel in the Barents Sea.

Therefore we departed from Archangel on a due northerly course. We did not have to wait long for bad weather. While still

over the White Sea, just after crossing the Arctic Circle, we saw dark squall-clouds above the Kola Peninsula on our left, and in the direction of Cape Kanin and the Arctic entrance of the Barents Sea there extended straight in front of us a blue-black wall of cloud which seemed very threatening. It was as if the Polar Sea was erecting a belt of fortifications against us: Abandon hope, all ye who enter here!

Already above the White Sea the temperature had gradually fallen from the 66 degrees we had measured over Archangel to 50 degrees. As we flew into the black wall, it quickly dropped to 43 and then down to 39. Cold rain lashed at the window-panes of the control car, and the airship began to pitch and bump around heavily. It was a typical "break-through battle" which we had to fight, no worse than those in the temperate zones, perhaps milder, if one considers the great temperature drop which occurred here on the boundary between the zones, if I may call it that. Actually it became calmer as we went on deeper into the bad-weather sector over the Barents Sea, and presently we were merely flying through cloud-masses which brought a heavy, very cold rain, but which were at a temperature too high for the icing danger to develop. And so we flew on comfortably at an altitude of 500-650 feet.

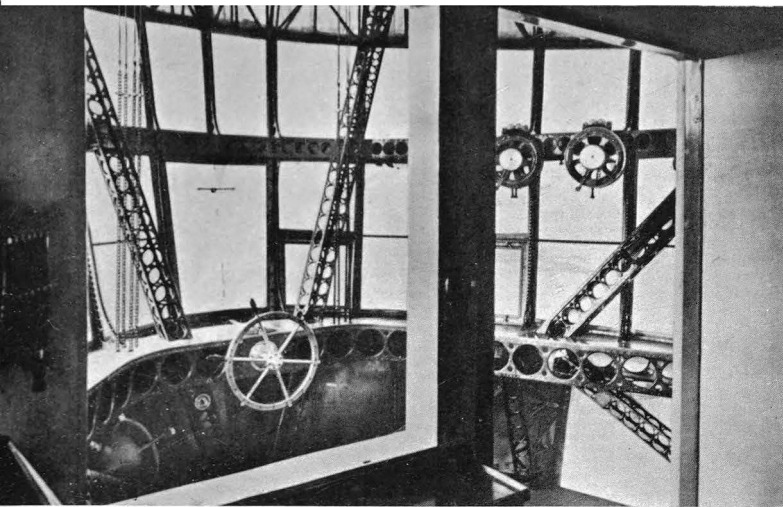
We continued like this for two or three hours, bucking a stiff north-west wind that blew between 27 and 36 miles per hour, gradually veering to due north and decreasing to 18-22 miles per hour—a sign that we were passing the low-pressure area on our right. Flying slowly, we made our way to the 73rd parallel of north latitude—slowly, because we not only had to fight against a strong head wind, but had also markedly reduced our own speed in order to ease the stresses on the ship's structure in the squalls. At this latitude it began to clear gradually; but unfortunately we discovered that a low cloud-ceiling had developed over the sea, above which we flew on without catching even a glimpse of the surface. So we continued for several hours without being able to determine our speed, or our exact position either. But this was not really serious, for we realized that we were over the open sea, we had more than enough fuel, and we knew things would soon change for the better, for a chance glimpse through the cloud-ceiling beneath had shown us that the wind had veered to north-

east, thereby indicating that we now had the bad-weather zone behind us.

So we idled along on three engines, heading into the north-east wind, while we waited for it to clear. Nor was this any dull wasting of time, for we had scientists on board who now had a chance to work undisturbed: meteorologists, physicists, and electrical experts. In particular, the Moltchankoff recording weather balloon was tested by its discoverer with the assistance of Professor Karolus. Several atmospheric measurements were taken, extending up into the stratosphere, with successful results. Other groups were making magnetic and electrostatic investigations, and the meteorologists were able to make a study of atmospheric phenomena and developments in this region which, in my opinion, were not only extremely rewarding, but also very informative.

Personally I must state that I had never seen anything comparable in the way of light, reflection, and colour phenomena to what was found here over the Polar Sea. The wonderful clearness and sharpness of the air and the mingling of air-masses of different temperatures, due to the intrusion of cold (Greenland) air, produced constant mirages, which we watched with continual fascination. How often we observed ice-fields or blue channels of water or rough sea, only to realize finally that it was just a weird illumination from clouds or mist at a great distance! A strange experience: to be floating peacefully above an ocean which had seemed unfriendly and treacherous in our imagination, and which now revealed itself in brilliant light and colour and beauty!

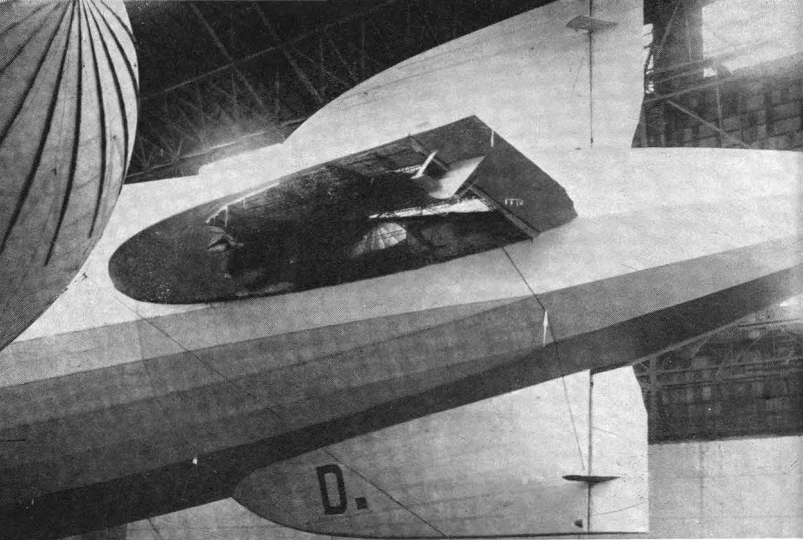
We flew on in this manner until after noon, and then appeared on the horizon something unmistakable: the edge of the ice-field! It was at about 78 degrees north latitude, which meant that this year it was unusually far to the north. At about the same time vision became completely clear, and in the distance we saw the glaciers and snow-covered mountains of Franz Josef Land. What now began to sparkle in light and colour was so overpoweringly beautiful and extraordinary, so unforgettable in comparison with anything I had ever seen before, that later, recalling it, I made bold to remark, "Whoever has not seen a Polar landscape like Franz Josef Land, with its gleaming and transparent glaciers, in the fairy-like delicate tones, and the endless symphony of colour of its ice-masses—its colourful beaches and the blue inlets between



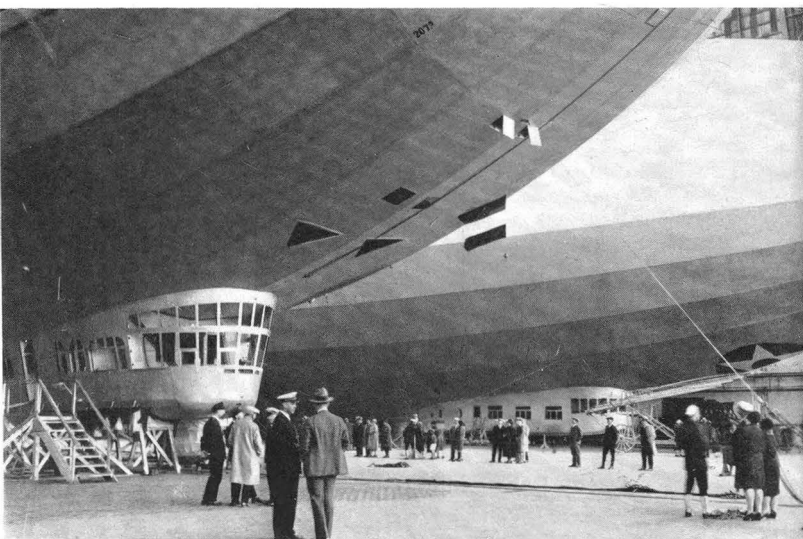
Inside the control car of the *Graf Zeppelin*: The rudder wheel appears prominently at the bow of the car, with engine telegraphs against the windows to starboard.



The roomy passenger lounge of the *Graf Zeppelin*, which at meal time doubled as a dining salon.



Near disaster over the Atlantic: The *Graf Zeppelin* at Lakehurst, showing the damage to the under side of the port fin incurred on her first ocean crossing.



During the layover at Lakehurst, October, 1928: In the foreground the bows and control car of the *Graf Zeppelin*, flying the German merchant flag; in the background the *Los Angeles*.

the fantastically shaped islands and foothills—has not known anything of the most beautiful thing which this earth has to offer to our eyes and our souls.” Perhaps one had to be flying 1,000 feet above this fairyland to see it like this, but I had the feeling that the victory of light and summer over a world of “night and ice”, as Nansen calls it, could not be more dramatically illustrated than in the way we were experiencing it. It was clear to me that a summer journey in the Polar regions in an airship was the most extraordinary that could be offered to a traveller hungry for beautiful scenes. But there must be airships to provide a wide and free view.

We flew past Cape Flora, where we saw traces of blooming vegetation and where Fridtjof Nansen, returning from the icy wastes of the Polar Sea and from the Franz Josef Land often named after him, had his famous meeting with the English explorer F. G. Jackson. We then ran into the so-called “Quiet Sound”, where we hoped to find the icebreaker *Malygin*. Sure enough, there she lay, in the deepest inlet of the sound, off the steep cliffs of a large island! We exchanged greetings with her by radio and informed her of our intention of landing on the water nearby. We went down slowly and sat down gently on the water 500 yards from the *Malygin*.

It was about 1700 hours by Greenwich time. A sea-anchor, shaped like a parachute, was tossed out, and the forward and after gondolas were ballasted with water. Thus the ship lay steady with her bow pointing into the light wind, and we waited for the arrival of the boat put over by the *Malygin* which was to bring us some visiting passengers from the icebreaker and some sacks of mail to be exchanged for some brought by the airship. As the boat approached, we recognized General Nobile, the commander of the Italian airship *Italia*, wrecked the year before. In the spring Nobile had offered to accompany me as a “Polar expert” when he heard of our plans. I declined with thanks, for we did not intend to accumulate experiences on a cake of ice. So he had gone with the *Malygin*, perhaps in the rash hope of finding traces of his comrades possibly carried off to Franz Josef Land with the wreck of the airship. Doubtless he would gladly have come on board the Zeppelin, and I would gladly have let him come for the rest of our flight; but something happened which made me decide to take off as soon as possible.

The light wind which barely ruffled the surface of the water was apparently blowing rather more strongly at the height of the ship's back than at the surface, and this caused the ship to drag the sea-anchor. I watched this with some concern while the mail was being exchanged, but it made no difference as long as we had open water and room to drift. But then we reached an area where many cakes of ice were floating, and there was the danger that one might knock a hole in one of the gondolas on which the ship was floating. A good-sized leak might have been dangerous. So I gave the order to transfer the mail as quickly as possible and to prepare everything to take off again. This we did, and it was not easy to haul in the sea-anchor, which had become fouled on the top of an ice-cake. We left the disappointed and perhaps puzzled *Malygin* people beneath us and soon flew over them 1,600 feet up, to disappear behind the next island to the north.

The reporter of a big German newspaper, who had made the journey on board the *Malygin* and wrote a brief account of it, complained that we had behaved very inconsiderately towards the people in the *Malygin*. "The youth so quickly forgets his parents!" He did not understand why we took off so quickly without, as we had promised, inviting the visitors aboard for a cup of tea. In addition to the difficulty with the floating ice, the "Quiet Sound" in which we lay was rather narrow and surrounded by high mountains. We had moored there only because we had to land close to the *Malygin*, otherwise we would have picked a clear, open stretch of water where we would have had more sea-room to drag the anchor and where we would have ridden on the gondolas like a surface ship.

We had often practised this on Lake Constance and off the mouth of the Elbe, and it can be done without danger or difficulty. We might have shoved ourselves up on a large cake of ice and could have made ourselves fast with an ice-anchor. This possibility makes the airship a really useful vehicle for Polar exploration. With calm weather, which may be encountered almost always anywhere in the Arctic, an airship can go down on the open sea or on level ice and there can make all kinds of different measurements, for which the ship, as a sort of flying laboratory, can carry the necessary instruments. Such considerations had inspired Fridtjof Nansen to found the International Association for Ex-

ploring the Arctic by Means of Airships, the "Aeroarctic". There are still extensive regions in the Polar Seas which are as good as unexplored.

After the meeting with the *Malygin* we were once more in the air by 1800 hours Greenwich time, to attempt a little of this exploration work. First we had set ourselves the task of checking the accuracy of the maps of the island groups then in use, and to correct the larger errors in them. We climbed to 2,000 feet and then gradually higher to 3,300 feet, and from this altitude could examine a large area and take photographs with our aerial camera. With amazement we established that Peyer, half a century earlier, had drawn the island group accurately in the main, but, in spite of subsequent explorations, significant inaccuracies and errors had persisted in the cartography of this area. Peninsulas were drawn as independent islands, and vice versa. A number of islands were missing, and the shape of larger islands was considerably distorted. All of this was recorded in comfort by our camera and accurately evaluated after our return home. I believe that Professor Samoilovich, the geographical leader of our expedition, has since prepared a more accurate map of the island group.

During our flight we passed over a large part of the island group, which stretches over a distance of 250 miles in an east-west direction and to the south almost 120 miles. At the extreme south-west end we encountered a small Norwegian expedition aboard a little steamer and exchanged greetings with them, while they for their part replied with brief radio messages as well as blank cartridges, which awakened many echoes from the ice-cliffs. Gradually we approached Cape Fligeli, where in his day Nansen, after wandering on the sea-ice for a month, set foot on land in order to pass the winter on a small island. A few hours earlier we had flown over Cape Flora, where Nansen a half year later had met the first men. We had traversed a whole universe of tribulation and danger of many months' duration in our comfortable flight. We told ourselves, half ashamed and half filled with pride, how much easier and better we had it than those heroes of Polar exploration, who had to battle their way forward straining every nerve to overcome treacherous hazards, while so immeasurably much more can be attained with the creations of modern technology. Even the steel-armoured and fully provisioned icebreaker down below on the

"Quiet Sound" was a miserable instrument compared to our airship!

It was nearly midnight when we reached Cape Fligellii. The sun was still about 4 or 5 degrees above the northern horizon. It was, indeed, still daylight, but a sort of twilight had developed which had seriously hampered photography during the last two hours. Simultaneously, as always at sunset, it became all the more colourful. The picture offered to us from an altitude of 3,300 feet by the ice-and-snow-covered island, mountains, and sounds, exceeded in its splendour and colourfulness the noonday scene as we had approached the island group gleaming in the sun.

Now we had another problem to solve, namely: whether previously unknown islands lay in this high latitude between Franz Josef Land and Severnaya Zemlya. Commencing shortly before midnight on July 28, we set a course for the northern tip of Severnaya Zemlya, which was supposed to lie around the 81st degree of north latitude (exact measurements were not available at that time), and then proceeded directly along the $81\frac{1}{2}$ parallel of north latitude for about 370 miles to the east until we found ourselves off the North Cape of little-known Severnaya Zemlya.

This flight was very pleasant and interesting, particularly in meteorological respects. The air was unusually calm and stable, resulting from the temperature at all levels being uniform. From the altitude of 300 feet above sea-level all the way up to 3,700 feet, the thermometer showed $44\frac{1}{2}$ degrees with only slight variations. Thus we were in the presence of an inversion, which was decidedly remarkable.

According to physical laws, an adiabatic temperature drop of 18-27 degrees might have been expected to occur up to an altitude of 3,700 feet; but it appeared that a warm air-mass overlay the Polar Sea, produced, as we had to conclude, by the summer sun over the Barents Sea on the preceding day. Then, after piercing the squall-front, we had found a temperature of 37 degrees, and this temperature prevailed steadily up to the southern coast of Franz Josef Land, even up to the spot where we landed on the surface of the water. Apparently this cold air-mass had come down, not from the open Arctic Ocean, but from the high central plateau of Greenland, and had caused the bad-weather zone extending over Spitzbergen, Franz Josef Land and Novaya

Zemlya, which had produced the snowstorm forecast for just prior to our arrival at Franz Josef Land.

It is very likely that such disturbances, which require relatively warm water (the Gulf Stream, for example), are very rare over the actual centre of the Arctic Ocean. Thus the Polar regions between Northern Siberia and Alaska would be a most suitable cruising ground for airships. The critical areas to be carefully avoided lie particularly in the region of Spitzbergen and Franz Josef Land and on the Canadian side around the Arctic Circle, but not very far north of there. Here most of the tragedies of Arctic exploration have occurred, insofar as they were caused by snowstorms.

The flight to the east was, as I have said, most agreeable and tranquil. At times we went through belts of fog, but generally we were favoured by such extreme clearness of the atmosphere that we could examine great areas round about for unknown islands. Nothing of the kind could be seen. During the first four hours, as far east as the 92nd meridian of east longitude, the sea beneath was covered with a solid sheet of ice. From here to the North Cape of Severnaya Zemlya this surface was broken up into individual cakes of ice, and open leads of water extended for long distances. This probably changes from day to day; but apparently during the summer months there is a certain amount of space for floating ice-fields and enough open water to be able to land on the surface of the sea and to take measurements. This is quite significant for aerial exploration in the Arctic. During our whole journey as far as the North Cape we had a strong north-west wind, which set the cakes of ice in motion at the eastern end of the continuous ice-field, thus producing the open leads and water surfaces on which we might have landed if we had not set ourselves another task: the exploration of Severnaya Zemlya.

Towards 6 a.m., being in 81 degrees north latitude and 96 degrees east longitude, we sighted land: the North Cape of the island. First we rounded the cape, to observe the eastern side of the land; but we found this side to be mostly hidden by cloud. So we flew diagonally across the glaciers on the northern tip to the clearer western side. An impressive Polar landscape with high mountains which, as we approached at an altitude of 4,200 feet in order to cross the glacier, we estimated to reach to an altitude of at least 5,000 feet! It was interesting to observe the strong melting

effect of the summer sun even in these latitudes: a large river flowed out of the mountains and on the snow-free west coast formed a wonderful, many-fingered delta. The photographers had plenty to do!

Parts of Severnaya Zemlya were still hidden by fog or clouds. This was apparently the remnants of the bad-weather zone, which meanwhile was passing over. But we could still take a lot of good pictures of the entire western side of the island and particularly could settle one point: the so-called Severnaya Zemlya is not *one* island, but *two* islands of approximately equal size, separated by a channel.

The Russians have christened this sound with the name of a date in their revolutionary history. I would not have considered it inappropriate if they had chosen to name it "Zeppelin Sound", for the Zeppelin had contributed a great deal to the knowledge of this land.

The important part of our voyage above the Arctic Ocean ended at this point, but there was a sequel, which in my opinion produced valuable geographical information, namely a flight over the northern part of the Taimyr Peninsula.

A strange land! And strange, also, was the sensation of flying comfortably over this fearful, inhospitable region at the top of Northern Siberia, which supposedly had been crossed by only one explorer fifty years before! It was worth it. Even as we entered the peninsula by passing over Cape Chelyuskin, we could see that the maps of its elevations were quite inadequate. A decidedly impressive mountain range, which on the available maps was drawn as an insignificant elevation of only slight extent, stretched from Lake Taimyr far off to the east. And Lake Taimyr, which on the map appeared as a body of water some 30-40 miles long, turned out to be so extensive that we flew a good three hours along its margins. Now for the first time we saw solid ground! In spite of its far northerly situation between 74 and 76 degrees north latitude, in the main it was free of snow and ice and very interesting. It was interlaced with extremely curious formations, labelled "structured soil" by the geologists, and owing their unusual geometrical shape to the extremely low winter temperatures and the thawing of the surface occurring during summer. The whole broad area was flat and covered with reindeer moss. And we saw

numerous herds of these animals, but of a very light, almost white colour. There was no trace of human beings. I doubt whether human life could endure through the winter on this storm-beaten plain on the Polar Sea.

After a flight of almost 300 miles above these wastes we arrived once more at the sea-coast shortly before reaching the mouth of the Yenisei. We intended to pay a visit to the weather station at Dickson Haven, the most northerly on the continent. By chance the Russian Government steamer was there, which at the end of July of each year, when the Yenisei opens for navigation, comes down the river from Yeniseisk to relieve the officials and also to replenish the provisions and special requirements for the next year. It is a holiday for the station. We added further to the spirit of celebration by dropping by parachute some strawberries and flowers destined for Professor Urzanov, adding some loaves of bread and a large sausage from our supply. Also we dropped a packet of the latest newspapers, which were not yet three days old and which undoubtedly brought the greatest pleasure to these people cut off from the world. For people eagerly read whatever has just come off the press, even if it is hardly worth the trouble. In any case, we soon afterwards received a radio message enthusiastically praising the sausage and the newspapers.

We were now headed out to sea again with our course set for the northern tip of Novaya Zemlya, for Professor Samoilovich took a particularly lively interest in the inaccessible and hardly known northern part of the island. Towards 2 o'clock on the morning of July 29, with the sun already high in the sky, we arrived at the Cape, which lies in roughly 77 degrees north latitude. We rose to an altitude of 4,300 feet and thus were able to fly across the northern part of the island and inspect it. Professor Samoilovich made copious notes, and the photographers snapped pictures. Everything is so deeply buried under glaciers, and the cliffs drop so steeply to the sea, that one can understand immediately how the Dutch seafarer Barents was held prisoner here for a year without being able to find a way of escape. The northern island of Novaya Zemlya is in fact a fortress of ice. After flying over its northern tip we went down to the sea again and flew along the east side of the island at an altitude of about 3,000 feet. We were able to get a good look at the glacier areas in the interior of the island as

well as the maze of crevasses in the vertical wall of ice which rims the island for long distances. We had the good fortune to be watching a glacier as it "calved", that is, as a large mass of ice broke off at the end and tumbled into the foaming sea.

After flying for five hours we finally came to Matochkin Strait, the large channel separating the southern and northern islands of Novaya Zemlya. At its mouth is a weather and experimental station, whose officials we greeted and cheered by dropping some newspapers. Our shipmate, the Russian Alsberg, who had worked for a year there as a radio operator, told us of the frightful mental torment and frequent nervous breakdowns caused by the solitary existence. As if in a bad dream he now stared down from the comfortable gondola of the airship at the scene of his previous existence. We pushed on further into the strait, with a wonderful view of its splendid Alpine landscape, whose complicated structure lay clear and open before us. Then, at the western end of the strait, we turned south towards the southern island, where Professor Samoilovich planned to make special determinations concerning its glacier formations. To do this, we crossed the middle of the southern island from west to east at 4,000 feet.

This ended our scientific and geographical activity, and we were aware of having made a rich haul to take home for the more accurate cartography of the great area we had flown across. We now set a south-west course, and flew over the flat region at the southern end of Novaya Zemlya at so low an altitude that we were able to have a good look at the Samoyed settlement there. Towards noon we reached the southern portion of the Barents Sea, exactly two and a half days after we first entered it, coming from Archangel, fighting the squall-front which lay above it.

The weather was now fine, and a moderate north wind helped us along, so that we flew with only four engines, as was usual during the greater part of the flight. At 7 p.m. we crossed Archangel, towards midnight we reached Lake Ladoga, and towards 3 a.m. on July 30 we were above the Leningrad airfield, exactly ninety hours after we had taken off from there. This was the duration of the Arctic flight from Leningrad to Leningrad. We had had fuel on board for 105 hours for all five engines, but had used it sparingly and now, after a ninety-hour flight, still had enough fuel to be sure of being able to reach our home base,

Friedrichshafen. So I decided not to land in Leningrad, in order to avoid the confusion that would be inseparable from our landing (and I heard later that actually all kinds of celebrations were planned). All of us on board were quite exhausted by the overpowering weight of our impressions and our experiences and longed for a rest, not for welcoming celebrations, which are generally a pleasure only for the greeters, not for those being feted. We had had some experience of this. In any event, it seemed that bad weather was developing, and it did not seem advisable to moor the ship to the short mooring-mast in such weather. So I dropped a message saying that I did not intend to land because of the uncertain weather situation, but would go on without stopping. Actually we flew into rainstorms near Riga which accompanied us to the German border. Towards 11 a.m. we passed Memel, and around 1 p.m., flying steadily, we passed Danzig, and with good weather, counted on being in Friedrichshafen about midnight.

But it turned out otherwise. During the noon hour we had taken in radio messages from the management of the Berlin-Tempelhof airport requesting us to land there. I replied in the negative, because we could easily get home by evening and very much wished to do so. Why should we make a ceremonial landing on the Tempelhof field? Four and a half days before, when we had taken our departure, the airport management had considered the matter and had offered us a not inconsiderable sum of money, which they had hoped to make by charging admissions. I had answered evasively, for one proverbially does not count one's chickens before they are hatched. But now we were returning victorious.

In reply to my negative answer, the Mayor of Berlin intervened to support the request of the airport officials. When the radio officer brought me the mayoral summons, I said, half resentfully, "Very well, answer that we must have twelve thousand marks for landing there!" I expected that through this shameless demand, which I meant only as a joke, the whole matter would be ended; but this was not the case. They offered me about half that sum and protested that Berlin awaited us with the greatest eagerness, and we could not deny the popular desire.

So I exchanged messages with the Mayor concerning a landing

at Tempelhof—and gave in. But I refused the payment, even though we could have used a few dollars in our perpetually empty cash-box, for I could not charge an admission fee to have our prominent passengers, like Professors Karolus, Weikmann, and Kohl-Larsen, stared at like conquering heroes. Later I understood that there was a further reason for the Berliners' insistent demand for a ceremonial greeting for the homecoming ship. For a whole day everyone had been seriously concerned about the Zeppelin, as no news had been received. Our radio messages had not been received during the period that we were north of the 80th parallel between Franz Josef Land and Severnaya Zemlya, and eventually we first regained contact with the German radio stations via a Hamburg-America steamer which was *en route* to Spitzbergen.

The landing at Tempelhof took place in the afternoon. Hundreds of thousands of enthusiastic people surrounded the broad field and stared at us—from a distance. But loud-speakers had been set up, and we had to address the crowd. Various people talked, particularly Professor Samoilovich as "scientific leader" of the expedition. Finally I had to try it and went rather unwillingly to the microphone. They probably hoped to hear something of the horrors and dangers of the Arctic, with some suitably modest comments on the skill and good fortune with which we, as good Germans, had overcome them; for a "thrill", as the Americans call it, an exciting sensation, should certainly be included in any report of such a flight. They did not get what they expected, for I told them that the terrors and hair-raising dangers of the Arctic, to which the Nobile expedition supposedly had fallen prey only a short time previously, were only a legend, that we had made a pleasant trip above the ice-fields in the clearest sunshine with all kinds of good things to eat and drink, and that in my opinion such excursions would enjoy great popularity in the future.

This was undoubtedly a surprise and a disappointment for many people, as I understood from several sources. How could they know that I was inclined to laugh at the heroic sensation business! Whether I was right in so doing I do not know. The answers to this question I shall leave to the politicians and the philosophers. But I would make the following statement in all seriousness about the Arctic flight: there was definitely a kernel of

truth in what I told the Berliners on the Tempelhof field. Actually, apart from the very bad weather we experienced on entering the Arctic Ocean, we *had* had very favourable weather, and as a result had seen a great deal which we were able to bring back with us as a contribution to scientific knowledge. But how would matters have gone if we had made the flight a day earlier or later, or had gone "left about" from Archangel, instead of "right about", as we in fact did? It is hard to say, but I suspect, and not without reason when I recall the strength of the air-masses through which we flew, that we arrived over Franz Josef Land and Severnaya Zemlya at a specially suitable time. If one is "lucky", it will always turn out so when one has made correct plans and decisions, even when flying over the edge of the Arctic Ocean. But this does not alter the conviction that I brought back with me, that in the centre of the Arctic Ocean airship navigation is no more difficult or dangerous than in the temperate zone, perhaps even less difficult than it can be under some conditions here.

After a three-hour delay we took off again and flew slowly on through the beautiful night towards our home hangar, mostly on only three engines. We arrived there shortly after 4 a.m., exactly a week after our take-off for the Arctic flight. An ancient dream of Count Zeppelin's had found its fulfilment. Will there be a sequel? Will Nansen's "Aeroarctic" live again?

VII

THE VICTORY OF THE ZEPPELIN CONCEPT 1931-37

IT WOULD be erroneous for the reader to assume that the great flights described in the preceding chapters led to a general acceptance of the Zeppelin airship and of its value as a vehicle of commerce over great distances. Neither the repeated crossings of the Atlantic Ocean, nor the world flight, the Mediterranean flights, nor the Polar flight—no, not even the South American flights, which were beginning to develop into a regular service, had sufficed to persuade certain circles to give up their markedly hostile attitude towards the airship. This refers particularly to the armed forces and to those groups directly concerned with the aeroplane and its further development, and naturally also to the officials in whose hands lay the control of German aviation. The armed forces of course could not expect that the airship, which eventually had proved in the first World War to be useless in combat, would be of any value for their purposes. The aeroplane interests considered air commerce to be their monopoly, and, in fact, a genuine aviator, to whom the thundering motors give a proud feeling of power and domination of the air, must feel in the inner reaches of his soul a lack of sympathy for the slow "gas bag". The better is the enemy of the good, or so the saying goes, and they expected that the better in this case would soon displace the good, and they would do next to nothing for the latter, although it was already here and could be made useful. It was clear that still further publicity and pioneering flights would be needed to obtain energetic support from the Government officials.

But the German people believed in the Zeppelin and loved it. The situation resembled that of more than twenty years before,

when the people had contributed to the Echterdingen Fund for Count Zeppelin so that he could build a new ship.

Whenever the general public have made great sacrifices for an idea, they are likely to remain devoted to it, largely from egotism and obstinacy, but will turn against it with even more violent abuse and outbursts of anger when they finally have to admit it was all a "swindle". And so the people maintained their devotion to the "Zeppelin Idea" despite the many set-backs that occurred in the early years, and although, even by the end of the first World War, the Zeppelin had appeared to have outlived its usefulness, at least as a combat weapon, and had been repudiated by the military. But when the *ZR III* made her successful crossing of the ocean in 1924 and achieved an important moral and political success, the smouldering fire of popular enthusiasm blazed up brightly again, as we saw in an earlier chapter. But something further was needed to increase this enthusiasm. The successful long voyages of the *Graf Zeppelin* were noted with all the more pleasure and satisfaction, as America, England, and France, which lacked the German experience in building and operating Zeppelins, were involved in disasters to their ships and as a result ceased to build them. And so there developed a national pride in the German Zeppelins, which one often heard expressed in rather arrogant language, such as, "Those other fellows can't copy us! This is the result of German cleverness and workmanship!" I have always regretted such foolish and politically tactless expressions, particularly since we always found in America, and even in England, a warm and completely ungrudging recognition of German achievements in the realm of airship flight, and I feared that this unfortunately typical German boasting could damage our cause.

This attitude of the German people to the Zeppelin led to everyone in Germany wishing to have the world-famous *Graf Zeppelin*, or at least to see her. After all, they had contributed their mite to building the ship! Invitations rained on us to come and visit all the big cities, and even the small ones. It was impossible to respond to all of these; but we did as much as we could, for we needed revenue to keep our business on its feet. Passenger fares and the fees charged by various clubs or special groups for admission to landing-grounds provided a nice income, but not enough to cover the full cost of the Zeppelin enterprise, including

depreciation on the ship and hangar. But it was enough to take care of current expenses. Therefore in the years between 1929 and 1936 we made more than five hundred flights, which, together with the big ocean voyages, added up to almost 1,300,000 miles. Since most of these flights were made to foreign countries, their publicity value was all the greater and more successful, both for the enterprise itself as well as for German interests in general. To the extent that these flights were limited to German soil, and only Germans saw the Zeppelin, they had a further influence on domestic politics.

I always felt that such effects as were produced by the Zeppelin airship were traceable to a large degree to æsthetic feelings. The mass of the mighty airship hull, which seemed matched by its lightness and grace, and whose beauty of form was modulated in delicate shades of colour, never failed to make a strong impression on people's minds. It was not, as generally described, a "silver bird soaring in majestic flight", but rather a fabulous silvery fish, floating quietly in the ocean of air and captivating the eye just like a fantastic, exotic fish seen in an aquarium. And this fairy-like apparition, which seemed to melt into the silvery blue background of sky, when it appeared far away, lighted by the sun, seemed to be coming from another world and to be returning there like a dream—an emissary from the "Island of the Blest" in which so many humans still believe in the inmost recesses of their souls.

Such formless ideas may have moved to a greater or lesser degree the millions of people who saw the *Graf Zeppelin* soaring over their heads and who were carried away by their enthusiasms. Added to the pride and hope which the ship awakened was an incalculable appeal to the senses and imagination, and this perhaps was the decisive factor. Who can deny that the Zeppelin in this troubled time fulfilled some deep-seated need? For every happiness, every ray of hope that one can give to a despairing soul can be life-saving. I myself have always found pleasure and a sort of proud satisfaction in observing the great impression which the ship made everywhere on our many flights over Germany. I did not consider it entirely appropriate that the ship's crew should describe these flights, worked in between the great transatlantic journeys, as "circus flights", which were really unworthy of the ship. No, they were important, and perhaps the best that the *Graf Zeppelin* ever made. The Zeppelin concept, the "Zeppelin dream",

was a very interesting episode in the history of German spiritual development, and how often I still have to hear today, "Oh, how fine it was in the old days, when the Zeppelin flew to America, followed by the thoughts and wishes of the entire people!" Unfortunately this dream was short-lived, and it was suddenly interrupted by the folly of a criminal madman.

One of the more important intermediate flights, which still gleams bright and enchanting in my recollection, we made in July, 1930—namely a flight to the far north. This flight was not made on account of publicity or politics, but originated in our Viking passion for voyaging and adventure and was intended as a preliminary study for our Polar flight, which we then had already in mind and which was described in the previous chapter. A group of twenty Swiss, among whom the well-known flier Mittelholzer played a leading role, had chartered the ship for this flight. It was to be a "Northland journey", such as the Kaiser had made increasingly fashionable since the beginning of the century, but it was the first such voyage in a passenger airship, and was supposed to go as far as Spitzbergen if the weather conditions permitted.

In chilly, unpleasant weather, which had covered Central Europe for many days, we took off around midnight of July 8, and towards 8 a.m. on July 9 we reached the North Sea at Amsterdam. At 4.30 p.m. we sighted the Norwegian coast at Stavanger, and towards 7 p.m. we were over Bergen and gave the astonished inhabitants of this ancient seafaring and mercantile city their first look at an airship, carrying tourists along the picturesque mountain chain of south-west Norway. From our elevated lookout we enjoyed the beauties of the cliffs falling into the sea along the coast and the splendours of the famous fjords, some of which we flew into for a long distance, as none of us had ever been able to enjoy them before. The sun provided a gorgeous illumination. It always seemed about to be setting and yet never really did go down, for every hour we were approaching the Polar Circle, where the twenty-four-hour day begins. It was like a race between us and the sun; but the sun won by a nose, for as we flew over Trondheim at midnight, the sun was about three degrees below the northern horizon, which was bathed in flaming red light reflected over the whole sea ahead of us in a fantastic glow of colour.

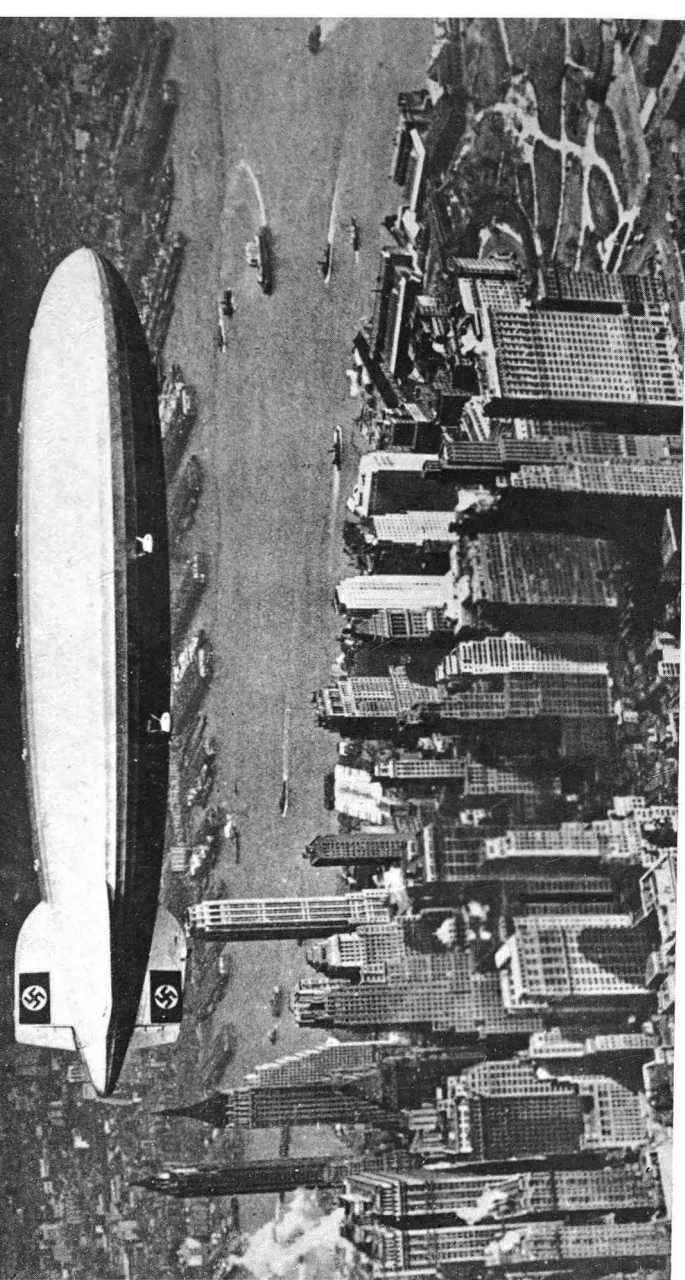
Towards 4 o'clock, as we arrived over the picturesque fjords of

the Lofotens, the early morning sun was once more high in the heavens and showed us, as with theatrical lighting, the romantic, winding straits in the labyrinth of rock, through which the sailor finds his protected way, while, outside, the westerly gale drives waves as high as houses. At 10 a.m. we were over Hammerfest, the most northerly city in Europe, on the 71st parallel of north latitude, as far north as the centre of ice-coated Greenland and farther north than the ice-blockaded north coast of Alaska.

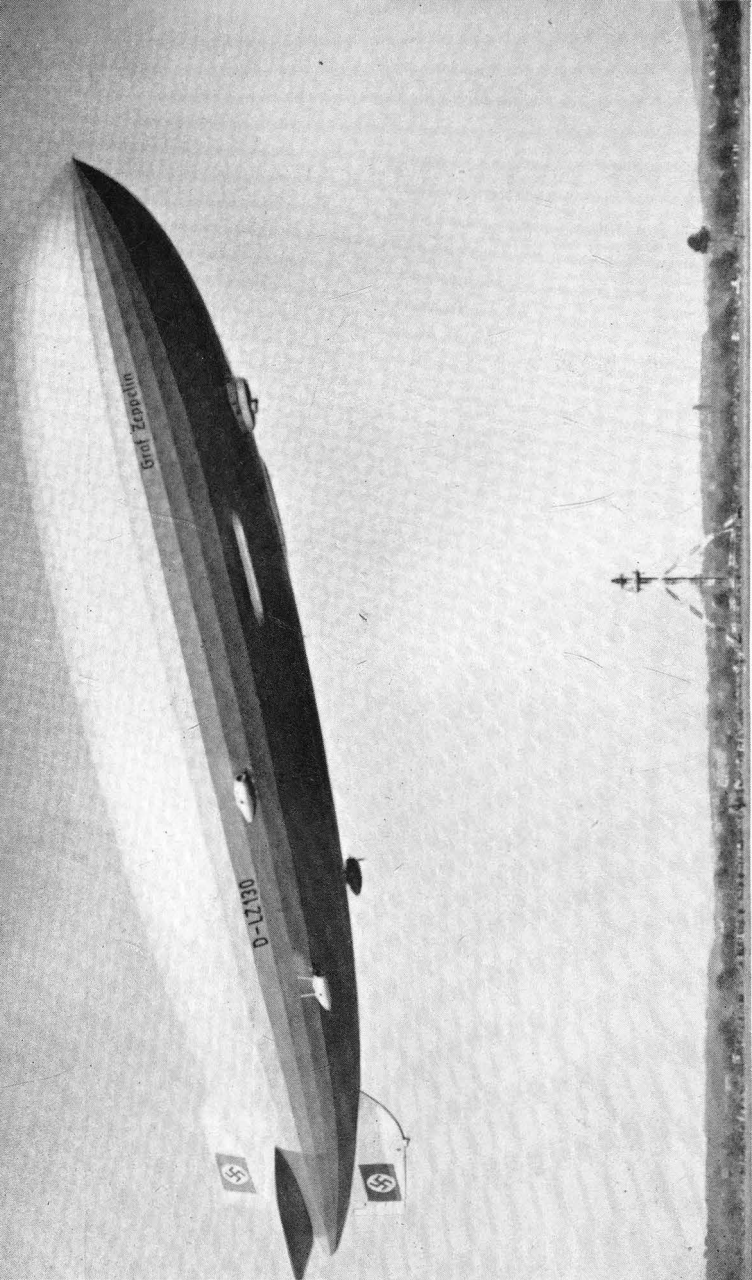
The Gulf Stream, whose warm waters wash the coast of Northern Norway, creates tolerable climatic conditions. On the day that we flew a wide circle over its picturesque red wooden houses clinging to the cliffs, Hammerfest had to show us a climatic miracle! Here we found an air temperature of more than 68 degrees, while up to then on our journey we had found a temperature of no more than 54-59 degrees at our flight altitude of 1,000 feet. Paradoxically we found this summer temperature as we entered the "Arctic Zone" at the Lofotens. And this fine warm weather stayed with us as far as Bear Island, half-way between Hammerfest and Spitzbergen. It was a wonderful flight over an almost glassy blue sea, as we set our course from Hammerfest to this island. A very gentle easterly breeze, which brought warm summer air from North Russia, was the reason for this phenomenon. And so, in the clearest sunshine, we were able to circumnavigate the interesting island and could study the ancient trading and shipping installations, which had previously served the island for mining coal.

A good hour later, at about 4.30 p.m., the mountain peaks of Spitzbergen appeared to our fascinated eyes far away above the horizon, magically clear and beautiful in their jagged shapes. An air of excitement and expectancy began to affect the whole ship's company. It looked like a mirage, fantastic and unreal. Only in the Arctic Ocean does one see such wonderfully clear and at the same time such colourful pictures in silver, blue, and bright green.

But an unpleasant disappointment awaited us. For some time I had been noting with concern how at first scattered, then increasingly dense, white clouds of mist began to form on the surface of the sea. Next the whole surface was quickly covered with a solid overcast, and we were flying as if over a broad snow-field. It was unpleasant, but not yet a cause for anxiety. Then we saw how the fog began to cover the base of the mountains and then started



The Hindenburg over New York on a 1936 journey to America.



The last Zeppelin: The LZ 130 Graf Zeppelin II on her first flight September 14 1938

to climb their sides. I observed these developments for a while, before it became clear to me that Spitzbergen would be entirely covered with fog in less than the hour it would take us to arrive there. So I decided to turn back.

Naturally the news of this decision caused great disappointment, not to say indignation among the passengers, and I was fiercely attacked later on this account in a Swiss paper by a particularly dissatisfied gentleman. But I had my own good reasons, which I did not want to communicate to the passengers, in order not to disturb them. It seemed likely that we would have thick fog, which would make navigation very difficult. We were furthermore extremely far north, at roughly the 77th parallel of latitude, and had a distance of about 1,100 miles to go, before we would see the mountains of the Shetland Islands looming ahead of us. All along this route on our left would lie the Norwegian mountain ranges with an altitude of up to 6,500 feet, while on our right, though at a considerable distance, were the mountains of Iceland reaching nearly as high. We would not be able to measure our drift if fog or low-lying cloud should prevent us from seeing the sea. Our adventure off Newfoundland two years before, described in a previous chapter, had taught us the great degree to which drift could amount in some circumstances. It appeared as though a westerly wind was springing up, which could cause us to drift towards Norway, to what extent we would not be able to determine. So, as a precaution, I had to turn round, even though the bad weather had not yet developed.

It soon appeared that my decision was correct. Two hours later, as we were passing Bear Island, nothing of it could be seen. But we were flying over a solid cloud or fog ceiling and had clear visibility ahead. Nonetheless, an hour later a cloud-ceiling had formed over us, and for some time we flew between the two layers, until they combined and we flew on in fog. That is always an unpleasant situation, even when one is sure one is over the open sea. But since the weather changes in the last six hours made it seem very likely to me that the east wind, which we had had on leaving Hammerfest, had given way to a west wind, I had the course set one point more to the west. Towards midnight, when we were in the latitude of the Lofotens, we were lucky to take in a weather report from Jan Mayen Island stating that a gentle north-

west wind was blowing there. Our correction angle had been accurately chosen, and we flew on contentedly on the plotted compass course. Towards 3 a.m. the fog became somewhat thinner, and we could occasionally snatch a glimpse of the sea and make some corrections in the course.

Towards 8 a.m. there loomed before us the northern tip of the Orkney Islands, for which we had been heading. With this we had solved a problem in navigation such as is hardly likely to be encountered today, and now we went on at high speed with north and north-west winds, which increased to 31 miles per hour, over Scapa Flow, Aberdeen, and Edinburgh and across the inhospitable North Sea to Amsterdam. The temperature had again dropped to between 46 and 50 degrees. We had come home from the warm Polar seas to the cold temperate zone.

At 10 p.m. we were in Friedrichshafen, after a flight totalling seventy hours. Twenty-eight hours had passed since we had turned our backs on the mountain peaks of Spitzbergen.

This fascinating "Northland flight" was partly repeated some eight days later in a journey to Iceland. It gave us an experience perhaps as impressive as that to the inhabitants of Reykjavik, to whom their Norse saga of Wieland the Smith must suddenly have seemed to come to life. We on board feasted on the sight of the scenic wonder of the ancient Thule, armoured in ice and rhymed in sagas, above which we glided at a comfortably low altitude. The numerous wrecks lying off the south coast showed us how unpleasant it can be to have to fight a south-west storm off this coast in a surface ship.

Such flights as this, and many other similar ones, promoted great confidence in the safety of the Zeppelin airship, and the incomparable charm associated with a voyage in a Zeppelin became more and more generally known. Pressing invitations came from all over the world to show off our ship, and we made flights to London, Helsinki, Stockholm, Copenhagen, Rome, Budapest, and to many other foreign capitals. At most places we landed and made an excursion flight in which the authorities were eager to take part. Thus in the autumn of 1932 we made a flight around England from a London airport, carrying a number of Members of Parliament. The British public gave the ship a tremendous reception both at the take-off and the landing.

Meanwhile there occurred that political earthquake, so fraught with consequences, which we are accustomed to call the "Assumption of Power". What attitude would the new regime take towards the Zeppelin concept? This was the question which interested me most of all and which disturbed me somewhat, for I was fully aware already that I was not liked at all by the new heads of the Government.

The old regime, which had been replaced on January 30, 1933, had been inclined to take a generally friendly attitude towards the airship. To be sure, this had been accompanied by some opposition, not only from the "rivalry" relating directly to the aeroplane and its practical employment, but more particularly from the Armed Forces and the Army circles which steadily persisted in a noticeable hostility to the Zeppelin, for what good would they be in case of war? But they now had to admit that their condemnation of the airship as a "fair-weather ship" and a fragile type of aircraft was incorrect. The countless flights over Germany and many other countries made a convincing argument in favour of the airship. And one had to pay attention to German public opinion, which demonstrated such warm enthusiasm for the Zeppelin wherever we landed. In fact the most stubborn aeroplane enthusiast could not deny the fact that the airship was carrying on commercial operations of which the aeroplane was not yet capable, and that it was able to create publicity and prestige for Germany whose value was beyond calculation.

So the old regime, as I have said, had gradually come round to backing the Zeppelin enterprise energetically, and I really expected that the new National Socialist Government officials, who seemed to have a good understanding of propaganda and public opinion, would systematically continue this encouragement and would make available to me the means to carry out my plans.

This in fact took place. But I was very much surprised when the Propaganda Minister himself, Dr. Joseph Goebbels, who was all things to all men, seemed to want to take the business into his own hands. In the summer of 1934, when I had to make a visit to the Propaganda Ministry, he asked me very incidentally how I was coming along with the new ship, and whether I had already assembled the necessary funds for her. When I told him I still needed half a million dollars, he said with great composure, "Is

that all? Why, that's a mere bagatelle! I will approach some big industrialists and suggest they contribute what you need."

Perhaps the Propaganda Minister's attempt at "unfair competition" had the advantage of provoking the Air Minister to a prompt and effective support of the Zeppelin enterprise. At least Herr Goering intervened personally in the matter in decisive fashion. As I mentioned, we needed large sums of money to expand our enterprise and improve its operations. We had to build a larger and faster Zeppelin, and on this account we had to erect a larger construction shed and later an operating shed as a base for the ship. The necessary funds, which at first were estimated at two million dollars, we obtained by instalments during these years: from the State of Württemberg, which contributed \$540,000, and from the National Government in the form of loans, which the Government later converted into non-repayable "subsidies". But they by no means sufficed to complete the new ship.

Then the Air Ministry decided on a step which appeared definitely to guarantee financially the further development of the Zeppelin enterprise. The Ministry got the idea of founding a "German Zeppelin Airline Company", in which the German "Lufthansa" airline should hold half the capital. Since the Government was the financial backer of the "Lufthansa", this meant that the Government would be extensively supporting the Zeppelin enterprise with Government funds. The founding of the Company, whereby the Zeppelin Company offered the *Graf Zeppelin* as its chief contribution, took place in March, 1935, with a capital of \$2,200,000. The German Air Minister, Herr Goering, took a personal part in the original conferences, and during them made a remarkable speech. He declared that in commercial aviation "the airship is on a basis of complete equality with the aeroplane", and that he would "give to both types of aircraft the same interest and the same type of support".

I believe it must have cost Herr Goering a great effort of self-control to say this, and privately I felt some doubt about the fulfilment of this promise. Herr Goering, as aviator and militarist, *could not possibly* think of the airship except with contempt, if not actual hostility. And this soon became apparent. When I in fact asked him if he would care to make a flight in a Zeppelin, he vehemently declined and declared that he had no real confidence

in the "gas bag". I am inclined to believe that it was not so much Herr Goering himself as it was his Secretary of State, the later Field-Marshal Milch, who stood behind the founding of the Company. Herr Milch always maintained a very objective attitude towards the Zeppelin, although he was a director of the "Luft-hansa" airline.

In his dislike of the airship Herr Goering was at least in agreement with his lord and master, Adolf Hitler. At least I was told this by Hitler's confidant, the highway builder Dr. Todt. This gentleman made a Zeppelin flight with me once, by way of Salzburg, Munich, and Stuttgart, to the Rhine valley, in order to observe the progress of the Government super-highways, above which, at his request, we set our course as closely as possible. In fact it was a wonderful way to reconnoitre a country for the first time to lay out the route for a highway or a railway line! By chance, there was a discussion as to whether Herr Hitler might have felt a desire to inspect "his" express highways from an airship. Dr. Todt replied, however, that he had already discussed the matter with the Führer and he said he "didn't want to have anything to do" with the airship.

However that may be, for the first time the Zeppelin concept, and with it, as I believed, the desires of the people, had triumphed, and through the same Government which soon after was to send both to the grave.

The Zeppelin enterprise was now at last guaranteed, but it was at the price of its independence, for Herr Hitler never did anything without demanding compensation either beforehand or afterwards. I now had to withdraw from the leadership of the concern. Previously I had been the responsible business manager of the "commercial department" of the Zeppelin Company. Now Captain Lehmann, who seemed more acceptable than I, together with an ardent Party member, Captain Christiansen, who previously had been Police President of Magdeburg, were nominated as managers of the successor company, the "German Zeppelin Airline Company". I myself had (not unwillingly) to retire to the position of chairman of the board of directors of the airline company.

In March, 1936, Hitler accomplished his entry into the demilitarized zone on the left bank of the Rhine. The world held its

breath and expected that France would resist. But, for the time being at least, nothing happened. The Propaganda Ministry took this action as an occasion to "request" a number of well-known Germans to declare their support for the occupation of the left bank of the Rhine as a clever act of Hitler's. I likewise received such a demand, which I refused, for the reason that I was not capable of judging its significance. I expected to be punished immediately for this undoubtedly very disrespectful answer, but this did not happen until a week later.

There then came a demand from the Propaganda Ministry that the managers of the airline should send their two airships, the old *Graf Zeppelin* and the newly completed *Hindenburg*, on a two-day election-campaign propaganda flight over Germany and should drop the Ministry's propaganda pamphlets on all the larger towns. Apart from my political convictions, I considered this misuse of the airships in bad taste, a sort of sacrilege, and I refused to participate, myself, although the *Hindenburg* still had trials to make in which I was interested. But I could not refuse to allow the ships to be used for this purpose, for that would have been considered an open insult to the ruling Party, particularly as the Government was co-owner of the ships. This is what happened next:

While the *Hindenburg* was being walked out of the shed during a very gusty wind, considerable damage was done to the lower fin and she had to be returned immediately to the hangar for emergency repairs that went on for two hours. I was naturally very angry over this incident, which could easily have turned out much worse and involved taking a chance with the new ship. In a rage, I went to Captain Lehmann, who was responsible for bringing her out, and said to him, "How could you, Herr Lehmann, order the ship to be brought out in such wind conditions? You had the best excuse in the world to postpone this idiotic flight; instead, you risk the ship merely to avoid annoying Herr Goebbels. Do you call this showing a sense of responsibility towards our enterprise? What do you want to do with it?"

Herr Lehmann assured me that he could repair the damage, temporarily, in two or three hours and could then take off after the *Graf Zeppelin*.

With bitterness, I answered his remark heatedly: "So, is that your only concern, to take off quickly on this mad flight and drop

election pamphlets for Herr Goebbels? The fact that we have to take off for Rio in four days and have made no flights to test the engines apparently means nothing to you!"

It was true that we had planned our first flight to Brazil for March 31, and had booked forty passengers and six newspaper reporters, and likewise it was a fact that we had not yet made the usual twelve-hour test flight at full power, and because of this propaganda flight, which was supposed to last till March 29, we could hardly work it in. So one may understand my anger, which erupted in remarks not intended for Herr Goebbels's ears. But unfortunately he learned of them indirectly from one of his aides, who was making the flight to direct the propaganda and had overheard my comments. Goebbels flew into a tremendous rage. As a result, at the next Press conference he solemnly advised the reporters present: "Dr. Eckener has alienated himself from the nation. In the future, his name may no longer be mentioned in the newspapers, nor may his picture be further used."

I was first informed of this event "on the high seas", so to speak. Punctually and according to plan, but not with thoroughly tested engines, we took off for Rio on March 31. We had good weather and were pleased with the excellent performance and the fine and comfortable equipment of the new ship. It was the first ship built that was especially designed for the comfort and security of passengers on overseas flights, and we saw with satisfaction that they were pleased with her. And so there was a splendid state of mind on board.

Then suddenly a bomb exploded. The reporter for a big English newspaper came to me and said, "I have just received a radio message from my paper asking me to inquire the reason for the 'declaration of banishment' which Dr. Goebbels has imposed on you. I would like to send five hundred words about this."

I would gladly have given the reporter this sensational story; but, to his regret, I was obliged to state that I knew nothing about it. And the other German reporters on board knew nothing about it either, since they were told nothing by their home offices because of the proscription against me. After some hours the representative of the *Berliner Lokalanzeiger* managed to receive from his paper the information that "Lotte's father is seriously ill" (Lotte was my daughter, not unknown as a photographer).

This sounded very mysterious and gave us no information, and, if a slight indiscretion had not occurred, I might have been figuratively buried alive, so to speak, without knowing it, even though I was the central figure. The participants in the German Press conference mentioned above had been ordered to divulge nothing concerning my defamation. My name was simply to disappear from the German Press, and from the Press generally. But unfortunately a journalist mentioned the matter to an English friend, who published a mention of it in his paper, which then asked that I be interviewed during the flight. The smart people around Dr. Goebbels had made the mistake, difficult to comprehend in their clever plan, of overlooking the interest of foreign countries and their Press in my flights and my person.

Therefore I had to complete the journey to Rio as "seriously ill" without being able to discover anything about my illness. I had hoped to be informed about it in Rio. But nobody there knew anything either, and this led to an amusing little episode. On the evening of our arrival, my officers and I attended a banquet given by the German Club to celebrate the first flight of the *Hindenburg*. During the banquet a gentleman, who, as an ardent Party member and leader of the local National Socialist group, played a role which most of the Germans did not care for, delivered a lengthy and violent speech on the "vileness of the foreign Press", which was trying to destroy the affection and respect which I enjoyed among all Germans abroad, and particularly in Brazil, by spreading lies alleging that I had fallen into disgrace with the Nazi Government!

I had to explain to the nonplussed and very embarrassed gentleman that "for once" the foreign Press was accurate and that the German Press representatives had just been told to say nothing about me on orders from Herr Goebbels. I could not restrain myself from adding that I was in no sense a National Socialist and that I greatly regretted the tensions and divisions which the local organization had caused in the German colony in Rio. The routine report of my remarks was hardly calculated to improve my position with the home officials, but this now was unimportant. In Rio I was thanked for speaking my mind in public by a number of distinguished Germans who had suffered from the terror of the

local organization and who had even been threatened in their commercial undertakings.

On my return to Germany eight days later I naturally wanted to find out what had happened and what further evidence they might have against me. I turned to the Air Ministry, as these were the officials with whom I was constantly dealing. Milch, the Secretary of State, who was always friendly to me, although he knew of my dislike of the Party, told me that the Minister, Marshal Goering, wished to speak to me about my problem.

Goering did not mention my disrespectful comments about the electioneering flight which Goebbels had ordered, which was the immediate reason for my disgrace. This was partly due to his dislike of Goebbels, partly also because I was actually justified in refusing to make this flight, as I shall show subsequently. Instead, he laid strong emphasis on my refusal to sing a hymn of praise for the reoccupation of the Rhineland at the beginning of March. He then brought up a few incidental matters, like my having "made fun of the Hitler greeting, according to newspaper reports. In fact, I had told a foreign journalist who had asked if I proposed to disregard the "Heil Hitler" greeting, "Yes, that's right! When I get up in the morning, I don't say 'Heil Hitler!' to my wife, but rather 'good morning!'" The newspaper man, to Goering's annoyance, had used this in his paper. But then Goering made a significant remark, which sounded like a question: "They say you would have liked to have succeeded Hindenburg as president!"

To this I could reply with a clear conscience that not I, but others, had had this idea; but I could see from Goering's dissatisfied manner that this point carried a certain weight in high Nazi circles. Did they, did Goering, did perhaps the very ambitious Hitler, fear that I could or would use my popularity for political purposes, and was the proposed silent treatment of my name and person connected with such considerations? I could not tell. Goering then informed me that I might write a letter to Goebbels explaining that my remarks about the propaganda flight were due to my understandable anxiety about the ship being endangered, and I would request that the prohibition of the Press be lifted. He himself would then speak to Hitler personally about having the decree of banishment withdrawn. "I've just had to straighten up a similar matter about Furtwängler, and now you

come along!" he remarked, not ungraciously, as I was shown out.

In the Ministry I also spoke with a general who was head of the department concerned with all engine problems. He held the opinion that, considering the *Hindenburg's* engine trials had not taken place, I could not possibly have permitted her to go on the questionable flight, and he added in public, "You were right! I would have done the same myself." And in fact he could not have maintained otherwise, for on the outward as well as the return flight we had so many engine failures that it was only by sheer accident that we got home. This I will describe in a later chapter.

VIII

THE *HINDENBURG*

THE FOUNDING of the German Zeppelin Airline by Air Minister Goering on March 25, 1935, I privately took to be practically the end of my activity in the Zeppelin commercial enterprise, and I earnestly considered withdrawing entirely from the control of flight activities, for, in a pioneering and experimental enterprise such as ours had been, planning and execution must be in the hands of one person, who takes full responsibility for proposed programmes and for all flights. The technical manager and superintendent of flight operations of the Zeppelin Airline would have to have a free hand to develop and execute his programmes, and this was no longer me, but Captain Lehmann. I had been "demoted" to chairman of the board of directors and, as such, could have an influence on commercial flight activities only in executing operation plans which had been made safe by long practice, thus offering practically no problems.

Had we actually progressed this far? With respect to the South America service, one might say so, as thirty-five such flights had already been made exactly on schedule; but a similar regularly scheduled commercial service to North America was now on our programme, and further investigation had to be made of the weather conditions above the stormy and squally North Atlantic. Could or should I leave these investigations to another? To be sure, both Captain Lehmann, the newly-installed operations chief of the Zeppelin airline, as well as his closest collaborators, were extremely capable and experienced airship commanders; but to pilot an airship is to a great degree a matter of character. One should be able to say "no" frequently, and that is often more difficult than to say "yes". It is particularly difficult when a continuous series of splendid successes can be anticipated, and a refusal may be interpreted as a lack of self-confidence and courage.

Thus I found myself in an undecided and uncomfortable situation, and debated what I should do. Finally, however, I reached the decision not to withdraw from active participation in flight activities "from considerations of health", in spite of my age of sixty-seven years, or from consideration of the strenuous activity of the past ten years. I would remain in commercial operations in the interest of the enterprise for which I had formerly been responsible, even if I were only a "fifth wheel". I would personally intervene in the enterprise as its responsible head whenever or wherever it would seem to me desirable, even if this risked conflicts of authority, which would probably occur very promptly.

What had we been able to prove and attain up till then, and what was there further to prove and to do? The *Graf Zeppelin*, if one includes the year 1935 in which the Zeppelin Airline was founded, had made altogether 500 longer and shorter flights and had decisively refuted the legend of the fragility and difficulty of landing a rigid airship. She had made more than a hundred ocean crossings, including forty-eight flights to South America and back in the form of regularly scheduled commercial service, and altogether had voyaged about 800,000 miles, carrying 16,200 passengers and 440,000 pounds of mail and express. She had created a transoceanic airline at a time when aeroplanes were still not in a position to do this, and thereby the airship had been the first to fulfil an ancient human yearning. She had finally persuaded the Government to support the airship energetically until such time as the aeroplane should be developed into a long-distance and ocean-crossing craft. Therein was a certain irony, for if the airship had had such State support twelve years earlier, Germany could have exploited a monopoly of transatlantic air traffic during these twelve years by virtue of its Zeppelins. One may think now, as I actually felt then, that the aviation historian might come to such a conclusion as this: "In the development of human flight the Zeppelin episode could only have been a very brief one, but the responsible authorities in German aviation lost an opportunity to encourage this episode and make use of it."

This was the most important matter we had proved and demonstrated. But we had also attained something else. It had come to pass with us, as with the Biblical King Saul, the son of Kish, of whom it is written in the Bible, "He went forth to seek his

father's asses, and found a kingdom." We had undertaken our American cruises in order to demonstrate the qualities and capabilities of the Zeppelin, and had in the process attained a moral and political success for the half-ostracized German people which, in its extent and value, was perhaps more important than the aeronautical benefits.

With which attitude should we proceed further? It was clear that we no longer needed to achieve moral and political successes in foreign countries. "The ice was broken" in this respect, as the Mayor of Detroit had expressed it at a reception in 1924. Now it was within the power of the German Government to improve further the attitudes of foreign countries towards Germany. And, unfortunately, in the year 1935 it did not appear as if this would happen. But we must and should enlarge on our aeronautical successes. We had to improve the performance and attractiveness of the airship. There was only one way to do so: we had to increase the speed, the comfort, and the safety of travelling by airship. We could achieve all this only by building a larger ship. The size of the *Graf Zeppelin* had been limited by the dimensions of our building-shed and by the amount of money available. Now we had a larger building-shed and could count on extensive financial assistance from the Government. And so in 1934 we had started building a ship which corresponded better to our concepts and wishes in regard to speed and size and also in respect to economy, compared to the obsolete *Graf Zeppelin*.

The *Graf Zeppelin*, operating at reduced power as we usually did, had a cruising speed of $71\frac{1}{2}$ –75 miles per hour. Her speed of advance over ground or water averaged, according to the winds, nearly 62 miles per hour. We wished to raise the cruising speed to about 84 miles per hour and the flight speed to about $71\frac{1}{2}$ –75 miles per hour, for this would mean shortening the flight time to North America or to Rio de Janeiro by about half a day. The first tentative calculations showed that the new, bigger ship would have to have almost double the horsepower and at least half as much fuel again, for a given distance, as the *Graf Zeppelin*.

We also wished to achieve greater safety, intending to gain this in the future by using heavy oil engines in place of petrol engines, and furthermore by using helium as a lifting gas in place of the dangerously inflammable hydrogen, *if* we could get helium from

the United States. Unfortunately this did not turn out to be possible.

Finally we wanted to increase the number of berths from the twenty on board the *Graf Zeppelin* to fifty, and to make the entire passenger quarters more roomy and comfortable, with a large amount of space for daytime activities and for moving about on board.

More detailed calculations showed that in order to meet all these requirements the ship would have to have a volume double that of the *Graf Zeppelin*—approximately 7,000,000 cubic feet instead of 3,500,000 cubic feet, if we were going to have helium as the lifting gas instead of the much lighter hydrogen. And on these assumptions the construction of the ship was actually started. The name *Hindenburg* was chosen in advance, and it is erroneous, as has been written since, that I fell into disgrace because I refused to christen the ship *Hitler*. I know that servile individuals in Hitler's entourage tried to insist that the ship be christened with his name, but Hitler himself refused because of his superstitious beliefs. The possible loss of an airship named *Hitler* should not be interpreted as an evil omen.

Apart from possible use in South American service, the *Hindenburg* was primarily intended to make regular flights to North America, and we planned to make ten flights there as our programme for 1936. For this we needed the permission of the American Government to use the naval hangar at Lakehurst for these flights. A legal provision stood in our way, according to which Government docks and similar installations were not to be regularly used for commercial enterprises. Accordingly our first inquiry to the Navy Department, which owned the hangar at Lakehurst, was answered with the statement that "it was true that with earlier flights permission had been given to land at the Lakehurst Naval Air Station, but only because these were exclusively experimental and pioneering flights in which the Navy was very interested; but the hangar could not be made available for enterprises of a purely commercial character. Only the President of the United States could permit an exception in case he should determine that the flights were experimental in character."

I was very disappointed. Was I to consider this decision a sign of a cool attitude towards the newly-arisen Nazi Germany? I

decided to travel to Washington, to request an interview with President Roosevelt, and to convince him of the experimental nature of the proposed ten flights.

At the end of February, 1936, I arrived in Washington and requested our ambassador, Herr Hans Luther, to arrange an appointment for me in the usual manner with President Roosevelt. The answer I received from Roosevelt's private secretary, Mr. McIntyre, stated that the President, "for the time being", could not, to his regret, grant me an interview concerning the proposed matter in view of the clear-cut legal restriction. For a few days I waited vainly for a more favourable decision, and felt my hopes already sinking. Then there came to visit me at my hotel a wealthy American with whom I had made friends. He had participated in the so-called "World Flight" and later in a South American flight, and was an enthusiastic supporter of the Zeppelin. His father, as a fisherman, had been an old sporting companion of the President, and he himself was personally well acquainted with him. And so he wanted to try to convince the President that he should listen to me.

The next day at noon he came to me from the White House and announced, "The President will see you tomorrow at five o'clock, but without the 'old gentleman'." This "old gentleman" meant our ambassador, who, according to customary protocol, was supposed to accompany me as a foreigner to a Presidential appointment. The appointment was supposed to take the form of an "invitation to tea". Shortly after I had received this news from my friend, our ambassador called me up to say, "The President will see you tomorrow at five o'clock. But without me!" This "without me" sounded rather resentful or surprised. With some reason! But once more I had to ask myself whether official Germany was already so disliked.

I had been received at the White House several times before, twice by President Coolidge in 1924 and 1928, and once by President Hoover in 1929, after the World Flight. I was not yet acquainted with President Roosevelt, and I was most interested in obtaining a personal impression of this very strong personality, concerning whom quite varied opinions naturally prevailed at this time. He received me seated, being condemned by his crippled state to sit permanently behind his big desk, with the

customary remarks, "Hello, Dr. Eckener! How are you? I am glad to meet you personally," and so forth. These were the conventional phrases, but they were spoken with such warmth and uttered in such a sympathetic tone of voice that they entirely lost their casual meaning and seemed to come straight from the heart. One was immediately aware of the oft-famed personal charm at his disposal.

After a few more questions and remarks complimenting me on the flights of the *Graf Zeppelin*, he suddenly came to the purpose of my audience with the words, "Well, now you want to make regularly scheduled flights over the North Atlantic?"

"Yes, Mr. President, I would like to."

"I must tell you frankly, I don't believe you can do it."

"I believe we certainly can; I am certain that we can do it."

"I am very doubtful. I am an old sailor, and I know how the North Atlantic can be in bad weather."

After a few assurances on my side that I was already well aware of the treacherous nature of the North Atlantic, Roosevelt said, "Well, and what can I do to help you?"

"I would like to ask you to make the Lakehurst hangar available to us again for the ten flights."

After considering briefly, Roosevelt then said, "Good, you shall have it! The question interests me. Go tomorrow to the Secretary of the Navy and discuss it with him further!"

He dismissed me then with assurances that he would be glad to help me in any way he could, and that he wished me good luck. In point of fact, I can say that he kept his word and helped me as long as the political situation made it at all possible. During the next two years he received me three more times, and till the last I got from him only assertions of his very friendly attitude towards me and my enterprises. More of this later.

In the Navy Department next morning, in place of Secretary Edison, a son of the famous inventor Thomas Edison, who was absent because of illness, I was received by Admiral Leahy, who later in the war became famous as the representative of the United States in Vichy. He was exceedingly friendly and said at once, "Good morning, Dr. Eckener! I have already been briefed on why you have come. Here on my desk is a note from the President that you are to be allowed to land in Lakehurst and that we are to

have the necessary ground crew available. How many people do you need?"

I said that we would like to have 100 to 120 men, in case of unfavourable weather while walking the ship in or out.

"Good!" said the Admiral. "I will send 250 men to Lakehurst. At the moment only a few people are stationed there."

I was as surprised as I was pleased by this generous concession, which I undoubtedly owed to the good will of the President as well as to the interest of the Navy in the transatlantic airship experiment.

At the beginning of March I was back in Friedrichshafen, where meanwhile the *Hindenburg* had been completed and was due to make her first trial flights. After satisfactorily completing her trial flights, which were to include a flight of at least ten hours at full power to test the new diesel engines, the ship was to start on March 31 on a voyage to Rio de Janeiro, for which about forty passengers were already booked. In the midst of the trial flights there burst in on us, as I have related, an order from the Air Ministry that both ships, the old *Graf Zeppelin* and the newly completed *Hindenburg*, should take off on March 26 for a three-day election-propaganda flight through Germany. The Propaganda Minister, Dr. Goebbels, had wanted this. I have written in detail in the previous chapter about this order and the serious conflict it caused between me and Herr Joseph Goebbels.

We therefore started the journey to South America on schedule, but without having made as thorough an engine trial as we could and would have done without the election-propaganda flight, since after we returned from this flight we first had to make thorough repairs to the stern, which had been damaged in the reckless attempt to bring the ship out. The whole matter, as I will now relate, almost led to the loss of the ship on her first transatlantic flight. I am not superstitious, but I could not help it: The wish that the ship should intervene in domestic politics in the interest of the Nazi Party, which Herr Goebbels, like a wicked fairy, had conferred on her as a present in the cradle, so to speak, and on account of which she had narrowly escaped being wrecked, seemed to me to be a bad omen for the future of the *Hindenburg*. And so it turned out, even on the first voyage.

The journey to Rio at first proceeded very satisfactorily. The

weather was fine and the ship measured up entirely to the expectations which we had placed in this first completely adequate transatlantic passenger aircraft. She developed the cruising speed we had hoped for, was wonderfully stable in the air, and fascinated the passengers with the comfort she offered in the roomy dining-salon and lounge. The long promenade along the rows of high windows to port and starboard offered freedom of movement and an unobstructed view of sea and sky. Especially prized was the comfortable smoking-cabin with bar, in which a lively and agreeable activity developed before the noon and evening meals. I myself was in a very good humour, which was hardly disturbed by the mysterious messages concerning the "illness" I was supposed to be suffering from and which I have mentioned earlier.

A small threat to my good humour occurred when one of our four 1,000-horsepower diesel engines failed in the middle of the ocean shortly after we had passed the Cape Verde Islands. It stopped suddenly with a violent jerk. Now this was nothing really disturbing, for such things were always happening, and we still had three other engines which were running well.

It was hardly pleasant, however, when I was told two hours later that the damage was considerable and the engine could not be repaired during flight. The wrist-pin of a connecting-rod had broken, and a new pin could only be turned for us in Rio. We thus had to complete our journey with only three engines, which nonetheless gave us a speed of almost 80 miles per hour, so that we were able to make the journey to Rio in four days.

In Rio the engine damage was repaired as well as possible, while we had the special experiences that I have described in the previous chapter. After two days we started the return flight, once more with about forty passengers. The repaired engine seemed to function satisfactorily, but we did not dare to run it at more than half power. And so we were running, so to speak, on three and a half legs instead of four.

Everything went well until we reached the Cape Verde Islands, right in the area where the north-east trade winds set in, which we had to buck until we reached Gibraltar. On that day they were unusually strong and opposed us with a velocity of 31 miles per hour. Just after we had made this discovery, rather to our concern an engine failed once more, this time a different one. Very

promptly it was discovered that it had suffered the same kind of failure as the first, on the outward flight: wrist-pin breakage. Now the situation was really critical! Apparently the site of the failure was a weak point in the engine, and we were afraid that other engines might fail. There was only one thing we could do—namely, to run the engines at less than full power. However, since one engine was already running at only half power, our air speed fell to a bare 63 miles per hour, and we had to fight our way against a trade wind of 31 miles per hour for a distance of 1,150–1,400 miles, now making a speed of advance over the surface of only about 32 miles per hour. Therefore, if we suffered no further damage, we would have to fly for forty or forty-five hours to reach the edge of the trade-wind zone, and if another motor should fail we would be reduced to an advance speed of practically zero.

Beneath us the open sea, to starboard the wastes of the Sahara Desert, and seventy-five people in the ship! A very, very serious situation! And the passengers suspected nothing of this, and must not be allowed to suspect. I counted for certain on further engine failures if we should have to run them at full power, and so I had to fly at half power to keep the ship capable of manœuvring. What could I do? I considered the idea of trying to run back with the trade wind to Recife, where we could make repairs at our leisure. But even if we got there, could we completely eliminate the defect in the engines? Considering the nature of the defect, this was practically out of the question.

I contemplated steering close to the African coast, so that, in case of emergency—meaning failure of another motor—the ship could be promptly set down on land in the desert, before the trade wind should blow us out to sea. This would certainly enable the seventy-five passengers to be saved, but would mean the loss of the ship. I confess that I have hardly ever experienced so much mental torture as in these hours of vacillation and perplexity. The picture in my mind's eye, which I considered very possible, was of a crowd of seventy-five people filing through the blazing sands of the Sahara towards a native settlement, provided, I hoped, with food and water salvaged from the airship.

At this point there came to our assistance something which properly could only be described as a "miracle". We decided to see if we could escape the trade wind by climbing above it. Above

the north-east trades there blows almost invariably from a westerly direction the so-called counter-trade-wind. It is to be found most usually at an altitude of 5,000–6,000 feet, and we never had encountered it at a lesser altitude. But we were still so heavily loaded with fuel that we could hardly climb higher than 3,000–4,500 feet without becoming much too heavy. Might we have the almost inconceivable good luck to find the counter-trades at these altitudes? We climbed to 2,600, 3,000, 3,300 feet. Still the same north-east trade wind! We rose to 3,600 feet, and who can describe our joy as we came upon a north-west wind here! It was not a real counter-trade-wind, but, in any event, in place of a direct head wind, we had a cross wind of no more than 18–22 miles per hour, which permitted us to make a speed of 80–87 miles per hour towards Gibraltar, which was twice the speed we had been making against the north-east trade wind in the lower levels of the atmosphere.

The reason for these abnormal weather conditions was, as we later discovered from a weather report, a very unusual low-pressure area over the Canary Islands which was advancing towards the coast of Africa. This enabled us to expect that with a further advance to the north we might experience a favourable change of wind to a westerly direction.

This in fact happened, and in twenty hours we ran from the Cape Verde Islands to the Straits of Gibraltar. The engines, very much throttled down, had held out, and when we were as good as certain of being inside the Mediterranean, with land extending all around us, we had the satisfaction of getting a third engine to run at full power, after thirty hours of self-sacrificing effort by our splendid engineers, so that we came home on three legs.

We were lucky, but so was Dr. Goebbels, who had prevented the thorough engine trial. The critical spot in the engines was now thoroughly tested and altered by the Daimler works, and four weeks later, when we undertook the series of regularly scheduled flights over the much more treacherous North Atlantic, we knew now that we could rely on our fine diesel engines. As a result these flights were a complete success, both technically and economically.

In connection with the last, it may be informative to give the simple statistic that the *Hindenburg* on the aforementioned ten flights over and back carried 1,006 passengers, thus averaging a

full fifty on each flight. Since the ship had fifty berths, this meant that she was completely sold out each time. She could be "fully" sold out only because we had built in a few emergency cabins to satisfy the demand for space, which in fact on many flights rose to more than a hundred. Therefore we decided during the winter of 1936-7 to add twenty new cabins. We could do this because the ship had been designed for only fifty beds with helium inflation, and at that time we had to do without it. With hydrogen inflation the ship could carry at least $16\frac{1}{2}$ tons more, and this would enable fifty more passengers to be carried, for the weight of one passenger, all in all, including food, wash-water, and berth, was calculated at barely 650 pounds.

The financial results of the ten round trips were an agreeable surprise for everyone who knew the considerable Government subsidies needed for every airline, as we were able to cover 80 per cent of our expenses from receipts, permitting us to fix a rapid rate of depreciation payments. It was a very satisfactory discovery, since a single ship with only fifty berths had to bear all the general charges, particularly the administrative expenses and operating costs on the landing-fields on both sides, and it was not difficult to prove that a weekly service with two ships would make a profit.

This led to the founding of a "German-American Zeppelin Transport Corporation", which eventually would put in service four airships, two German and two American, to make flights every five days from both sides of the ocean. In Detroit in the winter of 1936-7 I read a paper by invitation before the Association of American Commercial Engineers, and had the satisfaction of finding an extremely friendly and encouraging attitude towards my plans. No less a person than the very respected and influential head of the Bethlehem Steel Company, Mr. Charles Schwab, declared to me personally that he was convinced by my exposition and was inclined to participate in the execution of the plan. But the *Hindenburg* sailed under an evil star, and it was to turn out otherwise.

During 1936 all flights were carried out according to plan from the technical point of view and also with a good margin of profit. We became increasingly better acquainted with the North Atlantic and learned the possibility of avoiding its treacherous features, or even of making use of them. The average flight time from the

Straits of Calais to Sandy Hook was fifty-nine hours, in the opposite direction forty-seven hours. It seemed almost possible to make the flight in each direction in two days, if one accounts for the gain of five hours flying westwards. And likewise we hoped to make the flights to Rio, of which the *Hindenburg* carried out seven besides the North American voyages, in three to three and a half days, the return in four days, with no difficulty.

With these expectations we commenced the flying season of 1937 with a journey of the *Hindenburg* to Rio, beginning in the middle of March, which in fact lasted only slightly more than three days. Then the installation of the twenty additional cabins was completed, in order to begin the first flight to North America on May 4.

Towards the end of April I had started on a motor journey to Austria, where I had promised to give lectures in Vienna and in Graz. At Vienna I was invited by our ambassador, Herr von Papen, to a dinner which was attended by several Austrian politicians, including Prince Kinsky. But hardly anything was discussed which could have thrown light on the political situation. On the other hand, during my lectures it was clear that a very outspoken German nationalistic attitude in favour of annexation was prevalent among the public. This in itself was nothing new, for I had encountered it more than ten years before while giving lectures, from Innsbruck and Salzburg all the way down to Graz and Klagenfurt. But I was quite surprised when, on the following morning, I found a swastika flag attached to the front of my car waiting in front of the hotel. They insisted, as I heard later, that "Dr. Eckener absolutely must display the Swastika if he is going to drive through Austria". I did not consider it prudent to remove this flag publicly in front of the crowd of spectators crowding round the car, so I acted as if I had not seen it, but later I removed it during the drive, for I wished to avoid anything smacking of politics on all my journeys devoted purely to Zeppelin matters. But from this little joke which had been played on me I clearly realized the direction from which the wind was blowing in Vienna which a year later led to annexation.

Towards noon I arrived in Graz, whose character I already knew and loved, where previously in 1925 I had found a hearty welcome and enthusiasm over the reception of the *ZR III* in America. In

the course of the afternoon I went to call on the noted sculptor Ambrosi, who had invited me to visit his studio. I esteemed Ambrosi as a genuine artistic genius with an extraordinary grasp of form and fabulous imagination. I found him a man almost hopelessly deaf, but in his expressive face there shone a pair of overpoweringly illuminated eyes in which there burned an almost mystical fire. And what was it he wanted to show me? It was a vision of Icarus plunging into the sea! Was this intended as a warning, a premonition?

I spent the evening with some young men of an engineering society connected with an aeronautical technical school, of which I had become an honorary member in 1925, and afterwards went to my hotel. I was very tired from the long car journey and also from the rather liberal consumption of alcohol which can hardly be avoided in the company of young students, and intended to sleep soundly until the next morning. But during the night, between 1 and 2 a.m., I was aroused from my sleep slowly and with difficulty by a disturbing sound. I gradually came to my senses, and realized that the telephone had been ringing for a long time. Drunk with sleep, I seized the receiver, and was shocked wide awake by what I heard. It was a call from Berlin from the representative of the *New York Times*, whom I knew. He explained, "Herr Eckener, I felt it was necessary to inform you at once that I have just received a message from my office in New York, according to which the airship *Hindenburg* exploded yesterday evening at 7 p.m. above the airfield at Lakehurst. You will hardly be able to comment on this, for I still know nothing more about it."

Naturally I could not say anything. I was thunderstruck. The Icarus of Ambrosi! I had plenty of time to consider the matter during the stillness of the night. I doubted for no more than a moment the correctness of the message, for I knew the complete reliability of the news coverage of American papers of the rank of the *New York Times*. I was taken aback only by the fact that their Berlin representative had been able to find me so quickly to give me the melancholy news.

I thought about malicious or hysterical false reports, which had frequently been put in circulation whenever a Zeppelin was on a journey, once for instance when we were going from Buenos

Aires to Rio and had to circumvent a *pampero*, and again the year before when the *Hindenburg* was temporarily making no head-way against a storm over Nova Scotia. The accident was supposed to have happened at 7 p.m. American time, which was 1 a.m. Central European Time. It was now 2.30, only an hour and a half later! This was hardly long enough for the Berlin newspaperman to find out that I was in Graz, and which hotel I was in! In any event, if it was true, it was a very notable piece of journalistic enterprise, but still quite possible and not so improbable that I could laugh at the report and take it as a practical joke.

The hours of the night were long and painful to me, and, racking my brains, I came to the conclusion that it could only be sabotage if the airship "had exploded above the airfield". I recalled alleged threats against the "Nazi ship" when we had landed in Chicago in 1933. Finally it was daylight, and at 7 o'clock there arrived from the Air Ministry confirmation of the news of the disaster, together with a request to fly at once in a waiting plane from Vienna to Berlin. I awakened my friend and travelling companion, Colonel Breithaupt, whom the anxious Air Ministry had assigned to accompany me, in view of my impaired political health, as a sort of guarantee of my good behaviour. Already, as we were leaving, a number of newspaper reporters were on the spot with questions. I told them briefly that I could only conclude at the moment that an act of sabotage might be responsible for the catastrophe. I would have to wait for further information.

In Vienna we found a special aircraft of the Air Ministry, and at 4 p.m. we were in Berlin. Here meanwhile further information had arrived, from which it appeared that shortly before the landing of the *Hindenburg* a severe thunderstorm had passed over the Lakehurst air station. I was being attacked for my suggestion of possible sabotage, and I was being requested, "on political grounds", to deny in a radio broadcast to America the privately and publicly expressed suspicions of sabotage. Now, this was a delicate matter in view of the state of public opinion in America, which I knew much more about than the gentlemen of the Air Ministry; but I was not sorry to do it, since for me personally the idea of an act of sabotage committed in America was most unpleasant, and I preferred to believe there was a possible connection between the thunderstorm and the catastrophe. Privately I was certainly not

fully convinced of it, for how often had we landed in thunderstorm conditions, or had known lightning to strike the ships directly! There must have been some special circumstance in this case which was still unknown to me.

In America the Government had immediately set up a commission to investigate the cause of the catastrophe, for public opinion was very much concerned. Not only had thirty people lost their lives, but the whole world was very interested to find out how this disaster could occur, after more than six hundred flights had been made without the slightest accident, and immediately after the founding of a German-American company to operate a transatlantic Zeppelin line. The German Air Ministry likewise named a commission of six persons to participate in the American investigation. Besides myself, it included Count Zeppelin's old collaborator, Dr. Dürr, the chief constructor of the Zeppelin works, and Professor Dieckmann, an authority in the realm of atmospheric electrical phenomena. The next morning we flew to Cherbourg, where on the same afternoon we boarded the liner *Europa*, which brought us to America in four days.

Shortly before leaving Cherbourg I received from the *Graf Zeppelin's* commander, Captain von Schiller, the information that he had just returned with his ship from Rio de Janeiro and intended, on May 11, three days later, to start on schedule on the next flight to Brazil, for which the ship, as usual, was sold out. I had already cancelled this flight while in Berlin and now confirmed this in a message to Captain von Schiller: "All further flights are to be suspended until the cause of the *Hindenburg* catastrophe has been determined." It was hardly possible to decide otherwise, and, with this decision, this final flight from Rio to Friedrichshafen was in fact the last passenger flight of a Zeppelin airship, for the political events which ran their calamitous course during the following year crushed the life out of the Zeppelin enterprise.

Now I was to go to Lakehurst for the last time, at least for many long years. What memories came back to me as I sat once more in the hospitable dwelling of my friend, Commander Rosendahl, and spoke with him of the latest developments and our many common experiences and endeavours! How many great and solemn events, how much of historic significance, had I experienced on this broad landing-field and in this same attractive cottage on the Naval Air

Station! We spoke of the arrival of the *ZR III* in October, 1924, which had brought the first friendly contact and had so effectively created a bridge to a new understanding between the German and American people. We recalled the frantic onrush of a quarter of a million people who in October, 1928, had awaited the landing of the damaged *Graf Zeppelin*, which had been almost given up for lost, and who took a whole day to get out of this tangle of jam-packed cars and to get home on the blocked roads, and then the triumphal entry into New York. We recalled the "flight around the world" and the subsequent reception by President Hoover at the White House, where he spoke of the great adventurers, Vasco da Gama and Magellan, as having been put in the shade by our exploits. We enjoyed the recollection of so many delightful occasions and of the bustle and activity at Lakehurst every time a Zeppelin landed. This had been true even in the past year when we made the ten scheduled flights, the last of which was rounded off by an excursion in which we carried 101 passengers, including many Congressmen, in a twelve-hour flight above New England that was decked in autumn colours.

Now Lakehurst was dead. The ground crew had been transferred, the few remaining stood by in their barracks, idle and dejected; in hospitals round about lay the passengers and crew of the ship, Captain Lehmann had died of his burns and Captains Sammt and Pruss still hovered between life and death. Stretched out across the centre of the field lay the blackened framework of the *Hindenburg*, a disorderly tangle of girders, wires, and crumpled sheet metal. It appeared to me the hopeless end of a great dream, a kind of end of the world, a mournful symbol of what I, proscribed myself, expected to be the final outcome for Germany, for what went through my mind in Rosendahl's house was more than the offspring of a melancholy frame of mind caused by the pile of wreckage.

The investigation by the American commission proceeded in a very thorough, almost cautious, manner. It continued for a number of days, so that the great crowd of reporters present at the beginning gradually thinned out. Only three or four die-hards finally remained to follow the course of the testimony, which brought up nothing sensational or decisive. The investigation followed two courses: Is an act of sabotage demonstrable or

probable? Or is electrostatic ignition demonstrable or probable? Dozens of witnesses were questioned on these points, from the crew and from the crowd of spectators surrounding the landing-field. Concerning the first possibility, that an act of sabotage occurred from outside or within the ship, it was promptly determined that such was very improbable, for no person had observed the slightest sign of anything of the kind. Furthermore, it had to be admitted that the manner in which the catastrophe occurred precluded every imaginable type of sabotage. There remained only the question of electrical ignition. Here there were three findings which had to be considered important as causative factors. Firstly, the ship was certainly landing in thunderstorm conditions, that is, in conditions where very marked differences in electrical potential were prevalent. Secondly, three observers had noted independently of each other that a flame, appearing to be burning hydrogen, had first been seen on top of the ship towards the stern, which at first moved slowly about, and then suddenly resulted in a violent explosion. Thirdly, from testimony of the steersmen it appeared that the ship was very stern-heavy and continued so during the landing despite release of considerable ballast and efforts to trim her.

The first finding undoubtedly resulted as follows. Just as the ship was coming in to land after a severe thunderstorm had passed over, the barometer once more showed a tendency to fall, the temperature tended to rise, and the wind tended to back from north-west to south-west, so that the ship, heading north-west, was obliged to turn in a sharp curve with rudder hard over towards the south-west. Undoubtedly a secondary thundersquall was approaching, possibly bringing lightning with it, while in any case considerable potential differences must have accompanied it. Later I heard a passenger state most definitely that he had seen sheet lightning above the ship during the landing.

The second finding proves that pure free hydrogen must have been present in the top of the stern, and particularly at the point of attachment of the stabilizing fin. Naturally this is not ordinarily the case, and as a result we often had the experience of Zeppelins being struck by lightning without catching fire. The electrical charge is absorbed by the metal framework. This free gas must have been ignited either by so-called brush discharges when the

mooring line was dropped and made contact with the ground, or perhaps by a lightning stroke on the top of the ship. The authorities held different opinions concerning the possibility of the hydrogen being ignited by so-called spark or brush discharges; but I cannot concur in the opinion expressed by one such authority, that a spark discharge from a "puddle of water" on top of the ship caused the fire. Such puddles of water could not occur there.

The third finding is of the greatest importance. Before and during the landing the ship, despite continuous release of ballast, was much more stern-heavy than anyone would have cared, either for flying or landing her. This leads to the conclusion that during the landing she must have developed a leak in a gas cell, from which gas would rise upwards and would burn as "free" gas. The Chief Engineer of the ship, who happened to be in the stern during the landing, stated most positively that immediately before the catastrophe he had noticed that one of the stern cells had risen very high and had apparently lost a lot of gas.

These were the important facts and considerations which served to explain the cause. The president of the commission of inquiry then requested me to state my opinion. I replied with the following briefly summarized explanation, which I still today consider generally accurate, particularly as some details later revealed to me confirmed its correctness. "Three independent observers standing at considerable distances from each other, who give the impression of being very reliable, have stated under oath that a light or flame appeared at the point of attachment of the stabilizing fin about half a minute before the explosion. This flame appeared, according to one witness who must be considered an expert, like that of slowly burning hydrogen, hence pure hydrogen. From the position of the phenomenon it *could not* have been anything else. Thus there was free hydrogen gas in the top of the ship near the stern. This gas must somehow have been ignited by a spark discharge as the ship, in a highly charged atmosphere, dropped her mooring lines from a height of 300 feet, for the presence of such a marked difference in electrical potential was clearly indicated by the readings of meteorological instruments and from the fact that the wind suddenly backed to south-west during the approach for the landing. How and where the electrical discharge originated can hardly be determined. With a structure as complicated as a Zep-

pelin airship, brush discharges may develop in many locations, including the stern, where free gas had accumulated under the outer cover. The most important question is, how could free gas accumulate under the outer cover at the stern?

"It has been discovered beyond doubt that the ship was stern-heavy during the landing, and she remained stern-heavy, although she was being steadily lightened aft by trimming with a trimming-moment of roughly a million foot-pounds. From this one must conclude that during the landing manoeuvre a cell in the stern had developed a leak from which a large quantity of gas escaped. The Flight Engineer in fact had observed that the third cell from the stern appeared to be largely empty shortly before the explosion.

"Now, during the approach to the landing, the ship had made a very sharp turn to port, in order to head into the wind which had suddenly shifted to south-west. It is possible that with such a sharp turn, which is preferably to be avoided, a bracing-wire broke. Actually it seems very probable that this occurred, and the recoiling end of the broken wire could have torn a hole in the cell. Making these assumptions, everything else is readily understandable. The escaping gas would rise and fill the space inside the upper fin and beneath the outer cover. It would be set afire by an electrical discharge and at first would burn slowly until the fire reached the spot where the gas, streaming upwards, was being mixed with air to form an explosive mixture. This would produce an oxyhydrogen explosion which would instantly set fire to the gas within the damaged cell."

The commission of investigation concurred with this statement, and in its essential points it was also later accepted by a German commission. The rumour of sabotage, for which there was in fact not the slightest justification, was finally laid to rest, and only fanatic nationalists, who made a profession, so to speak, of constantly scenting plots and schemes against German causes, still insisted on believing in it. Among these was numbered the German Air Minister, Hermann Goering, who, as we have seen, had finally developed a certain acceptance of the Zeppelin, lukewarm indeed, but still strong enough for him to believe that a plot against it was not only probable, but certain.

IX

HELIUM TROUBLES AND A GLOOMY ENDING

IN 1922, when the French Zeppelin airship *Dixmude*, which had been allotted to France as reparations after the first World War and which, under her bold and inspired commander, Du Plessis de Grenandan, had fallen in flames during a thunderstorm off the west coast of Sicily, a French journalist wrote in his paper, "When will they finally stop people from flying in these criminally dangerous ships?" And in 1908, when I told a school friend, a chemist, that I had decided to join the Zeppelin enterprise, he stared at me in horror and cried, "That's terrible! Hydrogen and petrol, the two most treacherous substances in existence! I would never want to have anything to do with either of them! How can you meddle with these explosive substances?"

We of the Zeppelin Company had naturally known for a long time that both hydrogen and petrol required very careful handling, but we were convinced that petrol was the greater danger, with which, using it every day as we did, it would be only too easy to have some carelessness, some "mix-up", occur. With hydrogen, on the other hand, the routine careful precautions we took with it and our extremely careful checking of the gas cells had made it seem long ago that it was not so dangerous as is generally assumed. In fact we had discovered that in at least half the cases where Zeppelin airships were destroyed by fire, the petrol had caught fire first, and it was also generally known that in plane crashes the personnel were injured or killed as a result of fuel being ignited. On the other hand, we knew that in the only two known cases of an airship burning in the air through the hydrogen catching fire—in the case of the *Dixmude* and in the case of a wartime naval airship—the catastrophe had resulted from the ship rising over pressure height in a thunderstorm and blowing off gas which was set on fire

by lightning. For this reason a simple rule had been laid down: "Don't blow off gas in a thunderstorm!"

Therefore we had been very well pleased that we had been able to install diesel engines in the *Hindenburg* in place of petrol motors, the weight of the former being so decreased that they were not excessively heavy, while the consumption of fuel was less than that of the petrol engines. We were glad to get rid of the petrol, and in its place had the comparatively safe heavy oil in our fuel tanks.

The next step was to get rid of the hydrogen as a lifting gas and to replace it with non-inflammable helium, although this had less lift than hydrogen, which was only half as heavy. But helium occurred in appreciable quantities only in America, and we attempted to obtain it there. After the British airship *R.101* crashed and burned in France in October, 1930, I made an attempt to get helium from America. I was refused, because a law passed in 1927 stood in the way. Helium could be delivered only to the American Navy for filling large airships and could not be exported to foreign countries for this purpose. As a result, the *Hindenburg*, designed for helium, had to be inflated with hydrogen.

By the time the catastrophe to the *Hindenburg* occurred in May, 1937, the situation was entirely different. In particular, there had developed a strong conviction of the value and capability of the Zeppelin as a commercial vehicle. In the United States especially the Zeppelin had perhaps found more favour and esteem among the people than it had attained even in Germany, its native land. A "German-American Zeppelin Airline Company" had been formed to operate a regularly scheduled transatlantic Zeppelin airline with four ships. At the time of the *Hindenburg* disaster no public voice was raised, as had happened with the French journalist fifteen years earlier, to warn against further employment of Zeppelins. Rather, the Press urged that helium be made available to the Zeppelin Company. Furthermore, geological studies had meanwhile shown that the deposits in several States on the western slopes of the Rocky Mountains contained enormous quantities of helium, which could provide more than enough of the precious gas to meet American requirements for centuries. During the following year this rich deposit was estimated to

contain several hundred million cubic feet. Also the percentage content of helium in the natural gas was so high that, given sufficiently large orders, the price per thousand cubic feet would hardly be greater than what we were paying for hydrogen at intermediate landing-fields.

So it seemed to me that the situation was very favourable for a renewed attempt to obtain consent for the export of helium to Germany, and therefore I went from Lakehurst to Washington immediately after the conclusion of the investigation. I had already heard from well-informed sources that President Roosevelt was personally in favour of such an arrangement, and I had no doubts about the extremely friendly attitude which the President, as I have related, showed towards our enterprise. Actually Roosevelt was very willing to support a request from me, but advised me through his secretary, Mr. McIntyre, that Congressional agreement would be needed to repeal the law on the matter.

I therefore tried to get in touch with several influential politicians, and for this purpose turned to Senator Joseph Robinson of Arkansas, a much-respected member of the Democratic Party whose acquaintance I had made at an earlier date. Senator Robinson turned out to be very cordial and willing to assist, and proposed that I should join him next day in the Senate restaurant at a breakfast to which he would invite several powerful and important senators who would be concerned with the matter. Thus I met the Vice-President of the United States and the President of the Senate, Mr. John Garner; the famous Senator Borah, the Chairman of the Foreign Affairs Committee; Senators La Follette, McAdoo, Sheppard, Pittman, McNary, and Thomas, all very influential men in the Senate. After the meal I stated my desires at some length, and Mr. Garner proposed that I should appear next day before the Military Affairs Committee of the Senate to answer the questions they would want to put to me. I naturally agreed with pleasure. It was a very special distinction, and the *Washington Post* remarked that it was the first time in the history of Congress that a foreigner had been heard by the Military Affairs Committee of the Senate. The proceedings resulted in the chairman of the Military Affairs Committee of the House of Representatives inviting me to appear before his committee.

The questions put to me all revolved around the crucial point as

to whether a Zeppelin, if inflated with helium, would still have military value. I was able to answer in the negative with a good conscience and in convincing fashion. In the surprisingly short period of a couple of weeks Congress then resolved, and the President agreed, that the Helium Law of 1927 should be amended in favour of the Zeppelin Company. The relevant amendment provided that the Zeppelin concern should receive each year a limited amount of helium as required to inflate and operate its airships. Initially ten million cubic feet should be delivered to inflate and operate the replacement ship for the *Hindenburg*, the *Graf Zeppelin II*, which was then under construction. A Helium Commission, consisting of the Secretary of the Interior, the Secretary of State, the Secretary of the Army, the Secretary of the Navy, and the Secretary of the Treasury, should ensure that the helium was used for the stated purpose and not stored up for military use.

Once more the Zeppelin enterprise appeared to have been saved. Pleased with my success, I returned home to initiate the construction of helium shipping containers and storage facilities. Thanks to the enthusiastic co-operation of the German firms concerned, we made such rapid progress that by the end of 1937 the first deliveries began to come from Galveston, and we were warranted in hoping that we might inflate the *Hindenburg's* successor with helium by the end of 1938.

Then, in March, 1938, the American Secretary of the Interior, Mr. Ickes, the Chairman of the Helium Commission, forbade the further export of helium to Germany. What had happened? Friends in Washington informed me that in the opinion of American governmental circles the political situation had been rendered so tense by Hitler's march into Austria that they expected war to break out shortly. The American newspapers actually interpreted the embargo on the exportation of helium as a significant symptom of the increase in political tension.

I was much dismayed by Ickes' act and felt very pessimistic concerning the entire failure, not alone that of the Zeppelin enterprise. But at the same time I was rather surprised, for the agreement to sell helium to the Zeppelin Company had been made on the assumption that the Zeppelin no longer had any military value. Therefore why should the exportation of helium be halted because

of an alleged threat of war? I decided therefore not to simply give up, but to go to Washington to carry the problem to the President, who until now had been so encouraging in his attitude. I had to have the matter cleared up with reference to building new ships. But before I could take the necessary steps to obtain an interview with Roosevelt through the American ambassador in Berlin, I received a new blow: Herr Joseph Goebbels, the diabolical Propaganda Minister, conveyed to me the demand that I praise Hitler's seizure of Austria as a "stroke of genius". A similar demand had been made of a large number of other Germans.

This put me in a very uncomfortable position. On the one hand, on the basis of my experience in March, 1936, I had reason to fear that Herr Goebbels would have me severely punished if I should refuse his demand, particularly as the Nazi regime during the last two years had become ever more terroristic. The fact that I was held under strict and constantly maintained surveillance, so to speak, and nevertheless was now being wooed in order to glorify Hitler, showed the great importance attached to my extolling him. On the other hand, I had reason to fear that such an utterance from me would injure me and my undertaking. I finally decided to give in to the terror, because nothing could now be done about the accomplished fact, and because I would not and could not be torn away from my life work at this critical moment.

With some hesitation I next made inquiry in Washington, through the American ambassador in Berlin, Mr. Wilson, with whom I had formerly spoken, as to whether President Roosevelt was prepared to grant me an interview concerning the helium question. After a few days I received the answer that "the President would be happy to receive me". And so I left for America in the middle of April, accompanied by the business manager of the German Zeppelin Airline Company, which had been directly affected by the embargo on the export of helium.

After a two-day delay in New York I journeyed on to Washington, where our ambassador, Herr Dieckhoff, put me up in his house, despite, I might say, the low esteem in which I was held by the highest circles of the Party. I now heard from the ambassador that the President's secretary, Mr. McIntyre, had advised that the President, to his regret, could not receive me at the moment. The

helium question in the meantime had become a political issue of the highest importance and was being earnestly debated by the entire Press. In these circumstances the President would not dare to listen to any foreigner on the matter before it had been dealt with by the appropriate official agency. But I might approach the Secretary of the Interior, Mr. Ickes, who was fully informed concerning the President's attitude and was the chairman of the Helium Commission.

An American friend advised me that the Press was actively debating the pros and cons of delivering helium to the "German Zeppelin Airline", and that a statistical analysis showed that 60 per cent of the papers at the moment were favourable, and 40 per cent were opposed to the continuation of deliveries. Some of the negative comments were very hostile and rude. A large newspaper in the Middle West—in St. Louis, to the best of my recollection—wrote, for example, "Doctor Eckener, we like you and your Zeppelin, and would be glad to give you helium; but you will understand that we cannot give helium to a liar, thief and murderer like Hitler."

Apparently I had very heavy political weather for my activities, and my friend advised me that even the President would have to wait and see how public opinion on the subject would develop further. So I went next day, quite anxious, to see Secretary of the Interior Ickes. My conversation with him, a man not particularly famous for his even temper and politeness, proceeded at a level which could hardly be called agreeable. Mr. Ickes received me in a frame of mind which expressed his hostility, and, when I asked why he had abruptly interrupted the promised delivery of helium, he replied briefly and succinctly, "Because your Hitler is preparing for war." The following conversation developed, which I found sometimes amusing, sometimes annoying:

"On this matter, Mr. Secretary, you are better informed than I am; but I hope it will not come to that."

"Hitler is going to make war."

"Very well, if that is really so, what does it have to do with withholding helium for Zeppelins?"

"With a helium-filled ship you could fly over London and drop bombs."

"No, we certainly could not."

"Why not?"

"We couldn't last a quarter-hour in the air without being shot down by enemy planes."

"But you could drop bombs on ships at sea."

"No, we couldn't possibly do that."

"Why not?"

"Even at night we couldn't possibly reach the sea without being shot down."

"But you could use the helium to inflate captive observation balloons at the Front."

"Mr. Secretary, if anybody today should really try to use captive balloons instead of using aeroplanes for observation, which would certainly be better, one would certainly not fill these captive balloons with helium, because the equipment needed is too heavy and because hydrogen would provide a greater lift."

"But you could do it!"

I now became annoyed and said, "Yes, if we were German idiots, we could also try fighting with medieval swords instead of machine-guns, but you wouldn't expect us to be such fools."

To this Mr. Ickes merely repeated, "You could do it."

And I stood up, saying, "Mr. Secretary, I believe there would be no purpose in continuing the conversation," and I left.

Actually it would have been useless, for it was clear that Mr. Ickes was determined "not to give Hitler any helium". Three days later there was a session of the Commission, and it was decided to suspend the delivery of helium. I next called up the President's secretary and asked whether the President would now receive me. I saw him the next afternoon in the company of our ambassador, Herr Dieckhoff. As always, he was very friendly and said, "Yes, Dr. Eckener, you know that the Helium Commission has decided that for the time being you will get no more helium from the United States. I am very sorry, but I can do nothing about it. I am not in the fortunate position of your Führer [here he turned to Herr Dieckhoff], who can do whatever he wants. I have a Cabinet and a Congress, to whom I must answer."

This was a bitter pill he was giving us; but once again he was very pleasant and said, "Consider this decision as holding only for the present situation. Later on it may be altered. You still have a chance and a hope, Dr. Eckener."

But I did not feel reassured, for this marked the collapse of my mission. The path by which helium could be delivered had been closed for the first time; but I had to ask myself further whether the Zeppelin service had not at the same time come to an end. I had to ask myself whether everything we had striven for and carried out with undeniable success during the last ten or twelve years might not have been in vain, for privately I had to agree with Secretary Ickes, when he had declared so emphatically, "Your Hitler is going to make war!"

What had I left to show for my pains? It was clear to me that America would probably enter any war, at least if England and her allies were involved in difficulties or seemed in danger of being defeated. For me, with my knowledge of the enormous industrial capacity and the moral strength which, contrary to the arrogant opinions of certain influential National-Socialist politicians, lay concealed in the American people, this would be equivalent to our downfall. As had happened after the first World War, this would be followed by Germany's complete exclusion from aviation. But if America should not actually intervene in the war, and should Germany win, I did not expect that America would be inclined to make such a friendly exception in our favour with respect to helium policies as had been the case in the year 1937. But since we could not fly without American helium, I was forced to conclude that the Zeppelin enterprise had been driven to its death by Hitler.

Such at least was what I then felt was the fate of the German Zeppelin airline. But was this the general future prospect for the Zeppelin airship? Could not America, which possessed a capable airship-building organization in Akron and a great deal of experience in handling airships, assume Germany's role and continue the commercial airship enterprise? At that time I believed that this would come true, making use of German experience and German personnel. Today, after the war has been fought to the bitter end and has terminated in our total defeat, the situation is entirely different. It may be interesting to make a few remarks on the subject, although it does not really belong to the contents of this book.

This book was intended to relate and describe our efforts to bring about the acceptance of the Zeppelin airship as a reliable

commercial vehicle for transoceanic or other long-distance flights, at a time when the aeroplane was not yet capable of such feats. A tremendous war which, as always in life-and-death struggles between great peoples, had forced the rapid technical development of the weapons of victory without regard to cost and effort, had furthermore forced an enormous development and improvement in aeroplane performance, so that planes were now in a position to carry on a transoceanic service. The airship's monopoly was broken. And, since the aeroplane is much faster and can fly a given distance in half the time or less than is needed by an airship, the role of this aerial vehicle in commerce seems to have been ended after a brief period of glory, just as it had been developed to the point of acceptance, for speed and time-saving are trump cards in today's hurried age, which has almost completely discarded space and distance as obsolete concepts in its plans and undertakings. What does the airship have to offer now to the business man or statesman in a hurry to cross the Atlantic Ocean? And there is the further question, which has already been touched on—what good is the airship to the contemporary politician or State which is following a policy of ruthless pursuit of power and national safety, when the airship, considered from the military point of view, has become completely worthless? Every penny which a State spends nowadays in promoting aviation is lavished on aeroplanes, which can be weapons of the greatest value.

The Zeppelin's inventor considered it from the beginning as an instrument of peace and peaceful commerce; it acquired a certain military value in the period when the aeroplane was in its infancy, but already before the end of the first World War, as soon as phosphorus incendiary ammunition was used against it, it reverted to its original purpose. Due to its light construction and the vulnerability inherent in its large size, it can thrive and exist only in an atmosphere of unclouded peace, and whenever it leaves its own country it becomes a political burden and an object of solicitude, as is true of our expensive transatlantic liners whenever the situation is disturbed and they are lying in foreign ports. It is like one of those opalescent butterflies, which fascinate as they flutter in the summer sunshine, but seek a sheltered corner whenever a storm blows up. Often, when people greet it so enthusiastically as it appears in the heavens, I have felt as if they believed they

were seeing in it a sign and symbol of lasting peace, or at least as a symbol of the universal dream of lasting peace among peoples.

The replacement ship for the destroyed *Hindenburg* was completed in the autumn of 1938 and again was christened with the name *Graf Zeppelin*. She had to be inflated with hydrogen, in order to make a few trial flights during 1939 with only the crew on board. Several months after the outbreak of war she was dismantled in the hangar in Frankfurt, so that her aluminium framework could be used to build aeroplanes. At the same time the big hangar was abruptly blown up. There was no real urgency, and the whole thing was done with such haste and destructiveness, without consideration for the value of the material and property destroyed, that it not only demonstrated a complete indifference, but in fact an obvious and contemptuous antipathy towards the Zeppelin, of which Goering had given an impression in his arbitrary decrees. It was a decisive parting of the ways, and amidst all the regret for the unreasonable demolition of a valuable structure, which the shed was, I was not entirely dissatisfied, for it was a fact: the moral environment of old Count Zeppelin's concept and of Hitler's concepts were in the most fundamental sense irreconcilable.

What attitude do the German people have today towards the Zeppelin concept, not only in its technical and structural sense, but more particularly in the moral and political sense? Do they still believe in it, or have they lost this belief in the political events of the last ten or twelve years? I prefer not to believe in the latter assumption, for then human existence would, in my opinion, lose its value for a people with the spiritual orientation of the Germans. Hell itself would laugh with scorn, considering the opinion which the world generally has of us, and considering what has been done by us and on account of us during the past twenty or thirty years, if we should try to live up to the well-known words of the philosopher Fichte, who said, "The world should find pleasure in the existence of the Germans." But today it could be the mission of an entire people to preach to the whole world and to show it that they have not lost, and must not lose, their belief in the victory of good and in a noble humanity in spite of all that has happened and what is still going on. Let us continue our self-contemplation and find

therein the resolution and courage to acknowledge freely and openly our belief in such ideals and to demonstrate them practically by our actions in both domestic and foreign policy. Let us live by their example in a world devoid of ideals and beliefs which seems to recognize only the policy of naked power.

A NOTE ON
THE TECHNOLOGY AND DEVELOPMENT
OF THE ZEPPELIN AIRSHIP

by

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THE EXCITING fantasies spun through the years by many famous authors and scientists concerning flight into space, with the purpose of seeing the unknown side of the moon or of visiting neighbouring planets, seemed until recently to be Utopian dreams, as the vehicles necessary for their realization could not be developed. Recently, however, the development of large rockets, which was undertaken at enormous expense during the last war and which has been continued in various places since then with almost the same urgency, has so far progressed that we have reason to believe that with their assistance the bold concept of interplanetary travel may actually be attainable. In any event, the rocket vehicle will play a very significant role in the future. Whether or not it will succeed in displacing the aeroplane and the airship as commercial vehicles for travel on the earth cannot be foreseen at present. The rocket is not really an aircraft, for the atmosphere surrounding our earth, in which air travel goes on, is, for the rocket, a serious obstacle which greatly diminishes its efficiency. Only in the very thin air beyond the stratosphere, or, better still, in airless interplanetary space, can the rocket principle develop its full effectiveness.

The aeroplane and the airship, on the other hand, can fly only in the denser layers of the atmosphere, being fundamentally different in the nature of their supporting force. The aeroplane is driven at comparatively high speed by a propeller or a jet, and derives the lift necessary to support its weight from the resulting dynamic forces of the air on its supporting surfaces. This means that its power plant must operate constantly in order for the heavy

aeroplane with its load to be supported in the air, and this circumstance sets a limit on its efficiency. For the gas-filled airship, however, the air is its peculiar element, and it floats in the air like a fish in water. Its motive power is required only to propel it, and can thus be kept comparatively low, so that it is possible to use the ship's lift very largely for fuel and pay load. This is the source of the airship's chief advantages, its marked quietness and its relative economy of operation.

The physical laws responsible for the airship rising from the ground are exactly the same as those governing the free balloon, from which the airship actually was developed. In fact, an airship, with its engines stopped, is in the same situation as the free balloon and is handled in exactly the same way. Archimedes' Principle and the laws of Boyle and Mariotte and of Gay-Lussac, with which we became acquainted in high-school physics courses, are the basic natural laws which permit an airship to fly and which render it lighter or heavier with changing meteorological conditions.

The clever Archimedes discovered, supposedly while testing for its purity a tyrant's gold crown of questionable genuineness, that a body submerged in water appears to become lighter by the weight of the water it displaces. This principle holds true not only for all liquids, but for all gases as well. Suppose a free balloon to contain 350,000 cubic feet of hydrogen of specific gravity 0.1, then the gas in the balloon itself will weigh 2,200 pounds. But the air it displaces has a weight of 26,400 pounds, so that the contained gas produces a "lift" of 24,200 pounds. The total load, which is made up of the fabric of the balloon itself, the net and suspension ropes, and the basket with all its contents, can then amount to 12 tons, and the balloon will then float in the air without rising or falling. If the weight is somewhat reduced by dropping ballast, the balloon will immediately start to rise.

The English physicist Boyle and his French colleague Mariotte were the first to recognize, in the latter half of the seventeenth century, that with a given quantity of a gas, the product of pressure multiplied by volume remains practically constant as long as the temperature of the gas is not changed. If a balloon is rising, the pressure of the surrounding atmosphere naturally decreases with increasing altitude, in fact diminishing by approximately 1 per cent

for every 330 feet of increased altitude. According to Boyle's and Mariotte's Law the gas enclosed within the balloon's envelope must expand by a corresponding 1 per cent, in order for the original value of the pressure multiplied by the volume to remain constant. If the balloon were not 100 per cent full, or if it is made of an elastic material, then the gas would simply expand. But if it were previously completely filled, then, if it is not to burst, it must release gas through a safety-valve until the inner gas pressure again equals that of the outside atmosphere. A completely filled balloon will therefore pay for each 330 foot gain in altitude with the loss of 1 per cent of its buoyant gas content.

The third law of the behaviour of gases, and a very important one for practical airship navigation, was discovered by Gay-Lussac, who was in addition an enthusiastic balloonist and in the year 1804 was the first man to reach an altitude of 23,000 feet. In his balloon flights he confirmed the discovery he had made shortly beforehand in the laboratory, that when a quantity of gas is heated while the pressure remains constant the gas volume increases in direct proportion; while the gas pressure likewise increases if the gas is heated and the volume is held constant. This change in volume is always proportional to the absolute temperature. When heated one degree Centigrade the gas volume can be shown to increase 0.00376-fold, or by $1/272.5$, a figure which, for practical purposes, may be expressed in the rule of thumb that if the pressure is constant, a rise of 3 degrees Centigrade in the gas temperature, compared to that of the surrounding air, increases the gas volume and correspondingly the lift by 1 per cent.

One can see, then, that it is a completely natural occurrence for an airship to rise and float in the air, and certainly it is not the spasmodic, forced result of a clever technique. The fundamental natural laws which apply are extremely simple and belong to the realm of elementary physics. That one must constantly recognize the sovereign authority of these basic laws in order to handle an airship successfully, and constantly remember at all times their possible effects, is demonstrated by the tragic outcome of the initially successful polar flights of General Nobile with the airship *Italia* in May 1928.

Nobile had been able to fly across the North Pole, dropping a Papal cross and the Italian tricolor to mark the spot, when the

steering gear failed during the return flight and had to be repaired. In order to do the necessary work, the engines had to be stopped, so that the ship for a time floated in the fog as a free balloon. Since she had been lightened by the weight of the petrol consumed up to this time, and could no longer be held at a fixed altitude due to the rudder failure, the ship rapidly gained altitude. The gas expanded as the atmospheric pressure decreased and, on the ship reaching "pressure height", blew off through the automatic valves.

Up to then the situation had not become too serious, because, after the pressures had been equalized, the ship had again attained equilibrium. However, the ship had risen above the top of the fog and was now floating above the clouds in bright sunshine. The hot rays of the sun heated the gas, causing it to expand further, and large amounts escaped through the automatic valves. This procedure naturally caused the ship at first to be even lighter, as her weight decreased relatively from the increase in gas-cell volume, and also absolutely through blowing off gas. But when the repairs had been completed and the engines finally started up, Nobile was obliged to go down at once through the fog to try to get a sight of the surface so that he could set his course over the ground.

Here the previous loss of gas proved fatal. The "superheat" of the gas was quickly lost by cooling, and the volume of gas remaining in the cells was so greatly diminished that the resulting lift no longer sufficed to support the ship in the air. In spite of desperate efforts by her crew to lighten her by throwing overboard every disposable article, the ship sank inexorably down to the ice. If they had promptly released enough gas in the first place by deliberately opening the manœuvring valves, so that the ship would not rise above the top of the clouds, it is possible that the catastrophe might have been prevented.

As we have seen, the airship is a development of the balloon. It is understandable that despite initial enthusiasm there was dissatisfaction with the marked limitations of the free balloon as an aerial vehicle, and attempts were soon made to give it a power-plant and make it controllable. A great variety of paths were followed towards this goal, and the most diverse means were employed. The proposed schemes were sometimes fantastic or

childishly naïve, and the first practical experiments were made with inadequate means. It is remarkable that at the beginning of this development nobody understood how much power was required to hold a balloon in the same spot in even a light breeze, or to drive it through the air at even a very moderate speed. Only with the development of the internal-combustion engine, which was far lighter in comparison with other types of power-plants, could the concept of the dirigible balloon become practically attainable.

It had been promptly realized that the spherical shape assumed by the free balloon was not suitable for a power-driven dirigible balloon, and even the earliest projects presented the gas-filled bag in the shape of an ellipsoid. In order to maintain the exterior form of the airship body under all conditions of fullness, and also against the pressure of the airstream on the moving hull, an air-sack, the so-called ballonnet, was enclosed in the gas bag and pumped full of air by a fan or bellows. This maintained a positive pressure within the gas bag, even if it were not 100 per cent full of buoyant gas. In order further to stiffen the elongated gas bag, and particularly to prevent it from buckling amidships, the loads were more efficiently distributed by building the gondola hanging beneath the ship in the form of a long girder extending over almost its entire length. The French achieved a series of marked successes with airships of this type of construction, and thereby contributed a great deal to the progress of airship development. In place of the disproportionately long and separate gondola, there was later developed, almost of necessity, a rigid keel structure built integrally into the lower part of the pressure hull, running from bow to stern, to which a suitable small gondola and other loads could be attached. This type of construction was best suited for airships of small or moderate dimensions, and is the basic concept of the so-called blimps, the modern and excellent small airships which the Goodyear Corporation is still building today for the United States Navy.

Count Zeppelin followed a quite different path in the development of his airship concept. He did not simply motorize the original free balloon and make it controllable, as was more or less true of the previously mentioned systems, but he employed the elementary, but very important, principle of endowing a rigid

airship hull structure with the necessary power. The basic principle of a rigid airship of the Zeppelin type is the metal hull framework, which consists of a series of rings connected by longitudinal girders over which is stretched a smooth outer cover. This forms a large hollow structure with the well-known cigar shape. The interior of this structure accommodates a large number of balloons or gas cells, which can be filled or emptied entirely independently and are so fabricated that when entirely full they occupy the whole space. They can, however, accommodate themselves to any lesser gas volume, resulting either from partial filling or from temperature or pressure changes, without the ship's external shape being in any way affected. A continuous keel connects the gondolas suspended beneath the hull and permits a uniform distribution of the fuel and payload, while the control and propulsive elements are attached to suitable locations on the rigid framework. These are the important characteristics which distinguished the first Zeppelin airship, and their retention made it possible in a few decades to develop from primitive beginnings such efficient and comfortable giant airships as the *Graf Zeppelin* and *Hindenburg*, whose world-wide voyages have been described in the previous chapters.

Even with his earliest designs Count Zeppelin was determined "to build a large airship of considerable carrying capacity, which would be obliged to land only at relatively long intervals". The *LZ 1*, built in the year 1898-9 in the quiet Manzell Bay on Lake Constance, was in fact a boldly conceived structure and, considering the technology of the period, was a very large airship. The unforeseen possibilities of development of the Zeppelin concept, and the unexpected capabilities which therein lay dormant, can possibly be made more clear by skipping over three decades of progress and comparing the important characteristics of the first experimental ship with one of the last of the modern giant commercial airships.

The uniformly cylindrical hull of the *LZ 1*, which tapered only at the bow and stern, was 420 feet long and had a diameter of $38\frac{1}{2}$ feet. In its interior were installed seventeen gas cells made of rubberized cotton fabric, whose total volume when completely filled was 400,000 cubic feet. This provided a total lift of 27,400 pounds. The *LZ 129*, completed in 1936, was 811 feet long and its pronouncedly streamlined body had a maximum diameter of 135

feet. The lifting gas was contained in sixteen cells, made of two layers of cotton fabric with an intervening gas-tight membrane, containing 7,062,150 cubic feet of gas when completely filled. This produced a total lift of 485,000 pounds. In the *LZ 1* the lift was sufficient to carry into the air about a dozen persons and fuel for a few hours' flight, and in short trial flights over Lake Constance she attained a maximum speed of $16\frac{1}{2}$ miles per hour. The *LZ 129* was capable of transporting fifty passengers in truly luxurious comfort, in addition to a crew of forty and up to 26,500 pounds of mail and freight. In regularly scheduled service between Friedrichshafen or Frankfurt and Rio de Janeiro, a non-stop distance of more than 6,000 miles, her cruising speed was 76 miles per hour.

The performance of the power-plant in the first Zeppelin airship was quite unimpressive, for the petrol engine was then in its infancy and its development up to that time had naturally taken no account of the special requirements of aviation. The two open gondolas hung under the keel in the *LZ 1* each contained a 15-horsepower Daimler engine weighing 850 pounds. With a weight ratio of 57 pounds per horsepower the fuel consumption was 0.88 pound per horsepower hour. Each engine drove through bevel gears two airscrews which were attached to outrigger brackets on both sides of the rigid hull above the gondolas. The four-bladed metal propellers had a diameter of 4 feet and resembled in shape those of a steamship. The *LZ 129* was also driven by four airscrews, which, as in the *LZ 1*, were attached to the sides of the hull; but in place of the simple propeller brackets of aluminium, there had appeared complete, fully enclosed gondolas. In each of these four gondolas was a 1,000-horsepower diesel engine (once again made by Daimler-Benz), which, through reduction gears and a short drive-shaft, turned a four-bladed wooden propeller 20 feet in diameter and consumed in the process only 0.375 pound of diesel fuel per horsepower hour. On a South American flight the ship usually carried 60 tons of fuel, which gave an endurance of 100 hours at the usual cruising speed.

While clinging to the basic principles, all features and details had similarly been further developed and elaborated according to the progress in general technology and the special requirements and experience of practical airship handling. These few comparative

figures will suffice to show the general direction of these developments. Efforts were made to improve the performance of the ships, particularly in the following respects: in lifting power, range, speed, and naturally also in general safety and reliability.

The lifting power had to be increased in order to provide the greatest possible "payload" and thereby to lay the foundation for economical airship operations. The passenger quarters had to be expanded and constructed comfortably to accommodate and attract travellers. The operational range of the ships had to be increased so that they would be able to fly with an adequate payload on the great transoceanic trade routes, which alone are sufficiently economical and attractive in the long run for regular commercial airship flights. Naturally every effort was made to cover these great distances in the shortest time possible, hence the endeavour to increase the speed of the airships, but beyond a certain optimal figure there was no possibility or necessity of going farther.

If transoceanic communication by airships over well-travelled steamship routes is to be of any value, naturally their flight time must be markedly shorter than the crossing time of the best express steamers, for the comfort of airship travel would not alone justify the employment of airships. The speed should be sufficient so that if steady and strong head winds are encountered, such as must always be reckoned with in the trade-wind regions of the South Atlantic and heading west over the North Atlantic, the flight time will not exceed too greatly the average figure set forth in the timetable. Also the ships' officers should be able to count on sufficient speed to be able to escape dangerous storm-centres if the necessity arose. There is no need to approach the speed of the faster aeroplanes; experiences during hundreds of ocean crossings in all sorts of weather conditions have demonstrated that 90 miles per hour is an adequate and satisfactory speed for a transoceanic airship. To go much beyond this figure would hardly be desirable, particularly in a passenger ship, as this could be attained only at the expense of economy or comfort, which are two of the greatest advantages of the airship. Since the air resistance increases with the square of the speed, any increase in speed of the gigantic hull would require not only a marked increase in engine power, but also particularly a considerable reinforcement of the structure and

closer spacing of the frames, to resist the increased pressure on the outer cover. All this would lead to a marked increase in weight, whereby the useful load or endurance would necessarily be decreased.

As with all modern methods of transportation, whether the steamship, the train, the motor car, or the aeroplane, the development of the airship through the stages which we have skipped over so briefly was a gradual, step-by-step affair. In the process there were bitter disappointments and severe setbacks, the hard toil of difficult and consistent effort, but also enthusiastic, self-sacrificing creativeness. For the problem of constructing a rigid airship frame a very fortunate solution had been found in building the *LZ 1*, and the same principle was continued unaltered through the last of the big commercial airships. The so-called main transverse frames, for instance, whose radial bracing of steel wire serves the same purpose as the transverse bulkheads in ships and which divide the interior into spaces occupied by the gas cells, have been continued in their original form as flat-braced rings, although the Americans developed a "built-up" ring, an unbraced, rigid, three-dimensional structure.

The early solution of the matter of propulsion, with the internal-combustion engine, separation into several units independent of each other, and the arrangement of the air screws, was also improved but not basically altered with the passage of time. Difficulty arose in the early days through insufficient engine power, which produced such a low speed that the ships of the period for this reason could be employed only as "fair-weather craft". The chief problem for a long time was controllability of the airship. The rudders and elevators, more than any other features, underwent the most experimentation, and in the course of the first fifteen years were most frequently altered. As is very often the case with the development of a means of transportation, one proceeded in roundabout fashion from complicated, often strange and clumsy structures finally to simple, obvious and functional forms.

The *LZ 1* did not even have real elevator surfaces. In order to incline the ship to drive her up or down, the crew pulled a weight hung on wires between the two gondolas either backwards or forwards, and thus altered the position of the centre of gravity. Lateral control was by means of simple, balanced rudders placed

above and below the hull at the bow, and at both sides half way up the body at the stern. In the *LZ 2*, completed in 1905, the movable weight was replaced by box-kite elevators attached to the keel, where they produced a considerable but not entirely satisfactory effect. The third ship had numerous very important changes, whereby her flight characteristics were immediately greatly improved. For the first time four stabilizing surfaces were attached to the stern, between which the rudders were located, while the elevators were attached in a quadruplane arrangement near the ends of the ship at the level of the propellers. With these improvements the ship proved to be very stable and steady in flight, while she readily answered the elevators (the rudders between the stabilizing surfaces were not large enough). This ship attracted much attention and in the autumn of 1907 Count Zeppelin was encouraged to attempt a number of extended flights, in the last of which he travelled a distance of 220 miles in eight hours.

From then on the German Government began to be interested in the Zeppelin airship and granted the Count the funds to build his fourth ship. Although the *LZ 4* was destroyed after a short career in the well-known catastrophe at Echterdingen, it was this same ship that finally brought success to Zeppelin's efforts and which aroused the interest of the German people.

It was during the summer of 1908 that the *LZ 4* made her few but memorable flights. She was larger than her predecessors; her length was 446.2 feet, her diameter 42.7 feet. The gas capacity had risen to 529,650 cubic feet, giving the ship a total lift of about 35,000 pounds. She retained the well-proven multiple elevators of the *LZ 3*, but the rudders between the stabilizing surface were, after a few trials, finally supplemented by a large, rounded, semi-circular single rudder at the extreme stern. Some of my readers may remember the Zeppelin airship of the early years through the impressive outward appearance of this craft.

A decided advance was made in this ship, in that for the first time a small cabin was constructed in the middle of the gangway between the two gondolas, thus making her the first passenger-carrying airship. Two Daimler engines of 100 horsepower each with a weight ratio of only 8.8 pounds per horsepower gave the ship a speed of 29 miles per hour, both engines consuming about thirteen gallons of fuel per hour.

On July 1 Count Zeppelin astonished the public with a successful voyage into Switzerland, going from Manzell over the Rhine falls at Schaffhausen to Lake Lucerne and from thence by Lake Zug and Horgen Pass to Zürich. A turn over the cities at the eastern end of Lake Constance brought the flight to a successful conclusion. This journey was so uneventful and so convincing a demonstration that two days later the King and Queen of Württemberg entrusted themselves to the ship for a short excursion over Lake Constance.

On August 4 the *LZ 4* took off for an extended flight, which unfortunately was to be her last. At first she headed westwards by way of Schaffhausen to Basle and then followed the Rhine down to Mannheim and Worms. Here one of the motors developed a trivial defect which temporarily produced such a situation as we became acquainted with in connection with Nobile's polar journey. While flying slowly with only one engine, the buoyant gas was markedly warmed by the bright sunshine, since the air stream no longer had a cooling effect. The gas expanded to fill the cells and considerable amounts of it blew off through the valves. Before the repairs were finished, marked cooling of the gas took place and its volume contracted. In fact the volume was not sufficient to give the ship the necessary static lift, and one motor alone was not enough to supplement this lift dynamically, which could readily have been done with two engines running at full power by giving the ship a slight up-angle. The crew succeeded, however, in landing the falling ship undamaged on the Rhine and bringing her into calm water in the lee of the bank.

After repairs were completed and the ship sufficiently lightened, she took off towards 11 p.m. to continue the flight by way of Mainz and Mannheim. *En route* home still another forced landing was necessary, because an engine had failed again and the low speed that resulted was inadequate to make headway against a fresh south wind that had sprung up. The ship landed safely in a field near Echterdingen, but on the afternoon of August 5, while repairs were being made, a very heavy thunderstorm unexpectedly blew up, catching the ship broadside and tearing her away from her moorings. Inclined at a considerable angle, the ship drove away across the fields, and suddenly caught fire and went up in flames.

The cause of the fire could not then be clearly established; but it was undoubtedly similar to that which destroyed the *Hindenburg* in 1937 at Lakehurst. The atmosphere was full of electricity and the ship's aluminium hull, pointing up at a sharp angle, constituted an ideal electrical conductor, which—apparently elongated further by a banner of escaping hydrogen—bridged a difference in potential of several hundred thousand volts. Naturally, electrical discharges could very easily occur. And so the journey begun with so much hope and confidence ended in a shocking catastrophe. It was, however, one of those merciful acts of Fate which produce a turn for the better: the course of development, up to then tedious and weary, received a powerful impetus. The last few flights had aroused great enthusiasm among the German people, and their reaction to the misfortune at Echterdingen was a spontaneous contribution of one and a half million dollars, with the help of which the old Count was able to continue his experiments. With a part of this capital Count Zeppelin founded the Zeppelin Construction Company and set aside the rest for a foundation to promote aviation.

While the new airship factory was going up at the north-west edge of the city of Friedrichshafen, a few more ships were built in the old wooden hangar in Manzell Bay. These were generally improved, but incorporated no important changes compared to their predecessors. The personnel of the building company added to their experience in numerous extended and successful flights, which were varied by a number of instructive interludes. At the same time they won to an even greater degree the confidence and interest of the public. No longer could airship flight be dismissed as mere experiment or a form of sport. A useful aircraft had been created and must now be put to practical employment. To be sure, the Government had taken over a couple of ships for the Army, but this was not enough to keep the factory steadily busy. Furthermore, Count Zeppelin considered his airships to be the special means of realizing important peaceful and cultural goals. Therefore it was proposed to build special passenger-carrying airships which were to be owned and operated by the German Airship Transportation Company, known as the "DELAG".

During the years 1909-14, the airships *Deutschland*, *Schwaben*, *Viktoria Luise*, *Hansa*, and *Sachsen* were constructed at the new

factory in Friedrichshafen. The new construction shed permitted building these ships larger and therefore capable of carrying greater loads. The *Deutschland*, the seventh Zeppelin airship built, was 485.5 feet long and 45.9 feet in diameter. Her total gas capacity was nearly 670,900 cubic feet, which produced a total lift of 45,000 pounds. There was also a definite advance in engine power. In the forward gondola, which at the same time was the control car, one motor was installed as previously. In the after car, which was an engine gondola exclusively, two engines were now installed. Their total output was 375 horsepower and enabled the ship to attain a speed of $35\frac{1}{2}$ miles per hour. The quadruplane box-kite elevators were retained on the sides of the ship. The rudders, divided into four surfaces, were attached to the upper portion of the tail cone. An important innovation, characteristic of the ships of this period, was a roomy and attractive passenger cabin in the keel amidships. This, with its ample proportions and arrangement of seats in front of large windows, resembled the dining-car of a crack express train.

A particularly lucky gamble was the *LZ 10*, the *Schwaben*, put in service by the DELAG in the summer of 1911. Her gas volume was only 628,518 cubic feet, somewhat less than that of the *Deutschland*, as she was shorter by the length of one gas cell. With a diameter of 45.9 feet, she was only 459.3 feet long. For the first time the power plant consisted exclusively of Maybach engines, which had been built to meet the special requirements of the airship. Each produced 145 horsepower, with a weight ratio of only 6.6 pounds per horsepower, and consumed about 0.53 pound of fuel per horsepower hour. Equipped with three such engines, the *Schwaben* developed a speed of 44 miles per hour. The multiple surface elevators disappeared with this ship. For the first time all control surfaces were combined at the stern, with two pairs of elevators and two pairs of rudders being symmetrically arranged behind the stabilizing surfaces. The control surfaces had to be built comparatively large in this ship, because the hull was still generally cylindrical and ended in a short, blunt point at the stern. This caused the air stream to break away from the hull at high speeds, creating a very turbulent boundary layer aft in which the rudders were naturally rather ineffective. The close-coupled ship proved very handy with the controls designed for her and with

more powerful and reliable engines, and attained a noteworthy performance. Up till the summer of 1912, in only one year, she was in the air for 480 hours during 234 flights, flew more than 17,000 miles and in the process transported nearly 4,400 passengers.

The next ships again were 485.5 feet long and had a gas capacity of 670,900 cubic feet. Early in 1912 the Zeppelin factory completed the *LZ 11*, which was taken over by the DELAG under the name *Viktoria Luise*. In the summer of the same year the *Hansa* made her delivery flight from Friedrichshafen to Hamburg. In structural features both generally resembled the "lucky *Schwaben*"; with their greater lifting capacity and further increased speed their performance, however, was considerably improved. These were the first ships to make extended cruises over the sea and in the course of them reached Copenhagen and Heligoland. During hundreds of flights, in which many more than 10,000 passengers were accommodated, they demonstrated that the Zeppelin airship had now developed into a commercial vehicle with a worth-while cruising range. Also they offered the necessary reliability and safety, even if they had to be flown prudently and handled carefully—and what craft can be neglected in this respect?

Ten years later the first of the oceans was conquered: In October, 1924, the *LZ 126* crossed the North Atlantic in a direct flight from Friedrichshafen to Lakehurst. During the first half of that decade a war was raging, and under its merciless scourge the progressive development of aircraft received such a mighty impetus that the goals which seemed far distant in the future in peace time were reached much earlier than one could have hoped or expected with a normal rate of progress. Inasmuch as the airship, at that stage of military technology, could play a considerable role in reconnaissance and attacks on distant targets, the Zeppelin Company was helped and supported in every way. The chief customer was the Navy, which had placed in service only three ships before the war, but up to the end of the war had had sixty-six Zeppelin airships built. The demands made on the ships were for maximum carrying capacity, greatest possible ceiling, and high speed. To satisfy these requirements and to obtain the best possible overall performance, the ships had to be systematically improved and perfected in every detail. The fundamental soundness and

usefulness of the basic principle had been demonstrated with the craft built up to that time. The original idea was attained through sound technical knowledge and great skill in execution, and the innumerable problems encountered in the process were overcome by ingenious inspirations and frequently by very fortunate, even fantastic, but perfectly practical improvisations.

Now there occurred a period of development in which previous achievements, which in retrospect would appear to have been rather crude in form and execution, were refined and perfected by applying scientific methods. With accurate scale models in wind-tunnels studies were made of streamlined ships' hulls, gondolas, and control surfaces, in order to develop shapes with the least air resistance and the greatest possible efficiency, and to measure the forces operating on them in flight. In closest co-operation with the manufacturers the quality of construction materials was improved, and careful stress calculations finally created the foundation for building airship hull frames which provided the maximum strength for the minimum weight.

The cylindrical hull form was retained by the Zeppelin Company for a considerable length of time, as construction was much simpler and more economical with transverse rings of uniform diameter, and because with this shape the greatest gas volume was attained in comparison with the weight of the ship. With increasing speeds, however, more and more attention had to be paid to improved streamlining, and the new ships presented a short parallel midships section and a smoothly rounded bow, while the stern tapered gradually to a sharp point. The improved streamlining permitted the control surfaces to be made smaller, and then the rudders and elevators could be attached directly to the fins. The open gondolas were covered over to form enclosed, streamlined bodies, which not only decreased the air resistance, but gave the crew better protection against the slipstream. The resulting improved air flow meant that the propellers could be attached directly to the after-ends of the gondolas, and the propeller brackets on the hull disappeared completely.

The dimensions of the naval airships, their absolute and also their relative performance, increased from one type to the next. During the first two years of the war the gas volume grew from 880,000 to 1,950,000 cubic feet. The speed rose from $43\frac{1}{2}$ to 62

miles per hour, and the useful load from 26,500 to 62,000 pounds. In the year 1917 a ship was built which, in a quite extraordinary journey, demonstrated the special suitability of the Zeppelin-type airship for transportation and commerce over great distances. General von Lettow-Vorbeck, completely isolated, was still fighting with a small force of colonial troops in German East Africa, and it was planned to supply him by air with rifle ammunition, medicines, bandaging material, and other articles. The *LZ 104*, which bore the Navy designation of *L 59*, was detailed to carry out this mission. For this purpose she was rebuilt to a length of 743·1 feet, which, with a diameter of 78·4 feet, gave her a total gas content of 2,418,735 cubic feet. The total lift was 166,000 pounds, of which 114,500 pounds was available for useful load. She was driven by five Maybach engines, which together totalled 1,200 horsepower and developed a speed of 64 miles per hour. With 26,500 pounds of cargo the ship took off from Bulgaria on her long journey. But because of a British wartime stratagem, she was recalled by radio when she was near Khartoum. She had therefore already travelled more than half the distance. On return to her base this pioneer craft had travelled 4,200 miles in a hundred hours and still had on board sufficient fuel for thirty-five more hours of flight.

In spite of this impressive practical performance, the ships of that period were hardly capable of crossing the Atlantic. The rigorous demands of combat had caused their great lifting power to be developed at the expense of safety. Transoceanic airships would have to be built larger, if they were to possess the necessary strength and safety as well as the desired useful lift. Conditions immediately after the war made it impossible to build such large airships. The Zeppelin Company had to be satisfied with using the experience obtained with more than a hundred military and naval airships in building a small commercial ship of only 706,200 cubic feet. This was the 120th numbered project, which during the year 1919 took shape as the *Bodensee*.

This small ship, which was put in regular scheduled service between Friedrichshafen and Berlin and was a favourite with Swiss travellers, showed very clearly the relative improvement in performance when compared with the *Viktoria Luise* of about the same size from the year 1912. As we saw previously, this success-

ful DELAG ship had a gas capacity of 670,900 cubic feet. Of the resulting total lift of barely 45,000 pounds, about 30 per cent, or 14,300 pounds, was available for useful load. The total lift of the *Bodensee* was 48,500 pounds, of which 22,000 pounds, or 45 per cent, was available for useful load. The pencil-shaped hull of the *Viktoria Luise* was driven by two pairs of propellers on brackets on the hull, powered by three Maybach engines totalling 450 horsepower, which gave her a speed of $46\frac{1}{2}$ miles per hour. The excellently streamlined *LZ 120*, with an engine power totalling 960 horsepower and three airscrews, could develop a speed of $82\frac{1}{2}$ miles per hour.

The performance of the two ships is difficult to compare, for the first was admittedly an excursion ship and mostly made short journeys in good weather, while the last had to follow a regular schedule in almost every kind of weather. The reliability which the Zeppelin airships had attained by this date can hardly be better demonstrated than by giving the flight statistics of the little *Bodensee* on her round trips: in the three autumn months of 1919, she flew 532 hours in 103 flights, transported 4,050 passengers, and travelled a distance of 32,300 miles.

But we were not allowed to enjoy this fine little ship for long, as she had to be delivered to Italy in accordance with the Versailles Treaty. It was the same with the *LZ 121*, a sister of the *Bodensee*, lengthened to include an additional gas bag, which was intended for flights between Berlin and Stockholm and was to have been named *Nordstern*. This especially well-finished ship, built by the factory with loving care, was delivered to France. There, under the name *Mediterranee*, she made some cruises over the Mediterranean, but soon was withdrawn from service and broken up. When we in the *Graf Zeppelin* sought refuge at the airship base near Toulon in 1929 because of unusually severe engine trouble, we found there, hanging on the wall of the hangar, a ring from this ship's frame—a last, and for us naturally very painful, souvenir.

It seemed, therefore, that airship flight, in spite of all its technical possibilities, which had aroused the highest hopes, was to come to an inglorious end. Yet it was to attain its real goal through the construction of another reparations ship. Instead of financial reparations, a new ship was to be built and delivered to the United

States to replace a German naval airship intentionally destroyed by her own crew after the Armistice. Thus the *LZ 126*, which became famous under her American designation of *ZR III*, came to be built at the Zeppelin factory in Friedrichshafen during the years 1922-24. This was, indeed, the biggest ship completed up to that time, but she was neither intended nor able to carry out regular transoceanic passenger flights. The Americans naturally could not order a ship larger or better than the destroyed ship which she was intended to replace. But if she was to be delivered to America by air across the North Atlantic, she had to have the dimensions and characteristics which would be required for such a journey. The ship's size was designed so that when completely filled the gas volume would be 2,577,630 cubic feet, with a total lift of 88 tons. Since the empty ship weighed 43 tons, about 45 tons remained for useful load: more than 50 per cent. The length over all was 658.3 feet, the diameter 90.7 feet, producing a slender streamlined shape with a length/beam ratio of 7.3 to 1. The ship was driven by five Maybach twelve-cylinder engines of a new type, each developing 400 horsepower and consuming about 0.44 pound of fuel per horsepower hour. With a maximum output of 2,000 horsepower the ship could reach a speed of $79\frac{1}{2}$ miles per hour. At reduced speed, so-called "cruising speed", which was almost always used over long distances to save fuel and to reduce the strain on the engines, she could do 70 miles per hour and consumed 770 pounds of fuel per hour. Under these conditions the ship, carrying $38\frac{1}{2}$ tons of fuel, could fly for at least a hundred hours and cover a distance of 7,500 miles in still air.

Although intended for the United States Navy, the *LZ 126* was built as a passenger ship, since the conditions of the peace treaty forbade the Zeppelin Company to build any military ships. In addition, the Company was naturally interested in incorporating the experiences and the advances, achieved during the war years, in a large passenger airship in which they would be given more scope than in the small *Bodensee*. In her general layout and arrangement of gondolas and spaces the new ship generally resembled the two small commercial ships of the post-war period. The control car and passenger cabins were built integrally into the framework under the forward part of the ship. This was still called a "gondola", even though this structure bore little resemblance to the

unmistakable gondolas of the pre-war ships. The forward portion was taken up by the control car and steering positions, which, besides the two steering-wheels, included all necessary instruments and controls for flying and navigating the ship. Next to the rear was a small wireless-room, which, besides a radio receiver, contained a 200-watt transmitter with a range of about 1,500 miles, and adjacent to this were the passenger spaces. On either side of a central corridor were five staterooms altogether, resembling Pullman sections, each providing seats for six persons by day, which could be turned into sleeping-cabins by night with a bed for four people or two double beds. In the tail of the gondola were a small electric kitchen and rest-rooms. From here one could ascend a staircase to the gangway inside the ship, which extended from the bow cap to the lower fin at the stern. Distributed over the length of the ship at both sides of this gangway, and accessible and under control of the crew at all times, were the petrol and oil tanks, the water ballast bags for use in take-off and landing, the fresh-water tank for the kitchen, the food supplies, and all sorts of spare parts. Apart from this useful load, in the broad sense, the real payload, such as mail and freight, was stowed here, and lastly there were located here the canvas-enclosed sleeping and living quarters for the members of the crew off watch. Four of the five engines were hung in pairs on either side of the ship amidships, while the fifth was attached aft under the keel gangway.

It was a particular and important characteristic of the Zeppelin airships that their motors, just like marine engines, were accessible from all sides and could be tended and worked on even during flight. This principle was adhered to even when it was decided to give up the outrigger propeller brackets and, instead, to attach the engine itself to the side of the ship, and to cover it in to reduce the air resistance, while keeping the whole as small as possible. The interior of each gondola was large enough to provide space for several machinists, making it possible to carry out any repairs on board apart from major overhauls. Naturally all the gondolas were arranged so that it was easy to get in and out of them.

The relatively large dimensions of the *LZ 126* resulted in almost every part of the ship being easily accessible. The fins, for example, were thick, hollow framework structures inside which one could climb about, and in the lower fin there was space for an emergency

control position from which the control surfaces could be operated if the main controls were out of order for any reason.

For the first time the *LZ 126* incorporated a new feature introduced by the Americans, but which appeared in all subsequent Zeppelin airships, for, without it, scheduled operations on the long ocean crossings would hardly have been possible, or at least would have been much less reliable and economical. The nose was reinforced and bore at its extreme tip a special mooring mast attachment, a mooring cone of cast steel, with which the ship could be made fast to the mooring mast by a simple manœuvre. This useful arrangement, which had been developed by the American Navy, made it possible to hold even the largest airships safely and securely on the ground with a small ground crew, even in high winds. As a result, there was no absolute need for airship hangars at intermediate landing-grounds or at overseas bases.

With the arrival of the *ZR III* on American soil on October 15, 1924, after an eighty-one-hour flight, the development of the Zeppelin airship had taken a very significant step forwards. Although the flight had been carried out with no special incident, and with fairly normal, in fact quite favourable, weather for the North Atlantic, it had produced a number of worth-while experiences and had demonstrated as practical many theoretical assumptions. We now knew that airship commerce across the oceans of the world was no pipe-dream, and that we were going in the right direction to accomplish it. We had seen that it was possible, using weather information received by radio, to use the forces of the constantly changing storm systems so that the ship followed the most favourable route, that is, the fastest and safest one. The flight had been generally pleasant and comfortable, although crossing the ocean in a zone of particularly bad and stormy weather.

To all appearances, we were now ready to pursue the original goal farther. On the other hand, it had been definitely shown that the *LZ 126* was not the proper or suitable craft for the purpose. Even before the flight, it had been clear that the transoceanic ships would have to be larger, stronger, and faster, though improvements in these directions posed no problems. The design staff at the factory would take into account, in preparing new designs, the proposals of the crew, stimulated by the non-stop flight of several

days' duration, for setting up a regular transocean service. But a disturbing and ultimately very expensive peculiarity of the airship, which had not received attention during shorter flights, appeared in all its unpleasantness on this long voyage, and urgently required a solution.

An airship is most easily handled when she is "weighed off", that is, when she is neither "light" nor "heavy", but floats motionless in the air. If the weights are properly distributed, she remains horizontal and moves forward in the direction of her longitudinal axis in such a way that the air stream impinges on the hull directly from ahead and does not produce either a turning moment or any force in the vertical plane. But this ideal flight altitude cannot be maintained long, for the ship soon becomes progressively lighter through the consumption of fuel.

The *LZ 126* consumed, as we have seen, about 770 pounds of fuel per hour at normal cruising speed. After ten hours in the air she would have lost nearly eight tons in weight through consumption of petrol. To keep a ship at a constant altitude, when she is being lightened in this way and tending to rise, she has to be flown at a negative angle of inclination, that is, with the bow pointed somewhat down. This causes the air stream to strike the top of the ship at an angle, and produces a dynamic vertical force acting downwards that balances the static lifting force exerted upwards. But a "light" ship flies badly and inefficiently. She is very unstable, constantly pitching up and down, and makes a lot of trouble for the elevator man. From time to time one has to equalize the forces on the ship by valving enough gas to get rid of the excess free lift. A ship that has been lightened by four tons would have to blow off 110,000 cubic feet of hydrogen through the valves.

Before each landing, which naturally is always a rather ticklish manœuvre, the ship must be "weighed off" and trimmed with special care so that she will respond promptly to the controls even at low speed, and so that her movements will not be affected by static forces and moments. But when gas is blown off deliberately through the manœuvring valves, neither the amount released nor the distribution between the different cells can be properly estimated. Therefore one usually achieves this by rising over "pressure height" and allowing the gas calculated to be in excess to blow off through the automatic valves.

Of the 33 tons of petrol and two tons of oil which had been loaded on board the *ZR III* in Friedrichshafen, about $27\frac{1}{2}$ tons had been consumed by the time she reached New York. All in all, the ship before she landed was nearly 29 tons lighter than at the take-off. To be properly "weighed off" for landing, the ship would, therefore, have to have her lift decreased by 29 tons, and correspondingly would have to contain 850,000 cubic feet less of lifting gas. This meant that during the flight a good 33 per cent of her original gas content would simply have to be thrown away.

Since the take-off point at Friedrichshafen was 1,300 feet above sea level, the ship at the end of the flight would have to climb to an altitude of 12,000 feet, to effect a proper reduction in the amount of gas in her cells. Naturally everyone was trying to think of ways and means to prevent the need for such a troublesome and uneconomical procedure. The problem was attacked from many directions, and with the next ship we found, as will appear later, a solution amazingly simple in principle and very effective in practice, which was employed as long as engines with carburettors were used.

The happy outcome of this first journey to America had aroused the interest of the public in airship matters to such a degree that funds could be raised for a new ship and the limitations of the Versailles Treaty, which allowed Germany to build airships of no more than 1,059,300 cubic feet capacity, could be repealed. The factory in Friedrichshafen began the construction of the *LZ 127*, which was planned less as a definite commercial airship than as a sort of pioneering and propaganda ship. With her, experimental flights were to be made on the airship trade routes of the future in order to study meteorological conditions and the behaviour of the ship in various climates. Finally the capabilities of the new means of transportation were to be demonstrated in practical and convincing fashion under every possible variety of conditions, in order to gain the confidence of the public.

The size of the new ship could not yet be the optimum one, because we were limited by the dimensions of the largest available construction shed. The ship's hull was of a shape which would produce the largest possible gas capacity without being too unfavourable aerodynamically or from the point of view of the static strength of the framework. A comparatively long cylindrical mid-

ships portion increased the capacity compared to that of the last ship. With a length of 774·3 feet and a diameter of the cylindrical portion of 100 feet the ratio of length to diameter had increased again to 7·8 to 1. Circumstances required the *Graf Zeppelin* to have a very slender silhouette, which was an exception to the general tendency in development of the shape of airship hulls. The gas volume reached 3,954,720 cubic feet. With 100 per cent inflation with hydrogen this was equivalent to a total lift of 136 tons, which, after subtracting the weight empty of 66 tons, left 70 tons—more than 51 per cent—available for useful load. The sixteen lifting gas-cells were limited in size, however, so that they contained only 3,036,660 cubic feet of hydrogen when completely filled, producing a lift of only 105 tons. The lower portion of the space inside the hull, which was not occupied by the lifting gas-cells, was filled by a second series of fabric cells which could be filled with 918,060 cubic feet of gaseous fuel.

In order to prevent the ship from steadily becoming lighter in flight, and thereby having to valve hydrogen, the idea had been developed of using, in place of heavy petrol, a gaseous fuel of the same specific weight as the air, the consumption of which would produce no alteration in the ship's weight. For every ton weight of petrol, which could thereby be dispensed with, a lifting gas volume of 31,800 cubic feet was made available for carrying the practically weightless fuel gas. The 918,060 cubic feet of fuel gas thus took the place of about 32 tons of petrol. But while this amount of petrol sufficed for only sixty-seven hours of flight, the full load of fuel gas could drive the engines for over a hundred hours.

The new gaseous fuel achieved not only the improvement we had been striving for, namely, flight in a constant state of equilibrium, but also gave a greater range. It was true that the second series of cells required a number of installations, leading to a certain increase in weight, which would have been superfluous if petrol alone had been used. An axial gangway, for instance, had to be built, extending from the bow to the fins at the stern and suspended by the wire bracing of the main rings, in order to permit access to the gas-cells. This new constructional feature proved, however, to be so practical and useful in a number of ways that it was retained in later ships although the fuel-gas-cells were again discarded due to the installation of diesel engines.

These were the most important alterations in the *LZ 127* compared to her predecessors. Generally she was very similar to the *LZ 126*, but the increased lift had naturally been used to improve, strengthen, and enlarge her in many details. The power-plant was again installed in four side gondolas and one stern gondola. The engines themselves were a new design by the Maybach Engine Company. Their maximum output was 530 horsepower each, and they could be directly reversed by altering the position of the cam shafts, so that the air screws could be turned in the reverse direction to check the ship during landing manoeuvres, without interposing a set of reversing gears. With full power output of 2,650 horsepower the ship reached 79.6 miles per hour. On long voyages, however, the engines were run at only 370 horsepower each and with the resulting "cruising power" of 1,850 horsepower the ship made 71.5 miles per hour. The engines could operate on either fuel gas or petrol, and on long flights six tons of petrol were carried along with the 918,060 cubic feet of fuel gas. It was then possible to lighten the ship through consumption of petrol, if she should become heavy through a heavy load of rain or through gradual loss of gas. The overall fuel supply sufficed for 118 hours of flight at cruising speed, which was enough to cover a distance of 8,400 miles. The actual payload of passengers, mail, and cargo which could be carried in these circumstances amounted altogether to 13.2 tons.

The large control and passenger gondola was located rather more forward than had been customary up to this time. The idea was to achieve a clear field of vision upwards from the control car along the rising bow, in order to be able to make meteorological observations. Furthermore, a strong mooring attachment was built into the forepart of the gondola, so that the ship could be securely moored, turning with the wind, if this were necessary on an unimproved landing-field. The control-room itself was much enlarged and divided into a wide wheel-house and a connecting chart-house to the rear. The equipment and instruments in these spaces were very much improved over those in the *LZ 126*, but during many flights they were constantly being adapted and improved to meet the demands and requirements of safe and comfortable ship handling.

Thus the rudder man, who at first had to steer his course by the

small, minutely divided, and sluggish card of the magnetic compass, received in its place a gyro compass, on which a course variation of a tenth of a degree showed up more quickly and clearly than a previous variation of several degrees. The very fatiguing manual labour of handling the rudder and elevator controls in stormy weather was lightened by using servo motors. This not only relieved the steering personnel, but also led to a smoother and steadier course, which in turn made navigation more accurate and certain. The elevator man works his wheel according to the spirit level, the variometer, and the barometric altimeter. No better substitute could be evolved for these simple instruments, but they were supplemented in a valuable way by the echo sounder.

The altimeter, which is nothing more than an aneroid barometer graduated in feet, is set to the known height above sea level of the point of departure before the start of the flight. As long as the barometric pressure does not change, the altitude indicated by the instrument will be correct, for a decrease in atmospheric pressure will correspond directly to an increase in altitude. But if, on a long flight, one enters an unsuspected low-pressure area, it can be very dangerous to rely on the altitude reading of the aneroid instrument, since the decreasing atmospheric pressure, or "falling barometer", produces an entirely inaccurate figure. In fog or darkness one may believe oneself to be several hundred feet in the air, while actually only 150-200 feet intervene between the ship and the ground or water. Many aircraft have crashed for this reason, and for similar reasons the big American dirigible *Akron* flew into the sea.

With the echo sounder one simply measures the time interval between firing a blank cartridge in the ship, and receiving its echo from the ground, the sound travelling a distance double the ship's height from the ground. In this way not only is the absolute altitude over the ground measured and the barometric altimeter corrected, but one can also obtain simultaneously the true barometric reading, which is very important for meteorological navigation. The Boehm echo sounder, used for the first time aboard the *Graf Zeppelin*, was a rather simple and elementary device which gave rise to a lot of amusement, as the shots were fired from an ordinary shotgun. But it served its purpose and became extremely useful for piloting the ship.

As was the case with the *ZR III*, the new ship had radio direction-finding equipment as a navigational aid, but this was comparatively little used. The first and last rule for successful airship navigation is constant careful observation of the speed and drift over the ground. Over land the course is set and steered with the help of a map. Over the sea one flies almost exclusively by dead-reckoning. By measuring drift while steering two different courses, the direction and strength of the wind can be ascertained and a correction made in the compass course to be steered, so that the ship can move in the desired direction over the ground. At set intervals, or with course changes, the direction and distance made good are plotted on a navigation chart and the whole flight recorded from one dead-reckoning position to the next. A good drift meter is, therefore, the most essential instrument for navigation. For particularly accurate measurements, marker bombs can be dropped which produce smoke and flame on the surface of the sea which can be observed for a long time through a pelorus.

Abaft the navigation-room the kitchen and the radio cabin lay on both sides of a corridor. Both were enlarged in their measurements and functions, but in principle the arrangement had not been significantly changed. The corridor opened in the rear on the actual passenger spaces. For the first time in an aircraft there appeared a large and comfortably arranged lounge, and, separated from it, a series of individual sleeping-cabins. The twenty passengers sat as they chose in comfortable chairs around four tables, and could move freely between the large observation windows on either side. In the centre of the rear wall a door led to a long corridor, with five double-bed sleeping-cabins on either side. By day, just as in a Pullman car, the upper bed was folded down to serve as the back of a sofa, so that people could sit comfortably and privately at a small table looking out the window. In the aftermost part of the gondola were toilet and wash-rooms as before.

Electric current for lighting, for the radio equipment, for the kitchen, and for heating water was produced by three windmill-powered generators, which were attached by hinged arms to the outside of the gondola and could be swung out into the slipstream. This electrical source was soon discarded, as it was too complicated and dependent on the ship being in motion. Instead of the individual generators, a small enclosed central power-station was

built-in behind the control car, with two automobile engines alternately driving a 10-kilowatt generator. This arrangement enabled the electrical equipment of the ship to be increased, including a searchlight of 2,000,000 candlepower, which was mounted outside the electrical gondola. With its help the ground traversed by night could be recognized and the drift could be measured as accurately as by day.

Never before had so many valuable experiences been obtained, and so many improvements developed, as with the *LZ 127*. Many of these naturally were of an improvised nature, representing experimental and trial stages of development. But all this was to be incorporated in the next ship in a refined form. Altogether the *Graf Zeppelin* accomplished far more than had ever been expected when she was designed and her performance characteristics estimated. A few remarks will make this emphatically apparent:

From her first trial flight in August, 1928, to her being placed out of service ten years later, this especially lucky ship made 590 flights, of which 144 were ocean crossings. The total distance flown was 1,054,861 miles, and the total time in the air was 17,178 hours. This is equivalent to the ship spending two whole years in the air and travelling four and a half times the distance from the earth to the moon. Although she was intended more for experimental flights than for straightforward passenger traffic, the ship transported more than 13,000 passengers.

The next ship did not have to be any compromise solution. She was to possess at last the size and lifting capacity which had been recognized as necessary and striven for for so long. In her design and production all previous experiences, particularly those obtained with the *Graf Zeppelin*, were to find their culmination. Before such a ship could be built, a construction shed of corresponding size had to be erected. After the *LZ 127* had passed her last trials in the flight around the world, large investments seemed justified, and in 1929-30 a new construction shed was erected at Friedrichshafen in place of the first double construction shed, which was no longer used. The new building, 837 feet long, had a clear inner width and height of 164 feet.

Meanwhile plans had been drawn for the *LZ 128*. This proposal was not, however, realized, because of a decision to make the new ship large enough to have adequate lift with helium, which was

non-inflammable but heavier in weight (a given volume of helium has only 91 per cent of the lift of the same volume of hydrogen). To meet this requirement, as we have seen, the *LZ 129* was designed with a length of 811·1 feet, and a diameter of 135·1 feet, giving a maximum gas content of 7,062,150 cubic feet. The total lift of this ship inflated with hydrogen was 242 tons. The distribution of this total lift between fixed weights and useful load is broken down in the table appended to this article.

In order to give the fat-bodied ship, with a length/beam ratio of 6 to 1, the necessary stability, she was provided with quite large stabilizing fins whose shape and measurements were arrived at by very careful wind-tunnel investigations. The lower fin was specially reinforced along its leading edge and carried a pivoting wheel with low-pressure tyre which served as a stern support while manœuvring on the ground before take-off or after a landing. This installation took the place of the midline after-engine gondola, which had been built on to all previous ships, but in this ship was done away with. The *LZ 129* had only four engine gondolas, which were hung in pairs on either side of the hull.

A basic innovation in this ship was that diesel engines were employed for the first time. The greatest change compared to previous ships lay in the fundamentally different arrangement of the passenger quarters. They were no longer incorporated in the forward gondola immediately behind the control car, but were placed right inside the ship on two decks, one over the other. This rendered it possible for them to be given spaciousness unknown in any previous aircraft and permitted such a unique employment of space that the passengers enjoyed variety and an agreeable view, as well as great comfort. The big inclined windows along the promenade deck, which ran outside the passenger quarters, permitted a clear view horizontally as well as vertically downwards, so that the landscape passing below could be viewed in a most agreeable manner. Further inboard, separated from the promenade deck by railings, were the large dining-room on the one side, and a lounge and reading-and-writing room on the other. The sleeping-cabins were on the same deck amidships, and were reached by a staircase leading to two corridors. One deck below were a tiny bar and the much-discussed and very popular smoking-room. Famous artists and architects had co-operated with the Company's

engineers in the efficient arrangement and tasteful decoration of all these rooms.

It goes without saying that every technical detail which could contribute to the comfort of the travellers was constructed with especial care. Thus, all rooms were centrally heated with warm air, permitting the temperature to be controlled as desired in individual cabins. In place of common washrooms, each cabin had a wash-stand with running hot and cold water, and on the lower deck, besides toilet-rooms, was a real shower-bath. The roomy kitchen had a baking-oven as well as a four-burner electric stove, and every night on the transoceanic flights hundreds of rolls were baked fresh for the next day's breakfast. An electrical refrigeration system not only kept food fresh and drinks cold, but also permitted serving frozen desserts.

Considering the comparatively short crossing time of three days, the accommodation and meals for the passengers were really equivalent to those of the big transatlantic steamers.

The arrangements for control of the ship, and other technical details, were naturally correspondingly improved. The forward gondola was exclusively a control car and contained in the bow the control-room, in the middle the navigation- or chart-room, and next to this in the stern of the gondola a sight-taking room which provided a clear view directly aft. In the control-room the servo rudder motors were greatly improved, so that they could amply handle the rudder loads and could now be used in rough weather when they were most necessary. The elevator man not only received a signal when the gas cells were completely filled, as in earlier ships, but he also had a diagrammatic picture of the percentage of fullness of each individual cell and was, therefore, always informed of how close the ship was to the critical pressure height. Remote thermometers not only recorded the temperature within the gas cells, but also showed directly the difference in temperature between gas and outer air, which was so extremely important in determining variations in lift. An automatic, electrically operated echo-sounder gave out a sharp note from a compressed-air whistle in place of the clumsy and heavy shotgun discharges, and at brief intervals indicated the actual height above the ground or water, which, especially in thick weather, was very important for safe navigation. The navigator's task was generally

lightened by improvements in the direction finder and particularly in the drift-meter, which was set up in the sight-taking room at the rear of the gondola in order to give a good view of the smoke-bombs dropped on the water. A public-address system, with fourteen loudspeakers connected to the navigation-room, provided communication with all important parts of the ship.

In order to keep the control car small and not to limit all-round visibility, the radio-room was inside the hull. It was placed above the control car in the keel gangway and was equipped with a short- and long-wave transmitter of 200-watt output each, and an all-wavelength receiver. A pneumatic message tube between the control car and the radio-room permitted incoming or outgoing messages to be passed back and forth without loss of time.

The considerable amount of electricity required for the electric kitchen, the lighting system, the pumps and fans, the radio equipment, and the numerous electrical instruments and machines was taken care of by an electric power-station amidships alongside the gangway. This included a machinery-room and a switchboard room covering about 160 square feet together. Two diesel-electric units with an output of 30 kilowatts each, of which one was usually operating while the other stood by, powered the extensive main circuit of 220 volts. There was a special 24-volt circuit for instruments and signalling equipment. The switchboard-room provided space for the master gyro compass as well as the big five-million-candlepower searchlight, which enabled drift to be measured at night even from 6,500 feet up. Water for the passenger cabins and for the kitchen was heated simply and economically by using the cooling water from the diesel engines in the central power-station. In the same way the air used to warm the passenger quarters was heated in a heat exchanger by the cooling water from one of the big main engines.

Generally speaking, the interior arrangements of the ship showed no significant difference compared to the *LZ 127*, except that the size of the installations was increased. Thus the aluminium tanks containing fuel, water ballast, and fresh water, which had a volume of 119 gallons, now contained 660 gallons each. Apart from the ordinary cargo spaces, which were arranged over the whole length of the ship on both sides of the gangway, a specially large cargo-hold had been built with a big loading

hatch, in which heavy or unwieldy loads, like a motor car, could be stowed.

The performance of the *LZ 129*, and the loads she was expected to transport in overseas service, can best be appreciated from the following table:

Weight empty*	.	.	.	.	130.1 tons
Fuel					
Fuel oil	.	.	.	.	64.0 tons
Lubricating oil	.	.	.	.	3.3 tons
					67.3 tons
Useful load					
Landing ballast	.	.	.	.	2.8 tons
Flight ballast	.	.	.	.	5.5 tons
Stores and spare parts	.	.	.	.	4.4 tons
Crew with baggage (220 lb. per person)	.	.	.	.	5.5 tons
Provisions and cooking water (22 lb. per person per day for 4½ days)	.	.	.	.	2.5 tons
					20.7 tons
Pay Load					
Passengers with baggage (220 lb. per person)	.	.	.	.	5.5 tons
Provisions and cooking water (24 lb. per person per day for 4½ days)	.	.	.	.	2.8 tons
Freight and mail	.	.	.	.	12.7 tons
					21.0 tons
Humidity, take-off lift, fullness below 100%	.	.	.	.	3.3 tons
Take-off weight	.	.	.	.	242.4 tons
Lifting gas needed (78 lb. per 1,000 cu. ft.)	.	.	.	.	7,062,150 cu. ft.
Gas volume 100% full	.	.	.	.	7,062,150 cu. ft.
Cruising power (4 × 800)	.	.	.	.	3,200 h.p.
Cruising speed	.	.	.	.	77.5 m.p.h.
Fuel consumption per hour	.	.	.	.	1,170 lb.
Endurance	.	.	.	.	109 hours
Endurance needed for 4,500 miles in still air	.	.	.	.	57.5 hours
Endurance needed for 4,500 miles against headwind averaging 15.7 m.p.h.	.	.	.	.	72.8 hours
Maximum range in still air	.	.	.	.	8,420 miles

* Includes entire weight value of passenger quarters, about 13.2 tons.

This Zeppelin airship, the first ever planned and constructed expressly for carrying passengers in transoceanic commerce, made her first trial flight on March 4, 1936. In the same year, until December 4, she travelled 191,684 miles in fifty-six flights. During this time she crossed the ocean thirty-four times, flying seven times to South America and ten times to North America. She demonstrated in the process that a regularly scheduled airship service could be operated even over the North Atlantic, where weather conditions were comparatively unfavourable. On the ten westward flights from Frankfurt-am-Main to Lakehurst near New York, the average flight time was 64·5 hours and the average speed 68·5 miles per hour. On the homeward journeys going east an average of only fifty-two hours was necessary, corresponding to a cruising speed of 78 miles per hour.

KNUT ECKENER

Autumn 1957



Dr. Hugo Eckener, whose many pioneer airship flights made front-page stories in the world's newspapers during the 1930's, was born in Flensburg, Germany, in 1868. Later he attended the universities at Munich, Berlin and Leipzig. From 1906 he was the First Pilot of the Zeppelin Works and, during the war, trained airship pilots for the German Navy. He commanded the *Graf Zeppelin* on the first transatlantic flight, and later on flights around the world, to the Arctic and to South America. He died in August 1954. His son Knut, who has contributed a technical chapter to this book, accompanied him on many of his flights.

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