

**From the holdings of the Department of Special Collections , Princeton University Library,  
Princeton, NJ**

These documents are either in the public domain, or can only be used for educational and research purposes (Fair use) as per U.S. Copyright law (text below). By accessing this file, all users agree that their use falls in the public domain or within fair use as defined by the copyright law. We do not charge any permission or usage fees for the publication of images of material in our collections, including those provided by Princeton University Library, via our website, catalog, or directly from staff. For more information regarding copyright, credit, and citation please review the information on the Copyright, Credit and Citation Guidelines page of our website.

<https://library.princeton.edu/special-collections/policies/copyright-credit-and-citation-guidelines>. If you have any questions, including how to order higher-quality images from the collection, contact Special Collections Public Services via our Ask Us! Form. <https://library.princeton.edu/special-collections/ask-us>

---

Doctoral Dissertations, 2011-2026

East Asian Studies

---

2014

# ASSISTED TAKEOFF: GERMANY AND THE ASCENT OF JAPAN'S AVIATION, 1910-1937

Melzer, Juergen Paul

Princeton, NJ : Princeton University

---

<http://arks.princeton.edu/ark:/88435/dsp01p5547r51v>

*U.S. Copyright law: The copyright law of the United States (Title 17, §108, United States Code) governs the making of photocopies or other reproductions of copyrighted material. Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specified conditions is that the photocopy or reproduction is not to be used for any purpose other than private study, scholarship, or research. If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of fair use that user may be liable for copyright infringement. This institution reserves the right to refuse to accept a copying order if, in its judgment, fulfillment of the order would involve a violation of copyright law. <https://www.copyright.gov/title17/title17.pdf>*

**ASSISTED TAKEOFF:  
GERMANY AND THE ASCENT OF JAPAN'S AVIATION, 1910–1937**

Juergen Paul Melzer

A DISSERTATION  
PRESENTED TO THE FACULTY  
OF PRINCETON UNIVERSITY  
IN CANDIDACY FOR THE DEGREE  
OF DOCTOR OF PHILOSOPHY

RECOMMENDED FOR ACCEPTANCE  
BY THE DEPARTMENT OF  
EAST ASIAN STUDIES

Adviser: Sheldon Garon

June 2014

© Copyright by Juergen Paul Melzer, 2014.

All rights reserved.

Materials from this dissertation have been previously presented publicly at the following scholarly conferences or meetings:

“Navigating a Sea of Change: Germany and Japan’s Emerging Naval Aviation, 1919-1937,” at 1st EAJIS Japan Conference at Kyoto University, 9/29/2013.

“Building a Flying Fortress to Bomb the Philippines: Japanese Airpower and International Diplomacy in the Early 1930s,” at Columbia University Department of East Asian Languages and Civilizations, 2/16/2013.

“Germany’s Unexpected Role in Japan’s Emerging Aviation Industry, 1919-1925,” at Princeton, East Asian Studies Department Colloquium, 10/10/2012.

“Germany and the Development of Japan's Aviation in the Interwar Period,” at Johns Hopkins University, 2/10/2012.

“Germany and the Development of Japan's Aviation in the Interwar Period,” Science, Technology, and Medicine in East Asia: Policy, Practice, and Implications in a Global Context, at Ohio State University, 10/8/2011.

“Heavenly Rites and Earthly Purposes: The Birth of Japanese Air-Mindedness,” Ritual as Technology in East Asia Workshop, at Max Planck Institute for the History of Science (MPIWG), 5/12/2011.

“Germany and Japan’s Aviation,” at University of Tokyo, 12/14/2010.

Materials from this dissertation have been previously published in the following journal:

“Riesenflugzeuge und Blaupausen: Süddeutsche Luftfahrttechnik für Japan.“ *Bambusblätter*, Journal of the Deutsch-Japanische Gesellschaft Baden-Württemberg , pp. 10-15, Winter 2013.

## **Abstract**

### **Assisted Takeoff: Germany and the Ascent of Japan's Aviation, 1910–1937**

Juergen Paul Melzer

This dissertation examines the trajectory of Japan's aviation from its birth in 1910 until 1937, when, on the eve of war with China, Japanese military aviation matched and in many aspects even surpassed that of the West. In particular this study, which draws predominantly on archival material from Japan and Germany, seeks to demonstrate that German influence on Japan's aviation became dominant by the mid-1920s and continued for a decade. German assistance prepared Japanese engineers for the important transition from imitation to independent design. It also profoundly reshaped the Japanese military's air fleet and air strategy.

The 1919 Versailles Treaty drew the attention of the Japanese to the high standard of German aviation technology when it granted the Japanese free access to German factories and military facilities. These visits, together with the arrival of German war trophy aircraft in Japan, prompted the Japanese to purchase German airplanes and production licenses and to invite German engineers to Japan to educate a new generation of Japanese aircraft designers.

German aircraft manufacturers became instrumental in the rise of the Imperial Japanese Navy's air power. German hardware and know-how laid the foundation for the design and production of flying boats and carrier airplanes. These state-of-the-art aircraft substantially enhanced the navy's strike force and emboldened its air strategists to embrace a technology-driven hawkishness.

With the help of German aviation specialists the Imperial Japanese Army also modernized its air squadrons. During the 1931 invasion of Manchuria the army deployed some of the world's most advanced military aircraft. Yet, the successes of these airplanes made the army's planners complacent. They drifted into a doctrinal slumber that paid little attention to the further development of an advanced air strategy.

Shifting the focus from aircraft design toward aircraft production, the dissertation also addresses the limits of German influence. The Japanese were aware of the advances in Germany's production technology. However, the military's emphasis on aircraft with ever higher performance and the industry's continuing reliance on small subcontractors took a heavy toll on productivity. An industry that built world-class fighters and bombers was ill-prepared to produce them efficiently in large numbers.

## Table of Contents

|                                                                                                                      |            |
|----------------------------------------------------------------------------------------------------------------------|------------|
| MAPS, TABLES, AND FIGURES .....                                                                                      | viii       |
| ACKNOWLEDGMENTS .....                                                                                                | x          |
| <b>Introduction .....</b>                                                                                            | <b>1</b>   |
| Sources .....                                                                                                        | 3          |
| Arguments and Methodology .....                                                                                      | 6          |
| Technology: Transnational Transfer and National Diffusion .....                                                      | 9          |
| Mobilizing the Public: Visions, Images, and Perceptions .....                                                        | 11         |
| International Diplomacy and Geostrategy .....                                                                        | 13         |
| Chapter Overview .....                                                                                               | 15         |
| <b>I Powerful Images and Grand Visions: The Emergence of Japan's Aviation .....</b>                                  | <b>19</b>  |
| The Road to Japan's First Motor Flight .....                                                                         | 21         |
| The Qingdao Air War: Brief Encounters and a Lasting Myth .....                                                       | 39         |
| A Technocrat Shapes His Vision: Kusakari Shirō .....                                                                 | 47         |
| Conclusion .....                                                                                                     | 59         |
| <b>II Lessons from World War I and the Unintended Consequences of the Treaty of Versailles .....</b>                 | <b>60</b>  |
| Technocrats and Ideologists .....                                                                                    | 61         |
| The Rise and Fall of the French Aviation Monopoly .....                                                              | 70         |
| A New Window Opens: Post-World War I Reports about German Aviation .....                                             | 75         |
| War Trophies from Germany .....                                                                                      | 82         |
| Recruiting German Engineers .....                                                                                    | 89         |
| Squaring the Circle: Disarmament and Airpower Build-Up .....                                                         | 91         |
| <b>III Navigating a Sea of Change: German Aircraft Makers and Japan's Emerging Naval Aviation .....</b>              | <b>98</b>  |
| Early British Influence .....                                                                                        | 101        |
| An Early Compromise: Ship-Based Floatplanes .....                                                                    | 104        |
| Toward an Autonomous Airpower: Large-Size Flying Boats .....                                                         | 111        |
| Redefining Naval Airpower: Carrier-Based Aircraft .....                                                              | 123        |
| Conclusion .....                                                                                                     | 135        |
| <b>IV On the Way Toward Independent Aircraft Design: German Aviation Specialists and Japan's Army Aviation .....</b> | <b>137</b> |
| The Army's Troubles with a New Air Doctrine .....                                                                    | 139        |
| Turning Flying Boats into Bombers: Kawasaki's Tie-Up with Dornier .....                                              | 142        |
| The Theory and Practice of Aircraft Design: Alexander Baumann at Mitsubishi .....                                    | 151        |
| Ten Years in Japan: Richard Vogt .....                                                                               | 157        |
| Foreign Expertise Put to the Test: The Competition for the Army's New Fighter Aircraft .....                         | 161        |

|                                                                                                                               |            |
|-------------------------------------------------------------------------------------------------------------------------------|------------|
| Baumann and Vogt: Engineers as Teachers .....                                                                                 | 167        |
| The Army's New Aircraft during the Manchurian Crisis .....                                                                    | 172        |
| Conclusion .....                                                                                                              | 175        |
| <b>V German Airliners into Japanese Bombers: Junkers in Japan.....</b>                                                        | <b>179</b> |
| Early Japanese Interest in Junkers' Aircraft.....                                                                             | 181        |
| The Plan for a Long-Range Bomber Emerges .....                                                                                | 186        |
| License Negotiations.....                                                                                                     | 193        |
| Mitsubishi's Preparations for Production.....                                                                                 | 197        |
| Junkers Staff Comes to Mitsubishi .....                                                                                       | 199        |
| Production and Test Flight.....                                                                                               | 204        |
| The Press .....                                                                                                               | 207        |
| Evaluation and Aftermath .....                                                                                                | 209        |
| Conclusion .....                                                                                                              | 214        |
| <b>VI The Limits of German Influence: Japanese Aircraft Makers and Their Struggle for<br/>    Industrial Efficiency .....</b> | <b>217</b> |
| Mass Production and Military Strategy .....                                                                                   | 219        |
| Japan and Germany's Industrial Rationalization .....                                                                          | 220        |
| The 1938 Aircraft Manufacturing Industry Act.....                                                                             | 227        |
| The Japanese Aircraft Makers' Problems with Mass Production .....                                                             | 229        |
| Conclusion .....                                                                                                              | 247        |
| <b>Conclusion .....</b>                                                                                                       | <b>251</b> |
| A Window of Opportunity and the Dynamics of Technological Choice.....                                                         | 251        |
| A Balance Sheet of German Influence: Benefits, Drawbacks, and Legacies .....                                                  | 255        |
| <b>Works Cited.....</b>                                                                                                       | <b>260</b> |
| Archives .....                                                                                                                | 260        |
| Primary and Secondary Sources.....                                                                                            | 261        |
| <b>Index.....</b>                                                                                                             | <b>274</b> |

## Maps

|                             |      |
|-----------------------------|------|
| Map 1: Japan .....          | xii  |
| Map 2: Central Europe ..... | xiii |

## Tables

|                                                                                        |     |
|----------------------------------------------------------------------------------------|-----|
| Table 1: German aircraft in the three-stage development of Japan's naval aviation..... | 104 |
| Table 2: The army's new generation of all-metal aircraft. ....                         | 177 |
| Table 3: Three generations of Japanese bombers .....                                   | 180 |
| Table 4: The transfer of know-how between Junkers and Mitsubishi .....                 | 196 |

## Figures<sup>1</sup>

|                                                                                            |    |
|--------------------------------------------------------------------------------------------|----|
| Figure 1: The long-range research airplane Kōkenki .....                                   | 2  |
| Figure 2: The interplay of the public, engineers, and political and military leaders. .... | 8  |
| Figure 3: Tokugawa Yoshitoshi and his French flight instructor in a Farman biplane. ....   | 28 |
| Figure 4: Hino in his Grade monoplane and Tokugawa in his Farman biplane .....             | 31 |
| Figure 5: Young Tarō in his Farman biplane bombing the enemy. ....                         | 37 |
| Figure 6: Gunther Plüschow in his Taube monoplane.....                                     | 44 |
| Figure 7: Kusakari's sketches and the new concept of three-dimensional warfare .....       | 54 |
| Figure 8: Faure and his officers at Gifu Station in February 1919. ....                    | 72 |

---

<sup>1</sup> For copyright reasons all digital photographs have been removed while their captions and source references have been retained.

|                                                                                      |     |
|--------------------------------------------------------------------------------------|-----|
| Figure 9: The “giant aircraft” Zeppelin-Staaken. ....                                | 87  |
| Figure 10: The made-in-Japan version of Ernst Heinkel’s Hansa Brandenburg W-29. ...  | 107 |
| Figure 11: The launch of Heinkel’s floatplane. ....                                  | 110 |
| Figure 12: The central duralumin spar of Rohrbach’s giant passenger airplane ....    | 112 |
| Figure 13: The “purist of all-duralumin design”: Adolf Rohrbach (left).....          | 113 |
| Figure 14: The Rohrbach Experimental R-1 Flying-boat. ....                           | 119 |
| Figure 15: Claude Dornier (1884–1969).....                                           | 143 |
| Figure 16: Building the Do N: A look at Kawasaki’s shop floor. ....                  | 148 |
| Figure 17: The Kawasaki Type 87 bomber.....                                          | 149 |
| Figure 18: The Baumann family in 1926.....                                           | 153 |
| Figure 19: Baumann’s Experimental Washi-type Light Bomber. ....                      | 154 |
| Figure 20: Baumann’s 1927 reconnaissance aircraft.....                               | 156 |
| Figure 21: The Dornier-Kawasaki team. ....                                           | 160 |
| Figure 22: The proposed bombing-run from Taiwan to the U.S. bases at Manila. ....    | 189 |
| Figure 23: The heavily armed Super Bomber.....                                       | 203 |
| Figure 24: A large group of army officials posing in front of the Super Bomber. .... | 207 |
| Figure 25: The Japanese aircraft makers’ production and employment numbers ....      | 218 |
| Figure 26: Workers’ productivity in the United States and Japan. ....                | 250 |

## Acknowledgments

I would like to express my deepest gratitude to the members of my dissertation committee. With their guidance, intellectual support, and encouragement they offered new perspectives, sustained help, and strong motivation for my scholarly pursuits. I am profoundly indebted to my adviser Sheldon Garon whose important feedback and comments not only decisively shaped my thesis but also made me explore new avenues that helped me to put my topic into a wider context. I am also immensely grateful to Emily Thompson for her crucial input during all stages of the project. Susan Naquin's firm advice inspired me to strive for clear and concise writing. She also became a role model for me of a teacher who offers time and effort to students with boundless generosity. Richard Samuels' enthusiastic interest greatly stimulated my project during its final stage.

For their generous financial assistance, I thank Princeton University and John and Julia Sensenbrenner; for funding my year-long research in Japan, I thank the Japan Foundation. I was fortunate to be affiliated with the University of Tokyo, where I benefited from the guidance of Hashimoto Takehiko, whose own work on aeronautical research provided decisive input to this thesis. Kudō Akira and Tajima Nobuo imparted their immense knowledge about German-Japanese relations to me, and Kōzu Masao shared with me his life-time experience as an aeronautical engineer and open-handedly entrusted me with invaluable research material. I also want to thank Sigrun Caspary and Erich Pauer, who made their expertise on Japanese aviation available to me.

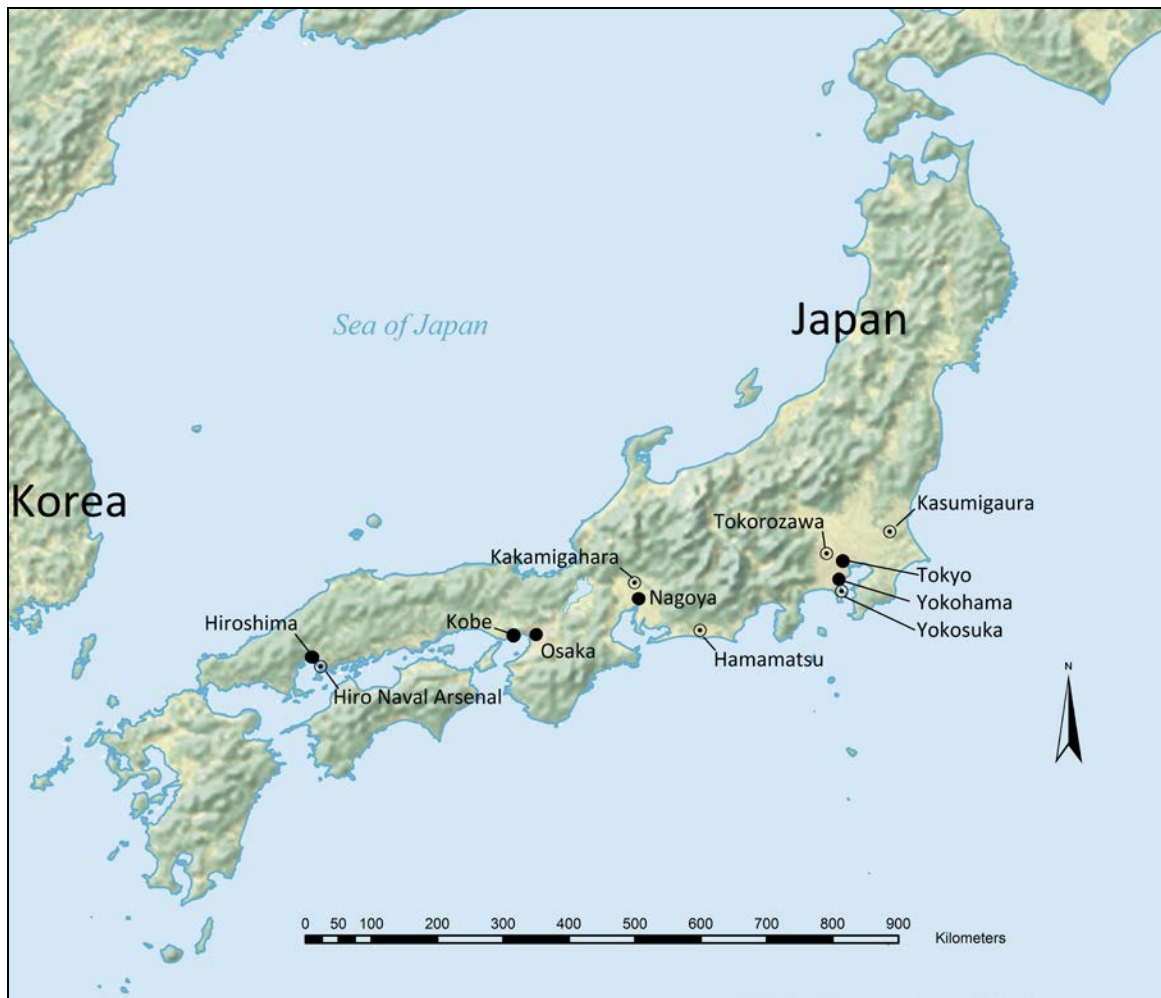
This project was possible only with help of the archivists who offered their professional advice and assistance. Tsubone Akiko greatly supported my research at the Mitsubishi Archives Tokyo. Hayafuji Hiroshi and Okano Mitsutoshi granted me access to a wealth of primary sources

at the Mitsubishi Nagoya Aerospace Museum. Takai Takasumi generously made the archive of the Kakamigahara Aerospace and Science Museum available to me, and Kikkawa Yō carefully prepared the material for my visits to the Mitsui Bunko Business Archives. My work would have been impossible without the resources provided to me by the Archive of the Deutsches Museum, München; the Mercedes-Benz Classic Archiv Daimler AG, Stuttgart; and the Department Military Archives (Bundesarchiv-Militärarchiv), Freiburg. I want to extend my special thanks to Edelgard Piroth at the Dornier Unternehmensarchiv EADS Corporate Heritage for promptly responding to my repeated requests.

My fellow graduate students strongly influenced my doctoral pursuits. Yamaguchi Mari and Masuda Yoshizumi at the University of Tokyo and Kjell Ericson, Joppa George Reut Harari, Dror Weil, and Xinxian Zheng at Princeton spent time and effort to help me with my work. Benjamin Uchiyama engaged with me in a fruitful exchange of ideas on the history of Japanese aviation. I am especially grateful to Christopher Mayo, Seiji Shirane, and Evan Young for their thoughtful comments on each of my dissertation chapters.

I thank the Graduate Coordinators in the EAS Department, Hue Su and Amber J. Lee, for their professional assistance with all procedural and administrative matters. I am also indebted to Yasuko Makino and Setsuko Noguchi for their sustained library support.

Last but not least I wish to thank Steve Gump, who helped me in the deteutonization of my writing and expertly guided me through the intricacies of *The Chicago Manual of Style*.



**Map 1: Japan**



**Map 2: Central Europe**

## Introduction

This thesis examines the trajectory of Japan's aviation from its birth in 1910 until 1937, when, on the eve of war with China, Japanese aircraft matched and in many aspects even surpassed those of the West. In particular, it investigates the central role of Germany in this remarkable development. At a time when Japan was relatively open to foreign companies, German aircraft makers could send their airplanes, motors, and machine tools, together with their engineers and aeronautical scientists. A new generation of highly trained German specialists transferred knowledge that, unlike that of their predecessors, was based no longer on individual designers' experience and intuition, but on scientifically founded aerodynamics, statics, and materials technology. In other words, aviation technology and research had reached a stage where it could be most effectively disseminated to a new breed of Japanese engineers and researchers who, within less than three decades, turned their design offices into hotbeds of aeronautical innovation.

Fixated on the attacks on Pearl Harbor and Singapore in December 1941, most historical accounts of Japan's aviation focus on the development of Japanese airpower after 1937. Japanese aviation technology did not, of course, arise out of the blue. As we shall see, it was the result of an ambitious campaign that was driven by national interest, aspirations for technological self-reliance, and competition with foreign powers. By 1937 mounting evidence was available that Japan had attained self-sufficiency in advanced aircraft design. Two highly publicized record flights directed the world's attention toward the high standard of made-in-Japan aircraft. In March 1937, Asahi Shinbun, one of Japan's major newspapers, bought one of Mitsubishi's latest prototypes for a widely advertised record flight. The aircraft, named Kamikaze (divine wind),

left Tokyo on April 6 and arrived in London three days later.<sup>2</sup> The Kamikaze not only set a new flight time world record but also became the first Japanese-built aircraft to fly to Europe. It attracted international attention as an epitome of Japan's technological advance—only after Japan's first suicide air attacks in autumn 1944 would its name become associated with spiritual fanaticism.

**Figure 1: High-tech made in Japan: The long-range research airplane Kōkenki. Note the design of the thin fuselage and the stretched wings that incorporate maximum aerodynamic efficiency.<sup>3</sup>**

In the following month, another remarkable aircraft, named Kōkenki (aeronautical research airplane) by the press, made its first flight. The Kōkenki, a futuristic-looking monoplane with unique design features (see Figure 1), was a national project to set yet another world record. In the following year the aircraft secured its place as a symbol of Japan's cutting-edge technology. It became the world's first airplane to cover non-stop a distance of more than 11,000 kilometers, and its record-breaking pilot Fujita Yūzō (1898–1939) was declared a national hero.<sup>4</sup>

While these spectacular endeavors emphasized international goodwill and scientific cooperation, the Japanese military set its own record flights that demonstrated its advanced strike power and its grim determination to use it. In August 1937, Japanese attack bombers took off from their airbase in Taipei, flew over the East China Sea, and bombed targets on the Chinese

---

<sup>2</sup> The airplane's name *Kamikaze* became widely associated with this goodwill flight. In the following year the Japanese composer Ōsawa Hisato (1906–53) even dedicated his Piano Concerto No. 3, "Kamikaze," to the record flight.

<sup>3</sup> A long, narrow wing produces less drag than a short, stubby one with the same surface area.

<sup>4</sup> Morikawa Hajime, *Sora no eiyū Fujita Yūzō chūsa* [Wing Commander Fujita Yūzō, the hero of the skies] (Tokyo: Shōwa Shobō, 1939).

mainland. The Japanese media celebrated this flight as the first “ocean-crossing bombing raid” and reported how it greatly shocked the “Great Powers” of the West.<sup>5</sup>

## Sources

Despite to my initial worries,<sup>6</sup> the archives of most major Japanese aircraft manufacturers (or those of their successors) preserve an impressive variety of valuable material that they make available to the public.<sup>7</sup> The same holds true for their contemporaneous German business partners and their transactions with Japan.<sup>8</sup> License contracts provide evidence for the amount and quality of technology transfer. Test reports, technical notes, and diaries of engineers clearly state successes and failures of each company’s research and development. Bulletins about production plans and manufacturing procedures also reveal the production engineers’ struggles for setting up an efficient mass production system.

The archives of the Japanese military have been another important source for relevant documents. They contain the army’s and navy’s correspondence with aircraft makers, reports about specifications for new prototypes, and evaluations of the airplanes’ frontline deployment.

---

<sup>5</sup> Quote taken from Nohara, Shigeru, *Nihon gunyōki jiten, kaigun hen, 1910–1945* [Encyclopedia of Japanese warplanes (Navy) 1910–1945] (Tokyo: Ikarosu Shuppan, 2005), 65.

<sup>6</sup> Before I started my search for primary sources on the history of Japan’s aviation I received several well-intentioned warnings about their limited availability or about the unwillingness of Japanese companies to grant me access to their archives. My concern increased when I learned that many documents were lost during the war or intentionally destroyed after Japan’s surrender.

<sup>7</sup> Mitsubishi Heavy Industries’ archives, both in Tokyo and at the company’s Komaki-Minami plant in Toyoyama, were especially helpful. The archival room of the Kakamigahara Aerospace and Science Museum contains a large number of primary documents on Kawasaki’s Kakamigahara aircraft plant. The Mitsui Archives in Tokyo preserves documents on Nakajima’s dealings with European and U.S. aircraft makers.

<sup>8</sup> German archives include the Bundesarchiv-Militärarchiv, Freiburg (hereafter cited BA-MA), the Deutsches Museum München (Junkers and Heinkel), the Deutsches Technikmuseum Berlin, and the Dornier Unternehmensarchiv in Friedrichshafen.

Documents authored by high-ranking officials in the Army and Navy Ministries are also available and include invitations to foreign experts and reports of aviation inspection teams that were dispatched abroad. Together with material from Japan's Foreign Ministry they also allow insight into the evolution of the army's and navy's air strategy.<sup>9</sup> Finally, it is very helpful for the historian of flight in Japan that the country's aviation project has received comprehensive press coverage since its early beginnings. Press reports not only allow following Japanese aviation history as it was presented to the public but also reveal the media's role in fostering widespread aviation enthusiasm and support for aerial armament.

Japanese company histories, most of them written after World War II, constitute a genre of their own. By their very nature company histories try to turn messy and often contradictory information into neat success stories that focus on technological achievement rather than on a company's involvement in armament and warfare. Nevertheless, a critical reading often can retrieve important details and reference to primary sources that would not be available elsewhere. Nearly all of Japan's major former aircraft makers like Aichi Tokei, Fuji Jūkōgyō (the successor of Nakajima), Ishikawajima, Mitsubishi, and Shinmeiwa (formerly Kawanishi) published corporate histories that include information about their aircraft manufacturing sections.<sup>10</sup>

---

<sup>9</sup> The Japan Center for Asian Historical Records' website (<http://www.jacar.go.jp>) has become an invaluable tool for online access to original historical documents. Material on Japan's foreign policy can be found at the Gaimushō Gaikō shiryō-kan of the Foreign Ministry. The National Institute for Defense Studies in Tokyo with its Military Archival Library and its 102-volume military history *Senshi sōsho* (published by Asagumo Shimbunsha between 1966 and 1980) provide primary sources on the history of Japan's military.

<sup>10</sup> Edagawa Ryūsuke, *Aichi Tokei Denki 85-nenshi* [85 years of history of Aichi Tokei Denki] (Nagoya: Aichi Tokei Denki Kabushiki Kaisha, 1984); *Fuji Jūkōgyō sanjūnenshi* [A thirty-years history of Fuji Heavy Industry] (Tokyo: Fuji Jūkōgyō, 1984); *Ishikawajima Jūkōgyō Kabushiki Kaisha 108-nenshi* [108 years of history of Ishikawajima Heavy Industries] (Tokyo: Ishikawajima Harima Jūkōgyō, 1961); *Mitsubishi no hyakunen* [One hundred years of Mitsubishi] (Tokyo: Mitsubishi Sōgyō Hyakunen Kinen Jigyō Inkai, 1970); Shin Meiwa

Kawasaki celebrated the fiftieth anniversary of its Gifu and Akashi aircraft factories with two sizeable books and, on the occasion of the company's one-hundredth anniversary, also published a two-volume edition titled *Like a Dream: 1896–1996*.<sup>11</sup>

Contemporary witnesses of the pre-war and wartime periods provide another view into the shop floor and the design offices of the aircraft industry. In 1970 a three-volume edition made available the personal memories of more than two hundred workers who had been employed at Mitsubishi's Nagoya aircraft plant.<sup>12</sup> Nearly two decades later Kawasaki brought out the personal recollections of its Gifu plant's employees.<sup>13</sup> As part of an “unearthing of civic culture” (*shiminbunka hakkutsu*) the city of Ōta in Gunma Prefecture interviewed former workers at Nakajima's aircraft factory and published their testimonies in 1995.<sup>14</sup> In a more triumphant manner the publisher Kantōsha collected and published the memoirs of thirty-nine Japanese aircraft designers and their “technological masterpieces.”<sup>15</sup>

The English-language reports of the United States Strategic Bombing Survey give additional insight into the history of Japan's air forces and aircraft makers with a focus on the

Kōgyō Kabushiki Kaisha Shashi Henshū Inka, *Shashi* [Corporate history] (Nishinomiya: Dōsha, 1984).

<sup>11</sup> *Kawasaki jūkō gifu kōjō gojūnen no ayumi* [The 50-year development of Kawasaki's Gifu factory] (Kakamigahara: Kawasaki jūkōgyō kōkūijigyōhonbu, 1987); Kawasaki jūkōgyō kabushiki gaisha, *Kawasaki jūkōgyō kabushiki gaisha hyakunenshi: Yume o katachi ni: 1896 1996* [100 years of Kawasaki Heavy Industries: Like a dream: 1896–1996] (Kobe: Kawasaki Jūkōgyō, 1997).

<sup>12</sup> Mitsubishi jūkōgyō KK, *Ōjibōbō: Mitsubishi jūkō Nagoya 50 nen no kaiko* [Memories of the past: 50 years of recollections of Mitsubishi Nagoya] 3 vol. (Nagoya Ryōkōkai, 1970).

<sup>13</sup> Kawasaki Heavy Industries, *Kawasaki jūkō Gifu kōjō no omoide* [Kawasaki Heavy Industries: Recollections of the Gifu factory] (Kakamigahara: Kawasaki Jūkōgyō, 1988).

<sup>14</sup> *Gin'yoku haruka: Nakajima hikōki gojūnen me no shōgen* [Far away silver wings: Eye-witness testimonies of 50 years of Nakajima aircraft] (Ōta: Ōtashi, 1995).

<sup>15</sup> *Sekkeisha no shōgen: Nihon kessakuki kaihatsu dokyumento* [The testimony of designers: Documents of the development of Japanese technological masterpieces], 2 vols. (Tokyo: Kantōsha, 1994).

period between 1941 and 1945. The 108 volumes of their *Pacific Survey* are based on on-site investigations and seized documents. They also contain an evaluation of the post-war interrogations of Japanese industrial and military leaders, who in many cases were astonishingly willing to cooperate with their former enemy.<sup>16</sup>

## Arguments and Methodology

This study seeks to demonstrate that German influence on Japan's aviation became dominant by the mid-1920s and that it continued for a decade during which the Japanese military was able to modernize its air fleet and Japanese engineers could make the important transition toward independent design. I will also argue that during the same time period the benefits and drawbacks of the German impact also affected Japan's air strategy and the efficiency of its aviation industry in a way that set the path for the trajectory of Japanese airpower after 1937. Furthermore, I contend that Germany was able to wield such a strong influence through a window of opportunity that was opened by a peculiar combination of public air-mindedness, international politics, and technological advance.

In order to address these issues I will contextualize the history of Japanese aviation. I conceive of aviation as a technological system that is embedded in a wider historical context. Such an approach goes beyond a narrow focus on flying machines and challenges the assumption made by numerous "encyclopedias" and "illustrated histories" of a predetermined technological progress that seems to have inevitably led from fragile biplanes to the streamlined jet aircraft.<sup>17</sup> I

---

<sup>16</sup> For a helpful introduction to the Strategic Bombing Surveys, see Gordon Daniels, *A Guide to the Reports of the United States Strategic Bombing Survey: I, Europe; II, the Pacific* (London: Royal Historical Society, 1981).

<sup>17</sup> The typical example for this type of secondary literature is Nozawa Tadashi's eight-volume *Nihon kōkūki sōshū* [Encyclopedia of Japanese Aircraft] (Tokyo: Shuppan Kyōdōsha, 1958–

also want to transcend the narrow scope of the memoirs and hagiographies of heroic pilots, designers, and industrialists that—while providing certain insights—largely qualify for the “great man” genre of historical writing.<sup>18</sup>

By using contextualism as the framework for this thesis I aim to contribute to a “New Aviation History”<sup>19</sup> that includes the people who ordered, designed, built, and flew the aircraft as well as the general public who, with their cheers, their money, and—unfortunately—their suffering, participated in the aviation project.<sup>20</sup> This contextual history of technology assumes

---

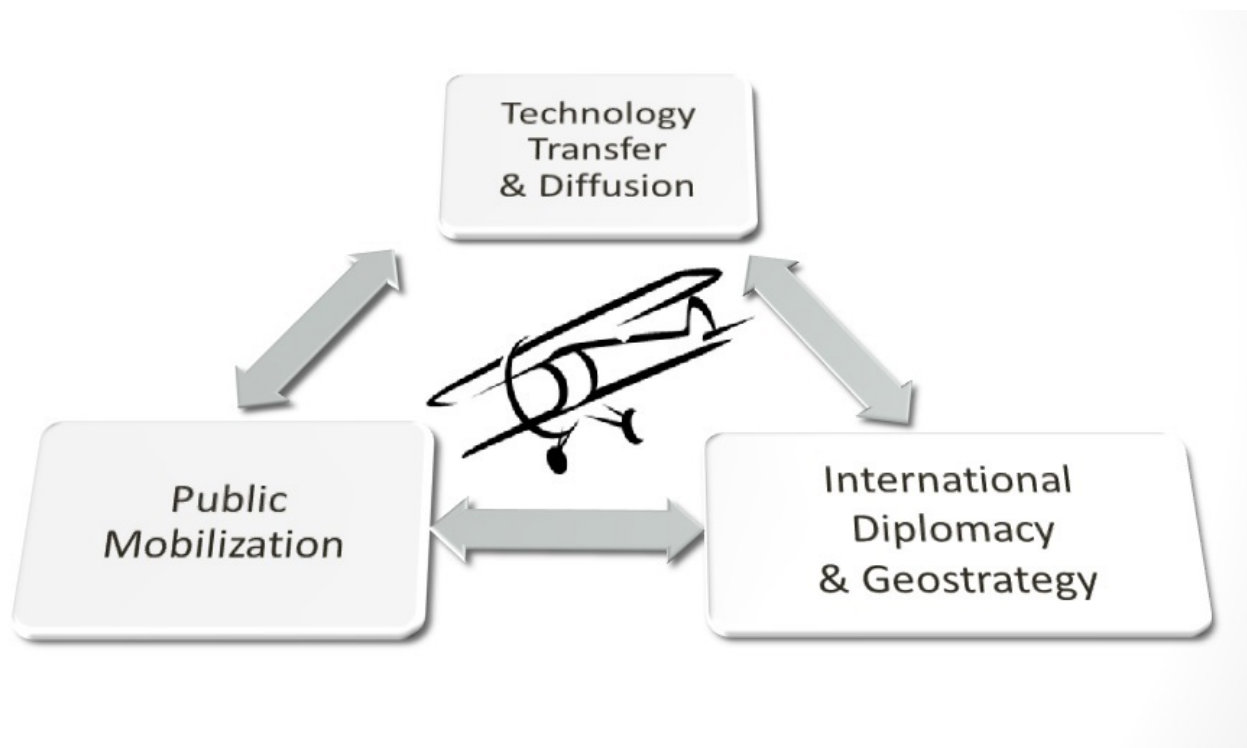
1980). The Western encyclopedias by Robert Mikesh and Abe Shorzoe, *Japanese Aircraft: 1910–1941* (London: Putnam, 1990) and by René Francillon, *Japanese Aircraft of the Pacific War* (Annapolis, MD: Naval Institute Press, 1987) heavily rely on Nozawa. See also Nohara Shigeru’s “illustrated warplane histories” on army, navy, and experimental aircraft. Nohara Shigeru, *Nihon kaigun gun’yōkishū* [Warplanes of the Japanese Navy] (Tokyo: Guriinarō Shuppansha, 1994); *Nihon rikugun gun’yōkishū* [Warplanes of the Japanese Army] (Tokyo: Guriinarō Shuppansha, 1997); and *Nihon rikukaigun shisaku keikakuki 1924–1945* [Experimental planes of the Japanese Army and Navy, 1924–1945] (Tokyo: Guriinarō Shuppansha, 1999).

<sup>18</sup> Autobiographies of early aviators include Tokugawa Yoshitoshi, *Nihon kōkū koto hajime* [The beginnings of Japanese aviation] (Tokyo: Shuppan Kyōdōsha, 1964) and Gunther Plüschow, *Die Abenteuer des Fliegers von Tsingtau, meine Erlebnisse in drei Erdteilen* (Berlin: Ullstein & Co., 1916). Autobiographies of engineers and industrialists include Doi Takeo, *Hikōki sekkei 50 nen no kaisō* [Reflections on fifty years of aircraft design] (Tokyo: Kantōsha, 1989); Claude Dornier, *Aus meiner Ingenieurlaufbahn* (Zug/Schweiz: published by the author, 1966); Ernst Heinkel, *Stürmisches Leben* (Stuttgart: Mundus-Verlag, 1953); Theodore von Kármán, *The Wind and Beyond* (Boston: Little, Brown, 1967); Richard Vogt, *Weltumspannende Memoiren eines Flugzeug-Konstrukteurs* (Steinebach/Wörthsee: Luftfahrt-Verlag W. Zuerl, 1976). More biographies of engineers and industrialists include Heinz J. Nowarra, *Die Flugzeuge des Alexander Baumann* (Friedberg: Podzun-Pallas-Verlag, 1982); Joachim Wachtel, *Claude Dornier: ein Leben für die Luftfahrt* (Planegg: Aviatic Verlag, 1989); Günter Schmitt, Angelika Hofmann, and Thomas Hofmann, *Hugo Junkers und seine Flugzeuge* (Stuttgart: Motorbuch Verlag, 1986); Toyoda Jō, *Hikōki-ō Nakajima Chikuhei* [Nakajima Chikuhei, the king of aircraft] (Tokyo: Kōdansha, 1992); Sanuki Matao, *Sanuki Matao no hitorigoto: kōkū no sekai o horiokoshite hakkutsu shita jijitsu* [Sanuki Matao’s monologue: Facts unearthed from the aviation world] (Tokyo: Gurin Arōshuppansha, 1997).

<sup>19</sup> I take this expression from Roger D. Launius, *Innovation and the Development of Flight* (College Station: Texas A & M University Press, 1999), 14.

<sup>20</sup> Two fine examples of national aviation histories that take such an approach are Peter Fritzsche’s *A Nation of Fliers: German Aviation and the Popular Imagination* (Cambridge,

that the choice of technology and its intended and actual use reflects the values and principles of people and organizations and looks into the complex and dynamic interplay between technology and the public, military, and political spheres. Furthermore, the study's transnational approach allows me to explore how technological advance both shaped and was shaped by international diplomacy and military strategy (see Figure 2).



**Figure 2: Aviation history in context: A diagram to illustrate the mutual interplay of the public, engineers, and political and military leaders.**

---

MA: Harvard University Press, 1992) that links German flight with the wider themes of modernity and nationalism and Scott Palmer's *Dictatorship of the Air: Aviation Culture and the Fate of Modern Russia* (New York: Cambridge University Press, 2006) that explores the connection of Russian and Soviet aviation with the country's politics and culture.

## Technology: Transnational Transfer and National Diffusion

Technology transfer is a central thread of my thesis. The economists Ruttan and Hayami presented a straightforward three-stage model of transnational technology transfer.<sup>21</sup> “Material transfer,” they asserted, comprised the import of hardware such as machinery and production facilities. With “design transfer” the receiving country would acquire know-how from blueprints and patents to set up licensed production. Finally “capacity transfer” enabled an industry to acquire enough insight into methods of research and development to arrive at an independent design.

As this thesis will argue, it is necessary to add several important aspects to this simple pattern. In addition to proficiency in independent design, the mastery of large-scale production is another defining feature of a country’s technological self-sufficiency. Furthermore, the speed and range of a technology’s diffusion are critical for its successful transfer. Such diffusion includes the spread of organizational structures that support the introduction of a new technology and the dissemination of know-how about its use and application.<sup>22</sup> Therefore, in the case of Japan’s aviation, any assessment of international technology transfer has to take into account the transfer and build-up of an efficient aircraft production technology; the organizational build-up of Japan’s airpower; the formation of an air strategy; and the training of Japanese engineers, workmen, and pilots.

Japan had a longstanding tradition of recruiting foreign technological expertise well before the first aircraft took off from Japanese soil. Throughout the Tokugawa era (1603–1867)

---

<sup>21</sup> Vernon W. Ruttan and Yujiro Hayami, “Technology Transfer and Agricultural Development,” *Technology and Culture*, 14 (1973): 119–51.

<sup>22</sup> For details about the diffusion process, see Emily O. Goldman and Leslie C. Eliason, *The Diffusion of Military Technology and Ideas* (Stanford, CA: Stanford University Press, 2003), 11–22.

Westerners found employment in Japan, and their number increased to about two hundred during the 1860s, the last decade of the shogunate.<sup>23</sup> The new Meiji government declared learning from other countries as a cornerstone of Japan's modernization drive and stipulated in its 1868 Charter Oath that "knowledge shall be sought throughout the world."<sup>24</sup> Between 1868 and 1912 the Japanese government established a system for the employment of more than three thousand foreigners and at the same time dispatched an increasing number of students overseas.<sup>25</sup> Starting in the early 1890s, private industry copied this pattern, often using trading companies for the selection of technology and the exchange of engineers.<sup>26</sup>

Close ties between the military and the private sector were a defining feature of Japan's technological transformation. As Richard Samuels has pointed out, the Meiji government used the slogan "Rich Nation Strong Army" (*fukoku kyōhei*) to engage in heavy military spending and to promote the substitution of imports, the transmission of know-how, and the fostering of private enterprises.<sup>27</sup> Japan's emerging aviation industry is a case in point. Throughout its existence, Japan's aircraft manufacturers had close ties to the military. A major impetus for the invitation of foreign aviation experts was the buildup of an independent aircraft production system that would allow the country to catch up with the West.

---

<sup>23</sup> H. J. Jones, *Live Machines: Hired Foreigners and Meiji Japan* (Vancouver: University of British Columbia Press, 1980), 1.

<sup>24</sup> Quoted in William Theodore de Bary et al., *Sources of Japanese tradition, Volume 2, 1600–2000* (New York: Columbia University Press, 2005), 672.

<sup>25</sup> Jones, *Live Machines*, xv.

<sup>26</sup> See Verein Deutscher Maschinenbau-Anstalten, "Handelsverkehr mit Japan: Mitsui und Mitsubishi," 1927, for an account of the central role of Japanese trading companies in the technology transfer to Japan. Source: Deutsches Museum: 0705 T3 1926-1927.

<sup>27</sup> Richard J. Samuels, *"Rich Nation, Strong Army": National Security and the Technological Transformation of Japan* (Ithaca, NY: Cornell University Press, 1994).

## Mobilizing the Public: Visions, Images, and Perceptions

Human flight has caught the public's imagination more than most other key technologies of the early twentieth century. Historians have explored how technology has revolutionized our notions of space and time.<sup>28</sup> The rapid development of surface transport with ever faster trains, cars, and ocean liners changed human perception and imagination.<sup>29</sup> The aircraft further intensified these experiences and also provided new perspectives and new thrills. For us, who now live in an era of flying as industrialized mass transport, it might be difficult to share the strong emotions and high expectations that accompanied the development of the early flying machines. As an artifact that was initially built by enthusiasts for no utilitarian purpose, the aircraft's image was elusive enough to promise both national identity and international brotherhood of man, quasi-religious redemption as well as the triumph of modern rationality.<sup>30</sup> The aircraft also stirred an aggressive enthusiasm for technology like that of the Italian Futurist Filippo Marinetti (1876–1944), who, in his 1909 *Futurist Manifesto*, included the aeroplane in his glorification of war.<sup>31</sup> For the architect and designer Le Corbusier (1887–1965) the airplane was “the symbol of the New Age” that can attract the masses with “sensational demonstrations.”<sup>32</sup>

In Japan the spectacle of flight stirred popular imagination as well. The imagery of a spectacular new technology proved to be remarkably effective in arousing widespread aviation

---

<sup>28</sup> Stephen Kern, *The Culture of Time and Space, 1880–1918* (Cambridge, MA: Harvard University Press, 2003).

<sup>29</sup> Wolfgang Schivelbusch, *The Railway Journey: The Industrialization of Time and Space in the 19th Century* (Berkeley: University of California Press, 1986).

<sup>30</sup> Joseph J. Corn argues in his *The Winged Gospel: America's Romance with Aviation, 1900–1950* (New York: Oxford University Press, 1983) for the elevation of aviation enthusiasm toward a secular religion.

<sup>31</sup> Apollonio Umbra (ed.), *Futurist Manifestos* (London, 1973), 22.

<sup>32</sup> Le Corbusier, *Aircraft: The New Vision* (New York: Universe, 1988 [1935]), 6 and 10.

enthusiasm together with national pride among the Japanese public. At the same time, worries about the backwardness of Japanese aviation and the need to catch up with the West became a recurring theme in the history of Japan's early aviation. In 1910 the public and the press celebrated Japan's first powered flight, thus securing the country's membership in the exclusive club of air-faring nations.<sup>33</sup> Then, in 1914, praise for Japan's pilots (and their aircraft) who fought the country's first aerial warfare with Germany over Qingdao conveyed an impression of being on equal footing with a powerful enemy. In the 1920s several nations had already successfully completed long-distance flights to Japan. These airplanes became known as "black ships from the sky," a reference to the U.S. steamboats that arrived in Japan in 1853 and became a synonym for foreign threat and national humiliation.<sup>34</sup> As a response to these worries the Japanese military and the press joined their efforts for a similar Japanese project of a flight to Europe that was carried out in 1925.

Sociologists of science and technology have argued that "the sociocultural and political situation of a social group shapes its norms and values, which in turn influence the meaning given to an artifact."<sup>35</sup> However, in the case of Japanese aviation this process worked in both directions. The lure of the aircraft also shaped social groups. Indeed, matter-of-fact technocrats become visionaries, and hard-boiled militaries engaged in visions of aerial supremacy that enticed them to initiate enormously expensive armament projects of questionable military use.

---

<sup>33</sup> Nihonkōkūkyōkai, *Nihon kōkūshi Meiji Taishō* [The History of Japanese Aviation in the Meiji and Taishō periods] (Tokyo: Nihonkōkūkyōkai, 1956), 34.

<sup>34</sup> Maema Takanori, *Asahi shinbun hōō daihikō, jō, Shiberia ōdan* [The *Asahi* newspaper's great visit—Europe—flight, Vol. 1: Crossing Siberia] (Tokyo: Kōdansha, 2004), 3.

<sup>35</sup> Wiebe E. Bijker et al., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, MA: MIT Press, 2012), 40.

Time and again the aircraft's image transcended the logic of practicality and replaced utilitarian thinking with visions of military supremacy and invincibility.

The Japanese press played a major role in creating and maintaining public air-mindedness. With their enthusiastic reports the nation's leading papers promoted Japan's aviation. The press also engaged actively in the aviation enterprise with their own air fleet in order to further incite and satisfy the public's interest in the flying machines and their daredevil pilots. The press participated in the military's aviation from its very beginnings. A mutually beneficial relationship evolved where the military provided the news which the press then presented to the eager public.

## **International Diplomacy and Geostrategy**

The interplay of technological advance, international diplomacy, and military strategy allowed German aircraft makers to fuel the strategic demands of Japanese military planners and—at the same time—to offer the advanced technology necessary to implement a new air strategy. After the horrors of World War I, international diplomacy concentrated on peace and disarmament. One direct result of these efforts was the so-called Versailles-Washington Treaty system that aimed at stability in Europe and in the Pacific region. Paradoxically, these treaties stimulated Japanese demand for advanced German technology and boosted the build-up of Japan's military airpower. The 1919 Peace Treaty of Versailles granted Japan, which had fought with the Entente Powers against Germany, unrestricted access to Germany's aviation industry. It also entitled Japan to receive war reparations from Germany that included aircraft, aircraft engines, and equipment. Furthermore, after the Versailles Treaty prohibited Germany from building any military aircraft, nearly all prominent German aircraft manufacturers started license negotiations with Japan and began to send their engineers abroad. This illicit move, which had

been sanctioned by both governments, led to a Japanese-German rapprochement and alienated Japan from its erstwhile allies.

Two major disarmament initiatives actually led to a significant expansion of Japanese airpower. In 1922 the Washington Naval Treaty was concluded among Japan, the United States, the United Kingdom, France, and Italy to prevent a naval arms race in the Pacific. The treaty banned the completion of two Japanese battleships. Yet instead of scrapping the half-finished hulls of these ships the navy converted them into aircraft carriers and started an ambitious program for carrier-based aircraft. In the wake of the 1925 “Ugaki Disarmament” the Japanese Army sharply reduced its troop numbers. At the same time, as we shall see, Army Minister Ugaki Kazushige (1868–1956) provided the army with the funds to radically revise its air force strategy away from reconnaissance and toward offensive air battle and bombing.

The growth of Japanese airpower coincided with major revisions of the armed forces’ air strategy. After World War I, Japanese observers brought back from Europe new concepts of air superiority and strategic bombing that demonstrated the key importance of powerful fighter aircraft and advanced bombers. After 1923 the need for heavily armed long-range bombers became especially pressing when plans for a future occupation of the Philippines included the development of an “ultra-heavy bomber” that could take off from Taiwan, cross the Luzon Strait, and attack Manila. After 1930, the Japanese Navy planners began to put increased emphasis on carrier-based bombers as an attack force. They devised a new doctrine of preemptive air strikes on American aircraft carriers. For such a high-risk strategy the Japanese needed aircraft with a superior flight range in order to “outrange” the enemy’s aircraft. Furthermore, the accuracy of the bombers had to be increased significantly. The proponents of the “first strike capability”

doctrine envisioned that this kind of advanced bomber could lead to victory even against a numerically superior enemy.

German aircraft makers capitalized on their own revolutionary technology for all-metal aircraft, which allowed them to fulfill the Japanese request for advanced machinery. German hardware and know-how thus played a key role in the formation of an increasingly aggressive Japanese air strategy of preemptive airstrikes on the enemy's airbases and carriers in a short, decisive war.

## **Chapter Overview**

The first chapter surveys the early years of Japanese aviation. An examination of Japan's first powered flight shows how the military introduced the new technology to the public as an orchestrated spectacle that featured a competition between French and German aviation technology. Soon after the outbreak of World War I Japan fought its first air battles over the German concession of Qingdao in China. War reports promoted the powerful image of the aircraft as revolutionary weapon. The Great War also provided an opportunity for Kusakari Shirō, an army technocrat who was dispatched to Germany and France between 1914 and 1917, to experience the rapid advance of aerial warfare in Europe. After his return to Japan, Kusakari's reports and lectures conveyed an image of German aviation technology on the rise that attracted the keen interest of Japanese military planners in German hardware and know-how.

The second chapter follows the course of Japanese aviation in the aftermath of World War I. The new concept of a total war absorbed the minds of Japanese strategists and prompted them to consider the related topics of strategic bombing, air defense, and public air-mindedness. At the same time, the Versailles Treaty unintentionally helped to propagate further the image of advanced German aviation technology to the Japanese. Its regulations granted an international

inspection team almost unrestricted access to Germany's aviation industry. The Japanese team members of the committee reported their firsthand experience back to Japan in great detail. The treaty also stipulated that, as part of Germany's war reparations, Japan was to receive scores of German aircraft. After their investigation, Japan's appetite for German technology increased, and the military became interested in hiring German pilots, engineers, and workmen for the assembly of confiscated aircraft and for further research.

The following two chapters explore the simultaneous development of the navy's and the army's air force. These parallel narratives take into consideration Japan's famed inter-service rivalry that prevented the establishment of a unified air force. Chapter three examines Germany's role in Japan's emerging naval aviation. It places Japanese aviation history in a wider strategic and geopolitical context, and argues that the import of German technology provided decisive stimuli for far-reaching changes within the Imperial Japanese Navy. It reveals how the navy recruited German aircraft makers who then worked hand in hand with Japanese manufacturers and arsenals. As a result a whole range of aircraft types from Germany offered new answers to the probing question of how to challenge a powerful enemy. These new technologies helped to strengthen the position of the Japanese Navy's modernizers and seriously challenged the "big-ship, big-gun policy" of the traditionalists. At the same time hardware and know-how from Germany transformed the character of Japan's naval airpower from a largely defensive force to an air fleet with aggressive first-strike capability.

The fourth chapter contrasts the build-up of Japan's Naval Aviation with that of the Imperial Army's air arm. Since the mid-1920s the Japanese Army entirely relied on civil companies to develop and build its aircraft. The chapter therefore follows the rise of Kawasaki's and Mitsubishi's aircraft sections and introduces German engineers as key figures in this process.

It highlights how these German teachers trained a new generation of Japanese aeronautical engineers who by the mid-1930s would come up with their own original designs. During this decisive transition from licensed production to independent design the Japanese Army was able to modernize its airpower with state-of-the-art bombers, reconnaissance aircraft, and fighters that matched and in many aspects even surpassed those of the West.

Chapter five investigates the army's "Super Bomber" project. It examines the interplay among international relations, strategy, and technology and the impact of these forces on the army's ambitious project. In the early 1920s Japan revised its Imperial Defense Policy and defined the United States as "hypothetical enemy number one."<sup>36</sup> The army envisioned a new bomber for surprise attacks on U.S. bases in the Philippines. In yet another instance of image-driven choice of technology, the army turned to the renowned German aircraft maker Hugo Junkers, who did not fail to impress the Japanese Army officials with his G 38, the world's largest land plane. The chapter looks at the various stages of a unique German-Japanese venture: the license negotiations, the interactions on the shop-floor level, and a successful test flight. It also analyzes the final outcome of the project, relating it to the army's air strategy and the technological advance at the civil manufacturer.

Finally, chapter six shifts the level of analysis from aircraft design and deployment to the topic of aircraft production. In order to situate Japan's emerging aircraft industry in a context of industrial development the chapter returns to the origins of the Japanese aircraft makers and follows the industry's successive efforts to build up an efficient system of mass production. Already in the mid-1920s both the Japanese military and Japanese aircraft makers turned their

---

<sup>36</sup> Kawata Akiharu, "Report on the Martial Spirit among the U.S. Service Personnel," 1923, Japan Center for Asian Historical Records (hereafter: JACAR) Ref. C03022632000.

attention toward German production technology. Assuming that a modern war would be a “war of factories” they were impressed by the German “rationalization movement” as a new ideology that propagated efficiency, economic planning, and scientific management. However, the mundane topics of standardization, interchangeability, and mechanization failed to impress the army’s and navy’s planners. This lack of foresight reveals a critical juncture of German influence that had far-reaching consequences for the development of Japan’s aviation after 1937.

Advanced aviation technology from Germany continued to spur the military’s ambition for ever-faster and powerful aircraft, while the problem of setting up an efficient mass production system had yet to be solved.

# I

## Powerful Images and Grand Visions: The Emergence of Japan's Aviation

A short glance at the countless illustrated books about early aviation suggests an almost linear development from clumsy flying wireframes to streamlined, powerful, and efficient machines. The history of flight did not, of course, proceed along a perfectly straight line. This holds especially true for Japan's early aviation. Even in 1909, six years after the Wright brothers' first powered flight in the United States, there was still disagreement in Japan over what word to use for the new flying machines.<sup>37</sup> At that time it was also far from obvious how Japan should take the effort to join the exclusive club of air-faring nations and if the import of foreign technology would be the best way to do so.

Historians of technology have examined the means or “vehicles” of technology transfer such as imported machinery, engineers, and technical publications.<sup>38</sup> While acknowledging the importance of these issues, this chapter further asks for the motives or the “motor” for the transfer of aviation technology to Japan. It deals with the question why, without any pressing need, this country imported a technology that so far had not proven its practical value and for which there existed neither an organizational nor logistic structure. I will argue that Japan's choice of technology was in large part the result of powerful images that shaped both the public's perception and the experts' imagination. These images of a new machine created visions of

---

<sup>37</sup> In March 1909, when Mori Ōgai (1862–1922) wrote his *Ogura Nikki*, he purportedly used for the first time the word *hikōki* 飛行機 (flying machine). Later versions of the word for “aircraft” include the homonym *hikōki* 飛行器 (flying device) and *kūchūhikōki* 空中飛行器 (aerial flying device).

<sup>38</sup> For an inventory of publications that cover various aspects of technology transfer, see Staudenmaier, *Technology's Storytellers*, 123–33.

national grandeur and military supremacy. An analysis of Japan's early aeronautic imagery can help to explain the motives behind the emergence of the country's aviation. As we will see, such an analysis will also account for the initial preeminence of French aviation in Japan and for the steady rise of interest in German technology during the same period.

The imagery of a new spectacular technology also proved to be remarkably effective in arousing a widespread aviation enthusiasm among the Japanese public. Popular participation in flight demonstrations, exhilarated press reports about Japan's "courageous air battles," and the military's call for a public "aviation craze" built the foundation for Japan's new air-mindedness that secured voluntary and at times even passionate support by the populace for the new aviation project.<sup>39</sup>

This chapter focuses on three prominent events that shaped the further course of Japan's aviation. Firstly, an examination of Japan's earliest successful motor flight in 1910 aims to demonstrate how this landmark event shaped the military's image of French and German aviation. Secondly, an analysis of Japan's first air battle above the German leasehold of Qingdao in 1914 will show how images of aerial combat influenced Japan's military leaders in their evaluation of the enemy's aviation technology. Finally, a review of the aviation expert Kusakari Shirō's stay in Europe from 1914 to 1917 will explore how an influential army engineer molded his image of French and German aviation according to the highs and lows of his personal experience.

---

<sup>39</sup> I am aware of the anachronistic use of the expression "air-minded." According to the *Oxford English Dictionary*, the word entered the English language only in 1927, nearly a quarter of a century after the Wright brothers' first powered flight in 1903. *Oxford English Dictionary*, 2nd ed., s.v. "air-minded."

## The Road to Japan's First Motor Flight

Within the first three decades of the twentieth century airplanes became a mature and efficient means of transport. They effectively shrank the world, promoting international trade and communication; they also became part of a new dimension of warfare.<sup>40</sup> Before the end of the nineteenth century the German engineer Otto Lilienthal (1848–96) was one of the first aviators who combined careful aerodynamic studies with relentless experiments that he carried out himself in various lightweight monoplane gliders. In 1889 he published his seminal book *Der Vogelflug als Grundlage der Fliegekunst* (Bird Flight as the Basis of the Art of Flying). Lilienthal's ideas about controlled flight caught the attention of the Wright brothers and influenced the design of their own flying machine.<sup>41</sup> Based on comprehensive wind-tunnel experiments the brothers built and tested a series of gliders. Then, in December 1903 Orville Wright became the first pilot to accomplish a controlled motor flight in an airplane.<sup>42</sup>

The U.S. military initially showed little interest in the Wrights' Flyer, and in 1908 Wilbur Wright decided to travel to Europe in the hope of finding a more receptive clientele. He made his first flight in France in August 1908. One month later he set a world endurance record of more than one-and-a-half hours covering a distance of about 66 kilometers. The flight not only won the Aero Club of France Prize but also proved the superiority of the Wrights' design over that of their European competitors. Wilbur Wright's trip to Europe was also commercially successful. In

---

<sup>40</sup> For an illustrated overview, see Peter Almond and Sally Bald, *Aviation: The Early Years* (Königswinter: H.F. Ullmann, 2007).

<sup>41</sup> John David Anderson, *A History of Aerodynamics and Its Impact on Flying Machines* (Cambridge: Cambridge University Press, 1997), 208.

<sup>42</sup> The word *airplane* derives from the French *aéroplane*, an expression which, according to the French Centre National de Ressources Textuelles et Lexicales (<http://www.cnrtl.fr/etymologie/aeroplane>, accessed January 13, 2014), was coined by the French inventor Joseph Pine in 1855. Pine suggested a flying machine that used a horizontal "plane" to create lift as opposed to the spherical bag of a balloon.

1908 the French Compagnie Générale de Navigation Aérienne bought the license for building the Wright airplanes, and one year later the German Flugmaschine Wright GmbH purchased the Wright patent as well and started production in a factory near Berlin.<sup>43</sup>

In 1909 several milestones drew the attention of the world's aviation experts toward France. In this year the French Army was the first military force to introduce airplanes as a new weapon of war. It also pioneered in creating a comprehensive organization for pilot training and the acquisition and maintenance of aircraft. Furthermore, the French general staff outlined a new doctrine and a new command structure to make best use of the possibilities offered by the flying machines. These efforts received valuable popular support from the aviation pioneer Clément Ader (1841–1925), who published his book *L'Aviation Militaire* (Military Aviation) the same year. His bold vision about airplanes revolutionizing modern warfare fascinated the French public and soon became a bestseller.

Yet the outstanding event of the year 1909 was Louis Blériot's (1872–1936) successful crossing of the English Channel on July 25. With his achievement the French pilot not only proved the feasibility of sustained powered flight but also aroused an unprecedented aviation craze on both sides of the Channel. Upon his return to France an estimated one hundred thousand people enthusiastically welcomed the man who had demonstrated that Great Britain was “no longer an island.”<sup>44</sup> After this landmark event the number of aviation aficionados rapidly increased. One month later half a million paying visitors rushed to the Reims Air Meet, or the *Grande semaine d'aviation de la Champagne* as it then was called. With the French president

---

<sup>43</sup> Gibbs Charles Harvard-Smith, *The Wright Brothers: Aviation Pioneers and Their Work, 1899–1911* (London: Science Museum, 2002), 44.

<sup>44</sup> Headline of the *Daily Mail*, July 27, 1909. The same phrase appeared in the July 29 edition of the *Asahi* newspaper.

attending and under the watchful eyes of a delegation of the War Ministry, twenty-five aviators from six different countries competed for cash prizes for the fastest, highest, and longest flights. The stunning performances of the new flying machines were celebrated by the general public as a feat of progress. For experts they proved that aviation was in a transition from a breakneck sport to a substantial means of transport and warfare. To nationalists the overwhelming success of the French pilots was further proof of the “glory and the honor of our race.”<sup>45</sup>

The driving forces behind these developments—even more than the courage of the daredevil pilots—were significant technological improvements conceived and worked out by the French aircraft designers. Blériot already anticipated with his monoplane the standard arrangement of motor, wings, and elevator of future aircraft. Henri Farman (1874–1958), another French aviation pioneer, became one of Blériot's fiercest competitors. He gained international fame for establishing a new world distance record of 180 kilometers with his Farman III biplane at the 1909 Reims meeting. The Farman III was a remarkable aircraft that could be steered by means of four ailerons at the wings' trailing edges. This innovative device was a decisive step toward improved maneuverability and avoided the notorious instability of the Wright brothers' method of wing warping for directional control. Farman built around thirty specimens of this aircraft. It became an international bestseller that soon could be seen in the skies of Belgium, England, Hungary—and Japan.<sup>46</sup>

Even though France established itself firmly as the leading aviation nation, French worries about German aerial armament increased. Warnings that Germany would build up its airpower

---

<sup>45</sup> A French newspaper article quoted in Peter Demetz, *Die Flugschau von Brescia* (Wien: Paul Zsolnay Verlag, 2002), 50.

<sup>46</sup> Gérard Hartmann, “Les premiers Farman,” in *Dossiers historiques et techniques aéronautique française* (<http://www.hydroretro.net/etudegh/index.php>, accessed January 13, 2014).

with “Teutonic tenacity” evoked an image of France losing its technological superiority to an enemy that soon would be able to ignore the Rhine River as France’s natural defense barrier and strike from the sky.<sup>47</sup> However, while the German military had shown a keen interest in the giant airships of the German aviation pioneer Count Ferdinand von Zeppelin (1838–1917), it initially was reluctant to invest in airplanes. A private initiative promoted the development of made-in-Germany aircraft. In spring 1908 the German industrialist Karl Lanz (1873–1921) offered an award of 40,000 marks to the first German pilot who successfully flew a flat “8” around two pylons, placed one thousand meters apart. An additional requirement stipulated that the aircraft had to be produced in Germany and powered by a German motor. More than one year later Hans Grade (1879–1946), an engineer who had specialized in the development of lightweight engines, became the first German pilot to meet this challenge. On October 30, 1909, in front of two thousand spectators, he completed his flight in less than three minutes. Making use of his prize money and his sudden popularity, he founded Germany’s first flight school and started the production of his prizewinning aircraft.

### ***Two Reports About Western Aviation and the Dispatch of Japan’s First Student Pilots***

The developments in European aviation did not go unnoticed in Japan. In March 1909 the naval officer Yamamoto Eisuke handed his “Opinion Paper on Aviation Research” to his superior Yamaya Tanin (1866–1940). The report emphasized the fast progress of Western aircraft technology and warned about the “horrible power” (*osorubeki iryoku*) of future “air

---

<sup>47</sup> Clément Ader, *L’aviation militaire* (Paris: Berger-Levrault, 1911), 79.

battleships" (*kūchū gunkan*).<sup>48</sup> Within the same month Yamaya approached the Army General Staff Office and proposed a joint cooperation in aviation research.

Already in January 1909 the Japanese Army had put its own aviation specialist to work. Kawata Akiharu, a captain in the Army General Staff, was in charge of collecting and analyzing information about the progress of foreign military aviation. Kawata based his investigations on foreign publications and on information received from Japanese military attachés based abroad. Based on a thorough comparison of power-driven lighter-than-air airships and airplanes Kawata concluded that airplanes were the advanced weapon of the future that combined maneuverability with endurance and speed. In May 1909 he had enough data at hand to submit a report to the Army Minister Terauchi Masatake (1852–1919).

Two months later Blériot's channel crossing received extensive news coverage in Japan's newspapers. The same article that reported the "mad enthusiasm" (*kyōkiteki nesshin*) of the French about the feat of their fellow countryman raised questions about the backwardness of Japan's aviation research with the author expressing his hope that "the Japanese rapidly learn this spirit of inquiry."<sup>49</sup>

Given the worldwide publicity of Blériot's flight it comes as no surprise that, in an updated version of his report, Kawata acknowledged France's leading position in the aviation world with Germany in second place. He supported his assessment with a comparison of each country's

---

<sup>48</sup> The original report is reproduced in Nihon Kaigun Kōkūshi Hensan Iinkai, *Nihon Kaigun kōkūshi 1 Yōhei hen* [The history of Japanese naval aviation 1 (strategy)] (Tokyo: Jiji Tsūshinsha, 1969), 50–53.

<sup>49</sup> *Yomiuri Shinbun*, July 28, 1909, morning edition, 1, and *Asahi Shinbun* (Tokyo), July 29, 1909, morning edition, 2.

number of military airplanes and crews.<sup>50</sup> Kawata's report, published under the title "Aerial Flying Devices" (*kūchū hikōki*) in October 1909, also introduced the latest French Farman and Blériot airplanes as exemplars of advanced French aircraft design.

Kawata's October 1909 report had an immediate effect on the military's upper echelons. In the same month that the army minister received Kawata's analysis he consulted with Navy Minister Saitō Makoto (1858–1936) about setting up Japan's first organization for aviation research. Considering the longstanding army-navy rivalry, the result was a rare example of inter-service cooperation. Both ministers agreed to establish a joint army-navy project, the Provisional Committee for Military Balloon Research (*rinji gunyō kikyū kenkyū kai*), or Balloon Committee for short. The committee's name reflects the dominance of balloons and airships as tools of aerial warfare at the time of its founding. However, in spite of its outdated name, the new organization was to play a key role in the advance of Japan's military aviation.

From the outset the army was in firm control of the Balloon Committee institution. The army not only covered the institution's whole budget but also installed Nagaoka Gaishi (1858–1933), the head of the army's Bureau of Military Affairs, as the committee's chairman. Furthermore, eleven of the twenty committee members belonged to the army. They were joined by six naval officers and three academics from Tokyo Imperial University. The restraint of the navy to engage more actively in aeronautical research and in the build-up of Japan's airpower seems unusual considering that, already soon after its creation in 1869, the navy had gained a reputation for openness to technical innovation.<sup>51</sup> One source claims that there was a widely

---

<sup>50</sup> Bōeichō bōeikenshūjō senshi shitsu, *Rikugun kōkū no gunbi to un'yō I* [The army's aerial armament and operations 1] (Tokyo: Asagumo Shinbunsha, 1971), 11–14.

<sup>51</sup> David China Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887–1941* (Annapolis, MD: Naval Institute Press, 1997), 1–31.

spread skepticism among naval officers about the value of land-based aircraft in future sea battles.<sup>52</sup> This proposition seems plausible, considering that, at the time of the committee's founding, the aviation world was still waiting for the flight of the first seaplane.<sup>53</sup>

Two members of the Balloon Committee were to earn their places in Japan's aviation history. One of them, Hino Kumazō (1878–1946), belonged to the army's Technical Research Group (*rikugun gijutsu shinsabu*).<sup>54</sup> A gifted engineer and inventor, Hino became a specialist in firearms before turning his interest toward the design of airplanes. In 1909 he began the construction of his Hino Type 1, a monoplane made from bamboo and cypress wood. However, due to its weak 8hp engine, the aircraft was never able to take off.<sup>55</sup> Nevertheless, Hino's efforts attracted the attention of the Balloon Committee, which made Hino a member in August 1909. Half a year later, in March 1910, Tokugawa Yoshitoshi (1884–1963) joined the committee as well. Tokugawa Yoshitoshi's father was Count Tokugawa Atsumori (1856–1924), the head of one of the three branches of the once powerful Tokugawa clan.<sup>56</sup> In addition to his illustrious ancestry he was extremely well connected. Tokugawa's superior officer in the army's Balloon Corps, together with committee chairman Nagaoka, recommended that he become a committee

---

<sup>52</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō I*, 15–16.

<sup>53</sup> The French pilot Henri Fabre is generally credited with having carried out the first successful seaplane flight in March 1910.

<sup>54</sup> For more biographical details, see Shibuya Atsushi, *Hino Kumazō den* [The life of Hino Kumazō] (Kumamoto: Tamakina Shuppansha, 2006).

<sup>55</sup> Bōeichō bōeikenshūjō senshi shitsu, *Rikugun kōkū heiki no kaihatsu seisan hokyū* [The development of the army's aerial weaponry, its production, and supply] (Tokyo: Asagumo Shinbunsha, 1975), 12.

<sup>56</sup> Tokugawa Yoshitoshi, *Nihon kōkū koto hajime*, 241.

member.<sup>57</sup> Some sources speculate that at the same time Tokugawa was promised an opportunity to promote the prestige of his lineage by becoming Japan's first pilot.<sup>58</sup>

Soon the Balloon Committee's activities picked up momentum. On April 8, 1910, the army informed Japan's Foreign Ministry about the dispatch of Captain Tokugawa and Captain Hino to Europe. The two officers were to receive flight training in France and Germany and to purchase a variety of the latest aircraft models.<sup>59</sup> The Balloon Committee granted Tokugawa and Hino considerable flexibility to choose the most suitable aircraft types with the proviso that the new machines be easy to operate and combine reliability with high performance. In addition the committee required that the two officers be able to fly any airplane purchased abroad and that all such planes could be maintained and repaired in Japan.<sup>60</sup>

**Figure 3: The eager student pilot Tokugawa Yoshitoshi and his apparently somehow less enthusiastic French flight instructor in a Farman biplane.**<sup>61</sup>

After his arrival in France in late April 1910, Tokugawa set out for the small town of Étampes, sixty kilometers south of Paris (see Map 2). There he became one of the first students of the *École de Pilotage de Henri Farman*, Farman's newly founded flight school.

In a detailed account Tokugawa described how the training began. Sitting behind his flight instructor he was clinging with one hand to the aircraft. With the other hand he reached over the

---

<sup>57</sup> Nihon Kōkūkyōkai, *Nihon Kōkūshi vol. 2* [The history of Japanese aviation] (Tokyo: Nihon Kōkūkyōkai, 1936), 186–87, 241–44.

<sup>58</sup> Yokota Junya, *Kumo no ue kara mita Meiji* [The Meiji era seen from above the clouds] (Tokyo: Gakuyō shobō, 1999), 15–16.

<sup>59</sup> Gunmukyoku gunmu ka, “Hino Tokugawa ryōtaii ōshū haken no ken” [The dispatch of the two officers Hino and Tokugawa to Europe], 1910, JACAR Ref. C06084949000.

<sup>60</sup> Tokugawa, *Nihon kōkū koto hajime*, 52–53.

<sup>61</sup> Source: Tokugawa, *Nihon kōkū koto hajime*, i.

instructor's shoulder in order to touch the control column lightly and to get the feeling of how his teacher steered the plane (see Figure 3). Several flights later, after Tokugawa had become proficient enough, he was allowed to change places with the trainer and to steer the aircraft by himself. Tokugawa described the details of his first solo flight and how he strongly felt the loneliness of the pilot fending for himself. He also mentioned that, much to his surprise, the aircraft was much easier to handle without the corpulent instructor on board. After a few more solo flights Tokugawa was ready for the final examination for which, however, he was obliged to buy the Farman aircraft for the steep price of ¥16,000.<sup>62</sup> On October 8, 1910, Tokugawa received his French pilot license with the serial number 289.<sup>63</sup>

Obviously the Japanese Army was not content to rely on the flying machine of only one country. It assigned Hino to go to Hans Grade's flight school at Johannisthal. Located at the southeastern fringes of Berlin (see Map 2), Johannisthal was one of Germany's first airfields and had already attracted a number of aircraft makers that had set up their workshops in its vicinity. It was also the place where Hans Grade had gained national fame when he won with his monoplane the *Lanz Preis der Lüfte*. Hino followed the army's advice and bought one of Grade's aircraft. The aircraft purchase also included the proper flight training. The Hans Grade Monoplane, built with an unusual mix of bamboo and welded steel tubes, was a marvel of lightweight construction. It was also simple and cheap – its price of ¥7,000 was less than half of

---

<sup>62</sup> Nagaoka Gaishi, "Request for the Release of the Contract Guarantee Fund," 1910, JACAR Ref. C06084948200.

Nohara Shigeru gives in his *Nihon gunyōki jiten, Rikugun hen, 1910–1945* [Encyclopedia of Japanese warplanes (Army) 1910–1945] (Tokyo: Ikarosu Shuppan, 2005), 38, a sum of ¥18,835 that includes two spare propellers and the transport cost. He calculates that this sum would amount to ¥94 million in today's monetary value.

<sup>63</sup> Tokugawa, *Nihon kōkū koto hajime*, 54–58.

the amount Tokugawa had to pay for his Farman biplane in France.<sup>64</sup> However, as a single-seater, the monoplane's military use was very limited. Moreover, its eccentric steering mechanism—the pilot had to operate the aircraft with a control stick hanging down from above his head—required a special piloting technique that included a mix of lateral, longitudinal, and twisting movements of the control handle. For a long time Hino was the only airman in Japan able to fly this aircraft.

### ***The Yoyogi Flight***

In November 1910, two shipments of oversized wooden containers arrived in Yokohama, the port close to Tokyo. They contained a precious load from Europe, two French aircraft built by Farman and Blériot and one German Grade monoplane. The dockworkers transferred the giant boxes with their high-tech artifacts to special carts which were then—in a very old-fashioned way—pulled by oxen to Tokyo. In an empty balloon hangar the army's specialists assembled the Farman and Grade aircraft and prepared them for the big event they had planned: Japan's first motor flight.

The Japanese Army chose the Yoyogi parade ground in the heart of Tokyo as the venue for the big event. The parade ground was a natural choice for Japan's first flight demonstration. It provided sufficient space for the flying machines to carry out their ground maneuvering, takeoff, and landing. The open space also could accommodate a vast crowd of spectators. Equally important was the fact that, already by the end of the nineteenth century, parade grounds were associated in the public mind with the immensely popular pageantry and ceremonial pomp of military parades, war victory ceremonials, and military reviews.<sup>65</sup> It could therefore be expected

---

<sup>64</sup> Nagaoka Gaishi, "Request for the Release."

<sup>65</sup> See Fujitani, *Splendid Monarchy: Power and Pageantry in Modern Japan* (Berkeley: University of California Press, 1996), 105ff, about the new rituals of the Meiji era and how they were exploited for nation-building and social disciplining.

that people would come in droves to watch yet another spectacle to be performed at the parade ground.

The forthcoming flight show began to attract increasing attention. It promised the public direct participation not only in the country's first motorized flights but also in a sensational competition between Europe's two leading aviation nations. German engineering, embodied by a small 24hp 225kg monoplane, was challenging French technology represented by an impressive 50hp 600kg two-seater biplane (see Figure 4). On a more personal level, the event could also be considered as a struggle between the lonely infantryman Hino, who had the reputation of being a more talented technician than a staunch military officer, and the aristocrat Tokugawa, who was a popular figure among his peers enjoying the full support of his comrades.

**Figure 4: Japan's first pilots: Hino in his German Grade monoplane (left) and Tokugawa in his French Farman biplane (right). Note the different sizes of the airplanes and the distinct postures of their pilots.**<sup>66</sup>

Preparations for the seminal event began in early December. The parade ground was gradually transformed into a quasi-ceremonial space with a short provisional airstrip at its very center. Large tents close to the runway were to be used as aircraft hangars. With their enormous white tarpaulins, these hangars cloaked the flying machines in a shroud of mystery. Special seating arrangements were provided in a well-planned layout for the members of the military's aviation committee and for distinguished civilian guests. The southern part of the parade ground was reserved for military officers and cadets while the western section was to accommodate various groups and school classes; the remaining space was to be open to the general public.

---

<sup>66</sup> Sources: Shibuya, *Hino Kumazō den*, 143, and Tokugawa, *Nihon kōkū koto hajime*, iv.

The final transport of the aircraft from the assembly place to the parade ground was done at night to avoid any obstructions by other vehicles or curious bystanders. The aircraft were put on horizontal ladders that were attached to wooden poles which then were hoisted by a large number of soldiers onto their shoulders. Contemporary observers did not fail to notice the obvious similarity of each airplane with a *mikoshi*, a heavily decorated portable Shinto shrine that is carried in a similar manner during Japanese ceremonial festivals.<sup>67</sup>

On December 11 the first test runs of the aircraft engines began. These motors filled the air with a penetrating noise which had never been heard in Japan before.<sup>68</sup> The strange intermittent sound must have excited the curiosity and expectations of even the more distant bystanders. The next day the two pilots could be observed in their aircraft while practicing ground maneuvering. During one of these exercises Hino's aircraft gained considerable speed, took off, and climbed to a height of two meters.<sup>69</sup> However, this short jump of the monoplane was declared an "unscheduled lift-off" and thus in the eyes of the officials did not qualify as Japan's first flight.<sup>70</sup>

The following days the crowds that gathered were kept waiting. The only spectacle that front-row spectators could witness was the capsizing of Hino's Grade airplane during another ground maneuver that resulted in damage to a propeller. Finally it was officially announced that the great event that everybody was waiting for was to take place on the afternoon of December

---

<sup>67</sup> Tokugawa, *Nihon kōkū koto hajime*, 63.

<sup>68</sup> The French *Gnome* motor was a seven-cylinder rotary engine. Its entire engine block rotated together with the propeller around a fixed crankshaft.

<sup>69</sup> Nihon Kōkū Kyōkai, *Nihon kōkū shi Meiji Taishō* [The history of Japanese aviation in the Meiji and Taishō periods] (Tokyo: Nihonkōkūkyōkai, 1956), 35.

<sup>70</sup> The question about who actually was Japan's first pilot has received a lot of attention. The discussion is further complicated by contradictory newspaper reports. The *Nichi Roku Shinpō* of December 15, 1910, reported Hino's flight, and the *Kokumin Shinbun* of December 20, 1910, announced Tokugawa's flight as being the first in Japan. A more recent publication of Hiraki Kunio, *Baron Shigeno no shōgai* (Tokyo: Bungei Shunjū, 1990), and the exhibits of the aviation museums in Tokorozawa and Kakamigahara give the credit to Hino.

17. One spectator's report shows how, in spite of earlier disappointments, an unwavering crowd continued its daily trip to Yoyogi in anticipation of the spectacle:

At one o'clock I went to the Yoyogi parade ground that has now become a maneuvering ground for flying. The northern part was already black with the general audience. Hundreds of members of the Balloon Research Committee and military officers were present near the hangars. Moreover, more than three hundred spectators, most of them high-ranking military officers and foreign attachés, were already there. But the airplanes stayed inside the hangars.<sup>71</sup>

Under the headline "An Out-of-Season Garden Party" an elderly person gave an even more excited account of the ongoing festival mood:

I will look at whatever I can see. Then I can die in peace. I came this morning to Yoyogi with my grandson to see the flight performance. Already so many spectators have arrived and still, with the nice weather, trainloads of people just keep on coming. They march like an army of ants from Harajuku Station to the north of the parade ground. A steady stream of people is rushing in, singing military songs. Soldiers try to control the crowd. Small school kids are pushing close. Even though the airplanes do not fly the sightseeing crowd encircles the whole parade ground. We wait for one hour, for two hours but nothing goes up.<sup>72</sup>

Later the notice "because of strong wind, flight demonstration has been cancelled" was put up. Guards dispersed the crowd and people went home disappointed. On Sunday, December 18, the patience of the crowd was further tested when the flight was cancelled again because of strong wind. With more than one hundred thousand spectators making a daily pilgrimage to the parade ground the pressure on the two pilots to fulfill the crowd's expectations increased.

The next day, presumably to avoid any gusts, as early as 4:30 Captain Tokugawa climbed into his aircraft. He had fastened to his back a heavy battery that was connected by two wires to the aircraft's engine to supply its ignition system. According to the somewhat breathless report of the *Tokyo Nichinichi Shinbun* paper, Tokugawa cast a quick glance at the committee members

---

<sup>71</sup> *Asahi Tokyo*, morning edition, December 18, 1910.

<sup>72</sup> *Ibid.*

and assured them: "Today I will definitely succeed" and "with these strong words he dashed off westward." Another article continues the story of the heroic flight:

Captain Tokugawa grabbed the control stick of his aircraft with his left hand and raised his right hand in a magnificent way. The big monster was lifted by a gale-like cloud of dust that moved it three hundred meters in a westerly direction. At that very moment it lifted off the ground and gently began to fly. In front of all our eyes it suddenly climbed straight up to a height of seventy meters.<sup>73</sup>

While Tokugawa was up in the air, Hino was desperately working to fix his aircraft's engine. Obviously aware of the pressure to get his aircraft into the sky as well, he reportedly said: "Let's see if in the end man or the machine will win."<sup>74</sup> With a spluttering motor running on just three of its four cylinders, he finally took off for his short flight. Hino successfully fought the winds that tossed his tiny aircraft up and down and managed to fly a half circle and to land safely.

As improvised as these flights might have seemed, they did not fail to impress the audience and to incite national pride. As one excited newspaper report put it, "for those who saw it, it was close to a miracle. This first official record was the dawn of our aviation era . . . [Japan] has become the fifth member of the international aviation world."<sup>75</sup>

Within a relatively short time the proficiency of the Japanese pilots and the reliability of their machines improved. Short jumps of several hundred meters were gradually replaced by air trips that left the airport's vicinity. When the radius of these flights widened, the spectacle of the air show gained a new dimension. Reports of Captain Tokugawa's first air-trip from the country's military airport Tokorozawa, about 30 kilometers northwest of Tokyo (see Map 1), to Yoyogi reveal more of the growing appeal of Japan's early flight shows:

---

<sup>73</sup> *Yomiuri Shinbun*, December 20, 1910, 3.

<sup>74</sup> Nihon Kōkūkyōkai, *Nihon kōkū shi*, vol. 1, 91.

<sup>75</sup> Quoted in Nihon Kōkū Kyōkai. *Nihon kōkū shi Meiji Taishō*, 36.

Spectators came with sleepy eyes to Yoyogi in order to watch a magnificent event. Harajuku Station was completely crowded. Around 5:30 already ten thousand people had gathered together with a large number of military policemen on horse and on foot. Everybody stared at the sky full of expectations. Then, at 6:15 at the northwest of the parade ground suddenly one black spot appeared. From all directions voices could be heard "he is coming." The black spot gradually became bigger and looked like a bird. Four soldiers waved with big white flags to show the landing point. Five minutes later the aircraft had made its impressive appearance over the forest and descended with a deafening sound. Any moment now it would come close and fly over the crowd. Everybody shouted "banzai" as often and as loud as possible. The crowd was running all over the place, so Captain Tokugawa could not land as planned. He landed southeast of the parade ground instead at 6:27. He had covered 31.5 km in 32 minutes. After the aircraft touched down everybody made a rush for Tokugawa still shouting "banzai."<sup>76</sup>

What might have seemed like a playful fairground spectacle with a crowd on the verge of getting out of control was an event carefully arranged by the Japanese military. Events like this did away with doubts about the practical use of the army's new weapon and secured public support for the development of Japanese aviation. The public's endorsement of the costly aviation project was important, especially when considering that the Japanese military's annual budget had to be approved by the Diet. Tokugawa himself was aware of the propagandistic effect of his endeavor. In his memoirs he expressed his satisfaction that his flight to Tokyo was reported with banner headlines and declared: "I believed that I contributed to the diffusion of an aviation ideology."<sup>77</sup>

Parallel to the military's efforts yet another way evolved to spread the nation's growing passion for aviation. Popular songs and children books reproduced the powerful images of the seemingly magical flying machines. Takano Tatsumi's "Song of the Big Contest between the Two Captains Hino and Tokugawa" praised enthusiastically Japan's first two airmen.<sup>78</sup> It was published in 1911 in a songbook that was lavishly illustrated with airplane photographs and even

---

<sup>76</sup> Article published in the *Yomiuri Shinbun* on October 28, 1912, the day after Tokugawa's flight.

<sup>77</sup> Tokugawa, *Nihon kōkū koto hajime*, 115.

<sup>78</sup> Takano Tatsumi, *Hino Tokugawa ryō taii hikōki daikyōsō shōka* [The song of the big contest between the two Captains Hino and Tokugawa] (Tokyo: Hotta Wataru Morikan, 1911).

provided an aeronautical glossary. The lyrics tells the story of the two skillful pilots who—in front of an audience that is already excited by smoke, explosions, and the daring sound of howling propellers—fly into the sky, “like arrows released from a bow.” The open-mouthed crowd watches them descend suddenly, dangerously almost touch the ground, then climb up again until they disappear. The aircraft then enter the realm of the heavenly princesses, a place full of cherry and plum blossoms, peaches, and nightingales. Then, in an unexpected change the two planes fly into the “clouds of war.” They succeed in pulverizing the enemy’s warships and fortresses with a “shower of air torpedoes and bombshells.” Returning to the waiting crowd, the two pilots head for the finish line where tens of thousands of spectators receive them with their cheers. The two airmen and their aircraft are celebrated for setting new records in the “civilized world” and “giving extreme joy to the people.”

The song gives evidence of the popular hero worship that developed in the wake of Tokugawa’s and Hino’s first flights. It also presents a public that is united by aviation enthusiasm and is proof of how the aircraft, even when absent from view, spurred fantasies of celestial paradises, military omnipotence, and Japan’s place among the advanced nations.

In 1911 the writer of children’s stories Iwaya Sazanami also published his *The Young Aviator, an Illustrated Picture Story*. His book tells a similar story to a much younger audience.<sup>79</sup> In an aircraft that shows the distinguishing features of Tokugawa’s Farman the young pilot Tarō daringly flies over smoking volcanoes and spouting whales and manages to park his aircraft on the mast of a magnificent Japanese warship. After all these achievements he even becomes involved in aerial warfare. When approaching a group of foreign-looking soldiers, Tarō wants to

---

<sup>79</sup> Iwaya Sazanami, *Hikō shōnen otogi ebanashi* [The young aviator, an illustrated picture story] (Tokyo: Bunundō, 1911).

scare them and drops a toy bombshell (*omocha no bakuretsudan*) that explodes in a powerful blast (see Figure 5). The soldiers are caught by surprise; they topple over and lose their guns. Even though some artillery soldiers attack Tarō from behind, he manages to escape. After he successfully repairs his airplane, Tarō continues his aerial adventures. The story ends with cheers for the Japanese empire: “Dainippon teikoku banzai.”

**Figure 5: Young Tarō in his Farman biplane bombing the enemy.<sup>80</sup>**

At first glance the picture book describes a children's fantasy about the appeal of the flying machines. But it also shows how, from the early years of Japan's aviation, the country's youth was brought up with texts and images that associated the flying machines not only with heroism and adventure but also with military action and patriotic enthusiasm.

It must be noted that such a conflation of militant nationalism and aviation was a transnational phenomenon. In 1907 the German author Rudolf Martin presented in his *Berlin-Bagdad* a hawkish vision of ten thousand German airships engaged in imperial conquest. One year later H. G. Wells published his *War in the Air*, conjuring a dark view of Britain's backwardness to defend itself against an imagined attack by the German air fleet, while the Frenchman Émile Driant expressed his high expectations for a powerful French air force in his 1909 *L'aviateur du Pacifique*. On a more sophisticated level the poet Gabriele D'Annunzio created an Italian version of the new myth of flight. In his 1910 *Forse che si forse che no* he

---

<sup>80</sup> Source: Iwaya, *Hikō shōnen otogi ebanashi*, 41

evoked a promise of moral and spiritual elevation based on danger and the sacrifice of human lives.<sup>81</sup>

### ***Two Different Trajectories***

After his seminal flight Tokugawa Yoshitoshi became a prominent public figure who appeared in countless publications. He also played a key role in the ongoing development of Japan's military aviation. Visits to the newly opened Tokorozawa Airport became increasingly popular, and Tokugawa gained fame as the master pilot who now also made flight demonstrations with a new Blériot aircraft. Subsequent articles in the *Yomiuri Shinbun* celebrated Tokugawa for carrying out Japan's first passenger flight, establishing new flight records, and making the first flight across Tokyo that attracted several tens of thousands of spectators.<sup>82</sup> In April 1911 Tokugawa and several members of the Balloon Committee started to remodel the Farman aircraft. In order to make the airplane faster they reduced the span of the lower wing, changed the airfoil's curvature to provide more lift, and modified the undercarriage to increase the propeller's ground clearance. These modifications resulted in a series of original aircraft, called Kai-Type, that were mainly used for pilot training.<sup>83</sup> All these airplanes were still based on the original Farman type and equipped with French Gnome motors and thus firmly established French aircraft technology within Japan's Army Air Force.

While Tokugawa rose to stardom, Hino Kumazō faded into obscurity.<sup>84</sup> When he worked on a new aircraft with a Japanese engine, he received only minimal support, whereas Tokugawa's expenses for the production of the Kai-Type aircraft were entirely covered by the

---

<sup>81</sup> Robert Wohl, *A Passion for Wings: Aviation and the Western Imagination, 1908–1918* (New Haven, CT: Yale University Press, 1994), 98–120.

<sup>82</sup> *Yomiuri Shinbun*, April 6, April 9, April 15, 1911; October 25, October 28, 1912.

<sup>83</sup> *Kai* refers to the last syllable of the Balloon Committee's name *rinjigunyō kikyū kenkyūkai*.

<sup>84</sup> For a detailed account of Hino's post-Yoyogi career, see Shibuya, *Hino Kumazō den*, 206–47.

Balloon Committee. Eventually Hino had to resort to his own funds and even sell his house. His efforts came to an end when the army decided to transfer him to the Fukuoka Infantry Regiment. Later, when World War I started in summer 1914 and Japan had no more access to imported foreign aircraft engines, the army became interested again in Hino's engineering knowledge. An offer was made to return him to Tokyo to help to build up Japanese engine production, but Hino turned it down.

The first years of powered flight in Japan show clearly how French aviation gained a superior foothold over its rival Germany in terms of both technology and prestige. France made its entrée into the Japanese aviation world not only with a most impressive airplane but also with a pilot who was immensely popular and well connected. Hino, who was arguably the better pilot and definitively a much more skilled aircraft engineer than Tokugawa, could not free himself of the image of the eccentric tinkerer who always came in second. It is easy to imagine that this mental picture almost inevitably rubbed off on the Japanese perception of German aircraft technology as a whole.

### **The Qingdao Air War: Brief Encounters and a Lasting Myth**

By 1914 the Japanese military had a small air fleet of twenty-eight imported aircraft at its disposal.<sup>85</sup> World War I provided the first opportunity for the Japanese military to test its new airpower under battle conditions. As we will see, Japan's first wartime bombings and air battles seemed ineffectual, even by the standards of the time. They nevertheless made the military and

---

<sup>85</sup> Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 15–16, and Nihon Kaigun Kōkūshi Hensan Inkaï, *Nihon kaigun kōkūshi 3 gijutsu seido hen* [The history of Japanese naval aviation 3 (technology)] (Tokyo: Jiji Tsūshinsha, 1969), 12–13, assert that the Japanese Army owned sixteen and the Navy owned twelve imported aircraft (while not giving any number of made-in-Japan airplanes).

the general public aware of the new weapon's potential to observe and to strike from the sky. At the same time, reports about a well-matched opponent cast doubt on Japan's sole reliance on French aviation technology.

A request from London triggered Japan's entry into the Great War.<sup>86</sup> On August 5, 1914, one week after the outbreak of World War I, the British Foreign Office asked for Japan's assistance against German armed merchant vessels in the East China Sea. Whitehall could refer to a clause in the 1902 Anglo-Japanese Alliance that laid down the mutual support of the two countries. The Japanese government not only responded quickly to the British appeal but even went one step further. On August 15, Prime Minister Ōkuma (1838–1922) presented Germany with an ultimatum to withdraw the German fleet from Asian waters and to hand over the Jiaozhou Bay concession by September 15. Japan's move to establish a foothold in China, at a place nearly 1,800 km away from Tokyo, went well beyond the scope of the Anglo-Japanese Alliance, which was concerned only with mutual defense and did not cover unilateral territorial expansion. However Japanese politicians did not want to waste this “one chance in thousand years”<sup>87</sup> for an advance into continental Asia, especially at a time when the Western powers were absorbed with their war in Europe. Receiving no answer, Japan declared war on Germany on August 23 and dispatched 30,000 soldiers to capture the German base at Qingdao, a small peninsula in Shandong Province in northern China.

For the first time in Japanese history, airplanes were to be deployed as weapons of war. However, with inadequate equipment, no coherent strategy, and no experience in air combat, it

---

<sup>86</sup> For details, see Ian Hill Nish, “Japan and the Outbreak of War in 1914,” in *Collected Writings of Ian Nish, Pt. 1* (Richmond, Surrey: Japan Library, 2001), 173–88.

<sup>87</sup> Unattributed quote in *ibid.*, 182.

was doubtful these flying machines and their crews would contribute much to the success of the Japanese forces.

The Japanese Navy welcomed the impending conflict as an opportunity to restore a reputation that had been damaged by the Siemens scandal in early 1914.<sup>88</sup> It sent the seaplane carrier *Wakamiya*, together with four airplanes that were equipped with floats for takeoff and landing on water, to the Chinese coast. All aircraft were French imports: three Type Mo Small Seaplanes and one Type Mo Large Seaplane.<sup>89</sup> The latter was a recent acquisition, which due to its strong 100hp engine, could carry three crew members and had improved flight performance. Apparently the navy had high hopes for the new aircraft. One exhilarated official declared that he was “happier about the timely delivery of one new Farman airplane than about one million additional soldiers.”<sup>90</sup> The planes, which for identification purposes carried for the first time the *hinomaru*, a red circle on a white background, were designated for reconnaissance and bombing missions. The *Wakamiya* arrived on September 1 and already three days later the naval pilots could fly their first sorties.

The Japanese Army sent its own transport ship with five landplanes, one Nieuport and four Maurice-Farman aircraft.<sup>91</sup> Four of these airplanes were made in France; one of them was built by the Tokyo Army Arsenal. The vessel arrived on September 2 at the Chinese port of Longkou, 180 kilometers north of Qingdao. However, even though the army's and navy's airplanes

---

<sup>88</sup> The Siemens scandal exposed that high-ranking naval officers had accepted bribes for granting the German company Siemens a monopoly for naval procurements.

<sup>89</sup> As yet another example of the labyrinthine Japanese designation system for military aircraft, “Mo” stood for the first syllable in Maurice Farman, the name of the aircraft's designer.

<sup>90</sup> Nihon Kōkū Kyōkai, *Nihon kōkū shi Meiji Taishō*, 142.

<sup>91</sup> According to Bōeichō, *Rikugun kōkū heiki no kaihatu seisan hokyū*, 15–16, out of the army's sixteen airplanes, these five aircraft were the only ones that were operational, so that the army had mobilized its entire airpower.

reached their destination at nearly the same time, their deployment was not well coordinated. On September 5, the day when the Navy Air Force reported the first successful destruction of a German minelayer by aerial bombs, the crews of the Army Air Force were still unloading their aircraft. The army then spent a considerable amount of time with the building of hangars at Longkou, with aircraft assembly, and with test flights, so it carried out its first reconnaissance mission only on September 21.

The activities of the Japanese airplanes over Qingdao received wide press coverage at home. According to one report, the bombing of enemy positions proved that Japan's air squadrons had made "a big leap forward" and that their brave pilots deserve the "greatest honor in history." Contrasting the safety of Japan's capital with the faraway heroic aerial combats, the article continued:

The same airplanes that the citizens of Tokyo could admire at the Taishō Exhibition [held from March to July 1914 in Ueno Park] a little while ago are now causing big damage to the German army. If we think of how they are carrying out their unmatched heroism in an actual air battle in the skies over Qingdao it feels like a dream having come true.<sup>92</sup>

A comprehensive report to Colonel Inoue Nirō, the head of the army's engineering department, described the fierce shooting with which the Japanese reconnaissance aircraft were "welcomed" by the German artillery, an event that even made it into an extra edition of the *Osaka Mainichi* newspaper.<sup>93</sup> The account then continued with the details of a successful bombing sortie on September 27, noted the safe return of all participating aircraft, and concluded that the mission must have left a strong "psychological impact" (*seishinteki ni wa kōka ga atta*) on the enemy.<sup>94</sup> Clearly this impact worked in both directions. The news about the air raids made

---

<sup>92</sup> *Yomiuri Shinbun*, morning edition, September 7, 1914, 7.

<sup>93</sup> *Osaka Mainichi Shinbun*, extra edition, September 27, 1914.

<sup>94</sup> Nihon Kōkū Kyōkai, *Nihon kōkū shi Meiji Taishō*, 145–47.

it quickly to the homeland, providing the press with headlines like “The Qingdao Enemy Fleet Pressed” and “Our Airplanes’ Bold Reconnaissance.”<sup>95</sup>

A consideration of the technology that was available to the Japanese bombing teams during the campaign casts a different light on the success of their missions. The Japan Aeronautic Association’s authoritative book on Japanese aviation history gives an impression of the primitive technology used by the French-made bombers: two cylinders containing ten 8 cm and six 12 cm shells were attached to either side of the Farman aircraft. The pilot used an aiming device that consisted of one wire in front of him and two lines on a celluloid board under his seat. Approaching the target and correcting the angle of his aiming sight for speed and altitude, the pilot had to determine the right moment to pass a loud “yoshi!” to the observer behind, who would then manually release the bomb.<sup>96</sup> With their limited explosive power and their primitive aiming and release mechanisms, these bombs were crude and inaccurate weapons that clearly impressed more with their loud noise than with their destructive capacity.

The aerial combats above the small German protectorate were fought with pistols and therefore hardly deserved this name. Nevertheless they are remarkably well documented. Most Japanese commentators agree on the noteworthy maneuverability of the only aircraft available to the German troops.<sup>97</sup> The German naval pilot Gunther Plüschow (1886–1931) in his Rumpler Taube was seemingly easily able to outmaneuver his enemies. Plüschow’s Taube indeed was lighter and therefore more maneuverable. In order to be able to take off from the short Qingdao

---

<sup>95</sup> *Asahi shinbun* extra edition, September 28, 1914.

<sup>96</sup> Nihon Kōkū Kyōkai, *Nihon kōkū shi Meiji Taishō*, 143.

<sup>97</sup> Kori Katsu, *Fifty Years of Japanese Aviation, 1910–1960* (Tokyo: Kantosha, 1961), 14; Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 15; Inoue Ikutarō Kankōkai, *Inoue Ikutarō den* [The life of Inoue Ikutarō] (Tokyo: Kōbun Shoin, 1966), 182; Kimura Hidemasa and Tanaka Shōichi, *Nihon no meiki hyakusen* [A selection of one hundred famous Japanese airplanes] (Nagoya: Chūnichi Shinbunsha, 1985), 27.

runway the aircraft had to be as light as possible, so Plüschow refrained from taking an observer with him (see Figure 6).

Japanese sources also mention the German aircraft's superior cruising and climbing speed, which made it possible for Plüschow to escape effortlessly into the clouds by climbing to an altitude of 3,000 meters.<sup>98</sup> However, as the maximum operation altitude of his monoplane was limited to 2,000 meters Plüschow's own version of his escape tactics seems much more likely. In his war diary he described that, due to the poor performance of his aircraft, the only way to shake off his pursuers was a nosedive out of an altitude of 1,700 meters.<sup>99</sup>

**Figure 6: The “Aviator of Tsingtao”: Gunther Plüschow in his Taube monoplane. Note that the fore observer's seat was kept empty in order to make the aircraft lighter and more maneuverable.<sup>100</sup>**

An eyewitness report written by *Asahi's* war correspondent under the headline “A Courageous Air Battle” gives an idea of the novelty of aerial warfare and how it impressed observers on the ground:

When the [German] Rumpler aircraft appeared its silhouette looked like a falcon. In the calm clear sky it was flying unbelievably high . . . and provokingly fast. After a while it descended to five hundred meters in circles. When our Nieuport aircraft flew close to it, the German airplane effortlessly escaped toward the mountain while our aircraft followed it. Our ground troops, getting impatient, started to shoot; their gunfire sounded like beans being roasted. Soon the Rumpler appeared again, brazenly continuing its reconnaissance mission. Now our Farman aircraft joined the fight. The three planes randomly shot at each other and returned their fire. I could see flashes of gunfire in the sky. After a while the aircraft returned to their bases and the air battle was over.

---

<sup>98</sup> Katsu, *Fifty Years*, 14.

<sup>99</sup> Bundesarchiv RM/16/19 *Kriegstagebuch zur Marine-Fliegerstation Tsingtau und Bericht des Oberleutnants zur See Plüschow zur Belagerung Tsingtaus*.

<sup>100</sup> Source: Plüschow, *My Escape from Donington Hall*, i.

Even with its unintentional humor and inconclusive ending the report conveys how the German aircraft could inspire a mixture of awe and trepidation. It is also interesting to note that the apparent superiority of the Rumpler does not match Plüschow's own assessment. In his memoirs, published as *Die Abenteuer des Fliegers von Tsingtau* (The adventures of the aviator of Qingdao), he paid respect to the enemy's "excellent huge hydroplanes" and to their "outstanding, courageous pilots."<sup>101</sup> He lamented that "with the poor climb rate of my Taube I could not get anywhere against the big [Japanese] biplanes with their three-men crews."<sup>102</sup>

The Japanese accounts also refer to the machine gun that Plüschow purportedly had installed in his Taube and that enabled him to put the Japanese aircraft under heavy fire. However, Plüschow's armament was far less dreadful than was imagined by his enemies. In addition to his *Parabellum* pistol he carried with him several makeshift bombs that had to be dropped manually. According to his descriptions, these devices were made from 2 kg coffee cans filled with dynamite, horseshoe nails, and scrap metal.

Praise for an opponent in order to put one's own achievements into a more favorable light has a long tradition. The myth of the Qingdao Taube persisted, and the Japanese military went to great lengths to procure two similar aircraft bought earlier by the Japanese Imperial Aero Society. But before these aircraft could be dispatched to China, the battle of Qingdao was over. On November 6, 1914, the night before the Germans surrendered and the Japanese took over Qingdao, Plüschow had already made his escape by air to Hai Zhou, a city 250 kilometers

---

<sup>101</sup> Plüschow, *Die Abenteuer des Fliegers von Tsingtau*, 53. The book ranked among the ten best-sold German books between 1915 and 1940. It was translated into English and—despite its racist undertones—into Japanese.

<sup>102</sup> *Ibid.*, 53, 56.

southwest of Qingdao, where, according to his own account, he landed in a rice field and set fire to his aircraft to prevent it from being captured by the Japanese.

The deployment of aircraft under battle conditions provided valuable experience to the Japanese. Even though the Qingdao conflict lasted less than three months the Japanese air forces could log an impressive overall number of 135 sorties and 234 bombings.<sup>103</sup> In an interview Navy Commander Yamauchi Shirō commented that aircraft had proved their worth for reconnaissance missions and that they would become indispensable for future wars.<sup>104</sup> In a similar vein another navy official emphasized that the experience gained from the Qingdao air battles would help further develop the army's and navy's war strategy and their pilots' flying technique. However, with the war going on in Europe the Western countries' aviation would advance rapidly. To keep pace, the officer concluded, Japan needed sufficient funds for further aeronautical study and research.<sup>105</sup>

Referring to previous victories over China and Russia in 1895 and 1905, some historians have called the Qingdao battle the "third great military triumph for Imperial Japan."<sup>106</sup> Yet Japan's foothold in China was short-lived. During the 1922 Washington Conference Japan's representatives gave in to U.S. demands and returned Qingdao to China. There was, however, a longer-lasting legacy of the Siege of Qingdao. French airplanes as new weapons of the Japanese Empire had clearly made their debut in the military theatre and—equally important—on the public stage. The only cloud cast on the general euphoria was a sneaking suspicion that there

---

<sup>103</sup> These numbers include 49 flights and 199 bombardments carried out by the navy.

<sup>104</sup> *Yomiuri Shinbun*, morning edition, November 29, 1914, 7.

<sup>105</sup> *Asahi Tokyo*, morning edition, December 24, 1914, 3.

<sup>106</sup> Frederick R. Dickinson, *War and National Reinvention: Japan in the Great War, 1914–1919* (Cambridge, MA: Harvard University Press, 1999), 85.

might be other countries that, with their own aircraft, might make equally good use of the new invention to strike from the sky.

### **A Technocrat Shapes His Vision: Kusakari Shirō**

In the same year when the Japanese Army began to analyze the Qingdao experience it sent a Japanese aviation expert to Europe. The on-site visits of Kusakari Shirō (1880–1919) to European aircraft makers and military facilities were to provide a much more detailed picture of the ongoing advances in Western aviation. Kusakari's engineering background—he was a graduate of the Army Artillery and Engineering School—and above all his experience gained during a prolonged stay in Europe made him a new type of aviation expert who was to have a profound influence on the development of Japanese military aviation.

The rather earthbound beginnings of Kusakari's career can be traced back to the 1904–5 Russo-Japanese War, when he served in a battalion that was in charge of railway construction in Korea. In 1907 Kusakari resumed his studies and entered the Department of Mechanical Engineering at Tokyo Imperial University. Following his graduation in July 1910 he was appointed a member of the new Balloon Committee.

### ***Three Eventful Years in Europe***

In April 1914 Army Minister Oka Ichinosuke (1860–1916) officially assigned Kusakari to be dispatched to Europe “for aviation research purposes.”<sup>107</sup> Kusakari's stay in Europe is well documented. His *taiō nikki*, the diary of his stay in Europe, covers the period from June 1, 1914,

---

<sup>107</sup> Army Minister Oka Ichinokuke, “Officers to Be Dispatched for Aviation Research Purposes,” 1914, JACAR Ref. B07090456200.

when Kusakari arrived in Germany, to his return to Tokyo on June 18, 1917.<sup>108</sup> Kusakari's records not only chronicle his wide range of activities but also provide insight into the dynamics within the upper echelons of the Japanese Army.

The first six weeks of his visit to Europe profoundly shaped Kusakari's image of German aviation. After his arrival in Berlin he was welcomed as a delegate of Japan, a country with the potential to become a prospective customer of the German industry. The doors of all major German aircraft manufacturers opened easily to Kusakari. According to his diary, in less than six weeks Kusakari was able to visit nearly all the big names of the German aircraft industry, which proudly presented their state-of-the-art technology.<sup>109</sup> Kusakari also witnessed German popular aviation enthusiasm when, at the Johannisthal Airport "in spite of heavy rain thousands gathered" to watch a flight competition.<sup>110</sup> Further visits to aircraft-related companies followed, and Kusakari excitedly put down in his diary the marvels of German precision optics, bombing devices, wireless telegraphy, and of light-weight, high-power aircraft engines.

In July 13, 1914, just two weeks before the outbreak of World War I, Kusakari left for Paris. Kusakari, who had a good command of French, proved to be a tireless information gatherer even when, with the beginning of the war, the French government imposed martial law. In spite of the fact that he was an officer of an allied country Kusakari's activities faced several restrictions. He was required to register with the police and had to cable his messages to Tokyo in French because he was no longer allowed to send encoded telegrams.

---

<sup>108</sup> The diary only recently became publicly available: *Kusakari Shirō no taiō nikki* [The diary of Kusakari Shirō's stay in Europe] (privately published by Shinozaki Masaru, 2008).

<sup>109</sup> The diary refers to visits of the aircraft makers LVG, Rumpler, Albatros, AEG, and Otto; the engine manufacturers Mercedes and Maybach; and the airship builders Parseval and Zeppelin.

<sup>110</sup> Diary entry on June 4, 1914.

Kusakari's regular reports drew upon a large variety of sources. He collected and translated newspaper articles about aviation as well as French and German aviation books. For a more direct observation he made frequent visits to the French aircraft manufacturers Farman and Caudron and to the engine makers Gnome, Rhone Motor, and Renault. During his factory tours Kusakari could see how France's aviation industry met the military's request for ever more and better aircraft with increasing production numbers and continuous technological development.

Even while in the French capital Kusakari was confronted with the threat of German airpower. His diary entries testify to his firsthand experience of a German airship attack on Paris. In January 1916 Kusakari could hear the nearby sound of exploding shells when a giant Zeppelin dropped more than twenty bombs that inflicted heavy casualties. Occasional meetings with Japanese war correspondents who had been at the front line further shaped his image of two countries caught up in a modern war that was fought in trenches and in the air. Through regular meetings of the Japanese Embassy staff and by reading the official gazettes from Japan, Kusakari had privileged access to information about the Japanese fighting "their" war over Qingdao on the other side of the globe. A telegram from Tokyo informed him that Japanese airships had bombed a German telegraph station and that a German aircraft's bombing had killed thirty Japanese.<sup>111</sup>

Kusakari's experience of Western aviation was not limited to France and Germany. Even though Europe was at war he could travel widely and was granted access to a large number of military and civilian facilities. During a two-week stay in Italy and a three-week stay in England he was able to visit several air bases and flight schools as well as factories, test grounds, and wind tunnels.

---

<sup>111</sup> Diary entry on September 20, 1914.

Numerous passages in Kusakari's notes are characteristic of the clashes between the reformist technocrats, like Kusakari, and conservative bureaucrats within the Japanese Army. Holding the rank of a major, Kusakari was in a relatively high position among Japanese military officials based in Paris.<sup>112</sup> He was, however, subordinate to the Japanese Army Attaché Fukuhara Yoshiya. Already soon after Kusakari's arrival in Paris the relationship between the two officers became increasingly strained.

The attaché's obvious unwillingness to help Kusakari establish a closer relation with the French aircraft manufacturers turned into a source of continuous contention. One of Kusakari's duties was to arrange for the purchase of several French Farman aircraft. Understandably such an undertaking was difficult during a time when France's aircraft industry was struggling to meet the country's own demand. Kusakari therefore depended on the attaché's mediation to ask the French military to lift the export ban. According to Kusakari's diary entries Fukuhara showed little enthusiasm; the attaché tried to get rid of Kusakari with comments like: "if Farman gets the permission of the French Army then I can do something."<sup>113</sup> Fukuhara reacted to Kusakari's complaints by reminding him repeatedly that Kusakari as a member of the Balloon Committee was in no position to make demands on him. On several occasions the attaché did not permit Kusakari to attend meetings with the French military or he failed to apply in time for factory visits so that Kusakari was denied access. The attaché's apparent indifference toward any military technological development clearly upset Kusakari. His summary of the year 1915 stated:

My biggest problem is the attaché who obstructs my work. This is a very important moment for the development of Japan's Army Air Force. The existence of this attaché

---

<sup>112</sup> Army Minister Ōshima Kenichi, "Japanese Officers Dispatched to France," 1916, JACAR Ref. C03024710400, contains a list of Japanese military officers in Paris during Kusakari's stay. Kusakari's name appears already in the third position.

<sup>113</sup> Diary entry on November 30, 1914.

causes heavy damage to our nation. He is unprofessional, thoughtless, and arrogant, a typical *tenpōsen*.<sup>114</sup> These graduates from the War College with their foolish and silly badges are automatically put into high positions and have no idea of technology.<sup>115</sup>

This *cri de cœur*—even though scribbled in the privacy of a diary—probably reveals more about the dynamics within the Japanese Army than any official account of Japanese aviation history. Considering that Kusakari had spent his entire military career in the army's engineering department, the army's technologically most advanced branch, his aspiration for a technologically advanced army and his ensuing irritation about being stonewalled becomes all the more comprehensible.

Kusakari's notes also shed light on the perennial rivalry between the Japanese Army and Navy. Kusakari seemed to be especially frustrated by the army's backwardness that he perceived in marked contrast to the navy's openness to technological change. Leaving behind the engineer's matter-of-fact tone he agonized:

Compared to the condition of Japan's Navy we are twenty years behind. Those *tenpōsen* guys' recklessness puts Japan at risk. In such a dirty environment I have to stay clean. The army has to become an army of technology.<sup>116</sup>

When on July 17, 1916, the Japanese Rear Admiral Akiyama came to Paris, a rare opportunity presented itself to Kusakari. He was invited to accompany this high-ranking navy officer on his visits to several French aircraft factories. This observation tour included flight demonstrations of the latest Spad and Nieuport aircraft. Kusakari finished his diary notes about these events with the exhilarated comment: "I cannot digest so many impressions." In other words, the visit had such lasting impact on him that, as soon as the Japanese Navy officials came, all doors opened.

---

<sup>114</sup> *Tenpōsen* 天保銭 was a disparaging term for the graduates of the Japanese Army University, whose uniform badge resembled an oval copper coin of the Tenpō era (1830–33).

<sup>115</sup> Diary entry on December 31, 1915.

<sup>116</sup> Ibid.

Toward the end of his stay in France Kusakari went to the renowned French military academy St. Cyr. More than 300 kilometers away from the French capital (see Map 2) and its crowded entanglements—both diplomatic and human—Kusakari rented lodgings at St. Cyr for two months for the purpose of conducting engine research. His studies involved taking apart and putting together a large variety of aircraft engines, both French and German.<sup>117</sup> What might appear as a technocrat's escapism actually was to become a central part of his future lectures in Japan, where he continually emphasized the importance of technological advance as embodied by the aircraft engine, the epitome of state-of-the-art technology of this era. Finally, only a few weeks before his return to Japan, Kusakari flew as a passenger in a Nieuport aircraft. Kusakari described this flight over Paris enthusiastically as the “happiest moment during my stay in Europe.”

Kusakari's diary entries clearly reveal his main concerns for the future of Japanese aviation. During his stay in Europe three major issues took shape, which in their connectedness were to become the leitmotif of his subsequent reports and lectures. First, Kusakari was convinced that Japan would need a national aviation ideology (*kokkateki kōkū shisō*) that would guarantee the public's enthusiasm and full support for the country's aviation project. Second, the overwhelming importance of technology left no choice but to transform the Japanese Army into a techno-army with the flying corps as its spearhead. Third, the air force must rid itself of all interference by the traditionalists—who would at best assign an ancillary role to military aviation—and become a fully independent unit.

---

<sup>117</sup> Kusakari's diary mentions the examination of French Rhone, Clerget, Renault, and Nieuport engines and of German Benz and Daimler motors.

### *Spreading the Aviation Gospel*

After his return to Japan in April 1917 Kusakari was in a unique position to circulate widely his firsthand experience of European aviation. As material evidence of his pursuits he brought with him a whole range of aircraft parts and related artifacts.<sup>118</sup> Kusakari had obtained German machine gun cartridges and several parts of a German Benz 225hp engine. He also brought with him various parts of French, Italian, and British aircraft, which he considered important for the army's research on robust and lightweight airplane structures. Without doubt the jewel of his collection was one electrically heated pilot suit made in Italy. He handed all items together with explanatory notes over to the Balloon Committee for further inspection.

Kusakari's publications attracted the attention of a large number of military personnel and civilians. In December 1917 he presented his "Outline of the Present Condition of the Aviation in Each European Country" (*Ōshū kakkoku ni okeru kōkūkai no genkyō yōran*) to the Balloon Committee.<sup>119</sup> Even for today's readers the report holds a certain fascination with its drawings of aircraft structures and its wealth of technical information that reveal an engineer's precision and attention to detail. Various charts compare the strength of each country's air force, industry, aviation expenses, and public donations. Organizational patterns of the various air forces supplement detailed maps of the French, German, and Japanese air force facilities. In addition Kusakari devoted several pages to the special flying techniques for air combat (see Figure 7).

Vested with the aura of one of the country's leading aviation experts, Kusakari presented his experiences and conclusions on various occasions to the public. In January 1918 he held a lecture on the "Present Condition of the World's Aviation" under the auspices of the Home

---

<sup>118</sup> Nihon Kōkūkyōkai, *Nihon kōkū shi*, vol. 1, 214–15.

<sup>119</sup> Kusakari Shirō, "An Outline of the Present Condition of the European Countries' Aviation," 1917, JACAR Ref. C08020891800.

Ministry, which the newspaper *Fukuoka Nichinichi* then published in a series of articles.<sup>120</sup> Six months later, Kusakari was invited to talk at the renowned Japan Society of Civil Engineers. His lecture titled “The Belligerent Nations’ Current State of Army Aviation” appeared in the society’s journal in October 1918.<sup>121</sup>

**Figure 7: Kusakari’s sketches illustrate the new concept of three-dimensional warfare. They show how to escape from the enemy’s line of fire by flying a vertical loop (upper left); the air battle technique of the first German fighter ace Max Immelmann (1880–1916) (lower left); and an illustration of an aircraft’s best shooting position during rapid descent (right).<sup>122</sup>**

Kusakari’s report and lectures discussed the development of Western aviation from its early beginnings until 1917. He put special emphasis on a comparison between France and Germany. Kusakari started by pointing out that before the war most military strategists had serious doubts about the efficiency of airplanes as new weapons. Since then, however, based “on the sacrifice of human lives and on enormous expense,” the progress of Western aviation technology had exceeded all expectations. Kusakari alerted his audience: “Compared to this, how primitive is Japan’s industry.”<sup>123</sup>

According to Kusakari, France was the first country to fully realize the importance of military aviation. France had started aircraft research early and had become the first nation

---

<sup>120</sup> “Sekai kōkū genkyō” [The present condition of world aviation], *Fukuoka Nichinichi Shinbun*, January 30 to February 1, 1918.

<sup>121</sup> Kusakari Shirō, “Kōsen shokoku rikugun hikōkai no gensei” [The belligerent nations’ current state of army aviation], *Doboku gakkai shi* [Journal of the civil engineering society] 4, no. 5 (October 1918): 977–1007.

<sup>122</sup> Source: Kusakari, *Ōshū kakkoku ni okeru kōkūkai no genkyō yōran*, 23–25.

<sup>123</sup> *Ibid.*, 979.

among the Great Powers to establish an air force. However, Kusakari acknowledged that, at the same time, German airpower had developed at an enormous pace.

Kusakari's account characterized Germany as a late starter that nevertheless could serve as a shining example for the advance of Japan's aviation. Even though Germany established its air force as late as 1911, it had turned into a serious opponent that could challenge the predominance of French aviation. Before World War I, France held the highest number of flight records. Germany held the second place and was catching up fast, with recently established records in flight time and flight altitude.<sup>124</sup> A comparison of each country's aviation expenses between 1911 and 1913, Kusakari argued, further illustrated German rise to ascendance. During this period France and Great Britain had tripled the sums spent on aircraft, airships, and related equipment. Germany had increased its aircraft expenditures by an impressive factor of eighteen to an amount equivalent to ¥27.5 million in 1913, roughly twice as much as France.<sup>125</sup> This happened during a time when Japan's already low aviation budget has been reduced to ¥300,000, an amount that for Kusakari was low "beyond comparison."<sup>126</sup>

Drawing on his firsthand experience of the 1916 Zeppelin bombing in Paris, Kusakari argued that the use of airships for warfare was yet another feature of the "prominence and excellence of German airpower."<sup>127</sup> Germany was the only country that had attached importance to the development of airships for military use. As a result, the number and performance of

---

<sup>124</sup> Kusakari referred to Karl Ingold's 1,700 km flight and to Guido Linnekogel's climb to an altitude of 6,370 m, both carried out in 1914.

<sup>125</sup> "Sekai kōkū genkyō" [The present condition of world aviation], *Fukuoka Nichinichi Shinbun*, February 1, 1918.

<sup>126</sup> The Militärgeschichtliches Forschungsamt in its *Die Militärluftfahrt bis zum Beginn des Weltkrieges 1914 Textband* (Berlin: Mittler, 1966), 264, gives similar numbers for the rapid increase of German aerial armament: from 1.6 million marks in 1911 to 23 million marks in 1913.

<sup>127</sup> Kusakari, "Kōsen shokoku rikugun hikōkai no gensei," 979.

German airships exceeded that of any other country. German plans for airship attacks on England showed the power of this new weapon and at the same time the urgency of maritime defense.

Emphasizing the importance of technology for air tactics and strategy, Kusakari argued that securing air superiority (*seikūken shōaku*) would be *the* decisive factor in future wars. To gain and maintain air superiority depended almost entirely on aircraft performance. Therefore each country would have to participate in a “war of technology” (*gijutsuteki sensō*), and its manufacturing capability was of crucial importance. For Kusakari the Great War showed that military success was no longer simply a matter of soldierly spirit on the battlefield: war rather had become one of industry and technology. Due to the high attrition and the frequent damage that occurred in air battle, each aircraft had to be replaced within three months. To ensure an adequate supply of airplanes, most countries employed a large number of civilian aircraft manufacturers that received orders and funding from the military. In 1917 as many as sixteen French and nineteen German aircraft makers were providing airplanes to their countries.

Kusakari's comments on production technology were remarkably farsighted. He emphasized that German aircraft production limited itself to a small variety of standardized aircraft bodies and engines and arranged them according to their required use. Such a production method not only saved time and expense but also simplified the supply of spare parts. Kusakari concluded that the technological standard of a nation determined the performance of its aircraft and the growth of aircraft production. It would therefore be absolutely necessary to strengthen Japanese aircraft manufacturers and advance their production technology.

Kusakari then turned to the organizational structure of a country's air force. In many cases these organizations could not follow the fast progress of aviation technology. Kusakari

acknowledged that even though presently France had no autonomous air division, everybody agreed that soon a “fifth arm,” that is, an independent French army air force, would be established.<sup>128</sup> Kusakari then pointed to Britain and praised its air force, which enjoyed the strong advantage of a unified command structure that was both effective and economical.<sup>129</sup> According to Kusakari neither Italy nor Germany could serve as an organizational model, as the air forces of both countries were a disjointed mix distributed over several divisions.<sup>130</sup> Given the highly specialized nature of aviation technology and flight training, Kusakari argued that a country's air force could not be an integral part of the infantry or any other subunit. He consequently drew the bold conclusion that ideally Japan should establish an air force on the same level of its army and navy. He conceded, however, that in the conditions then present, doing so would probably be impossible. Nevertheless, as a first step Kusakari suggested establishing an independent air force division within the army, with air force commander then under the direct control of the army commander.

Fostering public air-mindedness in order to gain popular support for a country's aviation project was for Kusakari as vital as the development of a technological and organizational

---

<sup>128</sup> In 1912 France installed a “permanent aviation inspectorate,” a board of control which was in charge of the mobilization, tactics, and armament of the country's military aviation. However the inspectorate could not avoid that French military aviation continued to be plagued by quarrels between artillery and military engineers. Both branches were aware of the air force's potential and competed for the lion's share of the new weapon. Another even more fundamental point of contention arose between the supporters of an independent air force and those who wanted aircraft and their crews to be at the direct disposition of the various ground units. This organizational deficiency was solved only with the establishment of an independent French Air Force as late as 1933.

<sup>129</sup> Kusakari must have referred to Britain's Army Air Force. Britain created the Royal Flying corps in 1912 with the Military Wing being controlled by the War Office and its Naval Wing by the Admiralty, with not much hope of a unified air force—especially when, in 1914, the Admiralty decided to reorganize the Naval Wing into the Royal Naval Air Service.

<sup>130</sup> The German Air Force's organization had to cope with the additional problem that each of the German Empire's constituent kingdoms had its own flight squadrons.

framework. He argued that both in Germany and in France popular pressure on politicians as well as patriotic donation campaigns procured the massive funds for the build-up of each country's airpower. He referred to a well-known German donation campaign that was launched after the explosion of a Zeppelin airship in August 1908. A private initiative managed within a short time to raise funds of more than six million marks to finance the construction of new airships. Kusakari emphasized how French and German newspapers and magazines successfully incited a national "aviation craze" (*nekkyōteki na kōkū shumi*) and "aviation ideology." Being aware of the strong connection between air-mindedness and nationalism in these two countries, he lamented that such a patriotic spirit was never seen in Japan. Kusakari implored his audience to engage in a similar all-out effort to support Japan's aviation:

It is absolutely essential for the aviation project (*kōkū jigyō*) to gain popular support. First the Diet has to press the government to establish aviation facilities. Then people will patriotically donate the necessary money, property, and buildings. Public aviation organizations shall receive patriotic funding from individual supporters, from the imperial family, wealthy citizens, and newspaper and magazine campaigns. Local patriotic aviation clubs shall be established, and private aviation must be encouraged.<sup>131</sup>

More than public flight shows, with their funfair atmosphere or patriotic war reports published by the sensational press, Kusakari's lectures were an effective means to address an educated audience. Kusakari skillfully mixed the unsentimental matter-of-factness of an engineer with an ardent patriotic concern for the future of the country. He thus was able to widely disseminate his ideas about the prospects of Japan's aviation far beyond the small circle of military experts. As we will see in the next chapters, Kusakari's prophetic visions of a strong Japanese airpower, large-scale aviation enterprises, and a national aviation ideology were to become the cornerstones of Japan's aviation project, enabling the country to catch up with the West and to integrate fully the new weapon into the nation's defense.

---

<sup>131</sup>"Sekai kōkū genkyō," *Fukuoka Nichinichi Shinbun*, February 1, 1918.

## Conclusion

Until the beginning of World War I France was internationally recognized as the world's leader in aviation. Relying on this image France could firmly establish itself as a key player in the emergence of aviation in Japan. France could claim that it was a French Farman aircraft that took off for Japan's first motor flight. French aircraft were the first flying machines that Japan used in actual battle over Qingdao; that experience demonstrated to the Japanese the enormous potential of a wholly new weapon. When Kusakari Shirō returned from Europe to Japan he disseminated his wide knowledge of French aircraft and engine manufacturing. So the ground was well prepared for French flight instructors and production advisors who immediately after the war set out for their declared aim to establish an aviation monopoly in Japan.

At the same time, the vision of a powerful competitor took shape. Initially the power of images worked in favor of French aviation technology. Tokugawa Yoshitoshi could present his French aircraft in a much more dashing way than his fellow airman Hino Kumazō, who cared more about technical details than about public appearances. However, when both civilian and military observers of the air battle over Qingdao had to put their impressions into words, they evoked a picture of a well-matched German enemy who skillfully made use of the advanced features of his aircraft. In a similar vein, Kusakari's reports about the progress of Western aviation conveyed an image of Germany's aviation on the rise. This combined imagery aroused great curiosity about German aviation technology and whetted the appetite for the latest German aircraft and equipment. As a result, as we will see in the following chapter, Japanese experts and planners would seize the first opportunity to obtain German know-how and machinery that, in their eyes, held the promise to boost Japanese airpower to entirely new heights.

## II

### **Lessons from World War I and the Unintended Consequences of the Treaty of Versailles**

**T**he Great War of 1914–18 was the first total war in history. Even though Japan sided with the Entente Powers, the country was spared the experience of the slaughter on the European battlefields. The new and disturbing nature of an all-out war nevertheless reshaped Japanese assumptions about future armed conflicts. In Japan, as elsewhere, reform-minded technocrats and conservative traditionalists each drew their own lessons from what we now call World War I to promote their positions. While one group claimed that a modern war would be a war of industry, science, and technology that provided modern tanks, artillery, and aircraft, the other side argued that the next war could only be won with a powerful national defense ideology that ensured unwavering patriotism and self-sacrifice of the populace.<sup>132</sup>

This chapter explores how Japanese discussions in the 1920s about industrial and popular mobilization were strongly influenced by Germany. A new concept of national mobilization emerged that would have profound consequences for Japan's fledgling military aviation. Japanese observers brought back from Europe—and especially from Germany—new concepts of air superiority, strategic bombing, and air defense. At the same time they emphasized the importance of a popular air-mindedness that would secure the voluntary and at times even passionate support of the Japanese people for the project of military expansion.

---

<sup>132</sup> For a discussion of these competing concepts see Edward J. Drea, *Japan's Imperial Army: Its Rise and Fall, 1853–1945* (Lawrence: University Press of Kansas, 2009), 146–62.

The chapter further examines another consequence of World War I, one that challenged French dominance in Japanese aviation. The Versailles Treaty granted the Japanese unprecedented access to Germany's aircraft manufacturers and their products. In 1919 early reports about the advances of German aviation attracted the attention of Japanese experts. After the establishment of the Inter-Allied Military Control Commission in the same year, the Japanese inspection team members gained free access to German factories and military facilities, and attention turned into intense interest. In 1920 the arrival of German war-trophy aircraft in Japan further fueled the desire for the latest German aviation technology. Then the Japanese took the decisive action to buy German airplanes and to invite German engineers.

The chapter ends with an explanation of how, in an era of extensive Japanese disarmament in the mid-1920s, Japan's air force could undergo a significant expansion that included the promotion of aeronautical research and the build-up of a large-scale national military aircraft industry. The stage was thus set for the broad reception of German technology and know-how that followed.

### **Technocrats and Ideologists**

"Mobilization" was one of the most powerful concepts that emerged during World War I. Germany's decision to declare war against Russia and France in August 1914 was welcomed with wide popular enthusiasm: soldiers cheerfully boarded the train carriages that would bring them to the battlefield. It soon became obvious, however, that modern warfare depended not only on soldierly virtue and determination but also on an efficient wartime economy and industry. As we will see, the Japanese military carefully studied all material available on the efforts of their German enemy to mobilize the country's material, industrial, and human resources for the

Great War. These studies had a profound impact on Japanese visions about future relationships among the industry, the state, and the populace.

On the German home front technocrats and ideologists engaged in an intense dispute about the relative values of the country's industrial mobilization over a mobilization of its people.

Walther Rathenau (1867–1922), an ambitious German businessman, became a central figure in completely reshaping Germany's wartime economic system. In the early phase of World War I, Rathenau put forth to War Minister Erich von Falkenhayn the crucial importance of managing the supply of raw materials for the German war effort. As a technocrat, Rathenau was convinced that the principles of central administration and coordination that he had learned from his father's major electrical company *Allgemeine Elektrizitäts-Gesellschaft* could be efficiently applied to Germany's wartime economy.

Falkenhayn approved of Rathenau's proposals and appointed him head of the new War Raw Materials Office (*Kriegsrohstoffabteilung*), founded in 1914. Even though Rathenau resigned from his position after just one year, his far-reaching vision of interventionist planning, sequestration, and the creation of government-supported cartels had a strong influence on establishing a wartime "command economy" (*Zwangswirtschaft*). Rathenau was confident that the new wartime economy would survive the war and serve as a model for the future: "The Raw Materials Office will continue into peacetime. It will be the core of an economic General Staff (*wirtschaftlicher Generalstab*)."<sup>133</sup>

The Japanese press looked with admiration upon Germany's wartime economy. In 1916, under the title "The European War and Its Industry," a series of newspaper articles dealt with

---

<sup>133</sup> Walter Rathenau, "Die Organisation der Rohstoffversorgung" (lecture, Deutsche Gesellschaft 1914, December 20, 1915).

Rathenau's "famous industrial mobilization" (*yūmei naru doitsu no kōgyōdōin*) in much detail.<sup>134</sup>

The articles admiringly described how the whole German industry had become one big integrated company. The articles also emphasized the "unanimous cooperation" between government and the people: popular support had made possible Germany's successful transition to a wartime economy and had achieved the country's industrial mobilization with "remarkable perfection."

Not surprisingly the Japanese military examined the events in Europe with even greater attention and care. In September 1915 the Army Ministry set up the Special Military Investigation Committee (*Rinji Gunji Chōsai Inkai*) to study the military situation of the belligerent European countries and to offer suggestions for improving the tactics, strategy, and armament of the Japanese military.<sup>135</sup> The army's experts chose to focus especially on Germany, because the country's relative dearth of resources appeared to it to be similar to Japan's.<sup>136</sup> The committee began submitting its monthly reports in 1916. A remarkably large number of these surveys dealt with Germany's industrial mobilization, with a special focus on Rathenau's policies of "industrial unification" via cartels, use of civil industries, and the control of resources.<sup>137</sup> In 1917 the committee compared Germany, France, and Great Britain under the

---

<sup>134</sup> Uemura Ryōsuke, "Ōshūsensō to kōgyō [The war in Europe and its industry]," *Taiwan Nichinichi Shinbō*, October 4 to 6, 1916.

<sup>135</sup> It was Akira Kudō who, in his "The First World War and Perceptions of 'Total War' in Japan" (paper presented at the Conference on Japanese-German Relations 1860–2010, Tokyo, December 2010), drew my attention to the *Rinji Gunji Chōsaiinkai*.

<sup>136</sup> A 1917 report on "National Defense and Resources" by Koiso Kuniaki emphasized the parallels between Japan and Germany. Koiso Kuniaki, *Katsuzan Kōso* (Tokyo: Koiso Kuniaki Jijoden Kankōkai, 1963), 337.

<sup>137</sup> Rinji Gunji Chōsai Inkai, "Dokukou kōgyō dōin ni kan suru fukoku rikugunshō genryō kachō no kōenshōshi [A summary of the speech held by the chief of the raw material section of the Prussian Army Ministry concerning the mobilization of German industries]," 1917, JACAR Ref. A04017272800.

headline “National Mobilization in a Protracted War” and concluded that “Germany’s mobilization is best.”<sup>138</sup>

Praise from far-away Japan notwithstanding, the German War Raw Materials Office came under growing criticism when German expectations for a short war did not materialize. Acute supply shortages caused by the British sea blockade that had been established right after the outbreak of the war, heavy losses during the French counteroffensive in autumn 1915, and the ongoing Battle of Verdun that lasted from February to December 1916 began to undermine the German public’s morale and belief in their leaders’ competence. In response to the increasingly dire conditions, in August 1916 Paul von Hindenburg (1847–1934) became the new Chief of the General Staff. Hindenburg’s aide Erich Ludendorff (1865–1937) was appointed as “Second Chief of Staff.”

Ludendorff was an outspoken opponent of what he saw as Rathenau’s bureaucratic approach and would accuse him after the war of having “played into the hands of Jewish-Roman world capitalism.”<sup>139</sup> Ludendorff believed that a nation’s “spiritual unity” (*seelische Geschlossenheit*), more than a powerful economy, would decide the war. He was determined to put the whole population under military-like discipline. Every German citizen between seventeen and sixty not serving in the army was to be forced into compulsory wartime service in the armaments industry. The parliament modified Ludendorff’s plan to include male Germans only and enacted the plan in December 1916 with the passage of the “Patriotic Auxiliary Service Law.” However, instead of boosting munitions production, the program led to an increase in

---

<sup>138</sup> Rinji Gunji Chōsai Inkai, “Doku, ei, bukkoku no kokumindōin [National mobilization in Germany, France, and France],” 1917, JACAR Ref. A05021009700.

<sup>139</sup> Erich Ludendorff, *Der totale Krieg* (Munich: Ludendorffs Verlag, 1935), 47. The chapter “Economy and Total War” (pp. 29–48) contains an account of the author’s wartime efforts that demonstrates Ludendorff’s then strong antagonism toward Rathenau.

workplace accidents and a severe shortage of cargo transport capacities that resulted in a food crisis; and soon the compulsory service requirements were met with sharp criticism by industry, unions, and large segments within political parties.<sup>140</sup> The failure of Ludendorff's program was a major factor that gave rise to the "stab-in-the-back" legend, a myth promoted by post-war German rightists who claimed that Germany had not been defeated on the battlefield but by a lack of support from the home front.

The concerns of German military leaders like Ludendorff about forging close ties between the military and the populace shaped the thought of Tanaka Giichi (1864–1929), one of the most influential figures in Japan of the 1910s and 1920s. Throughout his career as a high-ranking military officer, army minister, minister of foreign affairs, and prime minister, Tanaka was simultaneously a staunch anti-Communist and an open admirer of Germany. Even before World War I, he was convinced that Germany's well-organized association of reservists and veterans, the German Warrior League (*Deutscher Kriegerbund*), accounted for much of the country's military strength and popular support. He therefore vigorously promoted the establishment of a similar organization in Japan.<sup>141</sup>

Despite Germany's disastrous defeat, Tanaka's high regard for German spiritual strength did not falter. As one lesson drawn from World War I, he adopted Germany's paramilitary youth education system in the hopes of unifying public sentiment toward a firm belief of "everybody

---

<sup>140</sup> T. Hunt Tooley, "The Hindenburg Program of 1916: A Central Experiment in Wartime Planning," *The Quarterly Journal of Austrian Economics* 2, no. 2 (Summer 1999): 51–62.

<sup>141</sup> Tanaka Giichi, *Chihō to guntai tonō kankei ni tsuite* [The relation between regions and the army] (Tokyo: Zaigō gunjinkai, 1911), 31–32.

being a soldier.” He expressed his satisfaction that ultimately communism did not spread in Germany and was convinced that Germany would be superior to France within ten years.<sup>142</sup>

To fully include the public in any future war effort, Tanaka further developed the concept of a “national mobilization” (*kokka sōdōin*), an idea that the Special Military Investigation Committee had outlined in 1920.<sup>143</sup> Such a movement—which according to Tanaka “transcended class, status, and group interests”—would make the public aware of the importance of national defense.<sup>144</sup> Building on a 1910 slogan of everybody becoming a “good soldier and good citizen” (*ryōhei ryōmin*), Tanaka insisted that there would be no boundary between society and the military and ultimately no dividing line between the political and the military spheres.<sup>145</sup> Tanaka himself exemplified this marriage between the military and the political when, as a former army general, he became the president of the Seiyūkai Party in 1925 and, in 1927, Japan’s prime minister.<sup>146</sup>

The unfolding discussion about establishing a self-sufficient wartime economy and ensuring popular support for the war effort was of great importance to the development of Japan’s military aviation. As we have seen in the previous chapter, the army engineer Kusakari Shirō submitted his firsthand news about European aviation industries and public air-mindedness in early 1917.

Ironically, Kusakari’s claim to build up a powerful air force and to foster Japan’s aircraft industry received unexpected support from the poor performance of Japan’s army aircraft.

---

<sup>142</sup> Sawamoto Mōko, *Kokka sōdōin no igi* [The meaning of national mobilization] (Tokyo: Aoyama Shoin, 1926), 259.

<sup>143</sup> Rinji Gunji Chōsaiinkai, *Kokka sōdōin ni kan suru iken* [An opinion on national mobilization] (Tokyo: Rikugunshō, 1920).

<sup>144</sup> Ibid., 256. In his writings Tanaka does not employ the word for *total war* (*sōryokusen*).

<sup>145</sup> For the emergence of the motto “good soldier and good citizen” see Richard Smethurst, “The Creation of the Imperial Military Reserve Association in Japan,” *The Journal of Asian Studies* 30, no. 4 (1971): 816.

<sup>146</sup> April 1927–July 1929.

During World War I the extent to which the Japanese military had previously depended on foreign technology had become painfully clear. Once the war began, the fledgling Japanese air force was no longer able to import aircraft engines and had had to resort to domestic engine production. In 1916 the Japanese Army Artillery Arsenal started a trial production of aircraft engines at its Tokyo artillery arsenal. These motors were based on the design of the renowned 1912 German Daimler 100hp engine that the Imperial Flying Association (*Teikoku Hikō Kyōkai*) had imported before the war. But due to the low standards of Japanese manufacturing technology and the lack of appropriate metal alloys, these made-in-Japan engines were notoriously unreliable. Their deficiency became especially evident during a large-scale domestic military exercise in 1917 when most of the fourteen participating Farman M type airplanes could not even reach the maneuver area east of Lake Biwa that was three hundred kilometers away from their Tokorozawa base and had to make emergency landings due to engine troubles.<sup>147</sup>

These alarming events brought one of the army's best educated technocrats to prominence. Inoue Ikutarō (1872–1965) was a graduate of the Army Academy, the Army Artillery School of Engineering, and the Army War College. In January 1918 he was put in charge of an investigation committee whose task was to examine the underlying causes of the poor performance of the army's aviation.<sup>148</sup> Inoue submitted his memorandum "A personal view on the improvement of the aviation system" to the army minister on March 4, 1918. The memorandum confirmed that Japan's air force was "conspicuously inferior" (*chodai no sonshoku aru*) to those of the western countries. Inoue insisted that the main lesson to be drawn from World War I so far—the war came to an end only in November 1918—was the urgent need to

---

<sup>147</sup> Inoue Ikutarō, "Kōkūnihon no sōsho [The beginnings of Japanese aviation]," reprinted in Nihon Kōkūkyōkai, *Nihon Kōkūshi vol. 1*, 248–58.

<sup>148</sup> Inoue Ikutarō Kankōkai, *Inoue Ikutarō den*, 49–51.

“change the present system radically” (*konponteki ni seido o kaisei shi*). For this the Japanese government had to be ready to provide the necessary funds. The progress of army aviation should be given priority over any thoughts of cost saving, Inoue urged.

In his proposed reorganization and expansion scheme a new flight school should be established to provide facilities for theoretical and practical training, research, and material supply. It would also be necessary not only to expand the Tokorozawa airfield but also to build a new airport to which large parts of the present air unit should be transferred. Inoue further suggested establishing an Aviation Department within the Army Ministry. This bureau would then unify all aviation-related activities that were currently dispersed over such diverse departments as engineering, supply, utility, artillery, and arsenals. Referring to the accidents in the 1917 maneuver, he recommended establishing closer ties between aircraft producers and the military in order to better coordinate the purchase, examination, maintenance, repair, and supply of airplanes. The new Army Aviation Department should therefore be invested with the authority to supervise and control Japan’s aircraft manufacturing—both civil and military.<sup>149</sup>

In all likelihood Inoue’s far reaching proposals would have been consigned to oblivion if there had not been a reshuffle in the new Cabinet under Prime Minister Hara Takashi (1856–1921). In September 1918 Tanaka Giichi (1864–1929) was appointed army minister. Tanaka’s three-year term in office was a decisive period for the development of Japan’s military and civil aviation. Bringing together the diverging visions of technical experts and ideologists, Tanaka appointed air-minded army technocrats to influential positions and at the same implemented his

---

<sup>149</sup> The Japanese Navy established its own aviation department in its Bureau of Naval Affairs (Gunmukyokukōkūbu) in 1919.

“good soldier and good citizen” doctrine by forging a strong link between the army and Japan’s emerging civil aviation.

In 1919 Tanaka completely reshaped the structure and substance of the army’s aviation program. In addition to allotting extra funds for the army’s air units, Tanaka approved the outline based on Inoue’s memorandum.<sup>150</sup> This support for Inoue’s ambitious plan is less surprising considering that before being appointed army minister Tanaka had been the vice-director of the General Staff Headquarters. During that time, in June 1918, the General Staff Headquarters had issued a position paper on Japan’s military aviation that expressed a firm belief in airpower both as a new efficient weapon and as a means to direct popular enthusiasm toward support for the military. The memorandum supported the build-up of a strong air force and offered an even more radical vision than had Inoue: an independent air force as a third branch on a par with the army and the navy.<sup>151</sup> Although this vision of an independent air force did not materialize, Tanaka did convince the Diet of the urgency of modernizing Japan’s weapons and of providing the necessary funds for an expansion of Japan’s airpower. As a result the army established the Army Aviation Department (*rikugunkōkūbu*) in April 1919. The chief of the department was Inoue Ikutarō, who reported directly to the army minister.<sup>152</sup>

In August 1920, in a second step, Tanaka also promoted the development of Japan’s civil aviation by setting up an Aviation Bureau (*kōkūkyoku*), which he placed under the army’s jurisdiction. Tanaka explained the importance of this move at a meeting of local governors. Whereas in military aviation “we already can see the first light of dawn,” the civil aircraft sector

---

<sup>150</sup> Nihon Kōkūkyōkai, *Nihon Kōkūshi vol. 1*, 258.

<sup>151</sup> Reprinted in Bōeichō, *Rikugun kōkū no gunbi to un’yō I*, 86–89.

<sup>152</sup> Tanaka Giichi, “Rikugunkōkūbu chokurei [Army Flight Department Ordinance],” 1919, JACAR Ref. A03021185100.

still suffered from a lack of pilots and aircraft manufacturers. Tanaka therefore asked for the “enthusiastic support [and the] united efforts of government and people” to help the Aviation Bureau in its important role to protect, encourage, and guide the civil aviation project.<sup>153</sup>

The Aviation Bureau soon became involved in all fields of Japan’s aviation. It assigned high priority to the training of civil pilots who were offered courses at the army’s flight school.<sup>154</sup> It set up new “Rules for the Promotion of Aviation” that made additional funds available for civilians who contributed to the development of civil aviation with their skill and knowledge, for accomplished civilian pilots, and for producers and designers of civil aircraft and material.<sup>155</sup> The civil Aviation Bureau was also put in charge of determining the airworthiness of aircraft and the proper qualifications of pilots. Finally, in order to promote public aviation enterprises and flight schools, the army agreed to rent or sell surplus military machinery to civilians.<sup>156</sup>

### **The Rise and Fall of the French Aviation Monopoly**

Tanaka’s move to install Inoue in the influential position of chief of the new Army Aviation Department had far-reaching consequences. One of Inoue’s first and most momentous decisions was to equip the Army Air Corps entirely with French aircraft. His declared aim was to model everything on French aviation. He insisted that only after having reached the French level could

---

<sup>153</sup> “Tanaka rikugundaijin no kunji chihōchōkan kaigi ni oite [The Army Minister Tanaka’s instruction at meeting of local governors],” *Yomiuri Shinbun*, September 26, 1920, 2.

<sup>154</sup> Tanaka Giichi, “Rikugun kōkūgakkō ni oite minkan no kibōsha ni tai shi kōkūshutsu o kyōju shiuru [Giving civil applicants flight training at the army’s flight school],” 1919, JACAR Ref. A03021320700.

<sup>155</sup> Nihon Kōkū Kyōkai, *Nihon kōkū shi Meiji Taishō*, 498.

<sup>156</sup> Tanaka Giichi, “Gun’yōkōkūki no kashitsuke to uriwatashi [Lease and sale of military aircraft],” 1921, JACAR Ref. A03021320700.

Japanese aviation then achieve independence, at which point it could begin to absorb the technology, strategy, and organizational patterns of other countries as well.<sup>157</sup>

Inoue's decision seems to have been well informed. The period before and during World War I was the golden age of French aviation. The country's aircraft industry made remarkable technological progress. Public opinion and national politics supported aviation as a weapon of revenge for France's 1870 defeat by Germany and as an adequate response toward what was conceived as the "Teutonic menace."<sup>158</sup> In 1914 France held all world aviation records, and by the end of World War I the country not only had the largest air force at its disposal but was the leader in world aircraft production.

Not surprisingly French influence on Japan's early aviation was strong. As we have seen, Captain Tokugawa Yoshitoshi had taken off in a French Farman biplane for Japan's first official powered flight in December 1910. Two years later the Japanese military had begun licensed production of aircraft designed by Maurice Farman. In 1914 Japan had fought its first air battle in the skies over the German concession of Tsingtao with French Nieuport and Farman aircraft.

In 1919, therefore, even with Tanaka's unwavering admiration for Germany (which he shared with many high-ranking army officers), it was difficult to imagine that Germany would play any substantial role in the development of Japan's aviation in the foreseeable future.

French-Japanese collaboration grew at the time of the French aeronautical mission to Japan. In January 1919 a group of fifty-nine Frenchmen under the leadership of Lieutenant Jacques-Paul Faure (1869–1924) arrived in Japan (see Figure 8) for a proposed stay of eight months.<sup>159</sup>

---

<sup>157</sup> Inoue Ikutarō, "Kōkūnihon no sōsho," in *Nihon Kōkūshi vol. c1*, 248–58.

<sup>158</sup> Ader, *L'aviation militaire*, 79.

<sup>159</sup> Army Ministry, "Furansu haken nihon shōkō ni kan suru ken [The dispatch of the French team and its relation to Japanese officers]," 1916, JACAR, Ref. C03024710400, 2060–88.

Eager to dispose of its wartime surplus production of aircraft and to establish a monopoly for the sale and licensed production of airplanes in Japan, the French government paid for all expenses of the mission. Under the supervision of Inoue, the French mission gave instruction to Japanese pilots in reconnaissance, aerial shooting, and bombing. In addition the French experts helped to set up the licensed production of Salmson and Nieuport aircraft and aero engines.

**Figure 8: The heyday of French aviation in Japan. An *Arc de Triomphe* saluted Faure and his officers at Gifu Station near the Kakamigahara Airfield in February 1919. One of the arc's pillars shows a French *bienvenue* in big letters. The characters 迎撃 (partially visible on the top) welcome the team in Japanese.<sup>160</sup>**

Nonetheless, poor organization, insufficient funding, and mutual discord plagued the mission. The French government repeatedly turned down Faure's requests to send more aircraft, machine tools, and specific aviation material.<sup>161</sup> Friction developed between the Japanese and their French advisors who felt themselves victims of certain "Germanophile tendencies among the Japanese military."<sup>162</sup> Four serious accidents, including a disastrous crash in Hamamatsu, Shizuoka (see Map 1), which killed and wounded several spectators, further overshadowed the accomplishments of the mission.

---

<sup>160</sup> Source: Kakamigaharashi rekishi minzoku shiryōkan, *Kakamino no fūdo* [The natural features of Kakamino]. (Kakamigahara: Naka insatsu, 2004), 78.

<sup>161</sup> Report by Colonel Faure on the mission's work in July 1919: "The Spad Lorraine aircraft have not arrived and cannot be used. . . . The Spad monoplanes which we requested for demonstration flights have not arrived . . . not even the silicon which we need for hydrogen production [has] arrived," quoted in Rémy Porte, "L'échec de la Mission militaire française d'Aéronautique au Japon 1918–1920." *Revue historique des armées* 236 (2004): 96n26.

<sup>162</sup> Report dated July 16, 1919. Ibid., 96n10.

Japanese doubts about fully embracing French aviation technology increased with the delivery of defective French airplanes. In January 1919, the month of Faure's arrival, the Japanese Army had approved a large order of French aircraft. The proposed purchase included thirty Salmson 2A2 reconnaissance aircraft, one hundred Spad type 13 fighters, and forty Nieuport 81E2s to be used for flight training. Nearly twelve months later these planes finally arrived by sea at Yokohama. The Japanese purchasers were disappointed to find that a large portion of the delivery was unusable because of degraded plywood and corroded metal parts. Further discontent emerged when the Japanese discovered that most of the damage had not been caused in transit but was the result of slipshod production.<sup>163</sup> The army attaché to the Japanese Embassy in Paris sent a damage report to the French government, to the French Air Force, and to the manufacturers. But lengthy negotiations ended in May 1921 without any loss being recovered.

The Japanese did not press the matter. The army continued to feel some indebtedness to France for having received free training. Japanese politicians had an interest in maintaining good relations with the French government, especially after France—unlike the United States and Great Britain—had supported Japan's Racial Equality proposal at the 1919 Paris Peace Conference. Nevertheless it is easy to surmise that the incident strongly undermined Japanese belief in the reliability of French manufacturers and the quality of their products.

Further discontent about French airplanes emerged during the Japanese Army's efforts to build up its own bomber fleet during the early 1920s. Several reports about the effects of aerial bombing during World War I had attracted keen Japanese interest in long-range bombers. Being aware that Japan's aviation industry could provide neither the airframes nor the engines for such an aircraft type, the Japanese Army opted for the import of French bombers. Soon after the end

---

<sup>163</sup> Bōichō bōei kenshūjō senshi shitsu, *Rikugun kōkū heiki no kaiatsu seisan hokyū*, 57.

of World War I the army dispatched a “bomber technology committee” to France to select a suitable aircraft.<sup>164</sup> However, due to postwar cuts in the military budget, the French had postponed the development of any new bomber type, and the Japanese had to make do with the obsolete World War I twin-engine Farman F-50 bomber. On April 1921 five used F-50 bombers arrived at the Tokorozawa Army Flight School. As it turned out, in addition to their poor design and performance these aircraft were seriously degraded because of their previous use in the French Army. The Japanese flight crews soon became critical of the bombers. In a flight report one Japanese pilot described how part of a bomber’s wing had disintegrated during flight. He managed to land the aircraft safely, but the whole crew was so angered that they destroyed the rest of the wing in order to avoid having to fly that aircraft again.<sup>165</sup> The flight school soon grounded and finally abandoned all F-50s.

In spite of all these problems, the Japanese Army continued to rely on French technology and placed orders for sixteen Farman F-60 bombers, the first two of which arrived in Japan in December 1921. As an improved version of its predecessor, the F-60 was designed to carry a heavier bomb load. But it turned out that the aircraft’s increased weight resulted in poor maneuverability. The bomber’s new twelve-cylinder Lorraine engine had to be operated under full power during the entire flight, leading to frequent engine damage. Because of these continuing troubles all F-60s were finally decommissioned in 1928.<sup>166</sup>

---

<sup>164</sup> Nohara Shigeru, *Nihon gun'yōki jiten: Rikugun hen, 1910–1945* [Encyclopedia of Japanese warplanes (Army) 1910–1945] (Tokyo: Ikarosu Shuppan, 2005), 32.

<sup>165</sup> *Ibid.*, 33.

<sup>166</sup> *Ibid.*, 34.

## A New Window Opens: Post–World War I Reports about German Aviation

Soon after the end of World War I the Japanese military seized the opportunity to collect first-hand information about Germany. They wanted not only to learn the reasons for Germany's defeat but also to collect information about Germany's latest military technology, access to which had been barred to the Japanese since 1914.<sup>167</sup>

Admiral Katō Hiroharu (1870-1939) was one of the first Japanese officers sent to Germany between July 1919 and June 1920. He met with high-ranking military officers such as former Grand Admiral Alfred von Tirpitz and Admiral Paul Behncke.<sup>168</sup> After his return to Japan, Katō both informed his military superiors and delivered a lecture to the Crown Prince Hirohito.<sup>169</sup> In his report “An inspection of the military's condition in each Western country,” Katō described the 1919 Versailles settlement as the “severest peace treaty in recorded history.” For him the treaty aimed at a complete dismantling of Germany's military industry in order to prevent the country from waging any future war. Katō readily accepted the stab-in-the-back doctrine of the conservative German military by emphasizing that the German Army had not been defeated in battle. According to Katō Germany had lost because its government had failed to convince the people that the war was a “matter of life or death for the Teutonic race and the German empire.” As a result the German war effort had suffered from a “lack of spirit of self-sacrifice, loyalty, and patriotism” which ultimately led to the country's defeat.

---

<sup>167</sup> Besides the Hans Grade plane, discussed in the previous chapter, imports of German aviation technology had been limited to a Parseval airship in 1912 and a Rumpler Taube monoplane in 1913.

<sup>168</sup> Aizawa Kiyoshi, *Kaigun no sentaku: Saikō Shinjuwan e no michi* [The navy's choice: Reconsidering the road to Pearl Harbor] (Tokyo: Chūō Kōron Shinsha, 2002), 54.

<sup>169</sup> Katō Hiroharu, “Ōbei kakkoku gunji shisatsu jōkyō (tōmiyadenka e gokōen 6 gatsu 29 nichi) [An inspection of the military's condition in each Western Country—lecture to Crown Prince on June 29],” 1920, JACAR Ref. C11081069100.

Apart from analyzing the ideological dimensions of the Great War Katō also became interested in German technology. The progress of German science and industry—of which Japan had apparently been entirely unaware—surprised him. In his view it surpassed that of all other countries. Katō was especially impressed by German bomber technology, which he thought would allow the launching of surprise attacks on Great Britain in the near future.

While Katō was still in Germany another golden opportunity for direct access to German aviation technology presented itself to the Japanese. Section Five of the Versailles Treaty stipulated that an Inter-Allied Commissions Control, staffed by French, Belgian, British, Italian, and Japanese experts, be set up to enforce the treaty's military, naval, and air clauses. The commission members, among them seventy-three Japanese, had to ensure that Germany complied with the handover, dismantling, or destruction of all war matériel. The Berlin-based Inter-Allied Aeronautical Commission of Control, consisting of one hundred eighty-seven officers, was in charge of Germany's aviation.<sup>170</sup> It had to be granted unrestricted access to all German aircraft manufacturers, airports, and depots. The five Japanese members of the inspection committee were instructed to send detailed reports about their investigations back to Japan.<sup>171</sup>

---

<sup>170</sup> A diagram of the Supreme War Council Military Representative gives the following numbers of officers in the Inter-Allied Aeronautical Commission of Control: Great Britain (66), France (62), Italy (26), United States (18), Belgium (10), and Japan (5). Supreme War Council Military Representative, "Regarding the Principles Which Should Govern the Distribution of the Aeronautical Material, Given Up or to Be Given Up by the Central Powers," 1919, JACAR Ref. B06150307700.

<sup>171</sup> Hara Takeshi, "Tokumei zenkentaishi Matsui Keishirō ika 74mei o heiwa jōyaku jishi iin toshite jōsō [The ambassador extraordinary and plenipotentiary Matsui Keishirō and the following 73 members of the peace treaty enforcement committee report to the Emperor]," 1919, National Archives of Japan: Honkan-2A-019-00 • B00910100.

Starting in March 1920 the commission's reports arrived at regular intervals in Tokyo. The first account was written by Lieutenants Takada Yoshimitsu and Imamura Osamu.<sup>172</sup> These two authors plainly stated that the purpose of their inspection trip was not just enforcement of the Versailles Treaty but also an inquiry about the state of German aviation. The report claimed, though, that German officials had hampered the group's activities. The investigations at the various air squadrons, aviation arsenals, and other aviation-related facilities were met with what the Japanese saw as rampant distrust and unwillingness to cooperate. Takada experienced further frustration when his group could get hold of only obsolete aircraft stripped of all armament.

The Japanese Army did not fully rely on the Inter-Allied Aeronautical Commission of Control. In 1922 the army's Aviation Department organized its own inquiry into the state of French and German aviation that proved to be highly instructive. Colonel Koiso Kuniaki (1880–1950), an Aviation Department staff member, went on a ten-month aviation inspection trip to Europe. Koiso revealed in his autobiography how, during his trip, he had become discontent with French aviation technology and simultaneously developed a high regard for German aircraft manufacturers.<sup>173</sup> During his visits to French aircraft factories he noticed that the industry had just begun to experiment with all-metal aircraft. When observing the aircraft of the French Air Corps he concluded that there had not been much progress since World War I. To Koiso's surprise the French military were still using fabric-covered all-wooden aircraft that, due to their underpowered engines, were slow and showed only mediocre climb performance.

---

<sup>172</sup> Takada Yoshimitsu, "Doitsu kōkūkanshi geppō [Monthly German aviation inspection reports]," 1920, JACAR Ref. C04015195400.

<sup>173</sup> Koiso Kuniaki, *Katsuzan Kōsō* [Arrowhead mountain, wild goose claw] (Tokyo: Koiso Kuniaki Jijoden Kankōkai, 1963), 402–10.

When Koiso came to Germany he was granted access to almost all major branches of the German aviation industry. Even though Koiso was a member of the Allied Powers these companies openly revealed to him their efforts to evade the restrictions of the Versailles Treaty. In an obvious hope to do business with Japan the electrical engineering company Siemens showed him a secretly developed new machine gun for future heavy bombers, and the aircraft designer Heinkel explained to him how civilian passenger aircraft could be easily converted to bombers in wartime. The engine manufacturer BMW presented its new 450 horsepower aero-engine and offered to “bypass” the Versailles Treaty regulations by exporting the dismantled engine part by part. At Junkers, Koiso was shown the company’s large-size wind tunnel and was introduced to the company’s unique all-metal technology that completely replaced wooden parts with light metal components. At Dornier, Koiso learned that the company had already moved part of its production abroad to Italy. When, during his discussions with the company’s director Claude Dornier (1884–1969), Koiso suggested an improvement for a new fighter aircraft he was promised that a revised blueprint would be sent to the Japanese Embassy as soon as possible.

Koiso was aware of the confidential character of his visits. During his stay in Germany the Japanese Army informed him by telegram that it planned to appoint him as a member of the official Allied military inspection team, but Koiso refused the attractive offer. Having been shown various “absolutely secret weapons” (*zettai ni himitsu de aru heikirui*) at the German factories, he explained he could not join a committee that then would force these same companies to disclose publicly their armament production to the Allied Powers.

Numerous problems notwithstanding, the Inter-Allied Aeronautical Commission of Control continued its work. Access to German military aircraft and air strategy offered several opportunities to compare the military aviation of France and Germany in terms of both

technology and air strategy. In 1924 commission member Watanabe Kōtarō submitted a report that evaluated the performance of German and French airplanes.<sup>174</sup> In the following year he compiled an even more detailed summary of German airpower during the war that included an analysis of various German aircraft types and their use. Watanabe focused on the performance and armament of bombers and the new tactics of night bombing that the Germans had developed in 1917. Watanabe strongly advised that lessons be learned from Germany, suggesting a wide-ranging revision of the army's air strategy that until then had been completely based on the French model.<sup>175</sup>

Aware of the armament limitations imposed on Germany, the Japanese explored the idea of German companies designing and producing their aircraft outside of Germany. Most of the Japanese commission members conceded that the treaty regulations' damage to the German aviation industry was immense. It therefore seemed quite understandable to them that many German aviation manufacturers had started cooperating with foreign companies in order to survive. The Japanese were aware that some aircraft makers, especially Junkers, Dornier, and Caspar, still pursued their research and still manufactured aircraft parts in Germany. The commission members also learned that in order to evade the treaty regulations these companies

---

<sup>174</sup> Watanabe Kotaro, "Ō dai 2 gō shi 11 Taishō 13 nen 12 gatsu 15 nichi Doitsu hikōki seinō bessatsu no tōri gohōkoku [Europe No. 2-11: Report on the performance of German and French airplanes as shown in the attached document, December 15, 1924]," 1924, JACAR Ref. C08040448700.

<sup>175</sup> Watanabe Kōtarō, "Ō dai 2 gō shi 41 Taishō 14 nen 7 gatsu 14 nichi shoruisōfuduke no ken hōkoku [Europe No. 2-41: Report of sending documents, July 14, 1925]," 1925, JACAR Ref. C08040445700.

had established additional factories in Holland, Italy, and Sweden where these parts were assembled under the name of a foreign company.<sup>176</sup>

The commission's reports provided the Japanese military with valuable insight into Germany's latest aeronautical research. One recurring topic that obviously fascinated the Japanese experts was Germany's pioneering manufacture of all-metal airplanes. This cutting-edge technology depended on the use of duralumin, an alloy invented in Germany that was praised by the Japanese media as "the surprise of the world . . . lighter than aluminum, harder than steel."<sup>177</sup> The Japanese became familiar with the advantages of the all-metal airframe — strength, fire-resistance, and durability.<sup>178</sup> They also obtained detailed research material on the new technology.<sup>179</sup> Other advanced research topics that excited the commission members included giant aircraft, high-performance engines, radio-controlled aircraft, zero-visibility flights at night or in thick fog, and even methods for "stopping engines by electric waves."<sup>180</sup> A 1922 report emphasized the crucial role of Germany's renowned technical universities that combined theoretical study with practical training and continued to be centers of advanced aviation research. The Japanese observers concluded—perhaps overly optimistically—that due to the

---

<sup>176</sup> Author unknown, "Doitsu kōkūkai no genkyō [The current condition of the German aviation industry]," 1922, JACAR Ref. C08040371600.

<sup>177</sup> "Arumi yori karuku hagane yori kataku [Lighter than aluminum, harder than steel]," *Osaka Asahi Newspaper*, October 1, 1926.

<sup>178</sup> The alleged durability of duralumin was put into question when scientists at the U.S. Bureau of Standards discovered a type of erosion inside the metal that reduced its strength. For details see Eric Schatzberg, *Wings of Wood, Wings of Metal: Culture and Technical Choice in American Airplane Materials, 1914–1945* (Princeton, NJ: Princeton University Press, 1999), 54–56.

<sup>179</sup> Watanabe Kōtarō, "Kinzokusei hikōki ni kan suru kenkyū [Research on all-metal aircraft]," 1925, JACAR Ref. C08040449800.

<sup>180</sup> Navy Ministry, "Fuzoku kokusai kōkūkaigi kankei 43 satsu [Attachment to the 43 volumes on the international aviation conference]," 1926, JACAR Ref. C04015196500.

aircraft manufacturers' mutual support and open exchange of knowledge "Germany's whole aviation industry was fully capable of maintaining its leading position in the world."<sup>181</sup>

On several occasions the inspection trips turned from inter-allied cooperation into internal competition for privileged access to German technology. The Japanese became aware of the extent to which German aviation matériel attracted the interest of the other Allied nations.<sup>182</sup> Obviously, in many cases Allied inspection activities turned into outright industrial espionage carried out under the guise of weapons control. A 1922 report by the Japanese Army members of the Control Commission emphasized how much every Allied country was keen to import and imitate advanced German aviation technology.<sup>183</sup> The Japanese learned how French and British committee members dispatched their own specialists to German manufacturers and research facilities, each eagerly taking as many notes and photographs as possible. They not only confiscated aircraft and aircraft parts but also seized newly developed materials for their own research purposes.<sup>184</sup>

The Japanese observers also noted that the German public's aviation enthusiasm was left intact even after the country's crushing defeat. Engineer Lieutenant Colonel Hayashi Masaki, a member of the inspection committee, reported on German post-war efforts to promote popular air-mindedness. Continuing the activities of pre-war local aviation clubs the German Aviation Association (*Deutscher Luftfahrt Verband*) could build on a nationwide network of aviation

---

<sup>181</sup> Author unknown, "Doitsu kōkūkai no genkyō [The current condition of the German aviation industry]," 1922, JACAR Ref. C08040371600.

<sup>182</sup> Takada Yoshimitsu, "Doitsu kōkūkanishi geppō [Monthly German aviation inspection reports]," 1920, JACAR Ref. C04015195400.

<sup>183</sup> Author unknown, "Doitsu kōkūkai no genkyō [The current condition of the German aviation industry]," 1922, JACAR Ref. C08040371600.

<sup>184</sup> Watanabe Kōtarō, "Ō dai 2 gō shi 92 Furiidorihhisuhaahen kōkūseizōkaisha kenetsu hōkoku [Europe No. 2-92: Inspection report on the Friedrichshafen Aircraft Manufacturing Company]," 1924, JACAR Ref. C08040441100.

enthusiasts. The association organized glider and model aircraft competitions, held aviation related lectures, and published magazines and aerial photographs. The German government supported aeronautical research at universities and funded aircraft exhibitions, while the aviation industry continued its close ties with politicians through invitations to factory visits and sightseeing flights. The Japanese observers also commented on the development of Germany's post-war civil aviation. Regular passenger flights carried out with small hydroplanes at Lake Constance led them to the conclusion that safe passenger transport would eliminate the public's fear of flying, whereas in Japan hazardous flight shows with decommissioned military aircraft undermined public confidence in aircraft as a means of transport.<sup>185</sup>

## War Trophies from Germany

While the regular reports of the inspection teams provided extensive insight for the Japanese into all aspects of German aviation, another provision of the Versailles Treaty allowed for more immediate exposure to the products of German wartime industry. Treaty Article 202 demanded that within three months after the coming into effect “all military and naval aeronautical material . . . must be delivered to the Governments of the Principal Allied and Associated Powers.” The clause meticulously listed the items in question. Apart from airplanes and hydroplanes, dirigibles and their sheds, engines, nacelles, and fuselages had to be surrendered to places that were to be determined by the Allies. Furthermore Germany had to hand over all aircraft armament and munitions, including bombsights and other devices for

---

<sup>185</sup> Members of the Supervisory Committee on German Aviation “Ō dai 2 gō shi 30 Taishō 14 nen 4 gatsu 25 nichi Doitsu kōkūkai genkyō no ken hōkoku [Europe No. 2-30: Report on the current situation of the German aviation industry, April 25, 1925],” 1925, JACAR Ref. C08040446100.

dropping bombs or torpedoes.<sup>186</sup> Finally, the list also included aircraft instruments, wireless equipment, and reconnaissance cameras. As one of the victorious powers Japan was entitled to receive part of the seized material as war reparations. The lion's share went to France and Great Britain, but the treaty regulations still granted Japan 5 percent of the confiscated German aircraft and equipment. The rest was to be distributed among the United States, Italy, and Belgium.<sup>187</sup>

Being allotted even a small part of the war trophies from Germany was a matter of great importance for Japan. Army Minister Tanaka urged the cabinet to fund the shipping expense of one hundred aircraft and five hundred aero-engines. He argued that receiving the German aeronautical material not only would advance Japan's prestige by putting the country on the same level as the other Allied nations (*hoka rekkyō to hitoshiku*) but also would be extremely important for the progress and development of Japan's aviation. The cabinet agreed and granted the enormous amount of 2.5 million yen for the disassembly, packing, and transport of the war trophies.<sup>188</sup>

Japanese doubts about the fair distribution of the German aeronautical material arose as early as October 1919. One clause of the Versailles regulations determined that, if not enough airplanes of one type were available, each Allied Power was to be provided at least with detailed plans and blueprints of the aircraft type in question.<sup>189</sup> Regardless of this provision—meant to provide equal access to German know-how—a scramble for German aviation technology began.

---

<sup>186</sup> Supreme War Council Military Representative, "Regarding the Principles Which Should Govern the Distribution of the Aeronautical Material, Given Up or to Be Given Up by the Central Powers," 1919, JACAR Ref. B06150307700, 198.

<sup>187</sup> Ibid., 224, gives the following numbers: France (30 percent), Great Britain (30 percent), United States (15 percent), Italy (15 percent), Japan (5 percent), Belgium (5 percent).

<sup>188</sup> Tanaka Giichi, "Senri kōkūki bunpai ni kan suru [Distribution of war victory aircraft]," 1919, National Archives of Japan honkan-2A-011-00, rui 01325100.

<sup>189</sup> Supreme War Council, "Regarding the Principles Which Should Govern the Distribution of the Aeronautical Material," 194.

The Japanese noticed that most of the aircraft that the Germans had handed over were outdated, technologically obsolete, or intentionally damaged. It became clear that many German authorities and manufacturers were hiding or modifying their most advanced aircraft, making it nearly impossible to seize these machines.<sup>190</sup>

In October 1919 Japan expected that the Allies would receive about six thousand aircraft, of which Japan would be entitled three hundred. The Japanese reckoned that among those aircraft around 10 percent would be “very valuable.”<sup>191</sup> Then, in the same month, disturbing news arrived at the Army Ministry. In an urgent telegram Major General Watanabe informed army officials that France, Great Britain, the United States, and others had already begun to purchase secretly and under false names the latest German aircraft from Germans who were eager to sell their stock before it was confiscated by the government.<sup>192</sup> With the dwindling number of available aircraft the Japanese began to worry the country would be left behind with obsolete material. Adding to this sense of urgency was the fact that the long transport time required to bring the aeronautical material to Japan would render it outdated on arrival and further diminish the potential of a transfer of cutting-edge technology. Japanese officials therefore devised a strategy of acquiring just one or two aircraft of each type, together with their engines and

---

<sup>190</sup> Foreign Ministry, “Rikugun ni oite ōshū hikōkisaibu no buhinfuzoku kikaitō kōbaigata no ken [Purchasing aircraft parts and accessories confiscated by the army],” 1920, JACAR Ref. B07090277400.

<sup>191</sup> Army Ministry, “Dai 49 gō Doitsu yori rengōkoku ni kōfu subeki kōkūki no ken [No. 49 Aircraft to be handed over from Germany to the Allied Powers],” 1919, JACAR Ref. C08040384500.

<sup>192</sup> Army Ministry, “Dai 50 gō Doitsu yori rengōkoku ni kōfu subeki kōkūki no ken [No. 50 Aircraft to be handed over from Germany to the Allied Powers],” 1919, JACAR Ref. C08040384600.

accessories, and shipping them to Japan. At the same time the Japanese delegates in Germany were ordered to get hold of as much research material and as many blueprints as possible.<sup>193</sup>

When these measures did not show the expected results, Japan took its first step toward subverting the treaty regulations. Several telegrams were exchanged in August 1920 between Captain Kodama Tsuneo, who was sent to Germany to oversee the distribution of confiscated aircraft, and the Army Ministry. These messages allow us to follow the quarrel over German war matériel and how these disputes led to the gradual alienation of Japan from its erstwhile allies.<sup>194</sup> A simultaneous implicit understanding with Germany developed that bordered on complicity.

Kodama pointed out to his superiors the importance of securing accessories for German military aircraft that were soon to go out of production. He urged that “if we miss the opportunity to buy them now, we cannot get hold of them anymore later.”<sup>195</sup> It would also be necessary to buy special material for the repair of the confiscated aircraft. He therefore implored his superiors to entrust him with the selection and purchase of these articles.

With Kodama’s proposal the scramble for German aircraft technology reached a new stage where it threatened to strain Japan’s international relations. The Japanese Foreign Ministry intervened and forcibly reminded the Army Ministry that the Versailles Treaty banned any export of military material from Germany. Therefore “according to this interpretation of the treaty” the Foreign Ministry could not sanction the army’s proposed purchase.<sup>196</sup>

---

<sup>193</sup> Army Ministry, “Dai 49 gō Doitsu yori rengōkoku ni kōfu subeki kōkūki no ken [No. 49 Aircraft to be handed over from Germany to the Allied Powers],” 1919, JACAR Ref. C08040384500.

<sup>194</sup> Foreign Ministry, “Rikugun ni oite ōshū hikōkisaibu no buhinfuzoku kikaitō kōbaigata no ken [Purchasing aircraft parts and accessories confiscated by the army],” 1920, JACAR Ref. B07090277400.

<sup>195</sup> Ibid., 287.

<sup>196</sup> Ibid., 288.

Nonetheless, the Foreign Ministry acknowledged the necessity of carrying out the procurements and proposed to entrust the Japanese trading company Mitsui with the entire purchase, a procedure Major General Watanabe had suggested several months earlier.<sup>197</sup> The Foreign Ministry insisted that the Japanese Army had to stay out of the deal. “Let Mitsui carry out the transaction in complete secrecy and let them have it connected to Japan as little as possible.” The ministry continued, “if you proceed like this there will be no strong objection from our side.”<sup>198</sup>

The Foreign Ministry’s idea to commission a civil trading company to transfer military armament was not surprising. The Japanese government had already secured the services of the company Mitsui Bussan for the transport and assembly of confiscated aircraft from Germany.<sup>199</sup> The involvement of trading companies is significant because it paved the way for future Japanese-German business relations in the aviation sector. It is also important to note that Japanese trading companies, most notably Mitsui Bussan and Mitsubishi Shōji, set up their own teams of engineers who actively collected technical information abroad and provided technical expertise to their Japanese customers. These companies played a crucial, if often underestimated, role in the selection and transfer of foreign technology.<sup>200</sup>

In September 1920 the official reparations arrived in Japan. A massive delivery of seventy German aircraft, nearly three hundred engines, and countless pieces of equipment such as

---

<sup>197</sup> Army Ministry, “Dai 49 gō Doitsu yori rengōkoku ni kōfu subeki kōkūki no ken [No.49 Aircraft to be handed over from Germany to the Allied Powers],” 1919, JACAR Ref. C08040384500.

<sup>198</sup> Ibid., 289.

<sup>199</sup> Various authors, “Doitsu kōkūshi yatoiire ni kan suru ken [The employment of German aviation engineers],” 1920 JACAR Ref. C03025180000.

<sup>200</sup> For more details see Miyamoto Mataji and Yoshio Togai, *Sōgō shōsha no keieishi* [A history of the management of general trading companies] (Tokyo: Tōyō Keizai Shinpōsha, 1976).

wireless telegraphs, cameras, and aiming devices was unloaded in Yokohama.<sup>201</sup> Considering that most Japanese aviation experts' knowledge of the development of German aviation was then still sketchy at best—the 1910 Rumpler Taube was still considered the quintessential product of the German aircraft industry—there was widespread wonder and astonishment about this treasure trove of Germany's latest technology. Among the especially impressive items was a Daimler 260hp aircraft engine and a monstrous giant aircraft, a so-called *Riesenflugzeug*, the Zeppelin-Staaken R.XV (see Figure 9). This bomber had terrorized the skies over Paris and London during World War I. With a wingspan nearly equal to that of the largest World War II bombers it was designed to carry a bomb load of more than 4,000 kilograms.

**Figure 9: The “giant aircraft” Zeppelin-Staaken.<sup>202</sup>**

The authoritative 1936 book on “Japanese Aviation History” contains a detailed list of the delivered items. The authors emphasized that “all these German aircraft were powerful, sophisticated, and very well maintained.” They also mentioned that in an example of German thoroughness each aircraft was equipped with two interior boxes that contained repair tools and numbered spare parts. They came to the conclusion that “whatever aircraft type you look at they are robust and at the same time elaborate. They incorporate absolute scientific perfection.”<sup>203</sup>

---

<sup>201</sup> The above numbers can be found in Rikugun Kōkū bu, “Senri hikōkikanran no ken [The exhibition of aircraft obtained as war reparations],” 1921, JACAR Ref. C03025216900. Kōkūkyōkai, *Nihon Kōkūshi vol. 1*, 369, maintains that the delivery consisted of forty-five different types of aircraft and three hundred twenty engines.

<sup>202</sup> Source: G. W Haddow and Peter M. Grosz, *The German Giants: the Story of the R-Planes, 1914-1919* (London: Putnam, 1969), 272.

<sup>203</sup> Nihon Kōkūkyōkai, *Nihon Kōkūshi vol. 1*, 369.

During the first months after their arrival, however, the German war trophies were appreciated more for their visual impact and propaganda value than for any potential to advance Japan's aviation. As soon as the aircraft and engines arrived at their final destination of the military airfield at Tokorozawa they were stowed in a newly built hangar and held on display for army officials between October 1920 and February 1921. An illustrated catalogue was published and distributed among the officers for their orientation and as a keepsake.<sup>204</sup> In April 1921 the general public was admitted so that they too could marvel at the German aircraft. After their display all items were distributed to the research sections of the army's flight school, its artillery arsenal, and the Aerodynamics Department of the Imperial University. As one official effused, "It was a golden opportunity for us to examine [and use] them as research material."<sup>205</sup>

One trophy in particular perhaps best epitomizes the intense Japanese enthusiasm of the early 1920s for German aviation technology. According to the Allied distribution scheme Japan was entitled to confiscate one entire German airship hangar. The building in question was a 30,000-ton iron structure that had been erected during the war at Jüterbog, near Berlin. After careful consideration the Japanese exercised their right of ownership and dismantled and shipped the building to Japan at the enormous cost of 550,000 yen. Several tens of thousands of workers then reassembled the hangar at the navy base of Kasumigaura, 80 km northeast of Tokyo. After the construction was completed the Japanese Navy could boast of owning the largest building in

---

<sup>204</sup> Reproduced in parts in Kosakabe Yonichirō, *Yūhi sora no makuake Tokorozawa* [Launching out: Tokorozawa and the opening of the skies] (Tokorozawa: Daiichi insatsu, 2005), 209.

<sup>205</sup> Nihon Kōkūkyōkai, *Nihon Kōkūshi vol. 1*, 314.

Asia, a made-in-Germany superstructure that, according to the memoirs of the former Vice-Admiral Kuwabara Torao, could easily accommodate new Tokyo Station twice over.<sup>206</sup>

## Recruiting German Engineers

After examining the German aircraft and engines, the Japanese appetite for German technology increased. The need for detailed blueprints and information about production procedures became evident. As a result the army's aviation section proposed hiring German pilots, engineers, and workmen for the assembly of confiscated aircraft and for further research on the German engines and aircraft parts.

Again the Versailles Treaty put a formal limit on Japan's ambitious plans. According to Article 179 Germany had to agree "not to accredit nor to send to any foreign country any military, naval or air mission, nor to allow any such mission to leave her territory." Furthermore, as the article continued, "the Allied and Associated Powers agree . . . not to enroll in nor to attach to their armies or naval or air forces any German national for the purpose of assisting in the military training of such armies or naval or air forces, or otherwise to employ any such German national as military, naval or aeronautic instructor."

Despite these clear-cut regulations the temptation to violate the Versailles Treaty again became overwhelming. In September 1920 Captain Kodama, who already had been instrumental in the purchase of German aeronautical matériel, urged the army vice minister to consider the employment of German aviation experts. To avoid any suspicions of violating the treaty, the ambitious officer started negotiations two years earlier with Mitsui to select and to dispatch German pilots, engineers, and mechanics to Japan as Mitsui's employees. The salary of these

---

<sup>206</sup> Kuwabara Torao, *Kaigun kōkū kaisōroku* [Recollections of the navy air force] (Tokyo: Kōkū Shinbunsha, 1964), 195.

experts would be declared as transport, packing, and assembly expenses.<sup>207</sup> As Kodama put it, “if we do so there will be no accounting problems and no diplomatic embroilment.”<sup>208</sup> However, Kodama’s clever scheme was turned down both by his superior Major General Watanabe and the army vice minister on the grounds that such a maneuver would both “violate the peace treaty and strain Franco-Japanese relations.”<sup>209</sup>

The idea of inviting German engineers was not entirely abandoned. The Japanese Army felt increased pressure to catch up with the Great Powers’ aviation technology above all in the field of all-metal aircraft. A 1923 document authored by the Army Aviation Department again brought up the topic of all-metal aircraft and claimed that among all countries Germany’s design and technology for these types of airplanes was the most advanced. The department also felt the need for German designers and specialists in the fields of aero-engines and wireless communication. The report emphasized the eagerness of Britain, Italy, and the United States to employ such German aeronautical engineers and urged that Japan should do the same. To bypass the treaty regulations the Army Aviation Department suggested having civil Japanese companies invite the German engineers. These companies would then transfer the German specialists to the army’s arsenals at which point the army would take over their pay.<sup>210</sup> The Army Ministry was finally convinced of both the urgency and the feasibility of the project and approved the department’s proposal for this type of “indirect invitation.”

---

<sup>207</sup> Various authors, “Doitsu kōkūshi yatoiire ni kan suru ken [The employment of German aviation engineers],” 1920, JACAR Ref. C03025180000.

<sup>208</sup> Foreign Ministry, “Rikugun ni oite ōshū hikōkisaibu no buhinfuzoku kikaitō kōbaigata no ken [Purchasing aircraft parts and accessories confiscated by the army],” 1920, JACAR Ref. B07090277400.

<sup>209</sup> Various authors, “Doitsu kōkūshi yatoiire ni kan suru ken.”

<sup>210</sup> Army Air Section, “Gaikoku kōkūgijutsusha shōhei ni kansuru ken [The invitation of foreign aeronautical engineers],” 1923, JACAR Ref. C03011780200.

These Japanese maneuvers to obtain German aviation technology did not slip past other foreign observers undetected and led to numerous complaints by the other Allied countries. Japanese officials took the protests about the employment of German engineers and the import of German military aircraft seriously. Aware that any matériel found by Allied delegates to have come to Japan in violation of the treaty could be confiscated or destroyed, the Japanese military strongly dismissed any involvement in illegal imports from Germany.<sup>211</sup>

The Japanese used several strategies to obfuscate their breaches of the Versailles Treaty. These included indirect purchases via third countries. Orders to the German aircraft maker Rohrbach were placed to the company's branch factory in Denmark.<sup>212</sup> Another tactic was to draw a supposedly clear dividing line between the military and commercial enterprises. When the French attaché expressed his concerns about the cooperation of Kawasaki and Aichi Tokei with German companies the navy declared that it was not involved in the practices of these private companies.<sup>213</sup> Occasionally the Japanese Army would admit knowing about the purchase of sample German aircraft by Japanese civil companies, but it consistently insisted that these were experimental aircraft used for research purposes only.<sup>214</sup>

### **Squaring the Circle: Disarmament and Airpower Build-Up**

The last section of this chapter will explore the impact of two major disarmaments that were carried out in Japan in the mid-1920s. Japan's military aviation not only survived arms

---

<sup>211</sup> Navy Ministry, "Kōkū ippan (8) [Aviation general (8)]," 1925, JACAR Ref. C08051420300, 352.

<sup>212</sup> Multiple authors, "Mitsubishi zōsenjo ni oite Doitsu hikōki kōnyū no ken [The purchase of a German aircraft by Mitsubishi Shipyard]," 1924/5, JACAR Ref. B07090278600, 328.

<sup>213</sup> Navy Ministry, "Kōkū ippan (8) [Aviation general (8)], 352.

<sup>214</sup> Multiple authors, "Mitsubishi zōsenjo ni oite Doitsu hikōki kōnyū no ken [The purchase of a German aircraft by Mitsubishi Shipyard]," 1924/5, JACAR Ref. B07090278600, 329.

reductions and severe cuts in the military budget but also, after 1925, emerged astonishingly reinvigorated both in structure and in strength. As an important consequence modern aircraft technology, domestic manufacturing, and a new focus on research became an integral part of Japan's national mobilization. These far-reaching developments further paved the way for an eager reception of German aviation technology and know-how.

In the 1920s Japan entered an era of cooperative diplomacy that resulted in considerable military retrenchment. Between 1920 and 1929 Japan's military expenses shrank from 49 percent of the national budget to less than 29 percent.<sup>215</sup> Several factors contributed to this remarkable development. Recurring financial crises and above all the devastating Kantō earthquake of 1923 strained Japan's national finances to the limit and put the military budget under growing pressure. Moreover, public opinion in Japan and a liberal diplomacy during Foreign Minister Shidehara Kijūrō's first term in office (1924–27) led to a proactive policy of disarmament. Arguably the single most important factor was the Washington Naval Treaty signed by Japan, the United States, Britain, France, and Italy in February 1922. In order to prevent an arms race in the Pacific the treaty prohibited the extension of fortifications and strictly limited the number of capital ships.

Ironically the move toward naval disarmament gave a significant boost to Japan's aircraft industry. In an attempt to compensate for the cap imposed on battleships the Japanese Navy decided to direct its funds toward an expansion of airpower. As one Japanese newspaper article quite openly stated, "Following the Washington Naval Conference the Navy had to suspend

---

<sup>215</sup> Sugita Ichiji, *Nihon no seisenryaku to kyōkun : Washington Kaigi kara shūsen made* [Japan's political war strategy and lessons: From the Washington Conference to the end of the war] (Tokyo: Hara Shobō, 1983), 36–37.

building capital ships and now regards the manufacturing . . . of aircraft as extremely important for national defense.”<sup>216</sup>

After the Washington Treaty had been concluded Japan’s army was confronted with political pressure to implement cutbacks similar to the navy. In response Army Minister Yamanashi Hanzō (1864–1944) initiated a major army reorganization in August 1922 that became known as the “Yamanashi Disarmament.” He downsized the army’s infantry, cavalry, artillery, and engineering units, which resulted in a reduction of 56,000 troops.<sup>217</sup> However, the army’s airpower got off lightly. While Yamanashi reduced the budget for flight maneuvers and training he left the strength of the army air force’s six air wings untouched.

However, it turned out that a major expansion of the army’s aviation branch was only a matter of time. In 1925 an even more radical reshaping of the army’s internal structure took place under the new Army Minister Ugaki Kazushige (1868–1956). The “Ugaki Disarmament”—which some historians have called an “armaments revolution”—led to the elimination of four army divisions composed of 34,000 soldiers.<sup>218</sup> It is important to note that, in conjunction with the reduction of troop numbers, however, Ugaki substantially enlarged the army’s airpower.

With this decision the army minister followed an earlier proposal of Koiso Kuniaki, the young and ambitious modernizer in the Aviation Department discussed earlier whose views on the importance of airpower had been shaped during his 1923 visits to all the major German

---

<sup>216</sup> “The Navy’s aircraft building / a new project for next year,” *Yomiuri Shinbun*, February 19, 1923, 2.

<sup>217</sup> Bōeichō, *Rikugun kōkū no gunbi to un’yō 1*, 193.

<sup>218</sup> Yokoyama Hisayuki, “Military Technological Strategy and Armaments Concepts of Japanese Imperial Army—Around the Post-WWI Period,” *NIDS Security Reports*, No. 2 (March 2001): 117.

aircraft makers.<sup>219</sup> Koiso's rise within the Aviation Department is perhaps the best evidence of the increasing influence of air-minded technocrats in the Japanese Army. To his conservative critics who resented the troop reduction and still valued the soldier's fighting spirit over modern technology Koiso famously countered:

The future war will be a science war. Those people talking about the "Yamato spirit": will they not die when inhaling poison gas? Will they not burn when hit by incendiary bombs? In this [modern] world we cannot depend on the Yamato spirit anymore.<sup>220</sup>

Ugaki himself laid out the rationale behind his new focus on airpower in a 1926 essay addressed to a public audience on "The Imperial Army's new facilities and their connection to national mobilization."<sup>221</sup> In his impassioned appeal for the build-up of Japan's airpower Ugaki repeatedly referred to World War I, which he described as "a war of applied science and fully mechanized battles." He argued that this new type of war had completely changed the foundations of national defense and shown the urgent need to mobilize the whole country. Furthermore, Ugaki continued, while after World War I the Great Powers had made new efforts for their national mobilization Japan lagged far behind. Ugaki explained that with the notoriously bad condition of Japan's national finances it was impossible to wait for an improvement of the fiscal situation. Therefore he was forced to cut four divisions and at the same time to increase the air corps' military preparedness. Ugaki warned of the poor state of Japan's present air force, which made the Japanese homeland and especially Tokyo acutely vulnerable against "the enemy's air attacks."<sup>222</sup> Moreover he lamented the lack of bomber units for attacking the

---

<sup>219</sup> Koiso Kuniaki, *Katsuzan Kōsō*, 407.

<sup>220</sup> Koiso Kuniaki and Musha Kinkichi, *Kōkū no genjō to shōrai* [The present and future of aviation] (Tokyo: Bunmei Kyōkai, 1928), 74.

<sup>221</sup> Sawamoto, *Kokka sōdōin no igi*, 263–84.

<sup>222</sup> *Ibid.*, 266.

enemy's strategic points and military resources. The army minister concluded that the improvement of airpower must be the army's most urgent priority.

Ugaki's "reduce-and-modernize" doctrine completely changed the size, strategy, and organization of Japan's army air force (*kōkūheika*). To underline the increased importance of military aviation Ugaki advanced the army air force to the same hierarchical level as the army's infantry, cavalry, and artillery arms. The Army Aviation Department (*rikugun kōkū bu*) was renamed the Army Aviation Bureau (*rikugun kōkū honbu*). It remained under the direct command of the army minister and was given additional authority to supervise military flight training, aeronautical research, and the aircraft production of all civil manufacturers.<sup>223</sup>

Arguably even more important than the organizational promotion of the army's air arm was a fundamental change in its battle doctrine. The Ugaki reform provided the army with the funds to radically revise its air force strategy away from reconnaissance and toward offensive air battle and bombing. The extra resources made it possible to more than double the number of fighter squadrons and to establish four new bomber squadrons. The focus on bombers was an additional lesson that the Japanese Army had learned from World War I. The Japanese military were aware that during the Great War, bombers' fields of operations had expanded from support of ground troops to attacks on the enemy's hinterlands. Germany had been the first country to implement this new strategy with newly developed four-engine bombers that were equipped with incendiary bombs. When these aircraft attacked Paris and London they not only brought about widespread destruction but also caused mass panic and heavily undermined public morale. Detailed reports of these German air raids along with an examination of German war trophy bombers attracted

---

<sup>223</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō 1*, 255–56.

Japanese interest in the technology for a new type of aircraft capable of carrying a heavy bomb load over a long distance.<sup>224</sup>

Together with the modernization of its air force the Japanese Army increased its efforts to further boost domestic aircraft manufacturing. The aim was to set up an efficient industry that would be able to cover peacetime as well as wartime demand for aircraft, engines, and equipment. This move was met with criticism by those who suggested that it would be better and faster to import cheap foreign products than to use expensive made-in-Japan products. However, the Army Aviation Bureau could refer to the bitter experiences during World War I when the Japanese military was not able to import machines and material from the United States and Europe.<sup>225</sup> The arguments for an independent Japanese aircraft industry prevailed. To overcome the foreseeable initial problems of aircraft production the army devised a carrot-and-stick policy of strict inspections and guaranteed prices.

As a further important step toward putting Japanese aviation on a more independent footing the Aviation Bureau set up a new policy of aviation research and development.<sup>226</sup> In order to catch up with Western aviation technology the army increased its efforts to collect information about technological developments abroad. In addition, to promote domestic research, the Aviation Technology Department of the Tokorozawa Flight School received additional funds and gained the status of an independent institution that reported directly to the Aviation Bureau.<sup>227</sup>

\* \* \*

---

<sup>224</sup> Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 51.

<sup>225</sup> Inoue Ikutarō, “Kōkūnihon no sōsho,” in *Nihon Kōkūshi vol. 1*, 248–58.

<sup>226</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō 1*, 238.

<sup>227</sup> *Ibid.*, 241.

In the wake of World War I Japan's aviation underwent a dramatic change. A new doctrine of national mobilization provided popular support and government funding for an unprecedented expansion of Japan's airpower. Exposure to German aviation technology broke the French monopoly. It also intensified Japan's interest in German aircraft and engines to the extent that it enticed the country to violate the Versailles Treaty and to turn to complicity with its former enemy. Access to German technology, most notably all-metal aircraft and heavy bombers, held the promise of raising the level of Japanese aviation to meet or even surpass the world standard. It also nurtured hopes that in time a national aviation industry could become so established as to make the country independent from foreign imports and know-how. The next two chapters will follow the arrival of German aeronautical engineers in Japan during the second half of the 1920s and examine whether their activities lived up to the heightened expectations of their hosts.

### III

#### Navigating a Sea of Change:

#### German Aircraft Makers and Japan's Emerging Naval Aviation

In the fast-changing economic, political, and strategic environment of the early 1920s, military innovation became a dominant element of national security. In order to catch up with the Western powers, Japanese military planners felt the urgent need to modernize Japan's armament and to revise long-established strategies. However, in Japan as elsewhere, reform-minded military innovators encountered various challenges. They had to offer a realistic vision of future warfare that would not get lost in utopian fantasies or pure theory. They had to meet the challenge of budget cuts. Most importantly, these military officers had to prevail in an environment that valued discipline and strict adherence to established procedures, and that showed little inclination to consider unorthodox ideas or to experiment with new concepts.<sup>228</sup>

Historians have pointed out that the success of military innovation depends on a balanced interplay among strategic, organizational, and technological transformations.<sup>229</sup> The development of Japan's early military aviation provides a touchstone for such interplay. As we will see, the proponents of airpower had to convince their superiors of the value of a new doctrine. They also had to demonstrate how it could be implemented with a new technology and new organizational patterns. This process of persuasion was a difficult task, and it comes as no surprise that the modernizers' obvious choice was to turn to foreign know-how and experience.

---

<sup>228</sup> For a thorough discussion of the issues shaping interwar military innovation see Murray Williamson, "Innovation: Past and Future," in *Military Innovation in the Interwar Period*, ed. Murray Williamson et al. (New York: Cambridge University Press, 1996), 300–28.

<sup>229</sup> Allan A. Millet, "Patterns of Military Innovation," in *ibid.*, 335–36.

This chapter examines the development of Japan's naval airpower; the following chapter will deal with the concurrent rise of Japan's army aviation. Rather than following one strictly chronological narrative, these two chapters offer parallel narratives, reflecting the well-known interservice rivalry. The Imperial Japanese Army and the Imperial Japanese Navy inhabited their own universes. They jealously shielded their air arms against any attempts to create an independent air force.<sup>230</sup> Furthermore, the two services' proverbial unwillingness to cooperate led to entirely different technical standards and parallel developments. It even resulted in double license purchases, as it was the case with the German dive bomber He 118 and the Daimler-Benz aero engine DB601.<sup>231</sup>

Placing Japanese aviation history in a wider strategic context, I argue that the import of German technology provided decisive stimuli for far-reaching changes within the Imperial Japanese Navy. A whole range of different aircraft types from Germany offered new answers to the probing questions of how to overcome the huge distances of the Pacific Ocean and how to challenge a powerful enemy. These new technologies helped to strengthen the navy's modernizers and seriously challenged the "big-ship, big-gun policy" (*daikankyohōshugi*) of the navy's traditionalists. At the same time German hardware and know-how transformed the character of Japan's airpower from a largely defensive force to an air fleet with aggressive first-strike capability.

The competing doctrines of "battleship first" versus "aircraft first" (*kōkūheiryoku chūshinshugi*) dominated the development of Japan's naval aviation from its beginning in 1912

---

<sup>230</sup> For more details on the debate about an independent Japanese Air Force see *Kaigun kōkū gaishi* [An outline of the history of naval aviation] (Tokyo: Asagumo Shinbunsha, 1976), 74–79.

<sup>231</sup> "Nachlass Kissel Flugmotoren," 30.12.38, Mercedes Benz Archive, Stuttgart.

to the end of World War II.<sup>232</sup> The Japanese Navy had carefully studied Alfred Thayer Mahan's (1840–1914) seminal book, *The Influence of Seapower Upon History*, which was published in the United States in 1890 and translated into Japanese in 1896. The U.S. admiral forcefully argued that only a strong navy could guarantee a nation's great power status and emphasized the central role of the battleship for a country's defense and international status. After the navy's successes in the Sino-Japanese and Russo-Japanese wars, the “big-ship, big-gun policy” prevailed among navy officials. This doctrine of naval warfare was based on the belief that large ships and superior firepower would be decisive for victory at sea. Japan's economic boom during World War I further encouraged the battleship-first proponents. It provided substantial funding to entertain the Navy General Staff's vision of an ambitious fleet expansion program that would culminate in an “Eight-Eight Fleet” (*hachihachi kantai*) of eight battleships and eight armored cruisers.<sup>233</sup>

Under these conditions Japan's emerging naval aviation had a slow start. Even though Japan's navy had a reputation for being far more open toward technological innovation than the army, the aircraft as a new naval weapon suffered from the image of an immature technology that had questionable military value. Only in 1912, two years after the pioneering flights of the Japanese Army, did the Japanese Navy make its first successful flight demonstrations using imported airplanes. During World War I, the navy took its first steps toward a systematic buildup of a rudimentary naval airpower. In 1916 it decided to establish three flying squadrons (*hikōtai*),

---

<sup>232</sup> I am using the term “doctrine” in the sense of “fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives,” as defined in Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms* (Ft. Belvoir: Defense Technical Information Center, 2010), 78.

<sup>233</sup> The Japanese Diet approved the Eight-Eight Fleet program in 1920. However, budgetary restrictions during the postwar recession and the 1922 Washington Treaty resulted in a cancellation of the program.

each equipped with six aircraft, within the next five years. Development was still slow, and in 1919 the navy minister and future prime minister Katō Tomosaburō (1861–1923) had to respond to the Diet's questions about the slow build-up of Japan's naval air force. Katō acknowledged the “large gap between Japan's aviation and that of the western countries” (*ōbei no shokoku ni hishi ichijirushiiki sa*) and conceded that it was urgent to procure new aircraft types, train more personnel, and establish more air squadrons together with new aircraft factories. Katō further decided that in order to achieve these aims the navy would emulate the British Navy's air force and invite British instructors.<sup>234</sup>

### Early British Influence

The navy turned toward British aviation technology in 1919 for several obvious reasons. Already in 1870 the Japanese government had decided to base the navy's training and equipment on the British model and to employ British instructors at its naval schools.<sup>235</sup> During World War I several Japanese officers went to Great Britain to observe the development of British naval aviation.<sup>236</sup> They sent their reports about British flying boats, torpedo bombers, and, above all, the world's first aircraft carrier that the Royal Navy commissioned in September 1918. In 1919 the Japanese Navy recurred again to British experience and approved a new “Policy of Adopting Foreign Aircraft.” The Japanese Navy's General Staff argued that British naval aviation was leading the world—an assessment very much in line with the view of present-day historians<sup>237</sup>—

---

<sup>234</sup> *Nihon Kaigun kōkūshi I Yōhei hen*, 75.

<sup>235</sup> Masaomi Yui and Akira Fujiwara, *Guntai, heishi* [Armed forces and military personnel] (Tokyo: Iwanami Shoten, 1989), 33.

<sup>236</sup> *Nihon Kaigun kōkūshi I Yōhei hen*, 68–72.

<sup>237</sup> R. D. Layman, *Naval Aviation in the First World War: Its Impact and Influence* (London: Chatham, 1996), 195.

and that until now the Japanese Navy “essentially has learned everything from Great Britain.”<sup>238</sup>

It set up a draft for “Inviting British Air Force Officers,” and in August 1920 official negotiations with Great Britain for the dispatch of a group of aviation specialists began.<sup>239</sup>

Relying on the spirit of cooperation under the Anglo-Japanese Alliance, Japan asked for aeronautical training and technological assistance in October 1920. The Japanese were especially interested in learning about the Royal Navy's carrier program. However, not all British officials welcomed Japan's request. While the British Air Ministry perceived a welcome business opportunity for the country's struggling aircraft industry, the British Admiralty advised against offering any technological support to Japan, a country which it saw as an emerging rival. Thus the Civil Aviation Department at the British Air Ministry reached a compromise and decided to send an “unofficial British Aviation Mission.” The principal aim of this mission was to secure orders for the British aviation industry and to prevent the French from taking over Japanese naval aviation. Clearly the transfer of know-how in aircraft design and production played only a secondary role.

Sir William Francis Forbes-Sempill (1893–1965), a test pilot with considerable experience in aircraft design, led the mission. Sempill and his group of British experts stayed in Japan from September 1921 until March 1923. They brought more than one hundred aircraft of thirty different types to Japan. The British trained the Japanese Navy's pilots in a wide variety of operations that included aerial combat, reconnaissance, air attack, and carrier deck landing. According to recently released documents, Sempill even entered Japanese service as a spy,

---

<sup>238</sup> *Nihon Kaigun kōkūshi 3 gijutsu seido hen*, 269.

<sup>239</sup> *Nihon Kaigun Kōkūshi Hensan Inkai, Nihon Kaigun kōkūshi 2 Gunbi hen* [The history of Japanese naval aviation 2 (armaments)] (Tokyo: Jiji Tsūshinsha, 1969), 707–19.

passing secret details of the British military.<sup>240</sup> Even though the mission members considered the flight training as fairly successful, the large-scale orders from Japan, hoped for by British aircraft makers, never materialized. The Japanese Navy adopted only a light training aircraft and an all-wooden patrol flying boat for licensed production.<sup>241</sup>

During Sempill's stay, far-reaching diplomatic negotiations between Japan and the major Western powers were reshaping politics in the Pacific region. As discussed Chapter 2, in February 1922, Japan, the United States, Britain, France, and Italy concluded the Washington Naval Treaty in the hope of preventing an arms race in the Pacific. However, the treaty also revealed the growing antagonism between Japan and its former World War I allies. In the wake of a British-American rapprochement Britain decided not to continue the Anglo-Japanese Alliance that had been in force since 1902. With the official ratification of the Washington Treaty in June 1923, the Anglo-Japanese Alliance came to an end. As a result of the deteriorating diplomatic relations, British transfer of aviation technology to Japan declined, and the Japanese Navy more readily sought technological cooperation with other countries.

The Sempill mission introduced the Japanese to a wide spectrum of naval airpower that included advanced features like airborne torpedo bombing and carrier operations. However, the Japanese Navy took a more cautious step-by-step approach to developing its airpower. We thus can identify three major transformations of Japan's naval aviation during the two decades from 1912 to the early 1930s. Until the mid-1920s the navy continued to explore the possibilities offered by reconnaissance floatplanes. Then, starting in 1925, the navy turned its interest toward

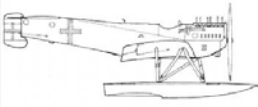
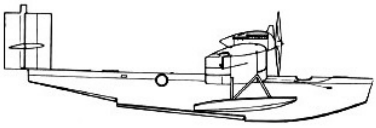
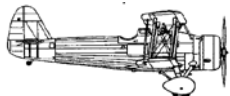
---

<sup>240</sup> The National Archives, Kew, "William Francis Forbes-Sempill," KV 2/871, 1921–1926.

<sup>241</sup> The Avro 504 K/L Trainer had been designed in 1913. The Japanese aircraft makers Nakajima and Aichi started the aircraft's licensed production in 1922 and produced 280 trainers before 1924. The all-wooden Short F.5 Patrol Flying-boat was a World War I design. The Navy arsenal and Aichi built sixty Short F.5s.

large flying boats, large multi-engine seaplanes that could land with their main bodies in the water. This aircraft type proved to be ideal for long-range patrol and transport missions. Finally, in the early 1930s, after a decade of trial and error, the Japanese Navy's new aircraft carriers, together with their advanced bombers, completely reshaped naval power in the Pacific. Each new technological paradigm went hand in hand with an increasingly aggressive use of naval airpower. As we will see, German aircraft technology played an important role at each stage (see Table 1).

**Table 1:** German aircraft in the three-stage development of Japan's naval aviation 1923–33 (created by author)

|                   | <b>Phase 1: Ship based float planes</b><br> | <b>Phase 2: Large-size flying boats</b><br> | <b>Phase 3: Carrier-based aircraft</b><br> |
|-------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <b>1923–1925</b>  | Hansa Brandenburg W-29<br>Heinkel U 1 submarine-borne seaplane                                                               |                                                                                                                               |                                                                                                                               |
| <b>1925–1930</b>  | ramp-launched Heinkel HD 25, 26, 28<br>catapult-launched Heinkel HD 56                                                       | Rohrbach R-1 Flying-boat<br>Mitsubishi R-2 Flying-boat                                                                        | Heinkel-Aichi carrier fighters                                                                                                |
| <b>After 1930</b> | catapult-launched Heinkel HD 62                                                                                              |                                                                                                                               | Heinkel-Aichi carrier dive bombers                                                                                            |

### **An Early Compromise: Ship-Based Floatplanes**

In the early years of naval aviation airplanes with floats for landing on water were an obvious technological choice. Landplanes could be easily converted into seaplanes by simply replacing their undercarriage with floats. Even though the floats added to a plane's weight and

air resistance, they made the aircraft independent of airfields or carrier flight decks. Furthermore, ordinary merchant ships could be deployed as transporters for these seaplanes by using the ship's cargo hoists to lower and recover the aircraft.

Even though these early naval aircraft still did not have the engine power and structural strength to carry heavy armament or bombs, they became a valuable tool for the navy's operations. During World War I surveillance aircraft in combination with wireless telegraphy and aerial photography had revolutionized military reconnaissance. Aerial observation became a prime duty of naval aviation. Long before radar was available—the Japanese Navy started research on radar only in the early 1940s—airplanes that could act as the “eyes of battleships” to make out a distant enemy were of paramount importance.<sup>242</sup> Ironically the development of “big-gun” technology had reached a point where battleships became even more dependent on aerial support. By the end of World War I the increasing firepower of naval artillery began to extend beyond the visual horizon. For the effective use of their large guns, battleships needed spotting aircraft that could provide them with accurate artillery guidance to direct their gunfire.

After World War I the Japanese Navy became acquainted with the latest German floatplane technology through various channels. In 1923 the Imperial Maritime Defense Volunteer Association (*Teikoku Kaibō Gikai*), a foundation for the promotion of coastal defense, bought two float planes from the German aircraft maker Junkers.<sup>243</sup> These all-metal monoplanes were maritime versions of Junkers' famous F 13, a state-of-the-art passenger aircraft that had set new

---

<sup>242</sup> For Germany's role in Japan's radar development see Erich Pauer, “The Transfer of Technology between Germany and Japan from 1890 to 1945,” in *Japan and Germany: Two Latecomers to the World Stage, 1890–1945*, ed. Akira Kudo et al. (Folkestone, UK: Global Oriental, 2009), 466–511.

<sup>243</sup> *Giyū zaidan kaibō gikai no mokuteki shimei* [The Maritime Defense Volunteer Association's purpose and mission] (Tokyo: Kaibō Gikai, 1927), 8.

altitude and endurance records. The association then donated the Junkers aircraft to the navy's Yokosuka Arsenal (see Map 1) for test flights and for research on all-metal aircraft design.<sup>244</sup>

Although the donation of the Junkers float planes received comprehensive press coverage, two other aircraft from Germany arrived in utmost secrecy in the same year.<sup>245</sup> As a result of the 1922 Washington Treaty, which limited Japanese naval power to four battle cruisers and six battleships, the navy's strategy placed a new emphasis on naval aviation as well as on large submarines.<sup>246</sup> In 1923 the German aircraft designer Ernst Heinkel (1888–1958) received a request by the Japanese Navy to build a reconnaissance seaplane that could be carried in a special container inside such a large-size submarine. To fulfill this task Heinkel referred to the U 1 aircraft that he had designed during World War I. In his German workshop he secretly built a remarkable aircraft that, according to his memoirs, could be disassembled aboard the submarine and stowed in a pressure-proof container within less than 30 seconds.<sup>247</sup> Heinkel shipped the parts of the dismantled aircraft to Japan, where it arrived in 1923.<sup>248</sup> The Naval Air Arsenal at Yokosuka carefully examined Heinkel's submarine aircraft. The arsenal's engineers then built their own copy of the imported aircraft and successfully tested it on one of the navy's submarines.<sup>249</sup>

---

<sup>244</sup> Nozawa Tadashi, *Nihon kōkūki sōshū: yunyūki hen* [Encyclopedia of Japanese aircraft: Imported aircraft] (Tokyo: Shuppankyōdōsha, 1972), 86.

<sup>245</sup> "Imperial Maritime Defense Volunteer Association purchased an all metal aircraft from Germany," *Asahi Shinbun*, February 10, 1923, 5.

<sup>246</sup> Asada Sadao, *From Mahan to Pearl Harbor: The Imperial Japanese Navy and the United States* (Annapolis, MD: Naval Institute Press, 2006), 107.

<sup>247</sup> Heinkel, *Stürmisches Leben*, 75.

<sup>248</sup> Kai Biermann and Erhard Cielewicz, *Flugplatz Döberitz Geburtsort der militärischen Luftfahrt in Deutschland* (Berlin: Links, 2005), 87.

<sup>249</sup> Mikesch and Shorzoe, *Japanese Aircraft*, 276.

Apart from direct purchases, the Japanese Navy also received twenty-two airplanes out of seventy-one that arrived in Japan as war reparations from Germany.<sup>250</sup> Among these aircraft the Hansa Brandenburg W-29, another World War I floatplane designed by Heinkel, interested the navy most. The advanced monoplane was already well-known for its superior performance and its impressive combat record. Compared with the French floatplanes that the Japanese Navy was still using in 1920, the German aircraft was nearly twice as fast and could carry twice the load. The navy adopted the Heinkel seaplane as Japan's first ship-based monoplane and ordered the aircraft makers Nakajima and Aichi Tokei to copy the aircraft. As yet another consequence of the Versailles Treaty, German companies had lost the protection of their patents so that the two Japanese aircraft manufacturers could start their production without having to acquire a production license from Heinkel. Between 1922 and 1925 the two companies built a total of 310 Hansa Brandenburg planes, which became the navy's main water reconnaissance aircraft (Figure 10).<sup>251</sup>

**Figure 10: The made-in-Japan version of Heinkel's Hansa Brandenburg W-29.**<sup>252</sup>

The navy's decision to entrust the former watchmaker Aichi Tokei with such a massive order for warplanes is not as arbitrary as it seems. The origins of most major Japanese aircraft makers like Mitsubishi, Kawasaki, and Ishikawajima can be traced back to shipbuilding. Aichi Tokei was different. The Nagoya-based company started its business as a clock manufacturing company in 1898. However, during the 1904–5 Russo-Japanese War Aichi Tokei diversified into

---

<sup>250</sup> Nozawa, *Nihon kōkūki sōshū: yunyūki hen*, 173.

<sup>251</sup> Nozawa Tadashi, *Nihon kōkūki sōshū: Nakajima hen* [Encyclopedia of Japanese aircraft: Nakajima] (Tokyo: Shuppankyōdōsha, 1963), 120.

<sup>252</sup> Source: "Hansa-Brandenburg W.29," accessed February 21, 2014, [http://en.wikipedia.org/wiki/File:Hansa-Brandenburg\\_W29\\_Japanese\\_navy.jpg](http://en.wikipedia.org/wiki/File:Hansa-Brandenburg_W29_Japanese_navy.jpg).

armaments production and began to produce torpedo fuses and detonators for naval mines. With increasing orders during World War I the factory expanded and engaged in the production of bombsights and communication instruments. Aichi made good use of its close relation with the Japanese Navy when it built up its own aircraft manufacturing branch in 1920. The navy provided comprehensive technical training for Aichi's workmen and engineers at its arsenals, so the company was well prepared to venture into large scale aircraft production.<sup>253</sup>

During the ongoing production of the Hansa seaplanes, Aichi engaged in a new project that aimed to combine the advantages of airborne reconnaissance with the firepower of a giant warship. The battleship *Nagato*, commissioned in 1920, was—with her eight 16-inch guns—the epitome of the “big-gun doctrine.” The navy decided to equip the *Nagato* with a ship-launched aircraft, an important innovation that vastly expanded reconnaissance at sea. A new launching technology was intended to allow the aircraft to take off from the moving battleship even under rough sea conditions. The naval planners considered this development as a major breakthrough which overcame the limitations of floatplanes as “fair-weather weapon.”<sup>254</sup>

The navy decided to draw again on Heinkel's expertise for its ambitious plan. To avoid any allegation of violating the Versailles Treaty that prohibited the production and export of German military aircraft, it used Aichi as mediator for negotiations with Heinkel. In 1925 Japan's Berlin-based naval attaché, Captain Kojima, encouraged Kaya Masaru, one of Aichi's engineers who had come to Germany, to establish personal contact with Heinkel. Referring to the large number of German engineers already in the employ of other Japanese companies, Kojima told Kaya: “Heinkel is still young, but he seems to be promising. Why don't you meet him?” Referring to

---

<sup>253</sup> Edagawa, *Aichi Tokei Denki 85-nenshi*, 90.

<sup>254</sup> Jörg Duppler and Heinrich Forsmann, *Marineflieger: Von der Marinefluchtstaffel zur Marinefliegerdivision* (Herford: E. S. Mittler, 1988), 18.

the companies Mitsubishi and Kawasaki, which had already begun cooperating with the German aircraft designers Rohrbach and Dornier, Kojima continued: “He is the only first-class [aircraft maker] left.”<sup>255</sup> It was easy for Kaya to win over Heinkel as the German engineer welcomed the opportunity of doing further business with Japan. In early 1925 he signed a contract for the design of two different seaplanes that could take off by their own power from a battleship’s gun turret on a 20-meter-long rail that also was to be designed by Heinkel.<sup>256</sup> During the design and construction process Aichi Tokei’s relationship with the *Heinkel Flugzeugwerke* company deepened. Both companies contrived a clever scheme to outmaneuver the control commission of the Allied Powers. Aichi’s Berlin-based engineers kept close contact with the Japanese members of the commission. They regularly warned Heinkel about impending visits of the commission, giving the company enough time to hide its production of military equipment.<sup>257</sup> This arrangement guaranteed steady progress; and already by May 1925 Heinkel had completed two aircraft, the He 25 and He 26, together with the launching device. The business with Japan was of such importance that Heinkel decided to travel to Japan himself to present his products. In autumn 1925, under the watchful eye of its designer, Heinkel’s aircraft successfully took off from a Japanese battleship’s gun turret (see Figure 11). Aichi was clearly impressed. The next day the company signed a license agreement for the two aircraft types and their launching device.

---

<sup>255</sup> Sekiguchi Eiji, *Nihon minkan kōkūshiwa* [Stories of Japan’s civil aviation] (Tokyo: Nihon Kōkū Kyōkai, 1966), 101.

<sup>256</sup> Edagawa, *Aichi Tokei Denki 85-nenshi*, 138.

<sup>257</sup> Heinkel, *Stürmisches Leben*, 130.

**Figure 11: How to take off from a canon turret: The successful launch of Heinkel's floatplane.<sup>258</sup>**

In the course of the following decade a mutually beneficial relationship developed. Aichi's continuous orders kept the young German company afloat. In exchange Heinkel developed a large variety of prototypes that he built in Germany and then exported to Japan. Heinkel's designs included several aircraft that could be deployed with catapults, a new technology that the Japanese Navy developed in the late 1920s.<sup>259</sup> The design of these catapult-launched airplanes was a challenging task because Heinkel had to make sure that they were robust enough to withstand the high acceleration during takeoff.<sup>260</sup> However, the new takeoff technology significantly improved on the older rail-launching method. Compared to the rail-launching technique these power-driven catapults could accelerate an aircraft to takeoff speed within a much shorter distance and also made it possible to launch considerably heavier and faster aircraft.

One important feature helps to explain Aichi's long-lasting cooperation with Heinkel. Until the mid-1930s Heinkel's company operated largely as a design company with a large research and development department that had only a small production section attached.<sup>261</sup> Heinkel acknowledged in his 1953 autobiography that the company's strategy had been to develop ten or

---

<sup>258</sup> Source: Mainichi Shinbun sha, *Nihon kōkū shi* [The history of Japanese aviation] (Tokyo: Mainichi Shinbun sha, 1979), 42.

<sup>259</sup> Details for the development of Japanese catapults can be found in *Nihon Kaigun kōkūshi 3 gijutsu seido hen*, 772–74, and in Okamura Jun, *Kōkū gijutsu no zenbō 2* [An overall picture of the aviation technology 2] (Tokyo: Hara Shobō, 1976), 309.

<sup>260</sup> Acceleration by early catapults could result in g-loads exceeding four times an aircraft's weight.

<sup>261</sup> Heinkel, *Stürmisches Leben*, 170.

more new designs per year, build one or two prototypes of each aircraft type, and sell them for mass production to foreign companies. Heinkel neither exported aircraft production technology nor concerned himself with the training of Japanese engineers. Under these conditions Heinkel could focus on the development of state-of-the-art aircraft in the hope that his Japanese customers would neither catch up nor even overtake him with their own designs. As we will see, this strategy worked well only until the mid-1930s, when the expertise of Aichi's engineers had reached a level that allowed them to successfully modify and improve Heinkel's latest designs.

### **Toward an Autonomous Airpower: Large-Size Flying Boats**

Catapult-launched seaplanes seemed to be a convenient compromise that satisfied both the proponents of big-gun battleships and those of naval airpower. However, the emergence of a new type of aircraft that could operate independently without a mother ship ushered in a new era of naval aviation. Flying boats had already proved their versatility during the final years of World War I. These aircraft could take off and land even under rough weather conditions, and their spacious fuselages provided ample space for fuel, cargo, and weaponry. Unlike landplanes of the same size, they did not need large airfields.

By the early 1920s flying increasingly attracted the interest of Japanese naval strategists who were especially intrigued by the vast flight range that made flying boats ideal for long-range patrol missions in the Pacific. The navy began to envision a chain of airbases in Pacific lagoons from which these aircraft could be deployed for transport, search and rescue, reconnaissance, and bombing missions. This plan was especially relevant since, by 1919, as a result of Article 22 of the Versailles Treaty, Japan had acquired a large number of islands in the Western Pacific as mandated territories from Germany. These islands were strategically important because they were situated along the sea route between the U.S. military bases in the Philippines and Guam.

Flying boats were the ideal means to establish a military presence within the former German protectorates in the Pacific, especially as the treaty did not allow building any military facilities on these islands.<sup>262</sup> During the Sempill mission the Japanese Navy already had become acquainted with British World War I flying boats. However, a path-breaking invention from Germany soon led to a major change in the construction of these large-size aircraft.

Duralumin was a new material that revolutionized aircraft design. In 1903 the German *Dürener Metallwerke* (see Map 2), invented this alloy that was nearly as strong as steel and weighed only one-third as much. During World War I German aircraft designers became interested in duralumin not only as lightweight construction material but also because the replacement of wood by metal parts allowed engineers to make more precise stress calculations. They could refer to the methods of structural analysis developed for the design of steel bridges and apply these techniques to the construction of airframes that combined light weight with proven structural strength (see Figure 12). In other words, the use of the new material provided one more step in a process where quantitative science replaced the hitherto more intuitive “art” of aircraft building. Equally important, the new technology lent itself to the mass production of standardized parts by unskilled workers.

**Figure 12: A workman holding the central duralumin spar that connected the wings of Rohrbach's giant 1920 passenger airplane with its fuselage. Note how the all-metal design borrowed the use rivets and braces from steel bridge construction.**<sup>263</sup>

---

<sup>262</sup> Akimoto Minoru, *Kyojinki monogatari: shirarezaru nihon no kūchū yōsai* [The story of giant airplanes: Japan's unknown flying fortresses] (Tokyo: Kōjinsha, 2002), 3.

<sup>263</sup> Source: BA-MA RH8-3606

The German aircraft designer Adolf Rohrbach (1889–1939) became known as the “purist of all-duralumin design” (see Figure 13).<sup>264</sup> Rohrbach joined Zeppelin’s airship company *Luftschiffbau* in 1914 and participated in the design of giant metal aircraft. Immediately after the war he took over the management of Zeppelin’s former Staaken factory (see Map 2) and started the construction of a large all-duralumin passenger aircraft. Rohrbach’s airplane was impressive. During its successful 1920 test flight Rohrbach could demonstrate the aircraft’s high cruising speed and long flight range—but the Allies ordered the aircraft to be destroyed, which meant the end of the Staaken factory.<sup>265</sup>

**Figure 13: The “purist of all-duralumin design”: Adolf Rohrbach (left).<sup>266</sup>**

Having lost his aircraft and livelihood, Rohrbach was nonetheless a much sought-after engineer. He received offers from the aircraft makers Fokker and Junkers and even from the Soviet government.<sup>267</sup> The most attractive proposal, however, came from Japan. The Japanese were interested in large seaplanes with a design similar to the Staaken monoplane. In 1922 Rohrbach signed a contract with representatives of the Japanese Navy for four long-distance reconnaissance airplanes, with two more to be built in Japan. Most importantly, the agreement included the training of Japanese engineers and workmen. In addition the contract provided for

---

<sup>264</sup> Lutz Budraß, “Rohrbach und Dornier. Zwei Unternehmen aus dem Zeppelin-Flugzeugbau in der Weimarer Republik und im Nationalsozialismus,” in *Zeppelins Flieger: Das Flugzeug im Zeppelin-Konzern und seinen Nachfolgebetrieben*, ed. Wolfgang Meighörner (Berlin: Wasmuth, 2006), 210.

<sup>265</sup> For details see Hans Joachim Ebert, “Rohrbach,” in *Neue deutsche Biographie*, ed. Otto zu Stolberg-Wernigerode (Berlin: Rohmer-Schinkel, 2005), 4–5.

<sup>266</sup> Source: Bundesarchiv BArch, Bild 102-10107 / Georg Pahl.

<sup>267</sup> Budraß, “Rohrbach und Dornier,” 210.

the Japanese Navy to receive blueprints, calculations, and the right to produce an unlimited number of aircraft.

A central statement in Rohrbach's own account of the "establishment and economic growth of the *Rohrbach Metall-Flugzeugbau* company" testifies to the vital nature of his cooperation with Japan:

The contract reveals the complete trust [of the Japanese] as at that time I did not have any factory, engineers, or workmen. Maybe only by means of this contract was I able to establish the Rohrbach-Metall-Flugzeug GmbH in Berlin in August 1922 and at the same time in Copenhagen the Rohrbach Metal Aeroplan Co. Aktieselskab.<sup>268</sup>

Japanese interest in Rohrbach and his aircraft developed as a result of the postwar peace settlement. For the aviation experts in the Japanese military, Rohrbach was already a household name associated with the design of their most spectacular war trophy, the Zeppelin-Staaken R.XV giant bomber, examined in detail in the previous chapter. Furthermore, Rohrbach was known personally to the Japanese members of the Aeronautical Inter-Allied Commission of Control. During the early 1920s the German designer had established friendly relations with one member of the Commission, Captain Takada Yoshimitsu, who, as a result of his numerous inspection trips, had emerged as an expert on German aviation.<sup>269</sup> Rohrbach offered to Takada to build any flying boat according to the Japanese Navy's request. When Takada submitted a favorable report on Rohrbach together with the German engineer's proposal, the Japanese Navy's Technical Department became well disposed toward a future collaboration.<sup>270</sup>

---

<sup>268</sup> Adolf Rohrbach, "Gründung und wirtschaftliche Entwicklung der Rohrbach-Metall-Flugzeugbau GmbH August 1922–Dezember 1923," 1924, BA-MA RH8-3606.

<sup>269</sup> Takada Yoshimitsu, "Doitsu kōkū kanshi geppō" [Monthly German aviation inspection reports], 1920, JACAR Ref. C04015195400.

<sup>270</sup> Kuwabara, *Kaigun kōkū kaisōroku*, 197.

The more conservative navy technocrats favored Rohrbach's design method over that of his competitors because of its affinity with shipbuilding. One advocate of a Rohrbach alliance was Wada Misao, a future vice admiral and chief of the Naval Air Headquarters. Initially trained as a shipbuilding engineer, Wada had previously gained experience in the design of seaplanes during his work with a group of British engineers in 1921. When in 1923 the navy sent him to Germany, he soon became aware of Rohrbach's unique design principles:

Rohrbach's airplanes had a completely new and original structure. . . . Because I have studied the structural strength of ship hulls, I thought that Rohrbach's duralumin all-metal method was outstanding, and I immersed myself in the study of Rohrbach's method.<sup>271</sup>

The navy decided to cooperate with the Mitsubishi Company for the production of the all-metal flying boat. Initially Mitsubishi had joined the aviation industry as an engine maker. Following a navy order for aircraft engines the company established an Internal Combustion Engine Section (*Nainenkika*) at its Kobe shipyard in 1916 (see Map 1). In May 1920, Mitsubishi founded a new company, the Internal Combustion Manufacture (*Mitsubishi Nainenki Seizō*) and put it in charge of all aviation-related activities. Mitsubishi Nainenki set up its factory on a stretch of reclaimed land at the port of Nagoya that had been abandoned earlier by Mitsubishi's submarine section.

The new department eagerly seized the opportunity to learn more about Rohrbach's advanced technology. As early as 1921 Mitsubishi Nainenki sent its engineers to Germany to be trained at Rohrbach's factories. For several of these engineers the trip to Germany was the starting point of a distinguished career with Mitsubishi. Ōtsuka Keisuke, the first Mitsubishi engineer to arrive at Rohrbach, was to become the head of Mitsubishi's Ki-20 "Super Bomber"

---

<sup>271</sup> Various authors, *Nihon no kōkū runesansu* [The renaissance of Japan's aviation] (Tokyo: Kantōsha, 2000), 111.

project. In the following year, Ōtsuka was joined by Hattori Jōji, the future head of Mitsubishi's airframe design section.<sup>272</sup> A third engineer, Shōda Taizō, who replaced Ōtsuka in 1924, was appointed as vice president of Mitsubishi Heavy Industries after the war. Shōda's eleven-month stay at Rohrbach made him a staunch supporter of German aviation technology—he was convinced that “because of its theory and logic, the German design method was leading the world.”<sup>273</sup>

The minutes of a Mitsubishi board meeting held in April 1923 reflect the high hopes invested in the affiliation with Rohrbach. Board members emphasized the “promising future” of metal aircraft and left no doubt that both the Japanese Army and Navy would adopt these airplanes in the near future. It was therefore considered an “extremely advantageous plan” to establish a tie-up with Rohrbach, whom the Board noted was the “leading expert in Germany.” The Board then unanimously agreed to conclude a contract with Rohrbach for the production of metal aircraft.<sup>274</sup>

Apart from the prospect of gaining access to an entirely new technology, cooperation with Rohrbach held another appeal. In order to elude the Allies' restrictions, Rohrbach outsourced his aircraft production to his newly established branch factory, Rohrbach Metal Aeroplane Co. A/S near Copenhagen (see Map 2). This clever move made it easier for the Japanese to maintain the appearance of respecting the Versailles Treaty even after the official tie-up with the German aircraft manufacturer had begun.

---

<sup>272</sup> For Hattori Jōji's vivid account of the humble beginnings of Mitsubishi's aircraft department see Mitsubishi, *Ōjibōbō* vol. 1, 28.

<sup>273</sup> Moriya Gakuji, *Meikōkōsakubu no senzengoshi* [The pre- and postwar history of aircraft construction at the Nagoya factory] (Nagoya: Mitsubishijūkyōgyō kabushikigaisha Nagoya kōkūkiseisakujo, 1988), 17–19.

<sup>274</sup> Board meetings, July 1922 to December 1923, Archives at the Mitsubishi Economic Research Institute (MERI), Tokyo (hereafter cited as Mitsubishi Archives, Tokyo), MHI-00342.

Rohrbach's deliberate separation between design and production had yet another important consequence. Because of the geographical distance between his creative and productive branches, Rohrbach adopted the "American system" by using specialized machines for the production of interchangeable parts. He also incorporated elements of Henry Ford's factory management and Frederick Taylor's time studies to further rationalize his production. The Berlin headquarters devised all designs, calculations, and drawings. It conceived of an elaborate system of blueprints and parts lists that enabled the Copenhagen plant to manufacture aircraft with a largely unskilled workforce. According to Rohrbach, "the shop floor can only work at low-cost if there is nothing left to think about."<sup>275</sup> After this organizational division was tried and tested, it became easy to establish another production line abroad—for instance, in Japan.

After Rohrbach received the Japanese Navy's initial order for several large-scale flying boats he started the development of the Ro II flying boat. The arrangement of the aircraft's two engines above the wing made it possible to install two machine guns that could be operated independently by two gunners. The rectangular cross-section of the flying-boat's hull increased its freight capacity, and a relatively small wing with a high load bearing capacity allowed a high cruising speed. According to Rohrbach such wings required a sophisticated design that was based on the company's unique method of scientific strength calculations.<sup>276</sup> The Ro II made its first successful test flight in November 1923. In the following year the aircraft proved its proficiency as a long-range bomber when it set world records in speed and in distance.<sup>277</sup>

---

<sup>275</sup> Budraß, "Rohrbach und Dornier," 211.

<sup>276</sup> Adolf Rohrbach, "Ganzmetall-Grossflugboote. Vortrag vor der Royal Aeronautical Society, London," 1924, BA-MA RH8-3606.

<sup>277</sup> "Close-hauled," *Flight*, November 6, 1924, 714.

By early 1924 the Japanese workers and engineers at Rohrbach's Danish factory finished their training and returned to Mitsubishi. Rohrbach praised them as "diligent and skillful, having reached the level of our best German staff."<sup>278</sup> In his 1924 report to the German Transport Ministry (*Reichsverkehrsministerium*) Rohrbach was optimistic about receiving further orders from Japan. He hoped to deliver the blueprints and prefabricated material for two duralumin carrier fighters and for a large long-distance bomber for the Japanese Army, but for which "the negotiations are not very advanced yet."<sup>279</sup>

In 1925 the Japanese Navy invited Rohrbach to Japan.<sup>280</sup> Under the personal supervision of Rohrbach and his head engineer Paul Ludwig, the experts of the Yokosuka Naval Arsenal assembled the aircraft and duly named it the Experimental R-1 Flying-boat (see Figure 14). In hopes of receiving additional orders from both the army and the navy, Rohrbach took the opportunity to promote further his design principles to the Japanese military. In a lecture to members of the Imperial Navy, Rohrbach tried to convince his audience of the benefits of hydroplanes over carrier-based aircraft. Clearly the navy kept its recent advances in carrier technology secret from Rohrbach. Doubting the feasibility of aircraft carriers, the German engineer estimated that it would take fifteen to twenty minutes after each landing to clear the carrier for the touchdown of the next aircraft.<sup>281</sup> He therefore envisioned future naval aviation to rely mostly on flying boats that either were launched from catapults or took off from the water. During his stay in Japan Rohrbach began negotiations with Mitsubishi Nainenki that resulted in

---

<sup>278</sup> Adolf Rohrbach, "Gründung und wirtschaftliche Entwicklung der Rohrbach-Metall-Flugzeugbau GmbH Aug 1922–Dez 1923," 1924 BA-MA, RH8-3606.

<sup>279</sup> *Ibid.*, 242.

<sup>280</sup> Multiple authors, "Mitsubishi zōsenjo ni oite Doitsu hikōki kōnyū no ken" [The purchase of a German aircraft by Mitsubishi Shipyard], 1924–25, JACAR Ref. B07090278600, 0334.

<sup>281</sup> Adolf Rohrbach, "Die Zukunft des Marineflugwesens. Vortrag vor der Admiralität der Kaiserlichen Japanischen Marine," 1925, BA-MA RH8-3606.

the establishment of Mitsubishi-Rohrbach Ltd. in June 1925. Mitsubishi held a majority stake of 60 percent in the new enterprise, which was conceived as an agency to oversee the licensed production of Rohrbach's aircraft both at Mitsubishi and at the navy's arsenals.<sup>282</sup> Funakoshi Kajishirō, board chairman and director of Mitsubishi Aircraft Co. Ltd., became the company's president.<sup>283</sup> The second Rohrbach flying boat was then to be built at the newly founded company. For this purpose Mitsubishi established a new plant which, according to one Mitsubishi employee, became the "cradle of Mitsubishi's light metal aircraft production technology."<sup>284</sup> As part of the thorough preparations the company compiled and printed a German-Japanese dictionary that included translations of all technical terms that appeared on Rohrbach's blueprints.<sup>285</sup> While Mitsubishi still had to import the major parts of the flying boat, several made-in-Japan components were used as well. Most notably, the aircraft was powered by two 450hp engines that were produced by Mitsubishi and provided a 25 percent increase in power compared to the German original.<sup>286</sup>

**Figure 14: The Rohrbach Experimental R-1 Flying-boat. The clumsy auxiliary wheels were used to move the aircraft into the water.**<sup>287</sup>

---

<sup>282</sup> Numbers from BA-MA RH8-3606. The Mitsubishi Archives, Tokyo, MHI 00220, gives a stock distribution of Adolf Rohrbach, 100; Rohrbach Metallflugzeugbau, 100; and Mitsubishi, 500.

<sup>283</sup> *Mitsubishi Jūkōgyō Kabushikigaisha shi* [The history of Mitsubishi Heavy Industries Ltd.] (Tokyo: Mitsubishi Jūkōgyō, 1956), 40.

<sup>284</sup> "Mitsubishi ni okeru kitai sekkei" [Airframe design at Mitsubishi], in *Minkan kōkūki kōgyōshi* [The history of civil aircraft manufacturing] (Place unknown, Kōkū kōgyōshi hensan iinkai, 1948), 156.

<sup>285</sup> Mitsubishi Nainenki, *R kata hikōtei zumenyō goi* [A dictionary for blueprints for the R-type flying boat], place and date unknown.

<sup>286</sup> Kuwabara, *Kaigun kōkū kaisōroku*, 197–98.

<sup>287</sup> Source: Shigeru Nohara, *Zukai sekai no gun'yōkishi. 8, Nihon rikukaigun shisaku keikakuki 1924–1945* [An illustrated history of the world's warplanes, Vol. 8: Experimental planes of the Japanese Army and Navy, 1924–1945] (Tokyo: Guriinarō shuppansha, 1999), 162.

Officials of the Japanese Navy also attached great importance to having their arsenals adopt the new technology. They decided to build the third flying boat at the Hiro Naval Arsenal (*Hiro Kaigun Kōshō*), the Navy's first airplane factory, established near Hiroshima (see Map 1) in 1920. Wada Misao, who, as mentioned above, had been trained at Rohrbach, supervised the construction. While referring to Rohrbach's basic design, the arsenal's engineers refined the shape of the aircraft's wing and floats in order to enhance the flying boat's takeoff performance. They also installed the arsenal's own Hiro Lorraine 450hp engines on specially designed struts. The result was an aircraft with improved takeoff performance and a remarkable flight endurance of twelve hours.<sup>288</sup>

In spite of their impressive payload, speed, and endurance, Rohrbach's flying boats could not meet Japanese expectations. As it turned out, Rohrbach's airplanes had difficulties during takeoff and touchdown on heavy seas. Ironically, this problem was a direct result of Rohrbach's proclaimed design philosophy that favored a strong all-metal structure with a high wing load in which a relatively small wing carried a comparatively high weight. Rohrbach's original idea, promoted in several of his lectures, was that such an aircraft would have an improved turning performance. The drawback of the advanced design was that it needed sufficient engine power for reaching the required high takeoff speed. Even though Rohrbach's flying boats were equipped with significantly stronger Japanese engines, their takeoff performance was still unsatisfactory, and the navy did not adopt the aircraft. Mitsubishi then discontinued production and dissolved the joint Mitsubishi-Rohrbach aircraft company. Funakoshi Kajishirō, the

---

<sup>288</sup> Nozawa Tadashi, *Nihon kōkūki sōshū: Kawanishi hiroshō hen* [Encyclopedia of Japanese aircraft: Kawanishi and Hiro Navy Arsenal] (Tokyo: Shuppan kyōdōsha, 1959), 178.

chairman of board of directors mentioned above, commented that Rohrbach's design was "imperfect" and that "it became clear that a further development would require a huge amount of expense and time."<sup>289</sup>

This sobering evaluation notwithstanding, Rohrbach had a significant influence on the development of Japan's aviation. As discussed above, already four years before the delivery of his first aircraft to Japan the engineers of Mitsubishi and of the navy arsenals received comprehensive training at Rohrbach's factory. They not only became proficient in the design of all-metal aircraft but also learned to master the various processing methods of duralumin. According to one source this group of German-trained Japanese experts established the foundation of Japan's metal aircraft industry.<sup>290</sup>

This claim can be further substantiated when we consider the very limited scope of aeronautical engineering training at Japan's foremost universities during the early 1920s. Sanuki Matao (1908–1997) was a former student of the Department of Aeronautics at Tokyo Imperial University. According to his memoirs the department's design-related lectures explained only the specialized terminology of aircraft design. At the same time the Japanese students learned to admire German scientists and engineers who—as their teachers told them—had laid down the fundamentals of aerodynamics and aircraft design. Sanuki therefore concluded that the transfer of advanced German know-how "was the ultimate reason behind the purchase of Rohrbach's flying boats."<sup>291</sup>

Certain features of Rohrbach's advanced design ushered in the era of what can be called a second generation of all-metal aircraft in Japan. To better understand the innovation that

---

<sup>289</sup> Quoted in *Mitsubishi Jūkōgyō Kabushiki Kaisha shi*, 640.

<sup>290</sup> *Nihon Kaigun kōkūshi I Yōhei hen*, 510–11.

<sup>291</sup> Sanuki Matao, *Sanuki Matao no hitorigoto*, 260.

Rohrbach introduced, we have to examine the so-called stressed-skin design principle. The German engineer Herbert Wagner (1900–1982) joined Rohrbach's company in 1924; he provided the crucial invention which he explained in the following way:

Rohrbach covered all outer-wall frame structures which were subjected to higher loads with thin metal, similar to the fabric-covered frame structures. I suggested omitting the diagonal rods within the frame and mounting the vertical rods closer together, so that under load the obliquely folding sheet metal skin takes up the lateral (vertical) forces. . . Comparative tests showed, for the same weight of the wall, a nearly doubling of the allowable lateral force; the workshops welcomed the simplification.<sup>292</sup>

Wagner's pioneering innovation allowed the design of a highly resilient airplane structure that could carry a considerably greater payload. The new technology also eliminated the need for struts inside the fuselage and at the same time provided more space for passengers and cargo—or bombs. It is important to note that Wagner also developed an appropriate theory for stress calculations that allowed designers to minimize the amount of building material.

The navy's decision to assemble Rohrbach's aircraft at three different places—near Tokyo, at Nagoya, and near Hiroshima—led to diffusion of the new technology within Japan. According to chairman Funakoshi Kajishirō, the cooperation with Rohrbach “laid the foundation for the production of metal aircraft and the successful adoption of this technology.”<sup>293</sup> This emphasis on the transfer of know-how rather than machinery helps to explain the rather short existence of the Mitsubishi-Rohrbach venture. In May 1926 Mitsubishi terminated the formal affiliation after only nine months, even with Rohrbach's aircraft still under construction at Mitsubishi's factory.<sup>294</sup> The records of Mitsubishi's board meetings do not reveal the details leading up to the

---

<sup>292</sup> Wagner quoted in Ernst-Heinrich Hirschel and Horst Prem, *Aeronautical Research in Germany: From Lilienthal until Today* (New York: Springer-Verlag, 2004), 270.

<sup>293</sup> *Mitsubishi Jūkōgyō*, 640.

<sup>294</sup> *Mitsubishi shashi* [History of the Mitsubishi company], vol. 34 (Tokyo: Tōkyō Daigaku Shuppankai, 1979), 7139.

decision. But we can safely assume that, with the training of engineers, the handover of blueprints, and the arrival of one sample aircraft, Mitsubishi had achieved sufficient know-how and material that made further cooperation with Rohrbach unnecessary.

Rohrbach left his impact on the navy as well. The Hiro Naval Arsenal started a succession of large flying boats that all were made from duralumin and featured the Wagner thin-board tension structure. In 1931 the arsenal's Navy Type 90-1 flying boat made its maiden flight. The Rohrbach-trained navy engineer Wada Misao had been in charge of the project. The impressive three-engined aircraft became famous as the first large all-metal plane entirely designed and built in Japan. With a takeoff weight of nearly twelve tons and maximum speed of 230 km/h the flying boat was twice as heavy and more than 40 percent faster than its Mitsubishi-Rohrbach predecessor. In the following year the arsenal entered into cooperation with the aircraft maker Kawanishi. The company had been operating one of Rohrbach's aircraft starting in 1927 and was familiar with Rohrbach's technology. Kawanishi produced a long series of outstanding flying boats that culminated in H8K, dubbed "Emily" by the Allied code name system, which in the view of some commentators was the "most outstanding water-based combat aircraft of the Second World War."<sup>295</sup>

### **Redefining Naval Airpower: Carrier-Based Aircraft**

A new type of warship radically changed naval battle strategy. Aircraft carriers, basically highly mobile seagoing airfields, significantly extended the range and fighting strength of a country's battle fleet. The airplanes based on these carriers would no longer be restricted by designs that had to combine seaworthiness with airworthiness. They could also overcome the

---

<sup>295</sup> Francillon, *Japanese Aircraft of the Pacific War*, 312.

flying boats' low cruising speeds and limited maneuverability. Furthermore, given the fact that the cost of aircraft carriers did not have to be covered by the Navy's aviation budget, carrier-based aircraft offered a more economical way of aerial armament.<sup>296</sup> With the money spent on one flying boat, around five carrier fighters or three carrier-based torpedo bombers could be built.<sup>297</sup>

At the end of World War I Great Britain was leading the development of carrier technology. In the early hours of July 19, 1918, British aircraft carried out the world's first carrier-launched air raid. They took off from the carrier *Furious* and, after around one hour of flight time, destroyed a German hangar together with two airships at Tondern, a small town near the Danish-German border. The operation received worldwide press coverage.<sup>298</sup> Already in the same month the Japanese Navy's Temporary Investigation Committee for Submarines and Aircraft (*rinji sensuikan kōkūki chōsa iinkai*) set up the specifications for Japan's first aircraft carrier based on the British model.<sup>299</sup> The construction of the *Hōshō* began in the following year. In December 1922, when the *Hōshō* was commissioned—only nine months after the United States' first carrier *Langley*—Japan joined the exclusive club of three countries that had aircraft carriers in active service.<sup>300</sup>

With its *Hōshō* project Japan's navy assumed a leading role in the design and construction of aircraft carriers. However, the carrier's integration into Japan's naval force still had to be

---

<sup>296</sup> Nihon Kaigun Kōkūshi Hensan Iinkai, *Nihon Kaigun kōkūshi 2 Gunbi hen*, 994.

<sup>297</sup> "Kaigunkantei sonota yosantankachō" [Research on the budgetary unit prices of naval warships, etc.] 1930, JACAR Ref. A09050370100.

<sup>298</sup> An article about the so-called Tondern raid appeared in the July 23, 1918, morning edition of the *Asahi Shinbun* (Tokyo).

<sup>299</sup> *Nihon Kaigun kōkūshi 1 Yōhei hen*, 194, and Mark R. Peattie, *Sunburst: The Rise of Japanese Naval Air Power, 1909–1941* (Annapolis, MD: Naval Institute Press, 2001), 17.

<sup>300</sup> The USS *Langley* was a converted collier that was commissioned as an aircraft carrier in March 1922.

determined: Should the new vessel and its aircraft be used for attacking land targets? Should they rather support the navy's battleships? Or should the new weapon become an independent part of a long-range strike force? At the same time operational questions for the carrier design concerning its anti-aircraft armament and flight-deck layout had to be answered. Most importantly, the navy had to develop the specifications and tasks for the different aircraft types that were to be deployed from the carrier.<sup>301</sup>

In 1921 the navy signed a comprehensive contract with Mitsubishi for fighters, bombers, and reconnaissance aircraft that all were to be used on the new carrier. To accomplish this demanding task Mitsubishi enlisted the help of foreign experts. With the navy acting as a mediator the company invited in the same year a group of eight British engineers, led by the aircraft designer Herbert Smith (1890–1978). Smith and his team were in a position to be persuaded by the Japanese offer. They had just lost their jobs at the renowned British aircraft maker Sopwith. The company was already facing a severe crisis due to excess capacity and had been forced into bankruptcy in 1920 as a result of the Excess War Profits Duty imposed by the British government.<sup>302</sup>

The Smith team went to work with great zeal. Already in the first year of their four-year-long stay in Japan they completed the Navy Type 10 fighter, the world's first aircraft specifically developed as a carrier-based fighter. The airplane was lightweight and had a powerful 300hp engine so as to be able to take-off from the *Hōshō*'s 168-meter-long flight deck. For landing on the carrier the aircraft was equipped with hooks attached to the wheel axle that would connect

---

<sup>301</sup> The different stages of the Japanese Navy's carrier program are discussed in Genda Minoru, "Evolution of Aircraft Carrier Tactics of the Imperial Japanese Navy," in *Air Raid, Pearl Harbor!*, ed. Paul Stillwell (Annapolis, MD: Naval Institute Press, 1981), 23–27.

<sup>302</sup> Peter Fearon, "The Formative Years of the British Aircraft Industry, 1913–1924," *Business History Review* 43, no. 4 (1969): 493.

with arresting wires on the carrier's deck after touchdown. In addition to the Type 10 fighter the Smith group designed a reconnaissance aircraft, a torpedo bomber, and an attack bomber that were all to be based on aircraft carriers. In February 1923, two months after the navy had placed the *Hōshō* in active service, William Jordan (1896–1931), the Smith team's test pilot, made a successful takeoff and landing on the new carrier. For this major achievement Mitsubishi rewarded him with a prize of ¥10,000.<sup>303</sup>

While this remarkable success ushered in a new era in naval aviation, Mitsubishi's hopes to improve its own expertise in aircraft design did not materialize. Smith's contract clearly stated that apart from supplying "all the necessary sketches, specifications, calculation sheets of performance and strength," Smith also had to "fully illustrate any new design or idea or improvement adequate enough to enable the principals to prepare the working drawings themselves and to satisfactorily manufacture or produce any aircraft or improvement so designed."<sup>304</sup> But a critical evaluation of the British engineers' impact on the development of Japan's aviation shows that while Smith and his British colleagues provided the requested blueprints and calculations, they imparted scant know-how about the design of airplanes. Rather than participating in the actual design process Mitsubishi's engineers were allowed only to "assist" in making blueprints. Such assistance often involved mere copying of the British-made drawings. One Mitsubishi engineer vividly remembered how even this menial task earned him the sharp criticism from a British designer. A copy he made that had obviously neglected some minor detail was returned with the written comment: "How to draw a nut. See your school

---

<sup>303</sup>Nozawa Tadashi, *Nihon kōkūki sōshū: Mitsubishi hen* [Encyclopedia of Japanese Aircraft: Mitsubishi] (Tokyo: Shuppankyōdōsha, 1961), 112.

<sup>304</sup>Mitsubishi Archives, Tokyo, MHI-00781.

book.”<sup>305</sup> This telling anecdote suggests that the Smith team’s judgment of Japanese design skills was affected by cultural stereotyping.<sup>306</sup> It also helps to illustrate how the British effectively excluded Mitsubishi’s engineers from the design process in an obvious attempt to keep the Japanese from developing their own independent design technique. Clearly Mitsubishi learned from this experience. As we have seen, in order to do business with Mitsubishi, Rohrbach had to agree to provide comprehensive training for the Mitsubishi engineers at his German facilities.

Despite Mitsubishi’s problems the navy’s carrier program gained momentum. Again the restrictions of the 1922 Washington Treaty provided a major stimulus for Japan’s aerial armament. While the treaty regulations banned the completion of the battle cruiser *Akagi* and the battleship *Kaga*, they allowed converting these two ships into aircraft carriers. So, instead of scrapping the half-finished hulls, the navy decided for such a conversion and commissioned the *Akagi* and *Kaga* as large-deck aircraft carriers in 1927 and 1928. Their extended flight decks allowed the operation of faster and heavier carrier aircraft that needed increased takeoff and landing distances.

Even with these gradual improvements Japan’s carrier technology still was in an experimental phase where it could not yet propose a real alternative to the navy’s flying boats. Throughout the 1920s the navy used the carriers mainly for the training of pilots, the testing of equipment, and the development of operational methods and tactics for carrier aircraft. During this trial period landing on a pitching and rolling aircraft carrier was still notoriously hazardous. Flying carrier airplanes was considered a special skill for which only the top 2 or 3 percent of the

---

<sup>305</sup> Mitsubishi, *Ōjibōbō*, vol. 3, 67.

<sup>306</sup> John Ferris argues in a similar way when discussing the British Air Ministry’s disparaging view of Japanese technical capabilities. John Ferris, “A British ‘Unofficial’ Aviation Mission and Japanese Naval Developments, 1919–1929,” *Journal of Strategic Studies* 5, no. 3 (1982): 422.

navy's pilots qualified after an extensive training period. Under these conditions the navy's leaders worried that reliance on such a small group of elite pilots would limit the expansion of Japan's carrier fleet.<sup>307</sup> A new generation of carrier planes was needed that allowed safe operation by a large number of pilots who could be trained within a reasonable time.

The navy's first official competition of carrier-based prototypes turned into a contest among Japanese, German, and British design. In 1926 the three aircraft makers Mitsubishi, Nakajima, and Aichi Tokei received orders to develop a new carrier fighter.<sup>308</sup> The new aircraft was to replace the 1921 Mitsubishi Type 10 designed by Herbert Smith's team. The navy's main requirement—for the aircraft to be able to float on the water surface after an emergency landing—clearly reflects persisting problems with engine reliability, insufficient flight range, and navigational errors. At the same time the navy emphasized the need for high speed and a long flight range that would expand both the carrier aircraft's dogfight capability and operational radius.

Designing and constructing a new aircraft that could meet these conflicting demands was a challenging task. Mitsubishi wanted to defend its position as the navy's sole supplier of fighter airplanes and put Hattori Jōji in charge of the project. Hattori was one of the company's most experienced designers who had been trained at Rohrbach in Germany in 1922–23 and had worked under Herbert Smith. He attached great importance to the floating capability of the aircraft by making the aircraft waterproof. To further facilitate an emergency touchdown on water he prepared the tank for fuel dumping and made the undercarriage droppable. The Taka (falcon) fighter, as the new aircraft was called, was also equipped with wing flaps that

---

<sup>307</sup> *Nihon Kaigun kōkūshi I Yōhei hen*, 196–97.

<sup>308</sup> *Ibid.*, 274.

significantly reduced its takeoff and landing distance, an important safety feature for carrier operation.

Aichi's managing director Masumoto Toshisaburō went to great lengths to win another navy contract for his company. In spring 1926 he traveled to Germany and passed the navy's request on to Ernst Heinkel. The German designer then devised an aircraft following closely the navy's specifications for high performance and advanced safety features: the aircraft could take off within only ten meters and was equipped with jettisonable fuel tanks that increased its flight range. The fighter's fuselage and lower wing were watertight in order to keep the aircraft floating after an emergency landing. Heinkel even added an elaborate mechanism that, in the case of an engine failure, allowed it to keep the propeller in a horizontal position, thereby preventing damage during touchdown.<sup>309</sup> The German company built two prototypes of the HD 23 and sent them to Japan in 1927.

The Nakajima Airplane Company outsourced its prototype development as well. It ordered the British Gloucestershire Aircraft Company to modify one of its all-wooden fighters for carrier operation and to ship it to Japan. By deliberately ignoring the navy's request for flotation Nakajima's engineers could keep his airplane much lighter than those of his competitors. During the final evaluation that was to decide which aircraft would be adopted for mass production the navy was impressed by the maneuverability of Nakajima's lightweight aircraft and accepted it as its official Navy Type 3 Carrier Fighter. The decision was met with harsh criticism. Heinkel argued that assigning different tasks to one aircraft would always result in an unsatisfactory tradeoff.<sup>310</sup> One Japanese commentator stated that this "obscure judgment" that preferred

---

<sup>309</sup> BA-MA RH 8 I/3679.

<sup>310</sup> Deutsches Museum Archiv FA 001 / 0821 07.1935–03.1939

Nakajima's British design over Mitsubishi's original design valued the copying of foreign designs over a "spirit of building made-in-Japan aircraft" and thus delayed the development of Japanese aviation technology for several years.<sup>311</sup>

A new effort for international arms limitation triggered another expansion of Japan's naval aviation. The 1930 London Naval Treaty further limited the construction of warships but did not include any restrictions on aircraft. During the first half of the 1930s Japan therefore increasingly focused on the build-up of an offensive naval airpower that relied on bombers for attacking the enemy's fleet.<sup>312</sup> During the early years the carrier planes' short flight ranges and their poor communication and navigation devices forced the aircraft carrier to stay within the visual range of the fleet's main vessel. This limitation significantly impacted their deployment to reconnaissance and patrol missions. Around 1935–36 the aircraft's flight range increased, and major advances in bombing and torpedo technology allowed a far-reaching change in the navy's strategy. In an attempt to overcome the limits of naval artillery Japanese navy planners began to put unprecedented emphasis on carriers and their planes as an attack force. They devised a new, aggressive doctrine of preemptive air strikes (*sensei kūshū*) on the enemy's aircraft carriers. Such attacks were intended to disable the opponent's strike power and establish Japanese air superiority. Only then would the navy fully engage with its main fleet, in what its strategists called the main fleet's decisive battle (*shuryoku kantai no kessen*) for sea superiority.

To implement such a high-risk strategy two important prerequisites had to be fulfilled. In order to be the first to locate the enemy's ships, Japanese aircraft needed a superior flight range in order to "outrange" the enemy's aircraft. Second, in order to achieve the required hit ratio, the

---

<sup>311</sup> Matsuoka Hisamitsu, *Mitsubishi hikōki monogatari* [The story of Mitsubishi aircraft] (Tokyo: Atene Shobō, 1993), 240.

<sup>312</sup> *Nihon Kaigun kōkūshi I Yōhei hen*, 203.

accuracy of carrier-based bombers had to be increased significantly. The proponents of the “first strike capability” doctrine envisioned that such precision bombing could lead to victory even against a numerically superior enemy.

In addition, while the traditional method of releasing bombs during level flight was notoriously inaccurate, a new bombing technique that emerged during the late 1920s nourished the hopes of the navy's airpower faction and seriously challenged the supporters of the big-ship, big-gun doctrine.<sup>313</sup> Dive bombing promised to be a most effective way to attack fast-moving ships that were strongly armed and heavily armored. Dive-bomber pilots would typically approach from a high altitude, then begin their high-speed dive over their target and release their bombs at a height of around five hundred meters. This technique ensured a high hit ratio while at the same time minimized the bomber's exposure to anti-aircraft fire. However, dive bombing put high demands not only on pilots but also on their aircraft, which needed the structural strength to withstand high acceleration loads while carrying bomb loads with sufficient explosive force.

In 1926 the United States Navy carried out its first successful dive-bombing exercises with dive angles of over seventy degrees from an altitude of 12,000 feet.<sup>314</sup> In 1930 the Japanese Navy dispatched its engineer Nagahata Jun'ichirō to America to visit several U.S. aircraft manufacturers including the Curtiss Aeroplane and Motor Company.<sup>315</sup> Curtiss had presented in 1929 a prototype of the company's F8C Helldiver to the U.S. Navy and Marine Corps.<sup>316</sup> Nagahata had an opportunity to watch a bomb-dropping demonstration of this new dive bomber.

---

<sup>313</sup> Okumiya Masatake and Horikoshi Jirō, *Zero! The Story of Japan's Air War in the Pacific: 1941–45* (New York: Dutton, 1956), 74–75.

<sup>314</sup> Peattie, *Sunburst*, 39.

<sup>315</sup> Nozawa, *Nihon kōkūki sōshū: Nakajima hen*, 144.

<sup>316</sup> Kenneth Munson, *Bombers Between the Wars, 1919–39* (New York: Macmillan, 1970), 111–12.

Upon his return to Japan the Japanese Navy started their own dive bombing experiments. Being aware of the dive bomber's potential to radically change existing battle doctrines the navy declared the project top secret. It even avoided the term dive bomber (*kyūkōka bakugekiki*) and used the designation "special bomber" (*tokushu bakugekiki*) instead.<sup>317</sup>

In 1931 the navy initially turned to Nakajima, at that time already one of the country's largest aircraft makers, for a joint development of Japan's first carrier dive bomber. The navy provided the basic design based on Nagahata's U.S. experience, and Nakajima developed two prototypes of the Experimental Kūshō 6-Shi Special Bomber. However, in late 1932, during a test flight, one prototype could not pull out of a dive and crashed.<sup>318</sup> Both the navy's Yokosuka Arsenal and Nakajima continued their efforts and built several prototypes according to new specifications that were to allow a trouble-free recovery from a high-speed dive.

While the arsenal and Nakajima were still trying to improve their designs the navy ordered Aichi to present its own prototype for a competitive trial that was scheduled for 1934. Aichi passed the navy's specifications on to Heinkel who, after consecutive improvement of two prototypes, built the He 66. Aichi sent its engineers Miki Tetsuo and Ozawa Yasushirō to Germany to watch the acceptance flight. Miki was fascinated with how, during this demonstration, the He 66 went into a vertical dive and dropped a mock-up bomb exactly over its target.<sup>319</sup> After the He 66 arrived in Japan Aichi modified the aircraft before presenting the aircraft for the competition. The company's engineers equipped the aircraft with a special bomb-release mechanism, a redesigned undercarriage, and a stronger Japanese engine that was driving

---

<sup>317</sup> Nozawa Tadashi, *Nihon kōkūki sōshū: Aichi, Kūgishō hen* [Encyclopedia of Japanese aircraft: Aichi, Navy aviation technology arsenal] (Tokyo: Shuppankyōdōsha, 1959), 78–79.

<sup>318</sup> Nozawa *Nihon kōkūki sōshū: Nakajima hen*, 144.

<sup>319</sup> *Nihon minkan kōkūshiwa* [Stories of Japan's civil aviation] (Tokyo: Nihon Kōkū Kyōkai, 1966), 102.

a propeller made from metal instead of wood. As it turned out, the dive bomber impressed the navy's officials as well. Its structural strength and combat performance clearly surpassed that of its competitors, and Aichi won the production contract.

Aichi's success was important for two reasons. First, it secured a large order for the company. Between 1934 and 1940 Aichi produced nearly six hundred D1A1 and the improved version D1A2. Even more importantly, after having outdone its competitors, Aichi became the exclusive builder of the navy's dive bombers. The navy deployed the dive bombers in large numbers in the Second Sino-Japanese War. In 1937, the D1A2 gained international notoriety when one of these dive bombers "mistakenly" attacked and sunk the U.S. gunboat *Panay* on the Yangtze River.

Ernst Heinkel's designs continued to shape Japanese naval aviation until the mid-1930s. His important inventions included speed brakes that could effectively control a bomber's speed during its dive and an elaborate mechanism for foldable wings that increased the maximum number of aircraft that could be stowed on a single carrier. Two of Heinkel's aircraft played an especially important role in the transformation of the navy's strike power. In 1935, one year before the conclusion of the German-Japanese Anti-Comintern Pact, Aichi imported Heinkel's He 70. The aircraft's high-speed design gave decisive inputs to Aichi for the development of its D3A1 carrier dive bomber. Mass production of the D3A1 began in late 1939, and it became the navy's main strike force for the Pearl Harbor attack.<sup>320</sup> In 1938 Heinkel sold his advanced dive bomber He 118 together with a production license to the navy.<sup>321</sup> The Yokosuka Arsenal used

---

<sup>320</sup> For the important role of dive bombers in the attack on Pearl Harbor see Israel, *Marineflieger*, 176.

<sup>321</sup> Okamura Jun, *Kōkū gijutsu no zenbō. I* [An overall picture of the aviation technology 1] (Tokyo: Hara Shobō, 1976), 339, and Nozawa, *Nihon kōkūki sōshū: yunyūki hen*, 158.

the He 118 as a model for the Suisei (Comet), the fastest carrier-based dive bomber of World War II that however was significantly lighter and aerodynamically superior to its German counterpart.<sup>322</sup> From 1942 until 1945 Aichi, together with the Hiro Naval Arsenal, built more than two-thousand aircraft of the Suisei type.

The Japanese honored Ernst Heinkel's contribution to the buildup of the country's airpower. In 1937 Navy Minister Yonai Mitsumasa (1880–1948) authored a document that recommended awarding the Order of the Sacred Treasure to Heinkel. The minister succinctly summarized Heinkel's fifteen-year-long "contribution to the development of [Japan's] naval aviation."<sup>323</sup> He began with Heinkel's submarine aircraft and launching ramps, which had "increased the fighting power of the Imperial Japanese Navy." The minister then paid tribute to Heinkel's effort to come to Japan for giving technological advice to the navy and its civil manufacturers. Furthermore, Heinkel's dive bomber received praise as a "turning point in bombing technology." Finally, the minister emphasized that Heinkel's research on flying boats and high-speed aircraft, the results of which he passed on without compensation, proved him as a "unique Japanophile" (*marenimiru shinnichika*). For his years-long contributions to the navy, Minister Yonai concluded, Heinkel truly deserved to be conferred the Order of the Sacred Treasure.

As mentioned above, Heinkel's business strategy explicitly excluded the training of Japanese engineers. Therefore the minister's emphasis on Heinkel's transfer of know-how seems exaggerated. It also could be seen as a diplomatic hint at the fact that, by 1937, Japanese designers had reached a level of expertise where they could devise their own original designs that no longer depended on the import of Heinkel's aircraft.

---

<sup>322</sup> Francillion, *Japanese Aircraft of the Pacific War*, 454–61.

<sup>323</sup> Foreign Minister, "Doitsujin 'Erunsuto Hainkeru' jokun no ken" [Conferring a decoration to the German Ernst Heinkel], 1937, JACAR Ref. A10113228100.

From his German office Heinkel returned the kind words. He thanked the naval attaché Kojima for his initiative and recommendation for awarding the decoration. Heinkel also praised his personal relationship with the navy's officers that, within the course of many years, had laid the very foundation for his business with Japan.<sup>324</sup> In his 1953 autobiography he emphasized that Japanese officers and engineers always had been welcome guests in his factory. In an obvious attempt to distance himself from the Nazi regime, he also pointed out that the Japanese had always been generous and honest partners whose "faithfulness and even friendship" he had to defend constantly against the "German government's suspicions of industrial espionage."<sup>325</sup>

## Conclusion

By 1937, on the eve of the Second Sino-Japanese War, Japan's naval airpower had made remarkable progress. With significant contributions from German designers and aircraft makers Japanese aircraft designers had reached technological self-sufficiency—Aichi bought its last aircraft from Heinkel in 1936, and two years later the engineers of the Navy's arsenal proved with their *Suisei* dive bomber that they could surpass the designs of their former mentor. The new technology not only provided the essential hardware—large flying boats and carrier airplanes with superior flight range, armament, and bombing accuracy—but also led to fundamental changes in Japan's naval doctrine. Both developments vastly increased the Imperial Japanese Navy's strike force and emboldened its planners and strategists.

As we have seen, technological advance increasingly accelerated doctrinal change. Float planes effectively supported the navy's battleships with their reconnaissance and artillery-spotting missions but left the "big-ship, big-gun policy" largely unquestioned. Then the new

---

<sup>324</sup> Deutsches Museum Archiv FA 001 / 0821 07.1935–03.1939.

<sup>325</sup> Heinkel, *Stürmisches Leben*, 224–25.

technology of large-size all-duralumin aircraft fired the imagination of military planners. It demonstrated the feasibility of huge military flying boats that could autonomously carry out patrol and bombing missions. Finally, an entirely new strategy emerged when a new dive-bomber technology delivered a high hit ratio that turned the aircraft carrier into a powerful weapon that ultimately was to challenge the battleships' *raison d'être*.

Ironically, by the late 1930s Japan's naval aviation clearly surpassed that of both Britain and Germany. The two countries whose aviation specialists had decisively contributed to the development of Japanese naval airpower neglected the modernization and growth of their own maritime air forces. Limited resources, inter-ministerial rivalries, a conservative naval doctrine, and an emphasis of the Royal Air Force on heavy bombers seriously hampered the expansion of British naval airpower.<sup>326</sup> The ill fate of German naval aviation further illustrates the interaction between technology and military doctrine. After 1935 the German Luftwaffe insisted on its monopoly of "all things flying." Lacking any clear doctrine for the development of naval airpower, the Luftwaffe showed no interest in providing dive bombers or effective torpedo aircraft for the navy. While until 1945 the Japanese Navy had been building thirty-two aircraft carriers, the two aircraft carriers being constructed by Germany were abandoned at early stages in 1939 and 1943. Lacking an effective naval aviation, the Luftwaffe could not cooperate with the navy's U-boats to interdict ship transport to Britain, a failure that would have decisive consequences for the outcome of the war.

---

<sup>326</sup> For an overview of British interwar aviation see David Edgerton, *England and the Aeroplane: Militarism, Modernity and Machines* (London: Penguin, 2013), 28–59.

## IV

### **On the Way Toward Independent Aircraft Design: German Aviation Specialists and Japan's Army Aviation**

In the previous chapter we have seen how the growth of Japan's naval aviation was closely related to the evolution of the Imperial Navy's air strategy. In order to implement its massive airpower expansion the navy chose a two-pronged approach. It substantially increased the production of aircraft in its own arsenals while at the same time employing civil manufacturers.<sup>327</sup> These companies received not only generous funding but also technical assistance by the naval arsenals that supplied them with know-how, designs, and the latest production technology.

The build-up of the Imperial Army's air fleet during the same period was markedly different.<sup>328</sup> In 1925 the newly established Army Aviation Headquarters (*rikugun kōkūhonbu*) decided to leave both the development and manufacture of army airplanes entirely to civil companies. Furthermore, as a result of the ongoing the army-navy rivalry, the only two companies engaging in large-scale production for both the army and the navy, Nakajima and Mitsubishi, were required to keep their army and navy production lines strictly separated.<sup>329</sup> This doctrine of a bifurcated production effectively precluded technological transfer between the two services. Therefore, without receiving any technological assistance from their government client, the private producers of army aircraft had to lay the foundation for their own research and

---

<sup>327</sup> According to Eiichiro Sekigawa, the naval arsenals produced one-third of the navy's aircraft between 1920 and 1930. Eiichiro Sekigawa, *Pictorial History of Japanese Military Aviation* (London: Allan, 1974), 33.

<sup>328</sup> For the army-navy rivalry and its effects on procurement policies see Samuels, "Rich Nation, Strong Army," 113–14.

<sup>329</sup> Moriya, *Meikōkōsakubu no senzensengoshi*, 45–46.

development. At the same time the army's new concept of "prototype competition" (*kyōsōshisaku*) increased the pressure for innovative designs. As a result all major aircraft makers turned to the help of foreign experts for the design of airplanes that could meet the army's requirements and win lucrative contracts for a large-scale production.

Furthermore, a second important feature of the army-navy divide deserves our attention. While the navy's expansion of airpower was clearly driven by a constant revision of its strategy, the build-up of the army's air force was mostly motivated by the basic need to replace obsolete aircraft types with a new generation of advanced military airplanes. As we will see, the army's strategists were well aware of recent developments in the deployment of airpower. Nevertheless the progress of the army's air strategy stagnated and by the early 1930s it fell into what I will call a "doctrinal slumber."

To examine this curious phenomenon, the chapter starts with the Japanese Army's internal disputes about an appropriate airpower doctrine. It then explores how the army's requirements for an ever powerful aviation technology prompted Kawasaki and Mitsubishi, two of Japan's largest aircraft makers, to invite German engineers, aircraft makers, and scientists to Japan. It also analyzes how the new procedure of prototype competitions put the designs of each company to the test. I argue that, under these conditions the German aviation specialists in the employ of Kawasaki and Mitsubishi played a pivotal role in the most advanced form of technology transfer: the transmission of the capacity for independent design. The chapter concludes with an evaluation of Japan's aerial warfare during the 1931–32 Manchurian Incident. As a result of Kawasaki's and Mitsubishi's collaboration with German experts the Japanese Army went to war against China with some of the world's most advanced airplanes. However, as we will also see,

the army air force's deployment in Manchuria provided little incentive for the army's planners to modernize their air strategy, so their doctrinal slumber continued.

### **The Army's Troubles with a New Air Doctrine**

In the previous chapter we have seen how the Japanese Navy's competing doctrines of "battleship first" versus "aircraft first" shaped the development of Japan's naval aviation. Soon after the Japanese Army introduced aircraft as a new weapon in 1910 a similar dispute divided the army's strategists into two camps. The army's traditionalists were at best willing to concede to airplanes a role as ancillary weapons for the tactical support of the ground troops and insisted on putting the army's air squadrons under the authority of the ground commanders. The more radical among the army's modernizers advocated an "all-powerful air force" (*kōkūbannōron*). Referring to the British Royal Air Force that was created in April 1918 as the world's first independent air force, they envisioned a similarly autonomous strike force that could be deployed for strategic bombing missions into the enemy's hinterlands.

During the early 1920s it was difficult for the Japanese General Staff to adopt such an extreme view. Most Japanese officers had little or no World War I combat experience, and it was challenging for them to develop a new air doctrine on their own. Those who placed their hopes on the 1918–19 French aviation mission to Japan under Colonel Jacques-Paul Faure received little help. Faure was an artillery officer who emphasized the importance of ground support and was skeptical about the merits of an independently operating air force. Therefore, while the French mission had exposed the Japanese Army to a wide spectrum of airpower deployment, it contributed little to the advance of the army's air strategy.

The discourse about air strategy was an ongoing international discussion. New ideas about the strategic use of bombers arrived in Japan when the Army Aviation Department (*rikugun*

*kōkūbu*) invited Marcel Jauneaud (1885-1947) to visit in August 1921.<sup>330</sup> Jauneaud, an instructor at the French Army Academy, gave lectures about French air strategy and the lessons learned from World War I. He attended several field exercises of the Japanese Army where he observed combined maneuvers of the army's air and ground troops as well as long-distance bombing. In August 1922 Jauneaud authored a memorandum for the members of the Army Aviation Department and the Army War College that gave strong support to the army's *kōkūbannōron* faction. Together with a large-scale expansion of Japan's airpower the French officer recommended the establishment of a substantial corps of long-distance bombers that could operate under an independent command.<sup>331</sup> Jauneaud elaborated on this idea in a book on military aviation that he published shortly after his return to France.<sup>332</sup> Referring to the German giant bombers that were deployed against London and Paris during World War I, Jauneaud envisioned a long-range strike force of heavily armed bombers. He called these aircraft "genuine flying fortresses" (*de véritables forteresses volantes*) that would burn the enemy's capital, destroy its industry and communications, and undermine public morale.<sup>333</sup>

Jauneaud's proposals were in line with the ideas of the Italian strategist Giulio Douhet (1869–1930), who, with his 1921 book *Il dominio dell'aria* (*The Command of the Air*), became

---

<sup>330</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō I*, 208–9.

<sup>331</sup> Christian Philippe Polak, *Fude to katana: nihon no naka no mō hitotsu no Furansu 1872–1960* [The brush and the sword: Yet another France in Japan, 1872–1960] (Tokyo: Zainichi Furansu shōkō kaigisho, 2005), 140.

<sup>332</sup> Marcel Jauneaud, *L'aviation militaire et la guerre aérienne* [Military aviation and aerial warfare] (Paris: E. Flammarion, 1923), 208, 214.

<sup>333</sup> Jauneaud's enthusiasm for aerial armament was not shared by the French War Ministry, which in 1925 began its plans for the Maginot Line, consuming a huge part of appropriations at the cost of airpower expansion until 1940.

one of the most influential airpower theoreticians.<sup>334</sup> Douhet proposed to deploy airpower as an aggressive weapon that would deliver a fast and sweeping victory. This idea was attractive to many European military planners who, after the experiences of World War I, were afraid of yet another war of attrition.<sup>335</sup> According to Douhet, a country's air force had to establish air superiority first. It should then start bombing the opponent's cities and industries. These attacks would defeat the enemy by crippling its aircraft industry and demoralizing its population.

Jauneaud's 1922 memorandum prompted the Japanese Army to draft a more systematic air doctrine, albeit one that diluted the idea of an autonomous airpower and emphasized the tactical deployment of the army's aircraft. Lieutenant Commander Ogasawara Nobuo, a teacher at the Army War College, had an influential voice in the ongoing discussion. After attending Jauneaud's lectures Ogasawara published his *Lecture Notes on Air Strategy* (*Kōkū senjutsu kōjuroku*).<sup>336</sup> The book's main chapter on the "General Operational Principles of the Aviation Corps" meticulously outlined the specific tasks of the army's reconnaissance, fighter, and bomber corps during different phases of battle. Ogasawara endorsed the independent deployment of the army's bombers for attack on the enemy's hinterlands before the actual battle started. However, he put forward that during battle the entire army air force should closely cooperate with the infantry. For the first time the deployment of the army's aviation arm was officially incorporated into the army's traditional doctrine of ground operations. According to the

---

<sup>334</sup> For an analysis of Douhet's works see Phillip S. Meilinger, "Giulio Douhet and the Origins of Airpower Theory," in *The Paths of Heaven: The Evolution of Airpower Theory*, ed. Phillip S. Meilinger (Maxwell AFB, AL: Air University Press, 1997).

<sup>335</sup> It is important to keep in mind that Douhet's new ideas were not universally appreciated. In 1916 Douhet was court-martialed and imprisoned for his open criticism of Italy's military leadership and the course of the war.

<sup>336</sup> Ogasawara Kazuo, *Kōkū senjutsu kōjuroku* [Lecture notes on air strategy] (Tokyo: Rikugundaigakkō shōkō shūkaijō, 1922), 1–31.

historians of Japan's Defense Agency, Ogasawara's book laid the foundation for further investigations by the General Staff Office on "ground troops and the deployment of the flying corps" during the second half of the 1920s.<sup>337</sup>

### **Turning Flying Boats into Bombers: Kawasaki's Tie-Up with Dornier**

The motive that ultimately prompted the modernization of the army's bomber fleet was not the result of theoretical discussions about a new air strategy but was rooted in a more down-to-earth problem. The increasingly obsolete French Farman F-50 and Farman F.60 Goliath had to be replaced with a new heavy bomber.<sup>338</sup> The shipbuilding company Kawasaki Dockyard was to play a major role in the army's new bomber project. Kawasaki had started building aircraft in 1918 at its Kobe factory and decided in 1922 to expand and upgrade this aircraft section into an aircraft department that then was established near the Kakamigahara Airfield, about thirty kilometers north of Nagoya (see Map 1). Around October 1923 Colonel Sugiyama Gen (1880–1945), section leader at the Army Aviation Department, met Takezaki Tomokichi, the head of Kawasaki's new aircraft department. Obviously being aware of recent advances in German all-metal technology Sugiyama gave the order to find a German aircraft maker who could design a new all-metal bomber for the Japanese Army.<sup>339</sup> Takezaki promptly arranged a meeting with the German trading company Illies, which assisted Kawasaki to successfully establish contact with the German aircraft designer Claude Dornier (see Figure 15) and the engine maker Bayerische Motoren Werke (BMW).<sup>340</sup>

---

<sup>337</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō 1*, 224.

<sup>338</sup> Mikesch and Shorzoe, *Japanese Aircraft*, 144.

<sup>339</sup> Taken from the memoirs of Tateyama Toshikuni, the former director of Kawasaki Heavy Industries. See Kawasaki, *Kawasaki Jūkō Gifu kōjō no omoide*, 5.

<sup>340</sup> *Kawasaki jūkō gifu kōjō gojūnen no ayumi*, 7.

Kawasaki's choice of the hydroplane maker Dornier for building a land-based bomber was carefully considered. The Kawasaki engineers were convinced that Dornier's design and production methods suited them best because they allowed the Japanese company to transfer its well-developed shipbuilding technology to its aircraft sector. Kawasaki expected to use large sections of its shipbuilding tools and devices. Furthermore it planned to rely on the experience its workforce had already acquired in shipbuilding to develop its aircraft construction skills quickly.<sup>341</sup>

### Figure 15: Claude Dornier (1884–1969)

Another key factor that made the cooperation with Claude Dornier attractive to the Japanese was his valuable experience in international cooperation. After the Allied Commission had ordered the destruction of Dornier's aircraft at his German factory in 1920 he decided to continue building aircraft by outsourcing large parts of his production to Italy.<sup>342</sup> With the help of one Italian member of the Allied Commission he started a German-Italian joint venture, the Costruzioni Meccaniche Aeronautiche S. A. Italian banks and industrialists provided the funds, facilities, and workforce while Dornier agreed to make his licenses, designs, and know-how available for a period of ten years. Dornier also sent about fifty of his own specialists to the Italian workshop in Marina di Pisa, a small port town about three hundred kilometers northwest

---

<sup>341</sup> Senba Tadashi, *Hikōki ni miserarete* [Fascinated by aircraft] (Gifu: Chūbu senkōkai, 2000), 36.

<sup>342</sup> *50 Jahre Dornier 1914–1964. Ein unvollständiges Bilderbuch zur Geschichte des Hauses Dornier* (Friedrichshafen: Dornier-Werke, 1964), 33.

of Rome (see Map 2).<sup>343</sup> In July 1922 the company began the production of the “Wal” flying boats that soon became a worldwide bestseller and propelled Dornier to international fame. As we will see, the political, financial, and technological aspects of this international cooperation provided a tried and tested pattern that could easily be adopted for the Dornier-Kawasaki tie-up.

The liaison with Dornier was of great importance to Kawasaki's aircraft section, as its head, Takezaki, himself travelled to Germany in January 1924. He took with him his chief engineer Tōjō Hisashi and four other engineers and foremen who were to be trained by Dornier in the production of metal aircraft.<sup>344</sup> Tōjō, the younger brother of the future general and prime minister Tōjō Hideki (1884–1948), was to become a central figure in the transfer of aviation technology to Japan. The former designer of submarines stayed eighteen months at Dornier. During this period he not only received comprehensive training in the design of all-metal aircraft but also became responsible for supervising the important acceptance flights, a series of flight tests that each aircraft had to pass before being delivered to Kawasaki. On his return to Japan in 1925 he was promoted to head of Kawasaki's aircraft design section and became the most important mediator between Dornier's and Kawasaki's engineering departments.

According to Kawasaki's official company history, the Kawasaki-Dornier cooperation started as a top secret project.<sup>345</sup> Nevertheless, government officials of both countries were well informed about it. In August 1924 Kawasaki's president Matsukata Kōjirō (1865–1950) notified Army Minister Ugaki Kazushige (1868–1956) about the cooperation with Dornier and the proposed sale of Dornier aircraft built under license by Kawasaki. Matsukata's memorandum

---

<sup>343</sup> Michiel van der Mey, *Dornier Wal: “A Light Coming Over the Sea”* (Vicchio, Firenze: LoGisma, 2005), 15.

<sup>344</sup> *Kawasaki jūkō gifu kōjō gojūnen no ayumi*, 7.

<sup>345</sup> *Kawasaki, Yume o katachi ni: 1896–1996*, 32.

also mentioned the invitation of “highly skilled engineers from Germany” for the design and production of all-metal aircraft that would meet the army’s demand.<sup>346</sup> Two months later, the German ambassador Wilhelm Solf (1862–1936) reported to the German Foreign Ministry similar news: Kawasaki, “with the support of the Japanese government,” had bought the license to build Dornier’s aircraft in Japan. Production would start soon with the help of German experts who already had arrived.<sup>347</sup>

The original license contract, concluded between Dornier and Kawasaki on February 6, 1924, testifies to the remarkable extent and intensity of know-how, manpower, and material that was transferred from Dornier to Kawasaki.<sup>348</sup> Rather than just acquiring the rights for the licensed manufacturing of a new bomber, Kawasaki decided for a wholesale purchase. The license permitted Kawasaki, under the name “Dornier-Kawasaki,” to build for ten years a full range of nine different types of Dornier’s aircraft, including small trainers, fighters, reconnaissance aircraft, and bombers. The contract was drawn up in English and granted Kawasaki the “sole license in Japan for building metallic [*sic*] aeroplanes.” Dornier agreed to provide one sample airplane of each type, together with two sets of blueprints, design calculation sheets, specifications of all materials, and instructions for maintenance and operating. In addition to the sample aircraft and documents, Kawasaki would receive “all theoretical and practical experience contained in the above designs.” The contract stipulated that for the proper transfer of “practical know-how,” Dornier’s technical staff would provide instructions in the manufacturing process and supply the necessary machine tools, templates, drilling jigs, gauges, etc. Dornier also

---

<sup>346</sup> Kawasaki Dockyard, “Manufacturing and selling of all-metal aeroplanes,” 1924, JACAR Ref. C03012003600, p. 933.

<sup>347</sup> BA-MA RH8-3606.

<sup>348</sup> EADS Corporate Heritage, Archiv Dornier, folder Lizenz Japan.

agreed to train Kawasaki personnel in its Italian factory. He gave the far-reaching guarantee that “with the assistance of the above-mentioned engineering staff, the drawings, and the given experience, it is possible to manufacture successfully the above-mentioned aeroplanes [*sic*] types.” On a more cautious note the contract then continued that “it is of course understood that Kawasaki places at the disposal of this engineering staff a first-class workshop, capable engineers, and workmen and the right raw material as, for instance, duralumin.” Kawasaki in turn agreed to pay to Dornier the impressive sum of ¥875,000, which in 1924 was about US\$400,000.<sup>349</sup> The amount was equivalent to nearly one-sixth of Kawasaki Dockyard’s annual profit.<sup>350</sup>

The effect of Kawasaki’s payment on Dornier’s financial situation, which had become increasingly dire, cannot be overestimated. Only in November 1923, a few months before the contract was signed, had German hyperinflation ended. It had wiped out all financial assets denominated in marks. Dornier’s 1924 balance sheet, still preserved at the company’s archive, shows that the net profit from the Kawasaki license agreement alone more than tripled Dornier’s 1924 revenues.<sup>351</sup>

The contract also stipulated the salaries of Dornier personnel dispatched to Japan. For their intended four-month stay Dornier’s pilots and mechanics were entitled to a handsome remuneration: The monthly wages paid by Kawasaki to Dornier’s workmen amounted to about

---

<sup>349</sup> Adjusted for inflation, that sum is worth US\$5.5 million in 2014.

<sup>350</sup> Abe Ichisuke, *Kawasaki Zōsenjo yonjūnenshi* [A 40-year history of Kawasaki Dockyard Company] (Kōbe Kawasaki Zōsenjo, 1936), 313, gives a 1925 net profit of ¥5,790,151. For comparison, during the same year the company spent ¥8 million for research and development. See Kawasaki’s semi-annual reports in the July 7, 1925, and January 4, 1926, *Asahi Shinbun Tokyo* morning edition, p. 1.

<sup>351</sup> EADS Corporate Heritage, Archiv Dornier.

ten times the monthly earnings of an average German industrial worker.<sup>352</sup> Claude Dornier, who agreed to come to Japan himself, would be paid two-and-a-half times what his mechanics received—reminding us that they were still in an era of relatively modest income inequality between CEOs and their employees.

Already in the same year the contract was concluded, Dornier delivered its first three aircraft to Kawasaki. Between July and October 1924 Tōjō Hisashi went to Italy and signed the documents for the successful acceptance flights of a Wal seaplane, a Falke fighter aircraft, and a Do C reconnaissance airplane.<sup>353</sup> The aircraft were then disassembled and shipped via India to Japan. Satisfying his obligations under the contract, Dornier himself set off for Japan to give his “personal advice and to demonstrate the sample machines in practical trials.”<sup>354</sup> On November 4, 1924, he arrived at Yokohama, just in time to supervise the reassembly of his airplanes. The public flight demonstration of Dornier's flagship was scheduled for December 3. Army and navy officials and journalists together with several hundred invited guests attended the event. Dornier's test pilot Erich Just (1898–1955) climbed into his narrow open cockpit, and the two companies' presidents—Claude Dornier and Takezaki Tomokichi—took seats in the more comfortable passenger cabin. At eight o'clock sharp Just pushed the engine throttles forward. The Wal flying boat accelerated and smoothly took off for its 600-kilometer non-stop flight to the Kasumigaura Naval Base, 80 km northeast of Tokyo (see Map 1). An exhilarated press report

---

<sup>352</sup> The monthly salary for pilots and mechanics was ¥1,500 and ¥800, respectively. According to Gerhard Bry, *Wages in Germany, 1871–1945* (Princeton, NJ: Princeton University Press, 1960), 58, in 1925 a typical German worker earned 32.12 marks per week. Bank of Japan Institute for Monetary and Economic Studies, “Gaikoku kawase sōba (1893 nen–1926 nen)” [Foreign exchange rates (1893–1926)], 2012, gives an exchange rate of 1.59 marks/yen for January 1925.

<sup>353</sup> EADS Corporate Heritage, Archiv Dornier.

<sup>354</sup> Ibid.

celebrated the “all-duralumin” hydroplane as a “monster in the sky” (*kūchū no kaibutsu*) and admirably quoted Dornier’s comment that his aircraft would make it possible to fly from Tokyo to Berlin in only thirty hours, an impressive improvement over an overland travel time of more than two weeks.<sup>355</sup>

After this successful publicity event a unique technical cooperation began over a distance of 10,000 kilometers. In his Friedrichshafen design office (see Map 2) Dornier redesigned the Wal passenger aircraft as a land-based bomber and renamed it the Do N. According to the license agreement the aircraft had to be equipped with two twin machine guns for defense against enemy aircraft, one camera for reconnaissance purposes, and—last but not least—a bomb-releasing device. In addition the aircraft had to be constructed in a way that allowed an easy disassembly for railway transport.<sup>356</sup> Dornier also supplied the complete raw material and semi-finished profiles, wing spars and ribs, wheels, propellers, instruments, and radiators.<sup>357</sup>

**Figure 16: Building the Do N: A look at Kawasaki’s shop floor.**<sup>358</sup>

After completing the blueprints and construction documents Dornier sent them to Japan. Then, in early 1925, under the technical direction of the Dornier engineer Richard Vogt, Kawasaki began the experimental production of a prototype (see Figure 16). The Japanese Army sent six officers of their “experimental production research team” (*shisaku kenkyūhan*) to Kawasaki to closely observe and study the production process. In February 1926 the “made-in-

---

<sup>355</sup> “Kūchū no kaibutsu” [A monster in the sky], *Asahi Shinbun*, December 4, 1924, and “Daiseikō ura ni migoto na hikōburi” [A very successful great flight performance], *Asahi Shinbun*, December 9, 1924.

<sup>356</sup> EADS Corporate Heritage, Archiv Dornier, folder Lizenzvertrag.

<sup>357</sup> EADS Corporate Heritage, Archiv Dornier, folder Dornier Flugzeugtypen nach Japan.

<sup>358</sup> Source: EADS Corporate Heritage, DWF 13301/41

Japan" aircraft completed its acceptance flights in strict secrecy. After the successful trials

Kawasaki set up an enthusiastic message of congratulations in English and cabled it to Dornier:

Test flights completed within three successive days and to clients' fullest satisfaction STOP Characteristic performances and mechanical fulfillments of machine proved perfect and excellent even beyond our expectation STOP Not single adjustment nor repairing was necessary during trials STOP Clients and ourselves all take our hats off and salute you for unparalleled success of your authentic design mutual congratulations.<sup>359</sup>

**Figure 17: The Kawasaki Type 87 bomber. Note the size of the aircraft and the shape of its fuselage that reveals the airplane's flying-boat origins.**<sup>360</sup>

The bomber evoked a mixture of awe and trepidation (see Figure 17). Gone was the graceful fragility of earlier constructions. With a wing span of nearly 27 meters, three machine guns, and one huge bomb attached to its fuselage, the aircraft had a takeoff weight of nearly eight tons and deserved to be called a *heavy* bomber. In 1927 the Japanese Army officially adopted the Do N and introduced it under the name Army Type 87 Heavy Bomber. It was Japan's first bomber able to carry a bomb load of one thousand kilograms, more than twice as much as its French predecessor, the Farman F-60. According to one source the army treated the new aircraft as its priceless treasure (*tora no ko*; literally, "tiger cub").<sup>361</sup>

At a time when Western powers still relied on wooden biplanes for bombing missions, Japan's fleet of all-metal monoplane bombers clearly was the world's technologically most advanced strike force. Between 1926 and 1932 Kawasaki built a total of twenty-eight Type 87 bombers. From 1927 on the army assigned them to the heavy bomber squadron of the

---

<sup>359</sup> "Dornier Flugzeuge in Japan," *Dornier-Post*, no. 3 (April 1973): 54–55.

<sup>360</sup> Source: EADS Corporate Heritage, DWF 19899.

<sup>361</sup> Kawasaki kōkūkikōgyō kabushikigaisha, *Kōkūkiseisaku Gifu kitai no bu* (Kakamigahara: Kawasaki kōkūkikōgyō, 1946), 7.

Hamamatsu bomber base. Only in 1933 was the Kawasaki Type 87 replaced by the more advanced Mitsubishi Ki-1, also based on a German design.

In light of the army's large-scale order, the aircraft's manufacturer, Kawasaki, took a most favorable view of its cooperation with Dornier. The company was proud of having become Japan's leading designer and producer of metal aircraft.<sup>362</sup> By mastering the cantilever wing and monocoque technology Kawasaki was clearly on its way to surpass the latest Western aircraft designs—the United States introduced their first all-metal monoplane bomber in 1931, and the Royal Air Force's first all-metal monoplane bomber entered service in 1936.<sup>363</sup>

Kawasaki's achievements also helped to soothe the public's worries about the backwardness of Japanese aviation technology, a recurring issue covered in the Japanese press. In a 1932 article the newspaper *Kōbe Yūshin Nippō* praised Kawasaki's cooperation with Dornier.<sup>364</sup> The paper emphasized that while for a long time Japanese had “swallowed Western technology without chewing” (*u-nomi*,; literally, “gulp down like a cormorant”), Kawasaki was now playing “an active role in the frontlines of the Japanese aviation industry.” The newspaper congratulated Kawasaki for its foresight in contracting with Dornier and adopting the all-metal technology. This move, the article emphasized, enabled the company to build “exactly the type of heavy bombers the army air force was so urgently looking for.”

---

<sup>362</sup> *Kawasaki jūkō gifu kōjō gojūnen no ayumi*, 8.

<sup>363</sup> These bombers were the U.S. Boeing YB-9 and the British Avro Anson.

<sup>364</sup> “The Kawasaki Aircraft Factory,” *Kōbe Yūshin Nippō* newspaper, April 9, 1932.

## **The Theory and Practice of Aircraft Design: Alexander Baumann at**

### **Mitsubishi**

The build-up of a modern strike force of bombers was only one aspect of the army's project to strengthen the country's aerial armament. In the mid-1920s Japan's emerging aircraft industry also made considerable efforts to start the domestic production of advanced reconnaissance aircraft and light bombers. The aim of this ambitious armament program was twofold. First, it was intended to provide the Japanese Army Air Force with the necessary equipment for a close support of the army's ground troops. Second and equally important, the program would also promote the development of an autonomous national aviation industry. As it turned out, two foreigners were to play a crucial role in leading Japanese aviation engineers toward independence from not only foreign imports but also foreign design.

In order to gain such an independence from foreign imports Mitsubishi decided to root its aircraft design in engineering mechanics and aerodynamics. In 1924 the company hired Alexander Baumann (1875–1928), one of the leading German scholars in the field. Baumann was well known as the first academic in Germany to be appointed to a professorship in aircraft design in 1910. His 1913 *Mechanische Grundlagen des Flugzeugbaues* (Mechanical foundations of aircraft construction) had become the standard textbook in the field. One month after the outbreak of World War I, Baumann became directly involved with the construction of military aircraft. When Count Zeppelin started his project for a giant aircraft he entrusted Claude Dornier with the development of hydroplanes at Friedrichshafen and appointed Baumann as a technical director for the design of landplanes at Staaken, near Berlin. Baumann's first giant aircraft, the VGO I, still had wooden structure and fabric covering. The bomber had an impressive wingspan of more than forty meters and made its maiden flight in 1915. When the war ended, Baumann

returned to academia, and Adolf Rohrbach, whose role in Japanese naval aviation was discussed in the previous chapter, became his successor until the closure of the Zeppelin Werke Staaken.

In all likelihood Baumann was already well known to Japanese aviation specialists for his key role in the design of giant aircraft, especially after the arrival of the war trophy Staaken R.XV in Japan (see chapter 2). Mitsubishi's interest in Baumann was also a result of the company's growing awareness of its inadequate research capabilities. As discussed in the previous chapter, the British engineers under Herbert Smith were unwilling to share their knowledge with Mitsubishi's engineers during their stay from 1921 to 1925, and when the shrewd businessman Rohrbach came to Japan in 1925 he had little interest in having his Japanese licensee setting up an independent design section. Mitsubishi's 1924 board meeting minutes dealing with the employment of Baumann reveal the company's concern to move past mere "copying of Western products." Referring to the fast progress of aircraft design in the West, board members emphasized the importance of promoting the company's own research and experimental production.<sup>365</sup>

Thus, in 1924 Mitsubishi invited Baumann to come to Japan and to introduce a "new design for the aircraft of the future."<sup>366</sup> Initially, it seems, the professor was not very keen to respond to the company's offer. According to one source, Baumann simply wanted to stop a Mitsubishi employee from constantly paying visits to his home in Germany. He therefore asked to be paid twice the usual salary earned by a foreign adviser. To Baumann's astonishment, after some hesitation Mitsubishi agreed to pay the requested sum, which far exceeded the income even of

---

<sup>365</sup> Mitsubishi archive Tokyo, MHI-00339.

<sup>366</sup> Board meeting, July 1924, Mitsubishi archive Tokyo, MHI-00339.

the Japanese army minister.<sup>367</sup> Mitsubishi's archives preserve Baumann's employment contract, which shows that he received a monthly salary of more than ¥4,000, about nine times more than that of the head of the Nagoya factory. Baumann did not resist Mitsubishi's generous offer, and he signed a two-year contract with the company's German branch office. He agreed to "instruct the workmen and engineers, draughtsman and designers of the employers in all details in relation of [*sic*] aircraft and motor construction." Baumann also committed himself to putting any new invention entirely at Mitsubishi's disposal by ceding all resulting patent rights to his employer.<sup>368</sup>

**Figure 18: The Baumann family in 1926 together with a Japanese doctor (left) and a German private teacher (far right).**<sup>369</sup>

In 1925 the army decided to start its first "prototype competition." According to the new procedure several aircraft makers had to submit their newly designed prototypes for competitive evaluation by the Army Technology Council (*rikugun gijutsukaigi*), the Chief of the General Staff (*sanbōsōchō*), and the Inspectorate General of Military Training (*kyōikusōkan*). Upon the recommendation of the three departments the army minister would then officially adopt one aircraft and give an order for large-scale production to the winning company.<sup>370</sup>

When in spring 1925 the army ordered Mitsubishi, Kawasaki, and Nakajima to design and build prototypes of a new light bomber, Mitsubishi put Baumann in charge of the project. The

---

<sup>367</sup> Vogt, *Weltumspannende Memoiren*, 76.

<sup>368</sup> Mitsubishi archive Tokyo, MHI-00781. The contract was set up in English.

<sup>369</sup> Source: Nowarra, *Die Flugzeuge des Alexander Baumann*, 120.

<sup>370</sup> Bōeichō bōeikenshūjō senshi sitsu, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 68–70. See also Nihon Kōkū Kyōkai, *Nihon kōkūshi. shōwa zenkihen* [The history of Japanese aviation in the early Shōwa period] Vol. 2 (Tokyo: Nihonkōkūkyōkai, 1956), 3–38.

company granted Baumann considerable latitude in airframe design and required only that the airplane had to be equipped with the Mitsubishi-made Hispano Suiza 450hp engine. Baumann had not yet made the full transition to an all-metal design. He decided, rather, to use a distinctive mix of materials. The aircraft's fuselage consisted of a fabric-covered duralumin skeleton. The wings were a mix of light metal and wood. W-shaped struts connected the lower and upper wings, thereby eliminating the need for additional bracing wires (see Figure 19). The aircraft's unusually long and narrow upper wing followed the aerodynamic theorem that such a shape reduces drag and increases performance.<sup>371</sup> Even though Baumann's aircraft was designed as a light bomber, it was heavily armed with four machine guns and could carry a considerable bomb load of 800 kilograms.<sup>372</sup>

In February 1926 Mitsubishi had good news for the army minister. The construction of the new bomber, named Washi (Eagle), was making fast progress. Using Baumann's design, the aircraft would be powerful, would be inexpensive to produce, and, the company emphasized, would "significantly contribute to Japan's weapons production becoming independent from foreign imports."<sup>373</sup> Together with the drawings and a detailed description of the aircraft, Mitsubishi handed over a request to the army minister for an examination of the aircraft by the Army Aviation Headquarters

**Figure 19: Baumann's Experimental Washi-type Light Bomber.**<sup>374</sup>

---

<sup>371</sup> An elongated wing generates less so-called induced drag which is a result of air flowing from the lower wing surface to the upper wing surface. Less induced drag results in fewer vortices, thereby increasing an aircraft's performance and efficiency.

<sup>372</sup> Nozawa *Nihon kōkūki sōshū: Mitsubishi hen*, 44.

<sup>373</sup> Mitsubishi Nainenki, "Application for experimental prototype Mitsubishi light bomber," 1926, JACAR Ref. C01001923800, p. 2097.

<sup>374</sup> Source: Ibid., 37.

In spite of a remarkable top speed of more than 200 km/h and a high maximum bomb load the army did not adopt the aircraft. The army's evaluation team decided that the aircraft's structure was too complicated and (in sharp contrast to Mitsubishi's claims) too expensive to build, with a production cost more than two times that of the designs by its competitors, Kawasaki and Nakajima.<sup>375</sup> Nevertheless, especially with its advanced wing design, it served as valuable "teaching material" for Mitsubishi's staff.<sup>376</sup> Baumann himself arrived at a positive evaluation as well, stressing the instructional aspect of his endeavor: "I am most delighted that this is the first aircraft that was designed, calculated, and built by Japanese engineers under my guidance. . . . I am sure that after I have left Japan those people will build excellent aircraft without me."<sup>377</sup>

The army's refusal of his last design did not discourage Baumann. He vigorously turned to his next task of designing a reconnaissance aircraft that was to replace the obsolete Type Otsu 1, which Kawasaki had been producing under French license since 1922. Once more Baumann envisioned a very unconventional arrangement. To maximize the pilot's field of vision—an essential requirement for reconnaissance missions—Baumann increased the distance between the upper and lower wings as much as possible (see Figure 20). This design feature also reduced the aerodynamic interference between the two wings, resulting in improved climb performance. In addition Baumann minimized the use of struts and wires in order to reduce the airplane's air resistance. The result was the Tobi (Black Kite), a fragile-looking two-seater with a half-size lower wing and a staggered wing arrangement that earned the aircraft the nickname "praying

---

<sup>375</sup> Nohara, *Zukai sekai no gun'yōkishi*, 8.

<sup>376</sup> Ibid.

<sup>377</sup> Hubert Weckbach, *Heilbronner Köpfe* (Heilbronn: Archiv der Stadt Heilbronn, 1998), 30.

mantis” (*kamakiri*).<sup>378</sup> However, during the official test flight in 1927 it turned out that the aircraft’s weak point was not its unorthodox wing construction but its undercarriage design. During landing one of the Tobi’s undercarriage struts collapsed, and the aircraft suffered heavy damage. The army did not adopt the aircraft. Mitsubishi took the Tobi accident seriously, even discussing it in one of the company’s board meetings.<sup>379</sup>

**Figure 20: Baumann’s 1927 reconnaissance aircraft that became known as the “praying mantis.”<sup>380</sup>**

Despite these setbacks Mitsubishi was eager to continue cooperation with Baumann, even after the professor’s return to Germany in autumn 1927. The company signed a three-year follow-up contract with Baumann as “designer and technological advisor for aircraft, engines, and equipment.”<sup>381</sup> For a handsome annual remuneration of ¥16,000, Baumann agreed to teach a number of Mitsubishi engineers who were to be transferred to Germany. He also agreed to return to Mitsubishi’s factory in Japan each summer for a period of four to six weeks. He further committed himself to prepare designs, specifications, and calculation sheets at Mitsubishi’s request and to give his opinion on the company’s own designs. But what could have turned into a unique type of technological counseling did not take place. Bauman died in March 1928 at the age of fifty-two. The professor’s influence on Mitsubishi’s aircraft design continued long after his death. Interestingly, one of his former students from Germany played a central role in the emergence of Mitsubishi’s major competitor.

---

<sup>378</sup> Sanuki Matao, *Sanuki Matao no hitorigoto*, 264.

<sup>379</sup> Mitsubishi archive Tokyo, MHI-0039, Records of the Board Meetings 1922–27.

<sup>380</sup> Source: Nozawa Tadashi, *Nihon kōkūki sōshū: Mitsubishi hen* [Encyclopedia of Japanese Aircraft: Mitsubishi] (Tokyo: Shuppankyōdōsha, 1961), 48.

<sup>381</sup> Mitsubishi archives MHI-00339, records of the board meetings 1922–27, October 1927.

## Ten Years in Japan: Richard Vogt

Richard Vogt (1894–1979), a young German engineer whom Dornier had dispatched to Japan in 1924, turned Kawasaki into one of the biggest aircraft makers. He also played a key role in the development of advanced fighters that allowed the army to implement a new strategy of air defense. A closer look at Vogt's early career helps us to better understand his impact and success. Already as high school student he made himself familiar with airplanes at a small airfield near Stuttgart, where aviation pioneers like Ernst Heinkel, Hellmuth Hirth, and Alexander Baumann tested their early inventions. Vogt engaged in the construction of propellers and provided basic calculations for new designs. In 1912, at the age of seventeen, he designed, built, and tested his first aircraft—which, however, crash landed shortly after liftoff. With the outbreak of World War I, Vogt joined the armed forces as a volunteer and was trained as a military pilot. However, after quarrels with his superiors Vogt was demoted to an infantry unit.<sup>382</sup>

An unexpected opportunity arose for the headstrong but highly motivated Vogt in the summer of 1916 when the German High Command decided to exempt from service all soldiers who were qualified for aircraft construction. This decree allowed Vogt to leave the Western Front and join the Zeppelin factory at Friedrichshafen. When in the following year the German Army ordered Dornier to establish a department of aerodynamics, the then twenty-three-year-old Vogt accepted Dornier's offer of becoming head of the department. Though he had no formal training as an engineer, Vogt managed to lead the section with Dornier's help and advice. After the end of the war he studied at the *Technische Hochschule* Stuttgart and finished his PhD under the supervision of Alexander Baumann in 1921.

---

<sup>382</sup> For an account of Vogt's early career see his autobiography, *Weltumspannende Memoiren*, 7–58.

After Dornier had signed the contract with Kawasaki he picked his team of experts who were to be dispatched to Japan. When he was looking for a head engineer who was familiar with the construction of Dornier metal aircraft and knowledgeable in the fields of statics and aerodynamics, he decided that Vogt would be the most suitable person to lead the group. Vogt gladly accepted the offer. Together with two other engineers, two master craftsmen, and one test pilot he travelled via Canada to Japan and arrived at Yokohama in September 1924.<sup>383</sup>

As soon as Vogt began his work at Kawasaki he realized that his job involved much more than supervising the assembly of aircraft delivered from Germany. Five army officers had their desks close to his office. Kazumi Kensuke, a former member of the Versailles inspection team, led the group that had been dispatched to Kawasaki for “research on the experimental production of the heavy bomber.”<sup>384</sup> It soon became obvious to Vogt that his salary was actually paid by the army and that the main purpose of his stay at Kawasaki was the training of these officers. The young engineer was expected to answer all their questions even when they were beyond the scope of his experience.<sup>385</sup> Vogt also became aware that Kawasaki ultimately aimed at independent design of their aircraft. When he brought up this topic to his superiors at Dornier he was told to “delay such a situation as much as possible.”<sup>386</sup> This short but revealing directive already hints at Vogt’s conflict of loyalties. The young engineer had to cope with Dornier’s insistence to stay in business by keeping Kawasaki in a semi-dependent position. Kawasaki, on the other hand, expected Vogt to lead its designers toward self-sufficiency.

---

<sup>383</sup> Doi, *Hikōki sekkei 50 nen no kaisō*, 43.

<sup>384</sup> Kawasaki kōkūki kōgyō kabushikigaisha, *Kōkūkiseisaku Gifu kitai no bu*, 1946, Kakamigahara Aerospace and Science Museum, not catalogued, 7, and Doi, *Hikōki sekkei*, 44.

<sup>385</sup> Vogt, *Weltumspannende Memoiren*, 65.

<sup>386</sup> *Ibid.*, 60.

Vogt's opportunity to demonstrate his talent presented itself two years after his arrival. In September 1925 the Army Ministry ordered each of the three aircraft makers—Mitsubishi, Kawasaki, and Ishikawajima—to develop a prototype for a new reconnaissance aircraft.<sup>387</sup> The new aircraft, which was to be used to observe enemy forces well behind the front line, was to have a flight range of one thousand kilometers, twice that of its predecessor. In addition it was to be heavily armed with four machine guns. Kawasaki appointed Vogt as chief designer for the project and assigned its chief engineer Tōjō Hisashi as a translator and intermediary (*torimatome*) between the German engineer and the Kawasaki staff.<sup>388</sup>

Vogt decided to use an all-metal “stressed-skin” structure, an advanced design feature that Hugo Junkers had introduced in 1923 and Adolf Rohrbach had put to practical use the following year.<sup>389</sup> The stressed-skin-design concept allowed building light yet robust aircraft by using the plane's casing to improve its overall structural strength. Vogt also devised an unusual airframe design that included two vertical struts that connected the upper and lower wings of the aircraft. Even though this arrangement minimized drag and reduced the overall weight of the airplane, Dornier let Vogt know from Germany that he did not approve of the design and suggested a more conservative approach. Vogt nevertheless convinced Kawasaki to accept his ideas—proof of the authority the young designer was already enjoying at his new employer. This is all the more remarkable as Kawasaki was still relying on the prestige of Dornier during its negotiations with the army.

---

<sup>387</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō 1*, 279.

<sup>388</sup> *Kawasaki jūkō gifu kōjō gojūnen no ayumi*, 9.

<sup>389</sup> John David Anderson, *The Airplane: A History of Its Technology* (Reston, VA: American Institute of Aeronautics and Astronautics, 2002), 261.

**Figure 21: The Dornier-Kawasaki team. The six Dornier employees can be seen in the two middle rows, with Richard Vogt being in the second row from the bottom, seventh person from the right.**<sup>390</sup>

In 1927 several aircraft manufacturers presented their prototypes to the army for competitive review that turned out to be an all-German design contest. Vogt's aircraft had to compete with Mitsubishi's Tobi, designed by Alexander Baumann, and Ishikawajima's T-2, built under the supervision of Gustav Lachmann (1896–1966). Lachmann was a German aeronautical engineer in the employ of Ishikawajima who already had been famous for his revolutionary design of slotted wings that improved an aircraft's low-speed capabilities. In January 1928, in spite of the vaunted expertise of his competitors, Vogt's prototype won the competition on account of its superior air speed and flight range.<sup>391</sup> This remarkable success not only led to the adoption of the aircraft but also earned Kawasaki a substantial prize of ¥200,000.

The Kawasaki Type 88, as the new reconnaissance aircraft was called, became one of Japan's most successful planes of the late 1920s. Japanese historians have called it "the pioneer of made-in-Japan aircraft" (*kokusanki no sakigake*).<sup>392</sup> It was manufactured for more than ten years, and over one thousand units were built.<sup>393</sup> The aircraft was later modified into a light bomber. Between 1929 and 1933 Kawasaki—together with the aircraft maker Tachikawa—produced more than four hundred of this Army Type 88-II Light Bomber. The airplane made Kawasaki one of the leading aviation manufacturers in Japan. Vogt's proud statement naming the plane "my first big success" fits with the comment of his Japanese apprentice engineer Doi

---

<sup>390</sup> Source: EADS Corporate Heritage, DWF 13301/29

<sup>391</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō 1*, 282.

<sup>392</sup> Ibid., 280.

<sup>393</sup> Doi, *Hikōki sekkei*, 53.

Takeo (1904–1996).<sup>394</sup> Doi, who was to become one of Japan's most influential aircraft designers, declared in an interview that, with the Type 88, the “obscure aircraft designer Vogt had become world-famous.”<sup>395</sup>

## **Foreign Expertise Put to the Test: The Competition for the Army's New Fighter Aircraft**

From its early beginnings the Japanese Army's air doctrine put great emphasis on fighter aircraft. The navy, in contrast, began its ambitious program of a large strike force of carrier-based fighters only in the late 1920s. The army's fighter aircraft had to perform both defensive and offensive roles. They were to guarantee the defense of the homeland and its colonies from air attacks. Furthermore they had to support the ground troops by engaging with enemy aircraft over the battlefield. In spring 1921 Inoue Ikutarō, the chief of the Army Aviation Headquarters, submitted to Army Minister Tanaka Giichi a proposal for a ten-fold expansion of the army's air force to forty-five reconnaissance squadrons, fifty-two fighter squadrons, and fifteen bomber squadrons through 1934, with a proposed total number of 1,164 aircraft.<sup>396</sup> The report contained detailed numbers for the wartime troop strength of reconnaissance, fighter, and bomber squadrons, with a clear emphasis on fighter aircraft that would make up more than half the army's airpower. While Inoue planned to assign two-thirds of the fighter force to front-line operations, he devoted the remaining fighter aircraft to the defense of strategic places (*yōchi*) and garrisons (*yōsai*) in the Japanese homeland, Korea, Taiwan, and the Liaodong Peninsula.

---

<sup>394</sup> Vogt, *Weltumspannende Memoiren*, 70.

<sup>395</sup> Interview with Doi Takeo in “Sekkei wa aato ofu conpuromaizu” [Design is the art of compromise], *In-house newsletter of Japan Airlines*, June 16, 1997.

<sup>396</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō* 1, 168.

The new emphasis on air defense led to the 1922 establishment of a Corps for the Defense of Strategic Locations (*yōchibōeibutai*) that consisted of anti-aircraft artillery and searchlight units. It took four more years until the army began to modernize its fighter squadrons. In the mid-1920s reports about the increasing flight range of Soviet bombers accelerated this development. A new powerful fighter aircraft was needed to intercept these enemy bombers before they could attack Japan's major cities.<sup>397</sup> The army's present fighter, a licensed production then based on a 1918 French design, had clearly become "inferior to the new fighter aircraft of the western Great Powers" and was judged unfit for such a task.<sup>398</sup> Thus, in November 1926, Inoue passed an urgent request to Army Minister Ugaki Kazushige. Reminding the minister that the development of a new aircraft would take almost three years, Inoue asked for permission to direct Japan's three largest aircraft manufacturers—Mitsubishi, Kawasaki, and Nakajima—to develop a new fighter aircraft. The minister approved Inoue's request three months later.

By that time the army had already set up the specifications for its new fighter. In order to engage successfully in combat with the enemy's fighter aircraft, the new plane had to be exceptionally fast and maneuverable. In addition, it had to have a superior climb performance, an obvious requirement for the effective interception of high-flying enemy bombers.<sup>399</sup> The experts of the army's Akeno Flight School, who were also involved in the initial planning, furthermore

---

<sup>397</sup> Tsuji Hideo and Kurita Masatada, *Hondo bōkū sakusen* [Strategy for the air defense of the mainland] (Tokyo: Asagumo Shinbunsha, 1968), 9.

<sup>398</sup> Inoue Ikutarō and Ugaki Kazushige, "The competition of the trial single-seat fighter aircraft," 1926–27, JACAR Ref. C01003741300, 9–10.

<sup>399</sup> The specifications required a maximum speed of at least 250 km/h and a climb to an altitude of 5,000 meters in less than 12 minutes.

emphasized the importance of an unobstructed downward view and therefore insisted that the new fighter had to be a high-wing monoplane.<sup>400</sup>

In a remarkable refinement of earlier examination methods, the army set up a new evaluation procedure that was based on numerical analysis and experimental evidence. Before giving the order to build any prototype, the army instructed each manufacturer to provide detailed performance and strength calculations together with a scale model of the aircraft to be used for wind tunnel tests. The three companies also had to submit all the necessary blueprints and data on the proposed aircraft's structure, wing arrangement, and profile, as well as on its engine and propeller.

All participating companies relied on the expertise of foreign designers. Nakajima had contracted the French designers André Marie and Maxime Robin from Nieuport to work in the company's design section from April 1927 to April 1929.<sup>401</sup> Mitsubishi's chief engineer Nakata Nobushirō began the design of the Hayabusa (Falcon) under the supervision of Baumann. Kawasaki put Richard Vogt in charge of the fighter's design and appointed Doi Takeo as his assistant. Kawasaki could use Dornier's Falke as a reference model. This airplane, which Kawasaki had purchased as part of the 1924 license deal, was a monoplane that Dornier had developed in 1922.<sup>402</sup> The Falke's wing arrangement matched exactly the army's request for a parasol-type aircraft that provided an excellent downward field of vision. Vogt and his team of thirty Japanese designers considerably modified the Falke's structure. They maintained the all-metal stressed-skin design, added additional diagonal wing struts, and reinforced the fuselage for

---

<sup>400</sup> Doi, *Hikōki sekkei*, 58.

<sup>401</sup> Nakajima Chikuhei, "Request for having foreigners enter and leave the country," 1927, JACAR Ref. C04015990700.

<sup>402</sup> *50 Jahre Dornier*, 21–25.

additional sturdiness. They also improved the flight control mechanism to increase the airplane's overall maneuverability.

In June 1928 each company's prototype was ready for the required flight tests. They each ended in a fiasco. Soon after takeoff, Kawasaki's test pilot Erich Just returned to the airfield after his engine failed. Mitsubishi's Hayabusa showed more perseverance, and its pilot Sumitoshi Nakao managed to climb to five thousand meters. This altitude was necessary to perform the most demanding maneuver the army required to be demonstrated: a nose-dive at an angle of sixty degrees under full engine power during which the aircraft was to accelerate to a top speed of 400 km/h. The pilot was allowed to throttle the engine only in the case of excessive airframe vibrations. Most aircraft designers considered this maneuver to be an absurd request, considering that the maximum speed of Western fighter aircraft at that time was 300 km/h.<sup>403</sup> However, Mitsubishi's pilot was eager to demonstrate fully the Hayabusa's high-speed capabilities and forced his aircraft into a vertical nose-dive. The Hayabusa did not sustain the maneuver and disintegrated in midair.<sup>404</sup> Sumitoshi had the presence of mind to jump out of the cockpit and open his parachute. He survived the accident unharmed and became famous for Japan's first successful parachute bailout from a crashing airplane.<sup>405</sup>

Nakajima's aircraft suffered a similar fate. During the dive test the airplane entered into a spin that could not be recovered. Sources state that the obvious reason for the accident was the aircraft's insufficient structural strength. We are not informed if the test pilot survived the crash. According to Vogt, who still harbored hopes that his aircraft would be the winner, the army

---

<sup>403</sup> Doi, *Hikōki sekkei*, 62–63.

<sup>404</sup> Mitsubishi, *Ōjibōbō*, vol. 1, 45.

<sup>405</sup> Nowarra, *Die Flugzeuge des Alexander Baumann*, 131.

canceled the competition “without further explanation” and did not adopt any of the three prototypes.<sup>406</sup>

Rather than being discouraged by this setback, Kawasaki decided to develop on its own initiative the new KDA-5 fighter, a rare move that clearly questioned the army's control of the fighter program. When the project began in 1929 Vogt's supervisor Takezaki gave him a free hand to build a fighter aircraft entirely according to his own ideas. Vogt opted for a biplane that was to be powered by a BMW 500hp engine. Doi Takeo, who meanwhile had been promoted to Vogt's chief assistant, closely studied the results of previous experiments carried out in wind tunnels in Britain, Germany, and the United States. Doi then proposed to use the so-called NACA M-12 airfoil that was thought to be especially suitable for fighter aircraft.<sup>407</sup> This wing shape had been devised, tested, and made publicly available by the United States' foremost aeronautical research institute, the National Advisory Committee for Aeronautics (NACA).<sup>408</sup>

Vogt took great care to build a robust aircraft that was able to withstand extreme flight maneuvers. He devised an extra strong main wing spar, a sample of which Doi took to Germany for a load test in 1931.<sup>409</sup> Furthermore Vogt connected the upper and lower wings with special triangle-shaped duralumin spars that significantly increased the airplane's sturdiness. As a result, during destruction tests the new wing could easily withstand a load factor of 15, exceeding the army's requirement by 2 points.<sup>410</sup> In July 1930 the first flight tests began. The KDA-5 impressed the test pilots with its outstanding maneuverability and a maximum speed of 320 km/h

---

<sup>406</sup> Vogt, *Weltumspannende Memoiren*, 71.

<sup>407</sup> Doi, *Hikōki sekkei*, 66–73.

<sup>408</sup> George J Higgins, “The Characteristics of the N.A.C.A. M-12 Airfoil Section,” *Technical Notes National Advisory Committee for Aeronautics* No. 343 (1926): 1–7.

<sup>409</sup> *Sekkeisha no shōgen*, vol. 2, 39.

<sup>410</sup> With a load factor of 15, an aircraft is able to hold out against a force 15 times greater than its weight.

that even outstripped the U.S. and British fighters of that time—only in 1932 did the American fighter aircraft Curtiss P-6 Hawk in its most powerful version reach comparable speed. Dornier's pilot Just compared the KDA-5 with its predecessor and commented, "it is as different as day and night."<sup>411</sup>

Kawasaki's next task was to convince the army officials as well. Takezaki conceived of the idea to set up a new world altitude record with the KDA-5 as a promotional campaign. On November 5, 1930, the newspaper *Asahi Shinbun* ran a headline "A World Record Set by a Military Aircraft" and reported that Kawasaki's test pilot Tanaka Kanbei had climbed with his made-in-Japan KDA-5 to an altitude of ten thousand meters, withstanding extreme cold and thin air. According to the report Tanaka continued the climb even after the altimeter stopped working at ten thousand meters and might well have reached twelve thousand meters.<sup>412</sup>

Finally the army allowed Kawasaki to present its aircraft at the Tachikawa Airfield. In April 1931, in the presence of the army minister and high-ranking officers, Tanaka skillfully demonstrated the performance of the KDA-5. The army became convinced of the KDA-5's potential and began its own test program the same month. In May the Japanese press reported that Kawasaki's new aircraft had "entirely different" performance features than its Nakajima competitor and might well be adopted if the military's budget would allow it.<sup>413</sup>

Japan's occupation of Manchuria in September 1931 hastened the evaluation of the aircraft. With urgent need for the immediate production of more fighter airplanes and a significantly increased budget the army officially accepted the KDA-5 as the Army Type 92 Fighter one month after the outbreak of the conflict. In an atmosphere of nationalist war fever the press

---

<sup>411</sup> Doi, *Hikōki sekkei*, 70.

<sup>412</sup> "A World Record Set by a Military Aircraft," *Asahi Shinbun*, November 5, 1930.

<sup>413</sup> "The Army Adopts Nakajima's New Fighter Aircraft," *Yomiuri Shinbun*, May 6, 1931, 7.

welcomed the army's decision to choose an aircraft that "flies like a bullet" and held the prospect of turning Japan into a major power.<sup>414</sup> Two months later the army also adopted Nakajima's remodeled fighter aircraft. This unusual move testifies to the great demand for more aircraft. At the same time it subverted the original idea of prototype competitions that were meant to determine one single best manufacturer. To the public this compromise was presented as a success. The press reported how the two new aircraft types were "Japan's pride before the world." By perfectly complementing one another in speed and maneuverability these fighters would "protect the skies of Japan in a time of crisis."<sup>415</sup> In early 1932 both Kawasaki and Nakajima began large-scale production of their fighter aircraft, of which they built a combined total of seven hundred in less than two years.<sup>416</sup> These numbers reflect the belief in the increasingly important role of airpower in defending Manchukuo, the territory which, according to a popular catchphrase, had become Japan's "lifeline."<sup>417</sup>

### **Baumann and Vogt: Engineers as Teachers**

An evaluation of Alexander Baumann's activities shows the importance of good personal relationships for the effective transfer of knowledge. While emphasizing the importance of

---

<sup>414</sup> "The Army Adopted Kawasaki's New Fighter Aircraft / Able to Fly within One Hour between Tokyo and Osaka / Special Speed Performance," *Yomiuri Shinbun*, October 22, 1931, 7.

<sup>415</sup> "The Power of Our Air Force Will Protect the Skies," *Yomiuri Shinbun*, April 9, 1933, 9.

<sup>416</sup> Nozawa Tadashi, *Nihon kōkūki sōshū: Kawasaki hen* [Encyclopedia of Japanese Aircraft: Kawasaki] (Tokyo: Shuppanyōdōsha, 1960), 62, and Nozawa Tadashi, *Nihon kōkūki sōshū: Nakajima hen*, 44.

<sup>417</sup> The expression "Manchurian lifeline" was first used by the Japanese politician Matsuoka Yosuke (1880–1946) in January 1931 and served as a metaphor for the vital importance of northeast China for Japan. See Louise Young, *Japan's Total Empire: Manchuria and the Culture of Wartime Imperialism* (Berkeley: University of California Press, 1998), 88.

research and theoretical investigation, Baumann entrusted the Japanese designers with the practical implementation of their studies. As one Mitsubishi engineer recollected:

Unlike in Smith's time [from 1921 to 1924] the abilities of the Japanese staff had already reached a relatively high level. Therefore Baumann taught us the [theoretical] fundamentals of aircraft design, but left the details of strength calculations and specific design features to us. Whereas Smith used Anglo-Saxon pragmatism, Baumann drew all his conclusions with a typically German rigor based on [aerodynamic] theory.<sup>418</sup>

Even though the above quotation exposes yet another instance of cultural stereotyping—the pragmatic Englishman versus the perfectionist German—it also illustrates how Baumann's aircraft, and arguably even more his instructions, played a key role in the transition of Mitsubishi's engineers from the empiricism of the British team led by Herbert Smith to a scientifically based design.

Apart from providing the theoretical framework of aircraft design Baumann also left more tangible assets to Mitsubishi. An itemized account shows the large number of Japanese patents attributed to Baumann.<sup>419</sup> His inventions encompassed advanced airframe and wing designs and a new type of shock absorber to be used with aircraft undercarriages. He also devised an innovative scaffold made from bamboo for the assembly of aircraft wings.

Baumann was a scholar who was genuinely concerned about the progress of his students. This characteristic made him different not only from the British engineers at Mitsubishi, who seem to have held their Japanese colleagues in little esteem, but also from Rohrbach, who was mainly interested in financial gain. As an academic who did not have to promote the sale of German aircraft or manufacturing licenses to Japan, Baumann could encourage and enable Mitsubishi's engineers to arrive at their own independent designs. As a consequence, he also

---

<sup>418</sup> *Aichi no kōkūshi* [Aviation history of Aichi prefecture] (Nagoya: Chūnichi Shinbun Honsha, 1978), 144–46.

<sup>419</sup> Mitsubishi archives MHI781, Contracts with Foreigners, 4–5.

engaged in formal teaching. A 1927 printed version of his lecture on “Material for Aircraft and Aircraft Design” (*hikōkiyō zairyō oyobi sekkei*) shows how Baumann instructed in the selection and processing of wood and metal, strength calculations, stress analysis, and performance calculations.<sup>420</sup> His careful consideration of both conventional and advanced construction material contributed to a successful transition from wooden to all-metal aircraft construction in Japan.

Baumann also managed to build personal relations with his Japanese colleagues. Engineers like Horikoshi Jirō (1903–1982), the future designer of the Zero fighter, or the aforementioned Nakata Nobushirō, remembered him as both a strict teacher and an instructor who devoted his time “from dawn to dusk” to the training of Mitsubishi’s engineers.<sup>421</sup> Baumann in turn held the Japanese in high regard. In a lecture held at the Technical University Stuttgart shortly after his return from Japan he cautioned his German audience against underrating the Japanese. He asserted that his Japanese staff was better than the one he had had under him in Germany. Baumann was of the opinion that the Japanese and Germans were equally intelligent and creative, but the “diligence of the Japanese was more than a match for their German counterparts.”<sup>422</sup>

Among the large group of foreign aviation specialists coming to Japan, Richard Vogt stood out. When he came to Kawasaki in 1923 he was twenty-nine years old and had never designed an entire aircraft on his own. Vogt developed his skills during his ten-year-long stay in Japan, where he had to grow into his role of the foreign expert. In order to earn the respect of his Japanese co-

---

<sup>420</sup> Mitsubishi Nainenki KK, *Baumann kyōju kōgi hikōkiyō zairyō oyobi sekkei* [The lectures of Prof. Baumann: Material for Aircraft and Aircraft Design], 1927.

<sup>421</sup> Mitsubishi, *Ōjibōbō*, vol. 1, 145.

<sup>422</sup> DFVLR Historisches Archiv Berlin, letter by Baumann’s son Alex to Heinz Nowarra, September 30, 1982.

workers, Vogt had to present answers for problems “he never had thought of before.”<sup>423</sup> As one commentator put it, “by trying to be always a step ahead, he pulled his Japanese colleagues along with him.”<sup>424</sup> During the first three years of his stay Vogt was able to make good use of Dornier’s efforts in Japan: Dornier, in addition to his established reputation, had brought the necessary manpower, know-how, and machines to Japan. Vogt was also able to rely on a number of Japanese who had already been trained in Germany. He then stimulated Kawasaki’s eagerness to arrive at an independent design—even to the detriment of Dornier. After his first success the company completely trusted Vogt and gave him ample leeway to devise his individual designs.

The results were remarkable. During his stay in Japan Vogt obtained numerous patents and authored several research articles.<sup>425</sup> He helped Kawasaki initiate an integrated production of aircraft and engines. As a gifted network builder he established close contacts with distinguished German aeronautical scientists who had also come to Japan, such as Alexander Bauman and Theodore von Kármán (1881–1963). Equally important, Vogt helped build a research and development infrastructure that tied together academic research at Tokyo Imperial University and the military arsenals and aircraft industry. This kind of cooperation had already been tried and tested in Germany and proved to be fruitful in Japan as well.

Vogt’s focus on independent design significantly raised the status of the Japanese designers. Before Vogt’s arrival Kawasaki relied completely on imported foreign technology research and native design was nearly non-existent. Minor design details were carried out by technicians who had graduated from technical schools or just finished junior high school and were paid on a daily

---

<sup>423</sup> Vogt, *Weltumspannende Memoiren*, 65.

<sup>424</sup> Sanuki Matao, *Sanuki Matao no hitorigoto*, 264.

<sup>425</sup> Vogt’s Japanese patent: “Improvement of Airfoil High-Lift Device,” 1929, Kakamigahara Aerospace and Science Museum, not catalogued.

basis. The work of these “draftsmen” was called *zūkō*, which referred to a mixture of drawing and handicrafts.<sup>426</sup> When Kawasaki decided to embark on the construction of metal aircraft, the company’s design section increasingly hired university graduates, who then began their careers under the guidance of Vogt.

Doi Takeo was one of Vogt’s most gifted apprentice engineers. Doi joined Kawasaki in 1927, directly after his graduation from Tokyo Imperial University’s new Department of Aeronautics, founded in 1920. During his close cooperation with Vogt he fully developed his design talent and, after Vogt’s return to Germany in 1933, became Kawasaki’s chief designer for the ambitious Ki-5 fighter project. Doi gained a reputation for being a strict supervisor who, like his teacher Vogt, corrected the drawings of Kawasaki’s engineers with comments that were written with a red pencil in German. Doi is best remembered for his design of the Hien. This outstanding fighter aircraft still showed the design influence of Vogt and was considered in many aspects superior to Mitsubishi’s much more famous Zero-sen.<sup>427</sup>

Andō Nario was another engineer who assisted Vogt in drawing and making calculations. Andō, who in his memoirs referred to Vogt as his honored teacher (*onshi*), became an important mediator between the army and Japan’s aircraft makers.<sup>428</sup> As a designer and examiner in the Army Aviation Headquarters he was involved in aircraft design at Mitsubishi and at Nakajima and in research at the Army Aviation Technology Research Center at Tachikawa. With his technical knowledge and close insight into the capabilities of the civil manufacturers he was one

---

<sup>426</sup> Doi, *Hikōki sekkei*, 58–62.

<sup>427</sup> Francillon, *Japanese Aircraft of the Pacific War*, 114.

<sup>428</sup> *Nihon no kōkū runesansu*, 81.

of the few influential aviation experts who could counter the army's often unrealistic specifications for new experimental aircraft.<sup>429</sup>

### **The Army's New Aircraft during the Manchurian Crisis**

On September 18, 1931, a bomb blasted on the tracks of the South Manchuria Railway near Shenyang in Northeast China. The sabotage was part of a plot carried out by field officers of the Kwantung Army who acted without the authorization of their Commander-in-Chief Army General Honjō Shigeru (1876–1945). For many historians this event, which became known as the Manchurian Incident, marks the beginning of Japan's fifteen-year war. Others have termed the conflict an “experimental war.”<sup>430</sup> No matter how it is categorized, the staff officers of the Army Aviation Headquarters saw the Manchurian crisis as the first opportunity since the 1914 Qingdao air war to test and demonstrate their new equipment. The Japanese navy could gain a similar experience—however on a much smaller scale—only in 1932, with its bombing attacks and air combat during the Shanghai Incident.

However, when Japan's Kwantung Army started the invasion of Manchuria on September 19—approved by General Honjō after the fact—it did not have any air squadron under its command. Therefore, only one day after the incident, several of the 6th Air Wing's Kawasaki Type 88 reconnaissance aircraft had to be dispatched over a distance of more than 350 kilometers from Korea to the Shenyang area to gather information about the Chinese forces. An additional squadron of fighter aircraft followed. However, after it became clear that all of the

---

<sup>429</sup> Kōno Fumihiko, *An Outline by the Engineer Andō about a “Next Generation” of Experimental Aircraft*, 1939, Mitsubishi Heavy Industries Komaki Archive, not catalogued.

<sup>430</sup> Fujii Tadatoshī, *Kokubō fujinkai: hinomaru to kappōgi* [The Women's Society for National Defense: The Hinomaro and cooking aprons] (Tokyo: Iwanami Shoten, 1985), 7.

enemy's airpower already had been destroyed by Japanese ground troops, the fighters were sent back to their Pyongyang base.<sup>431</sup>

In November 16, 1931, the Kwantung Army Flying Corps was newly formed. It was composed of twenty-seven reconnaissance aircraft, nine fighters, and nine light bombers, all of them built in Japan.<sup>432</sup> The small fighter contingent and the lack of heavy bombers clearly reflected the army's traditional doctrine of limiting the use of aircraft to the support of the ground troops.

During the first two months of the conflict the Kwantung Army hesitated to make full use of its bombers. The unusually late deployment of the army's heavy bomber squadrons was the result of considerable disagreement within the top ranks of the Japanese Army. The staff officers of the Army Aviation Headquarters had wanted to send their heavy bombers to Manchuria right after the outbreak of the conflict in order to gain experience under actual battle conditions, which they considered crucial for the training of their crews and for an investigation on bombing techniques. However, in fear of adding to the mounting international criticism of Japan's invasion, the General Staff Office was reluctant to make full use of the bombers.

Only on December 27 did the General Staff Office in Tokyo officially approve the assignation of four Kawasaki-Dornier Type 87 Heavy Bombers to the Kwantung Army Flying Corps for the "training of cold weather operations." On December 30, 1931, for the first time Type 87 heavy bombers entered actual combat in Manchuria. Soon a full-fledged bombing campaign against splinter groups, armed trains, and military bases started. Bomb attacks on the enemy troops continued in spite of their retreat into remote mountain areas.

---

<sup>431</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō* 1, 329.

<sup>432</sup> Ibid., 337.

During the conflict the Japanese learned valuable lessons about the tactical deployment of bombers that included long-range navigation, the use of advanced bomb sights for precision bombing, and the importance of a bomber's armament for self-defense. Furthermore, the army was impressed by the bombers' apparent capability to carry out "intimidation flights" (*ikaku hikō*) that terrified an already demoralized enemy, which seemed to confirm Giulio Douhet's assumptions about the moral impact of strategic bombing (see p. 141).<sup>433</sup>

Any assessment of the Japanese Army Air Force's operations during the Manchurian takeover must consider the fact that, after the first few days of the conflict, all Chinese aircraft in Manchuria were already either destroyed or captured before they could engage in air battle with Japanese planes. Thus the Japanese Army Air Force could operate with the advantage of complete air superiority. Under such conditions Japanese aircraft could watch and strike from the sky without any Chinese resistance. The army could therefore adhere to its traditional air doctrine of carrying out typical tactical operations that supported the ground troops with fire power, search and rescue missions, and intelligence reports.

At the same time, the activities of the army's aircraft over Northeast China provided the source for continuous press reports about the "splendid performance of our strong Army Air Force in Manchuria."<sup>434</sup> As a result a "donation fever" erupted in Japan that enabled the Japanese army to substantially reinforce its airpower.<sup>435</sup> The press campaigns went hand in hand with

---

<sup>433</sup> According to Japanese newspaper reports the army air force's activities had such an impact that the Chinese general Ma Chan-shan implored the Japanese not to let their aircraft fly anymore. *Yomiuri Shinbun*, November 15, 1931.

<sup>434</sup> *Yomiuri Shinbun*, December 5, 1931.

<sup>435</sup> Fujii Tadayoshi, "Shōwashoki sensōkaishiji ni okeru taishūteki gunjishien kyanpeen no ichitenkei: gun'yōki 'aikokugō, hōkokugō' ken'nōundō no katei ni tsuite" [The contribution of the warplanes "aikoku-go" and "hōkoku-go" to the war: A typical campaign for wartime

large-scale flight shows that included ostentatious naming ceremonies for newly donated aircraft that received the name *aikoku-gō*, “wings of patriotism.”<sup>436</sup> Each of these events was performed as a Shinto ritual with many dignitaries present and broadcast live nationwide. After the ceremonies the airplanes, which carried the names of their donors visibly on their fuselages, would take off and drop flyers that thanked the generous donors. These simple rituals created a strong identification of the contributors with “their” aircraft. After dropping their tokens of gratitude from heaven, the aircraft would take the names of their benefactors up into the sky and to the far-off battlefield. The *aikoku-gō* campaign stirred the war fever at home and helped the Japanese military secure the nation’s support throughout the Manchurian conflict.

## Conclusion

The arrival of German-designed aircraft in Japan was not a straightforward success story. Pessimists will point to aircraft with undercarriages collapsing or even breaking apart in the middle of the sky. Others will more positively emphasize the successful conversion of Dornier’s flying boat into a heavy bomber or Richard Vogt’s Type 88 reconnaissance aircraft, which was produced in large numbers.

It is necessary to separate immediate successes and failures from long-term benefits. The introduction of the new all-metal technology from Germany exposed the Japanese aircraft industry to entirely new design concepts and production methods. The engineers and workmen at the arsenals and civil manufacturers gradually built up their knowledge, experience, and skills. They became familiar with radically new design features like the Wagner beam, the monocoque

---

mass support at the beginning of the war in early Shōwa Japan], *Surugadai University studies* 6 (1992): 39–55.

<sup>436</sup> A loose translation, *gō* 号 being a name suffix for vehicles.

fuselage, and the cantilever wing. Their newly acquired expertise paved the way for the emergence of advanced aircraft and increasingly narrowed the gap with Western aviation technology.

When considering the role of German advisors it is important to make a clear distinction between the “money men” and the “teachers.” Rohrbach’s and Dornier’s initial enthusiasm to do lucrative business with the Japanese turned into frustration when follow-up orders failed to materialize and a spirit of close cooperation gave way to mutual distrust and squabbles over the interpretation of license contracts. The Japanese businessmen for their part had the foresight to include the training of Japanese specialists in Germany in the license contracts. This training, along with the delivery of aircraft parts and machine tools to Japan, laid the foundation for the adoption of the new technology.

The ground was thus well prepared for the German “teachers” who showed a sincere interest in passing their knowledge to their Japanese students and fellow engineers. A new generation of aviation specialists learned eagerly from Baumann and Vogt at a time when formal training in aeronautical engineering was still in its infancy. Baumann was enthusiastically welcomed by Mitsubishi’s engineers, who were eager to learn from him. Responding to the company’s high expectations he built a sound theoretical base for engineering at Mitsubishi and was held in high esteem even after his return to Germany. Vogt was sent to Japan in the wake of a license agreement between Dornier and Kawasaki. While he was supervising the experimental production of a new bomber for Kawasaki he gained the respect of his Japanese engineer colleagues and earned the complete trust of his Japanese employer. Vogt then grasped the unique opportunity to develop his own original designs while at the same time having his Japanese colleagues fully participate in this process. Baumann and Vogt significantly contributed to the

development of Mitsubishi and Kawasaki; as a result, the technological competence of the two companies and their employees' confidence in their own technical skills substantially increased.

German expertise helped the Imperial Japanese Army to equip their air squadrons with some of the world's best military aircraft. By the early 1930s the army's airpower had completed its extensive modernization. The Army Air Force's obsolete bombers, fighters, and reconnaissance aircraft, all of them based on French World War I designs, had been replaced by a new generation of all-metal aircraft (see Table 2). With the only exception of Nakajima's Army Type 91 fighter, these airplanes were all built by Kawasaki based on designs by Claude Dornier or Richard Vogt.

Table 2: The army's new generation of all-metal aircraft.

|                   | Bombers                                                                | Reconnaissance aircraft                                   | Fighters                                                                                                      |
|-------------------|------------------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| First generation  | Farman F-60 Goliath (1919)<br>16 imported 1921–26                      | Salmson 2A2 (1917)<br>600 built by Kawasaki 1922–27       | Nieuport 29 (1918)<br>608 built by Nakajima 1923–32                                                           |
|                   | ⇓ replaced by ⇓                                                        | ⇓ replaced by ⇓                                           | ⇓ replaced by ⇓                                                                                               |
| Second generation | Kawasaki-Dornier Do N<br>Army Type 87 Heavy Bomber<br>28 built 1926–32 | Kawasaki KDA-2<br>Army Type 88 Recon<br>710 built 1927–31 | Kawasaki KDA-5<br>Army Type 92 Fighter<br>385 built 1931–33<br><br>Nakajima Army Type 91<br>350 built 1931–34 |

Paradoxically this technological advance was not met with a similar breakthrough in the army's air strategy. As we have seen in the previous chapter, the development of Japan's naval aviation had taken a different course. Loopholes in the Washington and London Treaties, the specter of a powerful hypothetical enemy, and the availability of new technologies prompted the

Imperial Navy to advance its strategy to an extent that matched the progress of its airpower. In contrast, the doctrinal slumber of the army's planners continued even when the Japanese Army became the world's first armed force to use reconnaissance aircraft, fighters, and heavy bombers in an international conflict after World War I.<sup>437</sup> However, rather than giving rise to new concepts, the Manchurian Incident led to a consolidation of the army's traditional airpower doctrine of limiting the field of aerial operations to the close support of ground troops. Without the need to engage in air-to-air combat or in strategic air raids on the enemy's infrastructure, the conflict did not press the army's strategists to map out and implement advanced concepts of airpower, such as strategic bombing or the fight for air superiority.

---

<sup>437</sup> The only other country that made actual use of its bombers before 1931 was Great Britain. Between 1919 and 1932 the Royal Air Force deployed their bombers for anti-guerilla missions in the Middle East protectorates. Jafna L. Cox, "A Splendid Training Ground: The Importance to the Royal Air Force of its Role in Iraq, 1919–32," *Journal of Imperial and Commonwealth History* 13, no. 2 (1985): 157–84.

## V

### German Airliners into Japanese Bombers: Junkers in Japan

In the early hours of October 26, 1931, a giant aircraft made its first takeoff from Japanese soil. With substantial help from Germany, Mitsubishi had built the Type 92 Heavy Bomber, Japan's first long-range bomber designed to fly non-stop to the U.S. bases in the Philippines, where it could drop its bomb load of five thousand kilograms. Praised by the Japanese press as the "world's largest super-heavy bomber,"<sup>438</sup> the aircraft had a wing span wider than the United States Army Air Forces' Boeing B-29 Superfortress that made its first appearance in the skies over Japan in June 1944.

This chapter follows the development of Japan's first "Super Bomber." Shifting the units of analysis from international diplomacy and geostrategy to license negotiations and then to the daily routine at the shop floor, the chapter offers a multilayered account of an unusual international cooperation. Japan's Super Bomber project was the result of volatile international relationships and a revised defense policy. In the mid-1920s the Japanese Army's strategists began to envision a fleet of strategic bombers that could carry out long-range missions into the territory of a faraway enemy. When they searched for an appropriate airplane to implement their ambitious plans, the German aircraft maker Hugo Junkers seized the opportunity to enter the Japanese market with his latest aircraft.

When in 1928 the army took initiative and proposed to Mitsubishi a collaboration with Junkers, the Japanese manufacturer was eager to gain access to the design and production technology of a complex piece of military hardware. Even though both companies clearly

---

<sup>438</sup> "Rikukūgun ni shinei sekai saidai no chōjū bakugekiki" [The Army Air Force's new and powerful machine, the world's largest super heavy bomber], *Yomiuri Shinbun*, June 9, 1932, 7.

envisioned mutual benefits from the project, they had to overcome substantial obstacles. As we will see, during each stage of the joint venture the two manufacturers not only had to deal with technical, organizational, and financial issues but also had to navigate a treacherous terrain of distrust, prejudices, and stereotypes. Given the double challenge of bridging a gap both technological and cultural, the successful production of the Type 92 Heavy Bomber was a major achievement for Mitsubishi and a significant advance for the army that can be compared to the technological leap from the wooden Farman Bomber to the all-metal Do N in 1926 (see Table 3).

A concluding analysis will reveal the substantial divergence in the long-term outcomes of the Super Bomber project. Mitsubishi succeeded in its main objectives of adapting Junkers' innovative design features and production technology. As we will see, the licensed production of the four-engine bomber effectively contributed to the company's full independence from foreign design by the mid-1930s. As a result of the Mitsubishi-Junkers cooperation the Japanese Army had a flying fortress at its disposal that incorporated state-of-the-art technology at a time when the U.S. Air Corps still relied on biplane bombers whose technology had not changed during the previous decade. However, rather than being the epitome of technological advancement, the Super Bomber became a symbol for the fall of the Japanese Army's airpower faction. With the profound political and strategic transformations in the early 1930s the advocates of strategic bombing had to give way to the army's traditionalists who insisted on the army air force's subordinate role as tactical support for the army's ground troops. This shift in the army's air strategy increased doubts about the military benefits of the Super Bombers, and they were stored away without having ever been used in combat.

**Table 3:** Size matters—speed, range, and bomb load as well. Three generations of Japanese bombers: the French F.60 Goliath, Kawasaki-Dornier’s Do N, and Mitsubishi-Junkers’ Type 92 Heavy Bomber<sup>439</sup>

| Farman F.60 Goliath (1919) | Do N (1926) | Type 92 Heavy Bomber (1931) |
|----------------------------|-------------|-----------------------------|
| Wing-span: 28 m            | 26.8 m      | 44 m                        |
| Max. weight: 5.5 tons      | 7.7 tons    | 25.4 tons                   |
| Max. speed: 120 km/h       | 180 km/h    | 200 km/h                    |
| Flight range: 400 km       | 660 km      | 2,000 km                    |
| Max. bomb load: 800 kg     | 1,000 kg    | 5,000 kg                    |

### Early Japanese Interest in Junkers’ Aircraft

Hugo Junkers (1859–1935) was the archetype of a new generation of German engineer–scientist–entrepreneurs. Unlike in France, Britain, or the United States, where most aircraft companies were set up by the early flight pioneers, all major German aircraft manufacturing companies that survived World War I were established by professionally trained engineers who, as graduates of Germany’s technical colleges, managed to keep close ties with the universities. In 1910, during his tenure as a professor of mechanical engineering at the Technical University Aachen (see Map 2), Junkers obtained a patent for a revolutionary flying wing that would eliminate the air resistance of the airframe and the tail unit.<sup>440</sup> Junkers worked assiduously on his *idée fixe*: the all-metal airplane with a self-supporting wing that required no struts or wires. His

<sup>439</sup> All technical data from: Nohara, *Zukai sekai no gun’yōkishi*, 6, 25, 32, 43. The images are to scale. For comparison, the U.S. Boeing B-17 that made its first flight in 1935 had the following characteristics: wingspan, 31.6 m; max. weight, 29.7 t; max. speed, 462 km/h; flight range, 3,219 km; max. bomb load 2,700 kg.

<sup>440</sup> Gert Bersing, “Hugo Junkers,” in *Neue deutsche Biographie 10*, ed. Otto zu Stolberg-Wernigerode (Berlin: Rohmer-Schinkel, 2005), 695–97.

ideas materialized in 1915, when Junkers' J1, the world's first cantilever all-metal aircraft, took off.

In 1919 Junkers founded the Junkers-Flugzeugwerke AG to start the production of civil aircraft. As Junkers' design principles evolved his aircraft became easily recognizable. Their thick wing profiles challenged the conventional wisdom that such profiles resulted in high drag. Junkers' airframes and wing skeletons consisted of a sophisticated lattice of duralumin tubes on which special metal boards were riveted. These corrugated duralumin boards significantly increased the overall strength of the airplane structure and became the trademark of Junkers' aircraft through the 1930s.

Japanese interest in Junkers' technology started soon after World War I. As we have seen in Chapter 2, the 1919 Versailles Treaty granted the Inter-Allied Commission of Control access to all German aircraft makers. As a result, the Japanese commission members, all of them active-duty military officers, became familiar with the inventive design of Junkers' aircraft. Soon Junkers' airplanes and production methods attracted a wide range of Japanese military officials, representatives of Japanese aircraft makers, and trading companies, as well as researchers of the Aeronautical Research Institute of Tokyo Imperial University. They all took the time to travel to the small industrial town of Dessau, one hundred kilometers southwest of Berlin (see Map 2), where Junkers' plant was located. In 1921 Imai Kiyoshi, an attaché major in the Japanese Army, met with a Junkers representative and expressed the army's wishes to break up the French aviation monopoly in Japan and to replace the French airplanes with the "superior aircraft that can be found at Junkers."<sup>441</sup>

---

<sup>441</sup> Junkers-Japan Archivmaterial Deutsches Museum, "Verwertung Flugzeuge Asien Japan" (hereafter: Junkers-Japan Dt. Museum), folder 0705 T1 1919–1921.

A visit of great importance took place in 1922 when the Japanese Army sent Colonel Koiso Kuniaki to Junkers' factory. Welcomed as the representative of a future customer, Koiso received a comprehensive introduction to Junkers' research activities and all-metal construction technology (see also Chapter 2). Junkers' employees seized every opportunity to impress their Japanese visitor.<sup>442</sup> They explained the company's "scientific method" and highlighted the advantages of Junkers' designs over those of his competitors Dornier and Rohrbach. The colonel was even—misleadingly—told that Claude Dornier still followed the obsolete design of airships and wooden aircraft. In addition, Koiso learned that no Dornier land-aircraft had participated in World War I while Junkers' fighters, reconnaissance planes, and armored infantry aircraft had all been successfully deployed during the fighting. Junkers and his employees also tried to convince his Japanese guests that his experience in the design of civil aircraft and mass production put the company in a leading position by a wide margin. During his inspection trip Koiso became a great admirer of German aviation technology. As we will see, his visit to the Junkers factory in Dessau left an especially long-lasting impression.

In the meantime—and timed perfectly, though without Junkers' knowledge—Junkers attracted the attention of the Japanese public when one of his World War I all-metal monoplanes arrived in Japan as a war trophy. The Japanese military assembled the aircraft and proudly presented it at a flight demonstration at Tokorozawa. The event gained considerable importance with the attendance of Prince Regent Hirohito. *Asahi Shinbun's* praise of the Junkers aircraft emphasized the advantages of the all-metal design that eliminated any risk of fire and supposedly made the aircraft invulnerable to the enemy's attacks—a claim that reflects the journalist's

---

<sup>442</sup> Ibid.

enthusiasm rather than his aeronautical expertise. The paper surmised that “in the future our all military aircraft may become like this Junkers aircraft.”<sup>443</sup>

Instead of engaging in the delicate business of selling military aircraft, Junkers initially put high hopes in Japan’s emerging civil aviation. Already in 1921 he suggested that he could offer the organizational experience gained from his own airline, the Junkers Luftverkehr AG, which he had established in the same year. In addition Junkers sought to provide Japan with his F 13 passenger aircraft, a low-wing, all-metal monoplane that he had presented to the German public in 1919. The F 13, dubbed the “first real passenger aircraft,” set new altitude and endurance records. Its sophisticated design and the consistent use of duralumin allowed the F 13 to carry twice the payload and use one-fifth of the fuel of a then conventional wooden aircraft.

Confident about entering the emerging Japanese civil aviation market, Junkers approached the Japanese Aviation Bureau (*kōkūkyoku*), the administrative body in charge of civilian aviation.<sup>444</sup> Junkers offered the sale of twenty “six-seater commercial aircraft” together with the dispatch of two pilots and five mechanics in March 1921.<sup>445</sup> But Junkers’ aspirations to participate in the build-up of a large-scale Japanese air traffic network did not materialize. The company succeeded in selling only two F 13s as liaison aircraft for the Japanese Army in late 1922.<sup>446</sup> Rather than building up a sizable fleet of transport airplanes, the Army Aviation Bureau was content with using the two shiny all-metal aircraft on tours to promote an image of a modern

---

<sup>443</sup> “Gozen hikō no yu-shiki teisatsuki” [The flight of a Junkers reconnaissance aircraft in the Imperial presence], *Osaka Asahi*, morning edition, October 25, 1922.

<sup>444</sup> The Aviation Bureau was established in 1920 and put under the jurisdiction of the Army Ministry. In 1923 it was transferred to the Communication Ministry.

<sup>445</sup> Junkers-Japan Dt. Museum, folder 0705 T1 1919–1921.

<sup>446</sup> Nozawa Tadashi, *Nihon kōkūki sōshū: yu’nyūki hen* [Encyclopedia of Japanese aircraft: Imported aircraft] (Tokyo: Shuppankyōdōsha, 1972), 86, and Junkers-Japan Dt. Museum, folder 0705-T4 (1928 I).

air force that combined cutting-edge technology with flight safety, security, and even aesthetics. As one reporter who watched an F 13 taking off put it: “reflecting the light of the morning sun, the aircraft flew away into the western sky: a beautiful scene like in a movie.”<sup>447</sup> The Junkers aircraft also helped to promote the humanitarian aspect of the army’s airpower. In November 1925, with the help of the army doctor Terashi Masanobu, the army remodeled one F 13 into an ambulance aircraft.<sup>448</sup> Two months later the army presented Japan’s first air ambulance to a large group of medical officers and Red Cross officials at a test flight at Tokorozawa.<sup>449</sup>

Junkers’ prospects for selling military equipment and machinery to Japan suffered a serious setback from the company’s participation in a top-secret venture in Russia. In the wake of the Treaty of Rapallo, signed between Germany and the Soviet Union in April 1922, the Soviet Union agreed to assist in Germany’s covert rearmament by establishing a secret aircraft manufacturing facility in Fili near Moscow. The plant was to provide military aircraft for Germany in exchange for technological and financial aid to Soviet Russia.<sup>450</sup> The project would involve Junkers, for whom it offered a unique business opportunity to manufacture airplanes without having to worry about the Versailles Treaty restrictions. In November 1922 Junkers and the Soviets signed a contract for a “state-of-the-art” aircraft factory with an annual output of 300 aircraft and 450 engines. However, in spite of high expectations the project was plagued with delays and a large cost overrun. Friction between Junkers and the German military about insufficient subsidies increased, bringing the company to the brink of bankruptcy. When the

---

<sup>447</sup> *Asahi Shinbun Tokyo*, evening edition, August 14, 1924.

<sup>448</sup> Nozawa, *Nihon kōkūki sōshū: yu’nyūki hen*, 87.

<sup>449</sup> Junkers-Japan Dt. Museum, folder 0705 T3 1926–1927.

<sup>450</sup> For details see Edward L Homze, *Arming the Luftwaffe: The Reich Air Ministry and the German Aircraft Industry, 1919–39* (Lincoln: University of Nebraska Press, 1976), 7–11, and Lutz Budraß, *Flugzeugindustrie und Luftrüstung in Deutschland 1918–1945* (Düsseldorf: Droste, 1998), 101–28.

venture officially came to an end in 1926—the Fili factory had been handed over to the Russian manufacturer Tupolev in the previous year—the Soviets had achieved their aims of technology transfer, staff training, and the buildup of a domestic aviation industry. Fili made good use of Junkers’ design features and developed into the center of Soviet aircraft manufacturing. However, for the German aircraft maker, the international venture was a bitter experience that resulted in a fall from political favor, financial loss, and unrewarded technology export.

The Fili episode explains why Junkers initially failed to engage in the production of military aircraft for Japan. Given the secrecy of German-Soviet cooperation, Junkers could not boast about a successful production abroad—quite unlike his competitors Dornier and Rohrbach, who, as discussed in the two previous chapters, had set up their showpiece operations in Italy and Denmark. Furthermore, Japan’s 1923 Imperial Defense Policy considered the new Soviet Red Army as Japan’s “hypothetical enemy.”<sup>451</sup> It is therefore reasonable to surmise that any notion of Junkers’ involvement in Soviet aerial armament might have dissuaded the Japanese from engaging in business with him at the same time. According to Junkers’ own assessment, this problem was not able to be solved until 1925, when military aircraft production at Junkers’ new A.B. Flygindustri plant in Limhamn in the south of Sweden (see Map 2) was scheduled to begin.<sup>452</sup>

### **The Plan for a Long-Range Bomber Emerges**

Plans for a spectacular new bomber revived the interest of the Japanese military in Junkers’ technology. This project was the outcome of several major international developments that unfolded during the previous two decades. Since 1907 the Japanese military has based its

---

<sup>451</sup> Drea, *Japan’s Imperial Army*, 152.

<sup>452</sup> Junkers-Japan Dt. Museum, folder 0705 T2 1922–1925.

operational planning on a so-called Imperial Defense Policy (*teikoku kokubō hōshin*) set up by the army's General Staff Office and the Naval General Staff. After the 1917 October Revolution, Czarist Russia collapsed and the Imperial Russian Army and Navy ceased to exist. This event led to a paradigmatic shift in Japan's military strategy. For the first time Japanese military planners began to worry more about rising U.S. influence in the Pacific than about the threat of Russian territorial expansion. In 1918 the Japanese military revised its Imperial Defense Policy and set up a strategy of first defeating the U.S. Asiatic Fleet, whose main task was to protect the Philippines, and then to occupy Luzon, the main island of the archipelago. The Japanese Navy would then encounter the U.S. Pacific fleet on its way to the Western Pacific and destroy it in one decisive battle.<sup>453</sup> Five years later, in the wake of the Washington Naval Treaty, the Katō Cabinet passed another far-reaching revision of the Imperial Defense Policy.<sup>454</sup> The Japanese General Staff decided to promote the U.S. to "Japan's number-one hypothetical enemy" both for the army and the navy.<sup>455</sup> This move reflected a perceived increasingly anti-Japanese stance of the United States and a growing discontent with the arms limitation imposed by the Washington Treaty, a limitation that many Japanese saw as a threat to the nation's interest.

The new anti-American defense policy still included the preemptive occupation of the Philippines (*hitō kōryaku sakusen keikaku*). In 1925–26 the Japanese Army and Navy began drafting a concrete plan for an invasion of the Philippines.<sup>456</sup> The two armed forces put aside

---

<sup>453</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō 1*, 263, and Asada, *From Mahan to Pearl Harbor*, 55.

<sup>454</sup> Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 81–83, and Jōhō Yoshio, *Rikugunshō gunmukyoku shi, Jōkan (Meiji Taishō)* [The history of the Bureau of Military Affairs vol. 1 (Meiji and Taishō)] (Tokyo: Fuyō shobō shuppan, 2002), 292–93.

<sup>455</sup> Ibid., 287–88, and Kawata Akiharu, "Report on the martial spirit among the U.S. service personnel," 1923, JACAR Ref. C03022632000.

<sup>456</sup> Jōhō, *Rikugunshō gunmukyoku shi, Jōkan*, 292.

their traditional rivalry and agreed to cooperate in a surprise attack of the naval bases that they regarded as essential for the U.S. fleet's operations in the West Pacific. In a division of labor the Japanese Navy would destroy the U.S. vessels in Philippine territorial waters and blockade Manila Bay and Subic Bay, while at the same time the Japanese Army would invade the island and occupy Manila.

The invasion plan included the participation of Japan's air forces in air attacks on American bases on the island. However, it soon became obvious that such an operation was beyond the flight range of any of Japan's military aircraft. Initially the army planned to use the navy's carriers for launching its aircraft.<sup>457</sup> Another proposal was to disassemble the airplanes and transport them by ship to a prepared airfield on Luzon, from where they could participate in the battle. The invasion plan went through several stages until Koiso Kuniaki, who in 1927 had been promoted to chief of the Army Aviation Headquarters' General Affairs section, proposed an entirely new scheme. Koiso argued that, considering the still poor state of Japanese air defense, the only way to protect the homeland from an air attack would be the complete destruction of the enemy's bomber bases and aircraft factories immediately after the outbreak of a war.<sup>458</sup> He further pointed out that recent developments in the design of civil aircraft showed the feasibility of fast long-range airplanes carrying increasingly heavier payloads. Koiso also referred to the latest German civil aircraft that could be easily converted to long-range bombers.<sup>459</sup>

In early 1928 Koiso's proposal gained momentum. Inoue Ikutarō, chief of the Army Aviation Headquarters, suggested developing an "ultra-heavy bomber" (*chōjū bakugekiki*) that could take off from Kaohsiung Airbase in southern Taiwan, cross the Luzon Strait, and attack

---

<sup>457</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō* 1, 263.

<sup>458</sup> Kuniaki, *Kōkū no genjō to shōrai*, 43.

<sup>459</sup> *Ibid.*, 8.

Manila (see Figure 22).<sup>460</sup> In February 1928 the army minister ordered Inoue to start investigations into such an aircraft that could fly non-stop to such a faraway battlefield for bombing and reconnaissance missions.<sup>461</sup>



**Figure 22: The proposed bombing-run from Taiwan to the U.S. bases at Manila.**

In the same month the Army Aviation Bureau set up the specifications for an aircraft that could fulfill such a challenging task. These requirements tested the limits of aviation technology available at that time. The new bomber should have an operational flight radius of one thousand kilometers (Kaohsiung and Manila lie 940 kilometers [580 miles] apart) plus an additional five

<sup>460</sup> Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 81–83.

<sup>461</sup> Army Special Bureau of Aviation, “Kyūnishiki kyūbakugekiki seishi ni kan suru ken” [Establishment of the standard of the Type-92 Heavy Bomber], 1933, JACAR Ref. C01003983200, 649.

hundred kilometers for its activities over the target. It should be able to carry a bomb load of two thousand kilograms and be heavily armed for self-defense in order to perform its task independently, that is, without the protection of additional fighter planes. Furthermore, the aircraft should be equipped for night flight and long-distance radio communication. The army made a total sum of ¥800,000, to be distributed over three years, available for the bomber project. This bold decision earmarked 40 percent of the total the army spent on aviation material between 1928 and 1930.<sup>462</sup> The army ministry's decision to fully support Koiso and Inoue's ambitious project clearly testifies to the unprecedented rise of the army's airpower faction.

Domestic production was another important issue to be considered. Initially the Aviation Bureau insisted on employing Japanese civil aircraft manufacturers for the design and construction of the long-range bomber. However, despite the Aviation Bureau's rhetoric of an exclusively domestic design and production, no Japanese aircraft maker was in a position to undertake such an ambitious project without foreign help.

As it turned out, the aircraft that the Japanese Army envisioned was already taking shape on German drawing boards. After Lindbergh's successful Atlantic crossing in 1927, the German Ministry of Transport envisioned a "Transocean Program" where a new generation of long-range passenger aircraft would expand the Reich's aerial network all the way to the Americas. In March 1928 Junkers received a massive subsidy of more than two million Reichsmarks from the Ministry of Transport for the design and construction of a new airliner, the G 38, which could offer a regular passenger service across the Atlantic. The airplane was to become the world's

---

<sup>462</sup> Ibid., 658–62. For the Army's 1928–1931 budget see JACAR Ref. C12121666100.

largest land aircraft. Inside its enormous wings it could accommodate its four engines as well as a number of passenger seats, thus coming close to Junkers' original idea of a flying wing.<sup>463</sup>

For the experts of the Japanese Army the G 38 was the ideal aircraft for long-range bombing missions. Even though designated as a passenger aircraft, the G 38, with its all-metal structure and its wide fuselage, lent itself to conversion into a bomber with large bomb bays and machine gun turrets. According to Junkers' engineers the aircraft's innovative wing layout and advanced engines made it possible to carry a heavy bomb load over a great distance. With the specifications in line with Koiso and Inoue's ambitions, Junkers was able to convince the Japanese Army's technical experts. In a rare move—the G 38 still existed only on the drawing boards, and its first flight was planned for late 1929—they recommended buying the license for Junkers' G 38, remodelling it into a bomber, and starting the experimental production of this aircraft.<sup>464</sup>

The army also had to find a suitable Japanese manufacturer for the licensed production of the new bomber. In early 1928 Inoue proposed to employ Mitsubishi for this project, and the army minister approved his plan in August 1928.<sup>465</sup> Again Koiso was the central figure behind this important move. Koiso, who had long been a close friend of Shibuya Yonetarō, the managing director of Mitsubishi's Nagoya plant, seemed to be the right person to convince Shibuya to engage in the production of the bomber.<sup>466</sup> The proposal was attractive to Mitsubishi: the Army Aviation Bureau agreed to cover the cost of the experimental production and to

---

<sup>463</sup> Budraß, "Rohrbach und Dornier," 218, and Budraß, *Flugzeugindustrie und Luftrüstung in Deutschland*, 241.

<sup>464</sup> Bōeichō, *Rikugun kōkū no gunbi to un'yō 1*, 365.

<sup>465</sup> Katsuragi Yōji, *Rekishi no naka no Nakajima hikōki* [A history of Nakajima's aircraft] (Tokyo: Guranpurishuppan, 2002), 146, and Army Special Bureau of Aviation, "Kyūnishiki kyūbakugekiki seishi ni kan suru ken."

<sup>466</sup> Mitsubishi, *Ōjibōbō*, vol. 1, 8.

continuously place orders for the aircraft. Mitsubishi also received considerable leeway for setting up license negotiations with Junkers.<sup>467</sup>

Junkers, for his part, closely examined the background of his prospective partner. He wanted to be sure that Mitsubishi's aircraft manufacturing branch had enough capital available for the purchase of an expensive production license. In October 1927 Junkers' Japan representative Reimers & Co reported that the capital of Mitsubishi's aircraft division amounted to ¥5 million with an additional reserve fund of ¥2.8 million. Clearly this financial strength was reassuring to Junkers, who planned to sell the G 38 production license for ¥1 million. According to Reimers, Mitsubishi's Nagoya factory had an impressive production capacity of one thousand aircraft per year. However, due to the recent disarmaments, Mitsubishi's actual annual output had shrunk to only one hundred fifty aircraft. Nevertheless, the report concluded that the company was still making a healthy annual profit of ¥568,000.<sup>468</sup> During a personal visit Reimers observed how Mitsubishi was substantially modernizing its facilities with a large new wind tunnel, a high-altitude engine test stand, and a chemical laboratory for materials testing. However, on a more cautious note, the report also mentioned that Mitsubishi's production technology was underdeveloped. The company's aircraft manufacturing facilities were still equipped for the conventional production of wood-and-fabric aircraft. Skillful workmen were doing mostly manual work with only a few machine tools available, resulting in a costly and labor-intensive production process.

---

<sup>467</sup> Koiso Kuniaki, *Katsuzan Kōsō*, 422–23.

<sup>468</sup> Junkers-Japan Dt. Museum, folder 0705 T3 1926–1927.

A second report, authored by Junkers' managing director Erich Pfeiffer in the same year, added to the doubts about a successful cooperation with Mitsubishi.<sup>469</sup> Pfeiffer was dubious about prospects in Japan, a country that, in his view, suffered from overpopulation, a lack of resources, Communist influence on the workforce, high wages, and the aftereffects of the 1923 earthquake. In addition the "low standard of Japanese business morale" would make a trustful cooperation almost impossible. Most disturbingly, to compensate for their "lack of creativity," the Japanese resorted to brazen copying of foreign products. As a result, Pfeiffer concluded, "Japan will only buy from Germany if absolutely necessary."

These two reports are important for several reasons. In a time of cutthroat competition among German aircraft makers, they framed Junkers' image of Mitsubishi as a solvent customer. Revenue from Japan became especially important when the increasing political turmoil of the Weimar Republic endangered the flow of government subsidies to Junkers' company.<sup>470</sup> Furthermore a successful conversion of his largest passenger aircraft into a bomber would qualify Junkers as major supplier for the secret build-up of Germany's Luftwaffe. At the same time the reports also foreshadowed potential conflicts that could arise during the Mitsubishi-Junkers cooperation: production delays due to the low productivity of the Japanese aircraft maker and the specter of industrial espionage jeopardizing a trustful partnership.

## License Negotiations

The nearly one-year-long license negotiations demonstrate that there was much more at stake for Mitsubishi than the purchase of Junkers' aircraft. What really counted for the Japanese

---

<sup>469</sup> Ibid.

<sup>470</sup> As it turned out, the new German coalition government under Hermann Müller decided in 1929 for substantial budget cuts in the Transocean Program that also affected Junkers' G 39 project.

manufacturer was the transfer of know-how and production technology. When the negotiations started in 1927 Junkers made it clear that he preferred to sell his own finished products to Japan and at the same time took heed of warnings of illegal copies and patent infringements by the Japanese. He was reluctant to dispatch his specialists to Japan and argued that such a course of action would result in an unnecessary loss of time and money because “just a few engineers were not enough” to start such a demanding project.<sup>471</sup> Rather, Junkers suggested designing the bomber at his own plant and then carrying out the actual construction “in a neighboring country.”

However, when Junkers handed over his first tender in March 1928 he seemed to be more willing to consider an exchange of engineers.<sup>472</sup> Still presuming a wide technology gap between Mitsubishi and his own company, Junkers emphasized the importance of his “twenty years of knowledge and experience in the design and construction of metal-aeroplanes,” which he would place at Mitsubishi’s disposal together with patent rights and blueprints for all aircraft types and special factory equipment. Junkers agreed to send his engineers and foremen for the instruction of Mitsubishi’s staff in Japan and cover the cost for training Mitsubishi’s engineers and foremen at the Junkers factory. As compensation Junkers requested a first payment of nearly ¥1 million and an annual royalty of 10 percent for each airplane built and sold by Mitsubishi under the Junkers license. Furthermore Junkers stipulated that the first bomber had to be built at one of his factories in Dessau or in Sweden in the presence of Mitsubishi’s engineers and foremen. Such a procedure would provide the “best opportunity to get acquainted with the production methods of Junkers planes.”

---

<sup>471</sup> Junkers-Japan Dt. Museum, folder 0705 T3 1926–1927.

<sup>472</sup> Junkers-Japan Dt. Museum, folder 0705 T4 1928 I.

It took Mitsubishi only five days to consider Junkers' proposition and to prepare an appropriate response.<sup>473</sup> Pointing out that the army would require a maximum of ten "super-heavy attack planes" for the next five or six years, Mitsubishi argued that the foreseeable profit would not be high enough to justify the investment of such a large sum. The company therefore was willing to pay a maximum of about one-third of Junkers' requested sum for the manufacturing rights together with 3 percent royalties. The letter concluded in an imploring manner: "we have never paid such a large amount to any aeroplane manufacturer in Europe or America." After further negotiations and compromises—Mitsubishi improved its offer and Junkers agreed to include production licenses for his advanced aero engines—a license contract was finally signed on September 20, 1928.<sup>474</sup> Its preamble verbosely stated that "Mitsubishi are desirous of taking advantage of [Junkers'] experience in order to construct Metal Aeroplanes and Aeroplane motors according to Junkers types." The agreement, which had a validity of twelve years, involved fifteen aircraft types and three different aero engines for which Junkers would provide all necessary data, formulas, and calculation sheets. In addition the German company committed itself to deliver all required stencils, working drawings, and manufacturing information and to dispatch "fully skilled and trustworthy staff" from Dessau to Nagoya. The contract also entitled Mitsubishi to send its own technical staff to Junkers' Dessau factory. In return the Japanese company agreed to pay ¥600,000, out of which one-third would be considered as prepayment for future royalties.<sup>475</sup> The contract included four appendices that laid out in great detail design calculations, production procedures, and training schedules. These

---

<sup>473</sup> Ibid., and Mitsubishi Tokyo Archive MHI-339.

<sup>474</sup> Junkers-Japan Dt. Museum, folder 0705 T5 1928 II.

<sup>475</sup> Mitsubishi Tokyo Archive MHI-339.

documents demonstrate how Mitsubishi had successfully negotiated the wide range of know-how that was to be transferred from Junkers (see Table 4).

After the negotiations were completed Mitsubishi summarized with obvious satisfaction the benefits of the tie-up with Junkers. In its “outline of operations” presented at an October 1928 board meeting, Mitsubishi deemed it “worth noticing that now we have the exclusive patents from Junkers, the champion of the world enterprises (*sekaijigyō no hashha*) for all-metal aircraft and engines.”<sup>476</sup> The bulletin continued with praise for Junkers’ unique construction method that combined corrugated duralumin boards with duralumin tubes. It concluded that Junkers’ aircraft, with their extremely reliable and efficient engines, had not only gained worldwide reputation for their tremendous durability and safety but also set a large number of world flight records.

**Table 4:** The transfer of know-how as laid down by the 1928 license contract between Hugo Junkers and Mitsubishi Nainenki

|                                             |                                                                                                                                                                   |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Aircraft Design</b>                      | construction, weight, wings, body, engine system, landing chassis and floats, controls performance and safety                                                     |
| <b>Production Technology</b>                | duralumin treatment, aeroplane treatment, selection of materials, factory working instructions, instructions for controlling                                      |
| <b>Training Schedule for Japanese Staff</b> | sheet cutting, fitting, tool making, welding, punching, stamping, construction of framework, wings, flight controls, operation of machine tools, material testing |
| <b>Junkers Patents in Japan</b>             | fuselage made from corrugated metal sheets, cantilever monoplane, riveting of tubes and hollow parts, scaffolding for aircraft production                         |

---

<sup>476</sup> Ibid.

## Mitsubishi's Preparations for Production

After the successful negotiation of the license contract, extensive preparations for the construction of the Super Bomber began. In April 1929 the director of Mitsubishi's aircraft section, Shibuya Yonetarō, approved nearly ¥1 million for the construction of an entirely new factory and the purchase of machines, tools, and other production facilities.<sup>477</sup> Of equal importance to the project was the participation of three experienced Japanese engineers who were all well qualified to play major roles in the German-Japanese project. The background of these aeronautical engineers gives clear evidence of how pervasive German influence on the development of Japan's aviation had become and how German know-how was diffused not only among Japanese companies but also between the civilian and military spheres. In 1928 the Army Aviation Bureau put the army engineer Kazumi Kensuke in charge of the development team that was assigned to remodel the G 38. During his three years as a member of the Berlin-based Versailles Treaty inspection team, Kazumi had already been in close contact with the German aviation industry.<sup>478</sup> He also had been the army's team leader who had supervised the construction of the Dornier-Kawasaki bomber at Kawasaki's Kobe factory in 1924–25.<sup>479</sup> Andō Nario, who had worked as an assistant of Richard Vogt, was responsible for reinforcing the aircraft's wing and fuselage.<sup>480</sup> Ōtsuka Keisuke was the third engineer on the team. He had been trained at Rohrbach and had been in charge of Mitsubishi's construction of the Rohrbach flying boat.

---

<sup>477</sup> *Mitsubishi shashi* [History of the Mitsubishi company], vol. 35 (Tokyo: Tōkyō Daigaku Shuppankai, 1979), 246.

<sup>478</sup> Misato Shūhei, *Obake to yobareta kyojinki: aru rikushi jūkyūkisotsu gijutsusha no kiseki* [The giant aircraft that was called a monster: The tracks of an army engineer who graduated from the 19th class] (Tokyo: Chūō Kōron Jigyō Shuppan, 2005), 2.

<sup>479</sup> Doi, *Hikōki sekkei*, 44.

<sup>480</sup> *Nihon no kōkū runesansu*, 81–83.

The training of Mitsubishi personnel in Germany in the late 1920s played an essential role in advancing Mitsubishi's production methods. A detailed six-month-long schedule specified the training program for foremen, production engineers, and production controllers. Three months were dedicated to master the operation of machine tools at the mechanical workshop. The rest of the time was allotted to material examination and to the assembly and testing of engines.<sup>481</sup>

In spite of the careful planning, several unforeseen problems emerged when the first Japanese trainees arrived in December 1928. Among the six Japanese who would be joined in the following year by Horikoshi Jirō (1903–82), the future designer of the Zero-sen, only Nakata Nobushirō, the appointed chief designer of the project and a former assistant of Alexander Baumann, spoke German. Junkers therefore decided to include German lessons in the training schedule as well. As it turned out, some of the Japanese engineers were not content with just being taught the fundamentals of metalworking. Rather than spending their time with cutting, punching, and welding metal sheets, they wanted to learn more about the advanced design features of the Junkers bomber. However, the Junkers employee in charge of training the Japanese refused to change the training program and insisted that the Japanese had to study the basics of metal aircraft construction first before trying to tackle more specialized tasks. He pointed out that the Junkers personnel who were to be dispatched to Japan later would convey the specific know-how for the construction of the bomber.<sup>482</sup>

Incidents of industrial espionage led to further frictions. To the obvious irritation of the Junkers employees some of the Mitsubishi staff simply ignored the training schedule and were found busy with unauthorized note taking and photographing of the Junkers production

---

<sup>481</sup> Junkers-Japan Dt. Museum, folder 0705 T5 1928 II and MHI 1642

<sup>482</sup> Junkers-Japan Dt. Museum, folder 0705 T6 1929 I.

facilities.<sup>483</sup> The continuing presence of Japanese at Junkers' factory even after their training was finished led to additional resentments, especially when their unrestricted reporting by telegram or mail to Tokyo made it impossible to keep the results of Junkers' research confidential.<sup>484</sup>

### **Junkers Staff Comes to Mitsubishi**

The 1929 contract between the Japanese Army Aviation Bureau and Mitsubishi laid down the details for the hiring of the German specialists. It clearly testifies to the army's tight control of the entire project.<sup>485</sup> Mitsubishi and the Army Aviation Bureau agreed that the employment of each foreigner who was "to design and supervise the experimental production of a special experimental aircraft" had to be approved by the Army Aviation Bureau. The aviation specialists were to be put to work at Mitsubishi's Nagoya factory, and the company was responsible for ensuring that the foreigners would maintain complete secrecy about the project. Upon request of the army the Germans could also be employed at other places. Their travel costs, lodging, and monthly salaries would be paid by the army.

Compared to their Japanese colleagues the Germans received a generous salary. The monthly wages for foremen were settled at ¥900, about ten times a German worker's pay. Junkers' engineers and test pilots would receive ¥1,600, approximately twenty times as much as Mitsubishi paid its own engineers during their stay in Germany.<sup>486</sup> The German engineers could further increase their salary by giving lectures in German on aircraft design to the army's

---

<sup>483</sup> Ibid.

<sup>484</sup> Junkers-Japan Dt. Museum, folder 0705 T8 1930.

<sup>485</sup> Mitsubishi Tokyo Archive MHI-781.

<sup>486</sup> When Horikoshi Jirō was sent to Dessau in October 1929 he received ¥85 per month from Mitsubishi, his employer. Mitsubishi Tokyo Archive MHI-333.

specialists. The lecture topics would be decided by the army, and their contents would be translated, printed, and distributed in advance.

Junkers was well aware that, even with the prospect of an attractive salary, it was important to select carefully the employees who were to be sent to Japan. The strong advice of his Tokyo-based employee Gottfried Kaumann (1893–1954) already anticipated possible conflicts. In a letter sent to Junkers' main office in Dessau in April 1928 Kaumann emphasized that the Junkers engineers and workmen coming to Japan must be affable and endowed with an exceptional calmness and an almost "saintly patience." He warned to avoid at any cost a "drill sergeant's bark" or a too dashing manner and referred to previous cases when such behaviors had led to frictions with the Japanese that inevitably "resulted in a debacle."<sup>487</sup> According to Kaumann's advice, after an initial "period of suffering," most foreign employees would adjust to their new environment and seek comfort in their high wages and in the fact that their stay in Japan would be over after some time.<sup>488</sup> In addition, great care should be taken to choose personnel who would remain loyal to their original employer. This would avoid them being lured away, as had famously happened in the case of Kawasaki and the former Dornier engineer Richard Vogt.

As a clear sign of the high importance attributed to the bomber project, Hugo Junkers sent his personal assistant Benno Fiala von Fernbrugg (1890–1964) to Japan. Fiala departed for Japan in October 1928, barely one month after the conclusion of the license contract. As a man of many talents Fiala seemed to be the right person in the right place. The former World War I fighter ace had studied engineering after the war and had been working together closely with Hugo Junkers since 1925. Fiala's detailed day-by-day progress reports provide a clear picture of

---

<sup>487</sup> Junkers-Japan Dt. Museum, folder 0705 T4 1928 I.

<sup>488</sup> Junkers-Japan Dt. Museum, folder 0705 T8 1930.

the complex preparations for the production of the bomber.<sup>489</sup> As a first step Fiala assessed Mitsubishi's share in the production process so that special tools and machines could be ordered from Junkers. Then, together with Mitsubishi's engineers, he set up a schedule for wind tunnel experiments and arranged the construction of special earthquake-proof scaffolding. In addition Fiala examined the options for the future transport of the giant aircraft to the military airport at Kakamigahara, located about thirty-five kilometers north of the Nagoya factory. When it became clear that narrow roads and countless overhead wires would make an overland transport impossible Fiala prepared for shipment via the Kiso River. Fiala also gave instructions to compile a German-Japanese dictionary that contained all the necessary vocabulary for the Junkers construction method.

The procurement of duralumin was another important matter that had to be settled. In 1928 samples of made-in-Japan duralumin were sent for analysis to Junkers' research section in Germany. It turned out that the Japanese duralumin produced by the Sumitomo Company, which had just begun large-scale production of duralumin in earlier that year, was considerably less resistant to corrosion than its German-made counterpart. Therefore Junkers refused to use a mix of German and Japanese material. In several meetings with Mitsubishi and army officials Fiala laid out the advantages of using only German duralumin. Then, in December 1928 the army decided to build the first bomber exclusively with German material.

In addition to Fiala, Junkers dispatched two of his head designers, Eugen Herbert Schade and Willi Keil, to Japan. The two engineers left Germany in December 1928 and arrived at Nagoya two weeks later. Their 1929 contracts assigned them to work for Mitsubishi for a period of two years with a possible extension that depended upon "the progress of construction of the

---

<sup>489</sup> Junkers-Japan Dt. Museum, folder 0705 T6 1929 I.

Super Bomber.” Like the 1928 license contract the agreement attached much importance on the training of Mitsubishi’s personnel. It stipulated that both engineers would “undertake to the best of [their] ability to teach and instruct the engineers, constructors, as well as workmen of the employers in all details relating to aircraft construction of the Junkers types.”<sup>490</sup>

Despite a contractual agreement that emphasized close cooperation, discord surfaced in Mitsubishi’s factory soon after the arrival of the two German engineers.<sup>491</sup> The behavior of Schade increasingly irritated Mitsubishi’s engineers. According to Ozawa Kunojō, a Junkers-trained specialist who was in charge of important strength calculations, Schade spent most of his time typing in his office and showed little inclination to participate in the work on the shop floor. Furthermore, Schade’s Japanese colleagues, who were well aware of his high salary, disapproved of the ostentatious display of his newly found affection for fashionable clothes and a luxurious car. Watching Schade sitting listless in his office, the Japanese wryly commented that “each of Schade’s yawns must cost Mitsubishi a fortune” (*akubi o shitemo erai kane ni naru*). Mitsubishi also became dissatisfied with Junkers’ second engineer Willi Keil. The managing director Shibuya Yonetarō expressed his concern that Keil showed no initiative and seemed not to be qualified for independent design. His salary was therefore considered to be way too high, all the more as Mitsubishi was charged extra for each small design change.<sup>492</sup> Keil quickly responded to these reproaches.<sup>493</sup> He argued that, according to his contract, his main role was not to engage in design but to act as a mediator between the German design office and the Japanese shop floor. He therefore could not fulfill the “vanity of the Japanese” who obviously preferred to have a

---

<sup>490</sup> Mitsubishi Tokyo Archive MHI-781.

<sup>491</sup> Junkers-Japan Dt. Museum, folder 0705 T8 1930.

<sup>492</sup> Junkers-Japan Dt. Museum, folder 0705 T7 1929 II.

<sup>493</sup> Junkers-Japan Dt. Museum, folder 0705 T6 1929 I.

famous German aircraft designer teaching them the design of metal aircraft. He insisted that he was in no position to instruct the Japanese engineers in the design of advanced large-size aircraft. Keil received support from Schade who declared that his German colleague was busy checking the blueprints sent from Germany and making “small design changes.” He therefore had no time for redesigns that required “complex calculations” such as engine installations, bomb suspensions, or a new cockpit layout.<sup>494</sup>

Despite these frictions the conversion of Junkers’ passenger aircraft into a military airplane began. Fiala could draw upon his World War I experience, which endowed his proposals with considerable authority. He suggested equipping the bomber’s fuel tanks with additional fire protection and gave detailed instructions for the aircraft’s bomb bay; the number, size, and types of bombs; and their release mechanism. Furthermore, he determined the location and firing range of machine guns and cannons for the bomber’s protection against enemy fighters (see Figure 23). In order to use short runways the aircraft was to be equipped with additional wing flaps that would create extra lift and lower the takeoff and landing speed. Efficient wheel brakes would further decrease the required landing distance. Floating devices ensured that the aircraft could sustain an emergency water landing. And, in order to carry out air raids at night or under bad weather conditions, the aircraft was equipped for night flights and operation in low visibility.

**Figure 23: This illustration shows how the Super Bomber was heavily armed with six machine guns pointing in all directions. The door and windows along the fuselage reveal that the bomber initially was designed as a passenger aircraft.**<sup>495</sup>

---

<sup>494</sup> Ibid.

<sup>495</sup> Source: Nohara, *Zukai sekai no gun'yōkishi*, 6, 43

Apart from giving technical advice Fiala missed no opportunity to promote Junkers' aircraft and engines to the Japanese. In lectures held for officers of the army arsenal he laid out both the advantages of Junkers' all-metal design and the importance of Junkers' new diesel aero engine that just had set a new endurance world record during an East-West Atlantic crossing in 1928. He also informed Mitsubishi's managing director Shibuya Yonetarō about the reliability of the company's engines, especially in respect to Japan's emerging civil air transport. Fiala even successfully navigated the dangerous waters of Japanese popular beliefs. Being aware of Japanese sensitivities toward the number forty-two, whose pronunciation "shini" also means "to die," he assured his Japanese partners that the wingspan of the new aircraft was forty-four meters and not forty-two, as Kaumann had reported earlier.<sup>496</sup>

## **Production and Test Flight**

Fiala's activities did not stop Mitsubishi from complaining about the late start of production. By February 1929, five months after the license agreement had been signed, the company still had not received any drawings or manufacturing information from Germany. At the same time the army began to put increasing pressure on Mitsubishi. Junkers argued that he would be able to provide the necessary documents only at the end of the year, after the experimental production of his G 38, the giant passenger aircraft upon which the design of the Mitsubishi bomber was based, had made enough progress.<sup>497</sup>

Mitsubishi began to worry about having possibly backed the wrong horse when the Japanese Army attaché in Berlin reported the "promising future" of Dornier's new giant flying boat. The Do X, at that time the world's largest aircraft, made its maiden flight on July 12, 1929,

---

<sup>496</sup> Junkers-Japan Dt. Museum, folder 0705 T6 1929 I.

<sup>497</sup> Ibid.

and license negotiations between Dornier and Kawasaki were on their way. Again Junkers tried to set Mitsubishi at rest, pointing out that the flying boat of his arch-rival Dornier was too large and too complicated and therefore would be of little use as a military aircraft.<sup>498</sup>

While Mitsubishi was still waiting for the bomber production to begin, the project's costs began to escalate. In July 1929 the Army Aviation Bureau had to increase the initial budget of ¥800,000 nearly twofold, to ¥1.5 million.<sup>499</sup> Finally good news arrived from Germany. On November 6, 1929, Junkers' G 38 made its first flight at the Dessau Airport. In the following week Junkers invited the Berlin-based Japanese Army and Navy officials and Mitsubishi's representative, to whom he proudly pointed out the advantages of the G 38. He emphasized that the aircraft's short takeoff and landing distance, maneuverability, low engine noise level, and—above all—long flight range made it clearly superior to Dornier's Do X.<sup>500</sup> These claims were validated when, soon after its official first flight, the aircraft set new world records in speed, distance, and maximum flight time.

Those achievements notwithstanding, the maiden flight of the Japanese giant aircraft was still long in coming. By October 1930 production of the bomber was already one year behind schedule. In the same month the Junkers representative Kaumann, who was sent to the Nagoya factory, attested to the high quality of the work done at Mitsubishi's shop floor, while at the same time he criticized that the Japanese attached “no importance to the economy of production” and that each work process “took three times longer than in Germany.”<sup>501</sup> He therefore doubted the successful completion of the project. One month later Junkers acknowledged to Mitsubishi

---

<sup>498</sup> Ibid.

<sup>499</sup> Army Special Bureau of Aviation, “Kyūnishiki kyūbakugekiki seishi ni kan suru ken,” 683.

<sup>500</sup> Junkers-Japan Dt. Museum, folder 0705 T7 1929 II.

<sup>501</sup> Junkers-Japan Dt. Museum, folder 0705 T8 1930.

that the “transplant of entirely new construction methods and the immediate transition to a complicated large-scale aircraft” was extremely difficult. He therefore suggested delivering one prefabricated aircraft to Japan. This proposal for the wholesale import of Junkers’ aircraft was a delicate matter, as it went against the military’s declared aim to complete the project without foreign imports. Junkers, however, succeeded in convincing his Japanese business partners that such a sample aircraft would “accelerate Mitsubishi’s production and advance the schedule by at least one year.” It would also allow tests of the additional equipment, the training ground, and flight crews.<sup>502</sup> Mitsubishi then agreed to import the main parts for the first two bombers from Germany, while subsequent airplanes were to be built entirely from made-in-Japan components.

In autumn 1931 the first Army Type 92 Superheavy Bomber (*92-shiki chōjū bakugeki ki*) was ready for its maiden flight at the Kagamigahara Airfield (see Figure 24). Even though Junkers had sent his experienced head test pilot Wilhelm Zimmermann, the Japanese Army insisted the new bomber be flown by a Japanese pilot because the aircraft had been “paid for by the Japanese taxpayers.”<sup>503</sup> On October 26, 1931, Captain Katō Toshio took off with the new bomber and successfully carried out the aircraft’s first test flight. The next day Junkers informed the Japanese military attaché in Berlin about the event. Junkers also sent a letter expressing his “joy and satisfaction” together with a model of the bomber to General Watanabe Jōtarō (1874–1936), the new head of the Army Aviation Bureau.<sup>504</sup>

---

<sup>502</sup> Ibid.

<sup>503</sup> *Aichi no kōkūshi*, 152.

<sup>504</sup> Junkers-Japan Dt. Museum, folder 0705 T9 1931–1933.

The army engineer Kariya Masai, who participated in the flight test, gave a vivid inside picture of the Type 92 Bomber's operation that leaves little room for the glamour of flight.<sup>505</sup> The extraordinary large flight crew consisted of three pilots, five flight engineers, five gunners, and three operators who were responsible for radio communication, bombing, and photographing. According to Kariya, during the long flights at high altitudes, pilots frequently collapsed over their controls because of a lack of oxygen. The engineers who continuously had to attend each of the aircraft's four engines worked half naked in their noisy and overheated engine compartments. The gunners for their part suffered from the cold and the rough movement of the gun turrets. Another curious feature was the landing technique of the giant aircraft that required cooperation of the whole crew. Shortly before touchdown a ringing bell signaled to the flight engineers and operators that they had to run to the back of the aircraft cabin so that the bomber's rear part could be lowered and a three-point landing made.

**Figure 24: A large group of army officials proudly posing in front of the Super Bomber.**<sup>506</sup>

## The Press

Even though the members of the Army Aviation Bureau classified the bomber program as top secret they did not succeed in hiding it from a curious public. Already in November 1929 Japanese newspaper readers were well informed about Junkers' new passenger aircraft. Soon after the G 38's first flight in Germany, newspaper articles praised the aircraft with the headline

---

<sup>505</sup> Kariya Masai, *Nihon rikugun shisakuki monogatari* [About the Japanese Army's experimental machines] (Tokyo: Kōjin sha, 2007), 79–91.

<sup>506</sup> Source: *Nihon no kōkū runesansu*, 82. Date of picture unknown.

“another super-large aircraft from Germany” and “a large aircraft with passenger cabins inside the wings.”<sup>507</sup> The army felt uneasy about these reports and wanted to avoid at all costs making public the production of a military version of the G 38 in Japan. However, the first press reports about the bomber project soon appeared. In March 1931, as a first countermeasure, the army vice minister ordered the chiefs of staff in all divisions and the commanders of the military police not to call the aircraft a “super-heavy bomber” but to refer to it as a “special experimental aircraft.” The vice minister also insisted that the bomber’s performance and all other related information were to be kept absolutely secret. In addition he notified the Newspaper Censorship Bureau to prohibit journalists from publishing any articles about the aircraft.<sup>508</sup>

The combined efforts of the army and government censors showed little effect. Japanese newspapers reported with a mixture of sensationalism and national pride about the new aircraft. Already several months before the bomber’s first flight the *Asahi* newspaper announced the production of a “Super Bomber (*chōjūbakugekiki*) of which we can be proud before the whole world.”<sup>509</sup> The article emphasized that Mitsubishi already had spent “an enormous amount of money and time” on a “made-in-Japan machine” that would be an improved version of Junkers’ G 38. *Asahi*’s competitor *Yomiuri* ran the headline “The Army Air Force’s new and powerful machine, the world’s largest super-heavy bomber.”<sup>510</sup> The paper revealed details of the

---

<sup>507</sup> “Mata Doitsu ga chōdaiki yunkeru gata” [Again Germany made a super-large Junkers-type machine], *Asahi Shinbun*, November 5, 1929, 7, and “Tsubasa no naka ni kyakushitsu no aru daihikōki” [A large aircraft with passenger cabins inside the wings], *Asahi Shinbun*, December 5, 1929, 2.

<sup>508</sup> Army Special Bureau of Aviation, “Kyūnishiki kyūbakugekiki seishi ni kan suru ken,” 686–89.

<sup>509</sup> “Sekai ni hokoriuru chōbakugekiki seisaku” [The production of a super bomber of which we can be proud before the whole world], *Asahi Shinbun*, February 14, 1931, 3.

<sup>510</sup> “Rikukūgun ni shinei sekai saidai no chōjū bakugekiki” [The Army Air Force’s new and powerful machine, the world’s largest super-heavy bomber], *Yomiuri Shinbun*, June 9, 1932, 7.

production and examination process and also impishly reported that the heavy bomber was being called a “special experimental aircraft.” After revealing all the technical details about the dimensions, performance, and bomb load of the all-metal monoplane, the article concluded in a confident manner that “our army, which had been passive in the development of heavy bombers, could finally strengthen its [air] power.” Despite this ambivalent praise the army continued its efforts to crack down on press reports about flights of the heavy bomber, a seemingly impossible task considering the monstrous size of the aircraft.<sup>511</sup> Only in 1938 was the aircraft officially declared to be no longer secret.<sup>512</sup>

## Evaluation and Aftermath

By autumn 1931, after the first successful flight of the Super Bomber, Japan’s political, strategic, and military environment had fundamentally changed. A reshuffle of the Aviation Bureau, a radical shift in the military’s strategy in the wake of the Manchurian Incident, and a new army minister’s battle doctrine were to be fateful not only for the Super Bomber project but also for the whole of the army’s air branch.

Already in 1929 two central figures of the army’s airpower faction had left the Aviation Bureau. Koiso Kuniaki, the mastermind behind the bomber project, was transferred to the army ministry’s Economic Mobilization Bureau (*rikugunshō seibikyoku*), and Inoue Ikutarō, who had been a staunch supporter of the army’s aviation branch since 1911, became a member of the

---

<sup>511</sup> Ministry of Army Newspaper Group, “Sending Issue on Crackdown of Article on Aircraft Examination,” 1935, JACAR Ref. C01004075900.

<sup>512</sup> Army Special Bureau of Aviation, “Releasing Military Secret of Aviation Equipment Model 92 Heavy Bomber Construction,” 1938, JACAR Ref. C01001635900.

Supreme War Council (*gunjisangikan*).<sup>513</sup> Inoue's successor as the head of the Aviation Bureau was Watanabe Jōtarō. Watanabe seemed to be hardly qualified for promoting the build-up of a strategic bomber fleet against the resistance of the army's traditionalists. According to Koiso's memoirs Watanabe confessed to him in 1929 that he was a "total amateur in all matters concerning aviation" and asked if there was "any book to make [him] understand it easily."<sup>514</sup>

After the beginning of the invasion of China in September 1931, the army's general staff recognized the Kwantung Army's move as *fait accompli*, ignored the 1923 Imperial Defense Policy, and made the advance into China its new battle doctrine. This fundamental shift rendered the army's plans to bomb and occupy the Philippines obsolete. Furthermore, as discussed in the previous chapter, Chinese airpower in Manchuria was already annihilated during the first few days of the conflict, so the need to deploy the long-range bomber in Northeast China did not arise.

As a further fallout of the Manchurian Incident, Araki Sadao (1877–1966) was appointed army minister in the new Inukai Cabinet in December 1931. Araki belonged to the Army's radical Imperial Way faction (*kōdō ha*). He revised the policy of his predecessor Ugaki Kazushige, who, as discussed in Chapter 2, together with reduction of troop numbers, had enlarged the army's airpower. Emphasizing the Japanese Army's fighting spirit and spiritual mobilization over modern technology and material strength, Araki showed little interest in a technologically advanced army air force that carried out missions beyond the tactical support of ground troops.

---

<sup>513</sup> For an account of how the army's promotion policy obstructed the build-up of professional expertise see Ishida Keigo and Hamada Hide, "Kyūnihongun ni okeru jinji hyōkaseido [The evaluation of personnel matters in the former Japanese military]," *Bōeikenkyūshokiyō* 9 (2006): 55.

<sup>514</sup> Koiso, *Katsuzan Kōsō*, 425.

Under these circumstances there was little prospect for the Army Type 92 Superheavy Bomber to open up a new chapter in Japan's military history. Nevertheless, from December 1931 to May 1932 the new bomber underwent a thorough test program. The aircraft was then transferred to the army's 7th Air Wing at Hamamatsu (see Map 1), where the training of the bomber crews started in June 1933.<sup>515</sup> While in 1933 the bombers made nearly three hundred flights over Japan, mainly for the training of their crews, they mostly stayed on the ground in the following years.<sup>516</sup> With the bomber's *raison d'être* becoming increasingly doubtful, its production stopped after the sixth aircraft in 1935.

In a half-hearted attempt to assign a role to the bomber in future wars, the Japanese Army set up a special task force (*tokubetsu ninmu butai*) that, in the case of a war with the Soviet Union, could fly long-range missions that included preemptive airstrikes in the Soviet hinterland.<sup>517</sup> However, the task force was established only as a reserve unit that would be activated upon a mobilization order. Such an order was never issued, and the unit's bombers were disassembled and stored in a hangar at the Army Aviation Headquarters arsenal in Kakamigahara.

Even though the Type 92 Bomber was never used for its intended purpose of strategic bombing, it had a deep impact on Mitsubishi's aircraft manufacturing. As we have seen, Mitsubishi began building the first two bombers from prefabricated parts that were supplied by Junkers. The Japanese company then managed to take control of the complete production process. Considering the complexity of this large-scale four-engine aircraft, this transition was a

---

<sup>515</sup> Akimoto, *Kyojinki monogatari*, 160.

<sup>516</sup> Izawa Yasuho, *Nihon Rikugun jūbakutai* [The heavy bomber squad of the Japanese Army] (Tokyo: Gendaishi Shuppankai, 1982), 51.

<sup>517</sup> Akimoto, *Kyojinki monogatari*, 160.

remarkable achievement. It testifies that Mitsubishi could absorb Junkers' innovative design and production technology quickly.<sup>518</sup> According to one commentator the introduction of unified standards and efficient blueprint management became the foundation of Mitsubishi's aircraft production after 1932.<sup>519</sup> A former Mitsubishi engineer recounted that the "massive amount of technological information and manufacturing technology became one of Mitsubishi's most precious assets for the further development of the company's technology."<sup>520</sup> Even Mitsubishi's competitors became aware of Junkers' pervasive influence on Mitsubishi's production technology. The Kawasaki engineer Senba Tadashi paid a visit Mitsubishi's Nagoya factory in 1933. After having seen how Mitsubishi used the Junkers methods of standardized parts and efficient riveting he enthusiastically commented: "This is a factory we [other] aircraft makers can only yearn for."<sup>521</sup>

Mitsubishi's interest in Junkers' technology continued, and the Japanese company designed two more bomber types for the army that were based on a Junkers model. However, unlike the Type 92 Superheavy Bomber, these airplanes were not intended to carry out long-range strategic bombing missions. Rather, their purpose was the tactical support of ground troops over the battlefield, as advocated by the army's traditionalists. In September 1930 Mitsubishi imported one Junkers K-37 built in Junkers' Swedish factory. The aircraft, about half the size of the Super Bomber, was one of the few twin-engine airplanes fully certified for acrobatic flight. It combined the nimbleness of a fighter with the load-carrying capability of a bomber. Test flights started in early 1931, and the Junkers aircraft impressed the Japanese Army with its superior

---

<sup>518</sup> Nozawa, *Nihon kōkūki sōshū: Mitsubishi hen*, 39.

<sup>519</sup> Kōkūkōgyōshi hensan iinkai, "Mitsubishi ni okeru kitaisekkei shisaku no hensen" [Changes in Mitsubishi's aircraft body design trial manufacture], in *Minkan kōkūki kōgyōshi*, 156.

<sup>520</sup> Matsuoka, *Mitsubishi hikōki monogatari*, 176.

<sup>521</sup> Kawasaki, *Kawasaki Jūkō Gifu kōjō no omoide*, 54–55.

maneuverability.<sup>522</sup> Mitsubishi used the aircraft as a model for the design of two different bomber types. To accomplish this task Mitsubishi's all-Japanese team of engineers drew heavily on their experience gained during the Super Bomber project. They completely redesigned the Junkers K-37 and presented two vastly different aircraft types in 1933: the Army Type 93 Heavy Bomber, an enlarged version of the German model that could carry a bomb load of 1,500 kg, and the Army Type 93 Light Bomber, a highly maneuverable, lighter version designed both for air battle and bombing missions. The army adopted both aircraft types, and, starting from 1933, Mitsubishi produced them in large numbers.<sup>523</sup> The success of these bombers clearly testifies that Mitsubishi's expertise had reached a level where its engineers could significantly alter German design into custom-made aircraft that closely followed the army's specifications.

While the army's procurement policy followed the conservative relapse of its air strategy, the idea of strategic bombing was resumed and put into practice by the army's archrival, the navy. In 1932 Rear Admiral Yamamoto Isoroku (1884–1943) conceived of a fleet of land-based, long-range bombers that could complement the navy's carrier-based airpower. The Japanese Navy turned to Mitsubishi's expertise in the design of all-metal multi-engine bombers, and in 1934 Mitsubishi presented a prototype that incorporated typical features of the Junkers design, like the "double wing." The new aircraft could boast a flight range of more than six thousand kilometers. The navy was impressed and wanted the prototype to be remodeled into a heavily armed long-range bomber able to carry a bomb load of eight hundred kilograms over a distance of more than four thousand kilometers. Mitsubishi complied with these demands and, already in the following year, came up with a new attack bomber for the navy. The flight tests were

---

<sup>522</sup> Mitsubishi Tokyo Archive MHI-339.

<sup>523</sup> According to Nozawa, 118 Ki-1 and 174 Ki-2 were produced. Nozawa, *Nihon kōkūki sōshū: Mitsubishi hen*, 60 and 93.

successful and convinced the navy that the aircraft could compete with most Western designs of the time.<sup>524</sup> In 1936 production of the Mitsubishi G3M Navy Type 96 Attack Bomber began. The aircraft became famous for its first long-range bombing raid when it took off in Taipei and bombed targets in the Chinese mainland in 1937. In a twist of fate during the following years, the Japanese Army had to rely completely on the Navy's bombers for preemptive air strikes deep in the Chinese hinterlands.<sup>525</sup> The Army's lack of adequate long-range bombers became an even more pressing problem when, with the beginning of the Pacific War, the focus of the navy's airpower shifted away from China to the Pacific theatre.

## Conclusion

In spite of all the frictions and temporary setbacks, Mitsubishi reached new level of technological expertise during its cooperation with Junkers. The company became familiar with the advanced design of large-size, multi-engine aircraft. As we have seen, Mitsubishi was able to venture into a three-step process that began with the assembly of imported parts, led to the licensed production of entirely made-in-Japan aircraft, and ultimately resulted in independent design and manufacturing capabilities. Equally important was the buildup of a production system that allowed the construction of increasingly complex military airplanes. Mitsubishi became the army's and the navy's leading manufacturer of multi-engine bombers, leaving its competitors Kawasaki and Nakajima far behind.

---

<sup>524</sup> Mark R. Peattie comments that only the prototype of the Boeing B-17 was able to outperform the G3M. Peattie, *Sunburst*, 86.

<sup>525</sup> Hagiwara Mitsuru, "The Japanese Air Campaigns in China, 1937–1945," in *The Battle for China: Essays on the Military History of the Sino-Japanese War of 1937–1945*, Mark R. Peattie et al. (Stanford, CA: Stanford University Press, 2011), 237–255.

For the Japanese Army the Super Bomber project was a short term success and a long term failure. As we have seen, the Army Aviation Headquarters' grand vision of an aggressive air strategy put into action with superior technology was strong enough to carry through the Super Bomber project. The army was prepared to spend a considerable portion of its budget for the bomber; it took the risk to make Mitsubishi sign an expensive license agreement for an aircraft that was still under development; and it continued the project in spite of a large cost overrun and considerable production delays. As a result, in 1931 the Japanese Army had the world's most advanced four-engine bomber at its disposal. Its technology and performance could be compared only with the Tupolev TB-3—also based on a Junkers design—that entered the service of the Soviet Air Force in 1932.

However, the army's commitment to its bombing strategy was short-lived. After the 1931 invasion of China its aerial strategy changed and new emphasis on a close cooperation with the army's ground units brought the army's strategic bombing technology to a dead-end. The Super Bomber and its related strategy faded into oblivion. From the early 1930s on the army limited its orders to the design of fast and highly maneuverable bombers that sacrificed armor protection and firepower for speed and maneuverability.

With hindsight the Zero-sen designer Horikoshi Jirō argued that this procurement policy led to a fundamental shortcoming of Japanese airpower:

The fierce resistance with which the heavy American bombers opposed our fighters, unlike that of our own land-based medium attack bombers which too often fell easy prey to enemy fighters, was a most serious problem. In my opinion, which is shared by many Japanese combat officers, the ability of the B-17 and B-24 to defend themselves and carry out their intended missions despite enemy fighter opposition was the deciding factor in the final outcome of the war. . . . Had Japan developed such bombers as the B-17, I believe the war would have taken a different course.<sup>526</sup>

---

<sup>526</sup> Okumiya, *Zero!*, 226–27.

The Japanese Army resumed its plan for a large four-engine bomber only in 1943 when it ordered Kawasaki to start the design of the Experimental Long-distance Bomber Ki-91. As one of history's bitter ironies, American super-bombers began their own air raids on Japan in the summer of the following year. In early 1945 American B-29s dropped their bomb loads over the Kawasaki factories, bringing to a halt the Japanese Army's last Super Bomber project, which was by then in its prototype phase.

## VI

### **The Limits of German Influence: Japanese Aircraft Makers and Their Struggle for Industrial Efficiency**

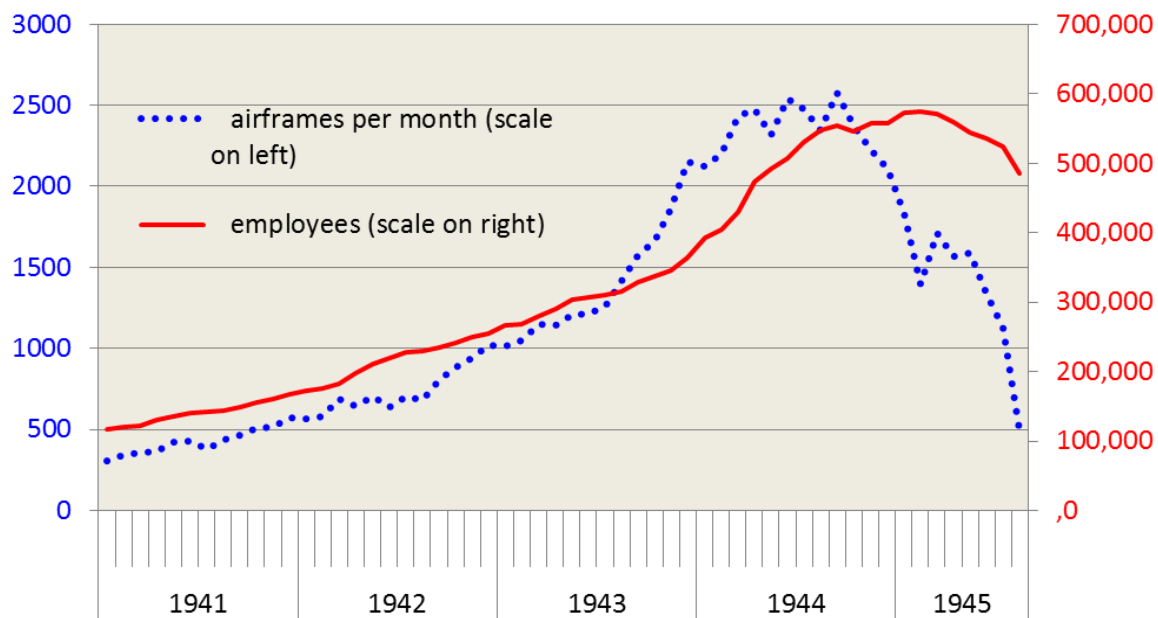
**H**istorians of Western aviation often describe the emergence of a large-scale aircraft industry as the last stage of a three-step process. According to these accounts it all began with amateur inventors and adventurous craftsmen who built the flying machines of the pioneer age. Their work was then taken over by engineers and scientists who replaced their predecessors' intuition and rules of the thumb with slide rules and wind tunnels. Then, in the 1930s industrial leaders and investment bankers began to take control of the aviation industry. They provided the management skills and the capital for an expanding industry that had to meet the growing demand for civil and military aircraft.<sup>527</sup>

Japan was different. As we will see in this chapter, most major Japanese aircraft makers emerged as ventures of large shipbuilders that could support their new aircraft divisions with capital and imported know-how. On the other hand, the growth of the Japanese aviation industry depended on a legion of subcontractors that supplied a large variety of components at a low cost. Furthermore, with no substantial civil aviation before the late 1920s, Japan's aircraft makers depended on the orders of the army and the navy. As a result the Japanese military and government had considerable power and authority to interfere with the manufacturers' management and production.

---

<sup>527</sup> See, for instance, Thomas M. Smith, "The Development of Aviation," in *Technology in Western Civilization, Vol. 2: Technology in the Twentieth Century*, ed. Melvin Kranzberg et al. (New York: Oxford University Press, 1967), 153–80.

This chapter will examine these Japanese particularities. By taking into account the interactions among the industrial, political, and military spheres I will explore the factors that led to a distinctly asymmetrical development within Japan's aviation industry. As we have seen in the previous chapters, by the early 1930s, the speed, endurance, and climb performance of made-in-Japan airplanes was making rapid progress. However, the technology to efficiently produce these aircraft lagged remarkably behind. An industry that built world-class fighters and bombers was ill-prepared to build them efficiently in large numbers.



**Figure 25: The Japanese aircraft makers' monthly airframe production and employment numbers 1941–45. Note the nearly parallel course of the two curves until the end of 1943.**<sup>528</sup>

These peculiarities of Japan's aircraft production developed during the 1920s and 1930s. The problem of low productivity continued, however, throughout the Pacific War. Until the end of 1944 Japan's production numbers rose impressively, peaking in a monthly production of more

<sup>528</sup> Source: *Strategic Bombing Survey, Vol. 15: The Japanese Aircraft Industry* (Washington, DC: The Division, 1947), 155–58. Employment numbers include the navy's air depots and the army's air arsenals.

than 2500 aircraft. At the same time the productivity of the aviation industry's workforce stagnated for several years before taking a nosedive when the effects of material shortage and bombing raids set in (see Figure 25). In other words, Japan's aircraft makers achieved their wartime growth by increasing the number of workers and factory plants rather than by developing more efficient production methods.

### **Mass Production and Military Strategy**

To better understand the strategic importance of mass production we have to go back once more to World War I. The Great War convinced military, political, and industrial leaders that a future war would be a war of factories. These leaders concluded that winning a war in the Industrial Age would crucially depend on a country's infrastructure and industrial mobilization that would enable its economy to out-produce the enemy. Massive industrial output was especially important in the case of military aviation. Any strategy based on a massive deployment of bombers and fighters also had to take into account the ensuing high attrition rate. For instance, in 1939, based on the experience from World War I, a German specialist calculated a need for tens of thousands of new aircraft per year.<sup>529</sup> He argued that air battles would be fought not only up in the sky but also on the ground, where each country's aviation industry and its effort to make the most efficient use of their workforce, machine tools, and material resources could decide the war.

World War I had also shown that the massive output of weaponry alone would not guarantee decisive advantages at the battlefield; armament production also had to be carried out in an efficient and flexible manner. Efficiency and flexibility were particularly pertinent in the

---

<sup>529</sup> Rolf Wagenführ, *Die Flugzeugindustrie der Anderen: Weltkriegserfahrungen, gegenwärtiger Stand, wirtschaftliche Mobilmachung* (Berlin: Hanseatische Verlagsanstalt Hamburg, 1939), 9.

aviation sector, where rapid technological progress rendered the stockpiling of a large number of aircraft pointless. Furthermore, as highly complicated weapons, military aircraft usually would be built by skilled workers. However, any preparation for wartime production had to take into account the lack of trained labor and how to compensate for it with specialized machine tools and simplified, standardized production methods.

Japan's failure to build up such an efficient and highly mechanized aircraft production reveals the limits of German influence. The Japanese were well aware of German efforts to raise industrial efficiency in the aftermath of World War I. During the 1920s they studied Germany's rationalization, mechanization, and scientific management. This chapter will explore the reasons why implementing these concepts at Japanese aircraft makers nevertheless proved to be difficult. In the mid-1930s the reemergence of a new, powerful German Air Force impressed Japanese military observers and convinced them of the benefits of a tight military control over a country's aircraft industry. I will however argue that when the Japanese military implemented a similar system of "guidance" for the country's own aircraft industry it obstructed rather than promoted the advance of Japanese airpower. Japanese aircraft makers had to follow the military's orders for aircraft with ever-increasing flight performance. As a result their engineers focused on the design of a large variety of different aircraft types while paying little attention to the development of an efficient production process.

## **Japan and Germany's Industrial Rationalization**

The origins of industrial rationalization in Germany's aircraft industry can be traced back to World War I. In the wake of America's entry into the war, the German Supreme Army Command was determined to drastically increase the country's aircraft production. The so-called *Amerikaprogramm*, named and launched after the United States' entry into the war in 1917,

aimed to double the output of the German aircraft makers to two thousand aircraft per month. As a response to these demands Germany's aviation industry introduced unified standards and more efficient production methods.<sup>530</sup>

After World War I a more systematic approach to raise industrial productivity, known as Germany's "Rationalization Movement" (*Rationalisierungsbewegung*), emerged as a response to the poor state of the country's industry, still recovering from the aftermath of the war. The loss of the Lorraine region's iron and coal industry, a shortage of capital, and an increasing tax burden severely hampered the recovery of Germany's economy. However, even under these circumstances, the economic machine had to be kept running in order to cover not only domestic needs but also the enormous reparation payments of 132 billion German gold marks that were stipulated in the wake of the Versailles Treaty.

By the mid-1920s German industrial leaders and politicians began to think of rationalization as a panacea that promised more efficient production through the systematic application of scientific methods.<sup>531</sup> The movement was based on three key concepts. First, "scientific

---

<sup>530</sup> Hans-Joachim Braun, "Fertigungsprozesse im deutschen Flugzeugbau 1926–1945," *Technikgeschichte* 57, no. 2 (1990): 112, and John H Morrow, "Die deutsche Flugzeugindustrie im Ersten und Zweiten Weltkrieg. Ein Vergleich," in *Luftkriegführung im Zweiten Weltkrieg: Ein internationaler Vergleich*, ed. Horst Boog et al. (Herford; Bonn: E.S. Mittler, 1993), 53–54.

<sup>531</sup> In spite of these high hopes German rationalization turned out to be a mixed blessing. It led to increasing unemployment, especially among skilled workers. Furthermore, while productivity increased, consumption did not. The industries' overcapacities became expensive, and the workforce had to be reduced further. For details on the "irrational consequences of rationalization" and the "rationalization mania," see Detlev Peukert, *The Weimar Republic: The Crisis of Classical Modernity* (London: Penguin Books, 1993), 112–17, and Harold James, *The German Slump: Politics and Economics, 1924–1936* (New York: Oxford University Press, 1986), 146–61. For a discussion of the social consequences of rationalization in Weimar Germany, see Ulrich Heinemann, "Rationalisierung in der Sackgasse: Technologiediskussion und Rationalisierungsprozeß in der Weimarer Republik," *WSI-Mitteilungen* 38, no. 3 (1985): 151–60.

management” (*wissenschaftliches Management*), proposed new analytical methods for planning and budgeting. It also included a more systematic factory layout and choice of machinery. Second, standardization was seen as an essential tool for efficient mass production and assuring inter-firm compatibility. Finally, inter-firm cooperation rather than competition was intended to guarantee coordinated research and development and to make patents available to the whole industry.<sup>532</sup> In addition to government-sponsored trusts, fixed production quotas and price agreements were to replace a volatile and wasteful free market. Such an all-out effort relied on the heavy involvement of the state, an idea that was clearly at odds with Anglo-Saxon *laissez-faire* policy.

In a very peculiar way the Versailles Peace Treaty also led to a promotion of German production technology, especially in the aviation sector. Since treaty regulations prohibited any aerial rearmament, the German military devoted significant planning and funds to the secret build-up of a new air force. However, the German Army Weapons Agency (*Heereswaffenamt*) opposed any secret production and expensive stockpiling of war matériel that might soon become obsolete. Instead, it decided to prepare extensively for future large-scale aircraft production that incorporated the key features of industrial rationalization. In 1926, in cooperation with the aviation industry, the Army Weapons Agency set up plans for efficient production that used standardized parts, detailed material lists, and design specifications that took into account the requirements of mass production. In addition, large investments went into the development of machine tools that would combine increased output with high product quality.<sup>533</sup>

---

<sup>532</sup> For an in-depth study of German’s rationalization campaign, see Robert Alexander Brady, *The Rationalization Movement in German Industry: A Study in the Evolution of Economic Planning* (Berkeley: University of California Press, 1933).

<sup>533</sup> Budraß, *Flugzeugindustrie und Luftrüstung in Deutschland*, 154–55.

The Japanese business world followed the reshaping of Germany's post-World War I economy with great interest. In summer 1929 the Osaka branch of the *Shinbun Rengō Sha* news agency sent its correspondent Tsukamoto Yoshitaka to Germany. With the financial support of several hundred Osaka industrialists, Tsukamoto stayed two years in Germany, from where he sent regular reports about the development of Germany's industry and economy.<sup>534</sup> Examining in great detail Germany's rationalization of its coal-mining, electric, textile, and transport industries, Tsukamoto was impressed by the effects of standardization, consolidation of companies, and centralized purchasing. Tsukamoto's reports met with great interest, and within a short time he was able to publish four books based on his German experience.<sup>535</sup> Around the same time other Japanese authors also examined the concepts of Germany's rationalization movement and how they were put into practice in the mining, steel, and munitions industries. The Tokyo Chamber of Commerce and Industry joined these efforts and, in order to "provide the most helpful material for Japan's rationalization movement," published in 1930 the translations of two German monographs on industrial rationalization and on the implementation of assembly-line work.<sup>536</sup>

The Japanese government studied developments in Germany as well. In 1926 the Ministry of Commerce and Industry had dispatched Kishi Nobusuke (1896-1987), a former student of

---

<sup>534</sup> A collection of Tsukamoto's reports can be found in Tsukamoto Yoshitaka, *Kinrō to kyōraku senjō no Doitsu-jin* [Germans straddling the line between work and leisure] (Osaka: Shinbun Rengōsha Ōsaka Shisha, 1931).

<sup>535</sup> Tsukamoto Yoshitaka, *Sangyō gōrika no jitsurei Doitsu no tankō* [An example of industrial rationalization: German coal mining] (Osaka: Shinbun Rengōsha Ōsaka Shisha, 1929); *Gōrikaseru Doitsu no denryoku jigyō* [Rationalization in the German electrical industry] (Osaka: Shinbun Rengōsha Ōsaka Shisha, 1930); *Gōrikaseru Doitsu* [Rationalization in Germany] (Osaka: Shinbun Rengōsha Ōsaka Shisha, 1930).

<sup>536</sup> Hans Hinnenthal, *Doitsu ni okeru gōrika undō to Doitsu sangyō gōrika kyōkai* [The German Rationalization Movement and the National Board for Economy and Efficiency] (Tokyo: Tōkyō Shōkō Kaigisho, 1930), and Doitsu Sangyō Gōrika Kyōkai, *Ryūdō sagyō ni kansuru keiken* [Experiences in assembly-line work] (Tokyo: Tōkyōshōkōkaigisho, 1930).

German law, to Germany for one year. In his memoirs Kishi wrote how already at that time he was impressed by the German government's tight control over the country's industry.<sup>537</sup> Initially Kishi's report to the minister received little attention. However, in 1930, the turbulent year of Japan's return to the gold standard, Kishi was sent once more to Germany to study in more detail the German government's protection of important industries. Upon his return to Japan in December of that year, Kishi became a member of the newly founded Provisional Industry Rationalization Bureau (*rinji sangyōgōrikyoku*) and was put in charge of implementing the principles of scientific management, standardization, and efficient financing. Kishi also joined the committee that prepared the draft of the Important Industries Control Law (*jūyōsangyōtōseiho*), which was enacted in 1931. The law showed a strong German influence and was the first of a series of regulations that increased the government's influence on Japan's economy. The Important Industries Control Law legalized the formation of cartels and even authorized the government to force external companies to join the cartels. Kishi, who was to become the head of the powerful Ministry of Commerce and Industry in 1941, continued to play an important role in the government's control of Japan's enterprises.<sup>538</sup>

In 1935 the Japanese Army sent an aviation inspection team under Major General Itō Shūjirō to Germany. The group arrived just in time to witness the official “unmasking” of the German Luftwaffe on March 1, 1935, when the Minister of Aviation Hermann Göring (1893–

---

<sup>537</sup> Kishi Nobusuke et al., *Kishi Nobusuke no kaisō* [The memoirs of Kishi Nobusuke] (Tokyo: Bungei Shunjū, 1981), 12–14.

<sup>538</sup> Janis Mimura, *Planning for Empire: Reform Bureaucrats and the Japanese Wartime State* (Ithaca, NY: Cornell University Press, 2011), explores the role of Kishi and Okumura Kiwao in the set-up of what the author calls Japan's “techno-fascism.” See pp. 34–36 and pp. 107–37 for the role of Germany as a model for Japan's political and economic mobilization.

1946) officially announced the existence of Germany's air force.<sup>539</sup> The organizational structure of the German military convinced Itō of the advantages of an independent air force. Impressed by the number and performance of German fighters and bombers, he argued in his report that Japan's airpower had to expand significantly in order to catch up with the Great Powers (*rekkyō*). He pointed out that, in order to accomplish this aim, Japanese aviation technology and also civil aircraft manufacturing had to be advanced considerably.<sup>540</sup>

A second mission to Germany was to support Itō's recommendations. Itō and his team were granted only limited access to the newly established German Air Force. Therefore, to further investigate the matter, the Japanese Army sent another team of high-ranking officers that included Ōshima Hiroshi (1886-1975), the Japanese Army Attaché in Germany, and Colonel Sugawara Michioo (1888-1983), a section chief in the Army Aviation Bureau. The group's detailed report was published in March 1937, six months before the outbreak of the Second Sino-Japanese War. It dealt with all aspects of military aviation, including education and training, national defense, and preparations for air battle. The Ōshima-Sugawara report clearly emphasized the importance of an efficient large-scale aircraft production and devoted one major section to the "study of [Germany's] aviation industry and its management of material."<sup>541</sup>

The report advocated tighter control of the aircraft manufacturers by the state. It suggested that, in order to expand Japan's aviation industry, the government should employ a carrot-and-stick policy of close supervision and massive funding. The establishment, planning, and

---

<sup>539</sup> "Enttarnung" (unmasking) was official expression for the end of Germany's secret aerial rearmament.

<sup>540</sup> Shūjirō Itō, "Rikugunkōkūshisatsudan ōbeikōkūjijōshisatu [The Army Aviation Inspection Team's report on the situation of Western aviation]," 1936, JACAR Ref. C01004242500.

<sup>541</sup> Ōshima Hiroshi et al., "Kōkū shisatsudan hōkoku daiichikan [Report of the aviation inspection team, part one]," 1937, Military Archive of the National Institute of Defense Studies, 33–35.

operation of Japan's civil aircraft makers needed to be controlled by a powerful government institution that combined the army, navy, and civil industry. Such an institution, the report continued, should guide the civil industry and their production of military aircraft, supervise their accounting, and have the power to impose sanctions. At the same time the manufacturers should be given the opportunity to earn the trust of the government authorities and the military. Furthermore, guaranteed orders and adequate compensation should relieve the manufacturers from worries about the volume of their sales and each company's profit. The Japanese team members expressed their "envy of the capabilities, sense of responsibility, and trustworthiness of German civil factories" where all this had already been accomplished.<sup>542</sup>

Ōshima and Sugawara also examined what they saw as important topics of mass-production and research. The authors emphasized that Japan's aviation industry had to set up an efficient mechanized production using a large variety of machine tools. Furthermore, a radical standardization of parts and materials would be necessary. They believed the driving force behind research and development should be a competition between a limited number of civil aircraft manufacturers, which all should be given the chance "to show their individual strengths." The development and production of prototypes should be fully funded by the military, which would be also responsible for their evaluation. All this required close cooperation among the military, government, and private enterprises (*gunkanmin to kinmitsu na kankei*), with the civilian aircraft makers counting on legal and financial support from the country's political and military leadership. Again, in an imploring manner, the authors concluded: "The German aviation industry is already such a perfect system."<sup>543</sup>

---

<sup>542</sup> Ibid., 58.

<sup>543</sup> Ibid., 34.

## The 1938 Aircraft Manufacturing Industry Act

State-controlled expansion of Japan's aviation industry was the single most significant consequence of the Ōshima-Sugawara report. In June 1937, one month before the outbreak of the war with China, the Army implemented a Five-Year Plan for Key Industries (*Jūyōsangyō gokanen keikakuyōkō*) that included a massive expansion of the aviation sector to a projected total production aim of ten thousand military aircraft.<sup>544</sup> This was an ambitious target, considering that the industry's output during the previous year amounted to fewer than six hundred aircraft.<sup>545</sup> At the same time, the proponents of a tight regulation of Japan's key industries could count on the public's worries about an uncontrolled growth of state-sponsored aircraft manufacturers. As one press report put it, by claiming their share of government contracts an increasing number of "dishonest [aviation] enterprises are dreaming of making a fortune at a stroke."<sup>546</sup>

The 1938 Aircraft Manufacturing Industry Act (*kōkūki seizōjigyōhō*) provided a legal base for the government's new strict regulation and control of Japan's aircraft production.<sup>547</sup> Using a rhetoric of "preventing the industry's uncontrolled growth and promoting its healthy development," the law drastically cut the numbers of aircraft makers. By imposing strict lower limits on capitalization and annual production capability, it consolidated the aviation industry to

---

<sup>544</sup> Army Ministry, "Jūyōsangyō gokanen keikakuyōkō" [Outline of the five-year plan for key industries], 1937, JACAR Ref. C12120069500, 700. The navy passed a similar scheme, the Third Supplement Plan (*Daissanji gunbihojūkeikaku*), that focused rather on fleet expansion than on increasing the number of the navy's aircraft.

<sup>545</sup> Nihon Kōkū Kyōkai, *Nihon kōkūshi, shōwa zenkihen*, 872.

<sup>546</sup> "Kōkūkiseizōjigyōhō" [Aircraft Manufacturing Industry Act], *Chūgai Shōgyō Shinpō*, March 10, 1938.

<sup>547</sup> "Kōkūkiseizōjigyōhō" [Aircraft Manufacturing Industry Act], 1938, JACAR Ref. A03022163100.

just fourteen licensed manufacturers.<sup>548</sup> It also empowered the government to limit the amount of foreign investment for each company to less than 50 percent. Competition among aircraft makers was abolished and replaced by the military's direct orders to one manufacturer for the design of a specific aircraft type that then was to be produced by several companies.<sup>549</sup>

The law entitled the government to interfere with all aspects of a company's management and production "if necessary for military reasons." Government officials could order the expansion of factories, set fixed prices, and administer the supply of material. Furthermore they were authorized to determine the training of personnel, the types of research to be carried out, and how to protect factories against espionage. In exchange, these licensed aircraft makers received several "privileges for protection and encouragement." The law granted them a five-year tax exemption, subsidies for the production of prototypes, and support for the expansion of their businesses.

The concept of advancing a country's aviation industry by consolidation and inter-firm cooperation and by limiting free competition was a transnational phenomenon. One year after the outbreak of the Pacific War the U.S. aviation industry underwent a consolidation similar to that of Japan. In April 1942 eight major West Coast aviation companies founded the Aircraft War

---

<sup>548</sup> Only firms with a capitalization of at least ¥3 million and an annual production of more than six tons of airframes or 300 engines per year could apply for a license. See "According to the Aircraft Manufacturing Industry Act fourteen companies were established as licensed manufacturers," *Osaka Asahi*, December 27, 1938.

<sup>549</sup> Odagiri Hiroyuki and Goto Akira, *Technology and Industrial Development in Japan: Building Capabilities by Learning, Innovation, and Public Policy* (Oxford: Clarendon Press, 1996), 219.

Production Council. Instead of competing with each other, the manufacturers agreed to exchange know-how, material, workmen, and production facilities in order to increase war production.<sup>550</sup>

While Japan's Aircraft Manufacturing Industry Act profoundly transformed the country's aviation industry, it had two serious shortcomings. Even though the law was intended to limit the number of aviation companies, it still allowed a considerable number of different manufacturers to continue their operation as licensed firms. Each of the fourteen licensed companies kept on developing and producing their own aircraft. As a result a large number of different aircraft types was delivered to the Japanese Army and Navy, which frustrated any hopes of inter-service interchangeability and standardization. Even more importantly, the Aircraft Manufacturing Industry Act did not concern itself with the advance of production technology. Several reports from Germany and elsewhere had emphasized the importance of setting up an efficient system for mass production. However, as we will see in the next section, the Japanese aviation industry still had to cope with several serious obstacles that hindered a significant productivity increase.

### **The Japanese Aircraft Makers' Problems with Mass Production**

Mechanized mass production is an icon of industrial modernity.<sup>551</sup> Its three main principles of standardization, interchangeability, and mechanization have grown into transnational maxims for industrial efficiency. Even though the origins of mass production are widely associated with the manufacturing of Ford's 1908 T-model, they can be traced back to the second half of the

---

<sup>550</sup> Robert G. Ferguson, "Airframe Manufacture and Engineering Exchange," in *Atmospheric Flight in the Twentieth Century*, ed. Peter Galison et al. (Boston: Kluwer, 2000), 273.

<sup>551</sup> The authors of the *Encyclopedia of the Age of the Industrial Revolution* include mechanized mass production along with the factory system as the major defining features of the Industrial Revolution. Christine Rider (ed.), *Encyclopedia of the Age of the Industrial Revolution, 1700–1920* (Westport, CT: Greenwood Press, 2007), xiii–xiv.

nineteenth century, when U.S. armories, sewing-machine makers, and the bicycle industry began to produce interchangeable parts on special-purpose machines.<sup>552</sup>

Ford's factory was mass producing civilian goods for civilian mass consumption. In Ford's view, "mass production was only possible through the ability of the public to absorb large quantities of the commodity thus produced."<sup>553</sup> But mass production also became the foundation of industrialized warfare during World War I. In order to increase the output of their weapons industries, the war-faring nations of Europe adopted methods of American mass production.

The efficient mass production of military aircraft is a difficult endeavor. While ammunition, cannons, and rifles can be assembled from a small number of standardized components that allow an easy implementation of mass production methods, aircraft are different. The production of these complex machines that consist of several tens of thousands of different parts requires huge organizational, technical, and financial efforts. In addition, constant technological innovation and ever-changing military specifications require continuous design modifications that can easily turn into a nightmare for a company's production engineers. Moreover, as most of the aircraft designers and their military customers were typically more concerned with the superior performance of a new aircraft than with its ease of production, consideration of production features at the early design stage was often neglected.

### ***From Watercraft to Aircraft***

In addition to the inherent problems of mass production, several major Japanese manufacturers had to cope with an extra set of difficulties that arose as a legacy of their

---

<sup>552</sup> David A Hounshell, *From the American System to Mass Production, 1800–1932: The Development of Manufacturing Technology in the United States* (Baltimore: Johns Hopkins University Press, 1984), 67–124, 189–216.

<sup>553</sup> Henry Ford, "Mass Production," in *Encyclopedia Britannica* (London: Encyclopaedia Britannica Co., 1926), 821–23.

shipbuilding origins. We therefore have to digress from our chronology and examine the very distinctive way in which the aviation branches of these companies emerged, a process that was distinctly different in Western countries, where pioneering pilots and engineers set up their own small workshops and ateliers.

A common feature of Japan's major shipbuilders was their continuous reliance on the government's support and protection. After the 1894–95 Sino-Japanese War, a war indemnity of ¥364 million, equivalent to more than eight thousand tons of silver, provided the funds for a massive naval armament program.<sup>554</sup> The 1896 Law for the Encouragement of Shipbuilding (*kōkai shōreihō*) allocated a subsidy of over ¥9 million to the building of large-size ships. Mitsubishi and Kawasaki received the lion's share.<sup>555</sup>

The technological development of Japan's shipbuilding industry followed a three-stage process of importation, imitation, and independent design, a pattern which was repeated later in the field of aviation technology. After the wholesale import of Western vessels, a phase of foreign-assisted domestic production began. In 1904 the Japanese Navy acquired five U.S. submarines along with their blueprints. Kawasaki received an order to build two additional submarines of this type and accomplished the task with the help of invited U.S. engineers in the following year.<sup>556</sup> In a similar way, Mitsubishi gained access to state-of-the-art steam turbine technology through a tie-up with the British Parsons Marine Steam Turbine Company. Making good use of the imported technological expertise, Mitsubishi established its own research

---

<sup>554</sup> The indemnity amounted to nearly one-fourth of Japan's 1895 GDP. Numbers taken from: Andō Yoshio, *Kindai Nihon keizaishi yōran* [An outline of modern Japan's economic history] (Tokyo: Tōkyō Daigaku Shuppankai, 1979), 2.

<sup>555</sup> *Ibid.*, 72.

<sup>556</sup> Kawasaki jūkō hyakunenshi hensan iinkai, *Yume o katachini*, 17.

department with experimental water tanks and material laboratories.<sup>557</sup> As a result the company's technical expertise developed to such a degree that it was able to design and produce its own high-powered turbines and generators in subsequent years.<sup>558</sup>

During World War I Japan's economy boomed. Exports more than tripled to over ¥2 billion in 1918.<sup>559</sup> With a rush of orders from Europe and the United States, the Japanese shipbuilding industry participated in the upsurge. The leading companies invested large portions of their rising profits in research laboratories and advanced production technology, leading to significant progress in know-how and productivity. It was during this period of ready money and growing expertise that both Kawasaki and Mitsubishi took their first steps toward diversification. Mitsubishi established its section of submarines, aircraft, and automobiles at Kobe in 1916 and Kawasaki founded a new automobile and aircraft branch at its Hyōgo factory in April 1918.

With well-established economies of scale, Mitsubishi, Kawasaki, and Ishikawajima could afford to invest in these new technologies. At the same time these companies could build on their close connection with the government and the military to secure capital, orders, and protection. From a technological point of view the major shipbuilders were well prepared to engage in the aviation business. They already had established a tradition of technology transfer and indigenization. They built up experience in machine manufacturing technology and trained scores of skilled artisans and workmen. In addition, they learned to master the two key technologies needed: all-metal ship construction and advanced combustion engines.

---

<sup>557</sup> Matsumoto Miwao, "Reconsidering Japanese Industrialization, Marine Turbine Transfer at Mitsubishi," *Technology and Culture* 40, no. 1 (1999): 74–97.

<sup>558</sup> Nagao Katsuko, *Nihon kōsaku kikaishi ron* [A history of Japanese machine tools] (Tokyo: Nikkan kōgyō shuppan purodakushon, 2004), 20.

<sup>559</sup> Andō, *Kindai Nihon keizaishi*, 100.

However, the same shipbuilding experience that helped Japan's major aircraft makers advance their technology also contributed to their failure to establish an efficient system for mass production. By their very nature shipyards were involved in the construction of a limited number of large trading vessels or battleships that met the particular specifications of their customers.<sup>560</sup> Production engineers call such a system where a specific product is made for an individual customer "job production."<sup>561</sup> Even when applied in industries of scale, job production had many features in common with traditional craft production, such as the employment of skilled workers, little emphasis on standardization, and the use of universal tools instead of specialized production machinery.

Thus, when shipbuilders like Mitsubishi and Kawasaki transferred their shipbuilding-based method of production management to their aviation departments, several problems occurred. Neither the managers nor the engineers of the emerging aircraft makers planned for efficient mass production. Each aircraft was built piecemeal by a group of specialized workers who used their manual skills rather than labor-saving machinery. Even though the job production process was slow and expensive, it still could meet the Japanese military's demand that only increased slowly from two hundred airplanes per year in 1931 to four hundred airplanes per year in 1937, when the Second Sino-Japanese War began.

After 1937 the need for new aircraft grew by roughly 100 percent per year, and without a significant rise in productivity it became increasingly difficult for Japanese aircraft makers to

---

<sup>560</sup> Wada Kazuo and Shiba Takao, "Nihonteki seisan shisutemu no keisei" [The formation of a Japanese-style production system], in *Nihonteki keiei no renzoku to danzetsu* [Continuities and discontinuities of Japanese-style management], ed. Yasuoka Shigeaki et al. (Tokyo: Iwanami Shoten, 1995), 129–30.

<sup>561</sup> S. Eilon, "The Production Smoothing Problem," *Production Engineer* 51, no. 4 (1972): 123–29.

fulfill the military's orders. This problem continued throughout the Pacific War. A 1944 analysis of Japan's industrial mass production by Aikawa Haruki (1909–53), one of Japan's leading theorists of technology, illustrates this point. Aikawa, a Marxist who turned into a staunch supporter of Japan's wartime mobilization, was convinced that technological efficiency was the key to Japan's social transformation.<sup>562</sup> In his harsh critique of the Japanese aircraft industry's low productivity, Aikawa argued that the aircraft makers could not liberate themselves from their shipbuilding legacy. They did not reorganize their production methods when orders for new aircraft increased rapidly. Instead of adopting a sequential series of operations that would efficiently employ special-purpose machines, they built more and more factories and employed an increasing number of workers. The resulting fragmentation of the production process led to poor coordination, unbalanced production, countless different production tools, and slipshod production by subcontractors. Aikawa concluded that the aircraft makers' efficiency declined to such an extent that they soon reached the limits of their expansion.<sup>563</sup>

### ***The Downside of the Military's Influence***

Close ties with the military were yet another heritage of the aircraft makers' shipbuilding past. The military provided the industry with generous funding together with constant requests for advanced design features which became the driving forces behind the rapid progress of Japan's aviation sector. Continuous orders ensured the aircraft makers' survival even in times of recurring economic downturns. For example, a newspaper article published in 1930 under the

---

<sup>562</sup> For an account of Aikawa's visions and theories, see Aaron Stephen Moore, *Constructing East Asia: Technology, Ideology, and Empire in Japan's Wartime Era, 1931–1945* (Stanford, CA: Stanford University Press, 2013), 21–63.

<sup>563</sup> Aikawa Haruki, *Gijutsu oyobi ginō kanri: taryō seisan e no tenkan* [Management of technology and technical skill: Conversion to mass production] (Tokyo: Tōyō Shokan, 1944), 146–48.

title “Only the Aviation Industry Is Flourishing” reported that even in a time of global recession Japan’s aircraft manufacturing industry was booming. Large orders by the military allowed these companies even to increase their workforces and to expand their production facilities.<sup>564</sup>

However, with generous loans, guaranteed purchases, and price agreements, munitions companies had little incentive to care about a streamlined production that made the best use of its workforce and its material resources. As one historian put it, rather than improving their efficiency and investing into advanced production technology, these companies were more concerned with improving their relationships with the military’s top brass in order to secure as much funding as possible.<sup>565</sup>

High-ranking officers, both retired and on active duty, increasingly interfered with the production of civil manufacturers, which on many occasions turned the military’s strong influence into a burden for the aircraft makers. A 1934 article reported “a recent trend” to install more and more retired officers in important positions in the munitions industry to inspect the production process.<sup>566</sup> The military’s influence increased with the 1937 revision of the Law for the Protection of Military Secrets (*gunkihogohō*). The new law allowed active-service military to enter factories and to take over their management and administration.<sup>567</sup> However, the army’s and navy’s promotion policies did not encourage the build-up of an officer corps with extensive technical expertise. Many leading officials in both the army’s and the navy’s Aviation Headquarters were officers who had little or no aeronautical knowledge but who were eager to

---

<sup>564</sup> “Only the Aviation Industry Is Flourishing,” *Hōchi Shinbun*, November 27, 1930.

<sup>565</sup> Okumura Shōji, *Gijutsushi o miru me: jidōsha kara kyōyūzen e* [An eye on the history of technology: From the automobile to the Kyoto Yūzen process] (Tokyo: Gijutsu to Ningen, 1977), 68–71.

<sup>566</sup> “The Military Sphere Colors the Great Munitions Industry,” *Osaka Mainichi Shinbun*, October 15, 1934.

<sup>567</sup> Kishi, *Kishi Nobusuke no kaisō*, 40ff.

advance their careers.<sup>568</sup> For instance, most of the heads of the Aviation Bureaus of the army and navy stayed less than one year in office before moving on to their next career steps.<sup>569</sup> These officers could be easily impressed by the latest foreign technology, which they then asked the companies' engineers to emulate or even to surpass. Their numerous unreasonable requests for aircraft with superior flight performance often puzzled the companies' engineers, who mostly tried in vain to point out the conflicting requirements that were impossible to implement. For instance, the aviation engineer Andō Nario starts his book about the design of military aircraft with a story about how in 1933 he tried in vain to convince the militaries of the simple fact that an aircraft can have either an excellent horizontal speed or a superior climb performance but not both.<sup>570</sup>

Both the army's and navy's emphasis on maneuverability, extended flight range, and minimized weight obliged the engineers to give more consideration to an aircraft's performance than to its suitability for mass production.<sup>571</sup> Even after the outbreak of the Sino-Japanese War, when the demand for large-scale production became much more urgent, Japanese engineers kept their main focus on fulfilling the technological requirements of their military customers for

---

<sup>568</sup> For complaints about the incompetent leaders of the Army Aviation Headquarters, see Koiso Kuniaki, *Katsuzan Kōsō*, 425, and Hata Shunroku et al., *Gensui Hata Shunroku kaikōroku* [The memoirs of Marshal Hata Shunroku] (Tokyo: Kinseisha, 2009), 192, 469–79.

<sup>569</sup> Hata Ikuhiko, *Nihon rikū-kaigun sōgō jiten* [A general dictionary of the Japanese Army and Navy] (Tokyo: Tokyo Daigaku Shuppankai, 2005), 318.

<sup>570</sup> Andō Nario, *Nihon rikugun-ki no keikaku monogatari* [A story of the design of military machinery] (Tokyo: Kōkūjaanarusha, 1980), 1. Andō, who had been trained by the German engineer Richard Vogt, was one of the few members of the Army Aviation Headquarters with appropriate aviation expertise. For a critical view of the Navy's emphasis on aircraft performance over considerations for mass production, see Okamura, *Kōkū gijutsu no zenbō*, 1, 35–46.

<sup>571</sup> Nihon Kōkū Kyōkai, *Nihon kōkūshi, shōwa zenkihen*, 937.

continuous upgrades of existing aircraft types and the development of new prototypes rather than directing their efforts to more efficient production technologies.<sup>572</sup>

The problem of poor production design continued well into the 1940s. In 1942 Mitsubishi's construction bureau published a description of the German aircraft maker Heinkel's design and production process. The authors criticized their company for having no coherent policy toward establishing mass production.<sup>573</sup> They pointed out how the designers of the German company carefully considered the factory's production capability, types of machine tools, number of workmen, and availability of warehouses. After an additional analysis of each single production process these engineers would start to design the aircraft. Together with the evaluation of the prototype, an examination of the new aircraft's experimental production would be held. The German designers would follow the principle that, "no matter how excellent the performance of the airplane, if it is not suitable for mass production the aircraft will have no value as a military aircraft."<sup>574</sup>

Yet another problem severely hampered the efficient wartime production of Japanese military aircraft. In order to stay in business, the aviation industry eagerly complied with the military's demands for the constant development of new aircraft. As a result, a bewildering variety of different aircraft types entered service. A conservative count by the United States Strategic Bombing Survey gives ninety basic aircraft types with 164 variations that were

---

<sup>572</sup> Wada, "Nihonteki seisan shisutemu no keisei," 125–57, and Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 404.

<sup>573</sup> Mitsubishi Nagoya Aircraft Construction Bureau, *Taryōseisan sankōshiryō* [Reference material about mass production], 1942, Mitsubishi Heavy Industries Komaki Archive, not catalogued, 2.

<sup>574</sup> *Ibid.*, 5.

produced by Japan during the Pacific War.<sup>575</sup> In retrospect, several Japanese sources acknowledged the failure to limit the range of aircraft types to a small enough number that could be produced efficiently in large quantities.<sup>576</sup> Instead, many different production lines had to be set up. For instance, when the Pacific War started, Kawasaki had to manage the parallel production of six different aircraft types in one single factory.<sup>577</sup> In addition, considerable efforts became necessary for the training of flight crews and the stockpiling of spare parts. The large number of different aircraft types also led to a confusing designation system that puzzled the Allies to such a degree that they decided to attribute their own code names to most Japanese aircraft types.<sup>578</sup>

### ***The Struggle for Standardization***

Standardization is a key feature of an integrated industrial economy. The implementation of industrial standards allows the production of interchangeable parts at different factories. Standardization not only increases the efficiency of the industry as whole but also provides a “cushion” for a wartime economy, because, after the bombing of one factory, identical parts can be produced elsewhere.<sup>579</sup>

Standardization developed into a transnational concept when, beginning in 1901 with the British Engineering Standards Association, most major industrial countries established their

---

<sup>575</sup> *Strategic Bombing Survey, Vol.15: The Japanese Aircraft Industry* (Washington, DC: The Division, 1947), 2.

<sup>576</sup> See, for instance, the evaluation of Horikoshi Jirō, the designer of the Zero fighter, in Okumiya, *Zero!*, 357–60.

<sup>577</sup> Kawasaki Kōkūikōgyō Kabushikigaisha, *Kōkūkiseisaku enkaku kitai no bu* [The development of aircraft production – airframes], 1946, Kakamigahara Aerospace and Science Museum, not catalogued, 48.

<sup>578</sup> These names covered a range from “Abdul” for the Nakajima Ki-27 to “Zeke” for the Mitsubishi Zero fighter. See Francillon, *Japanese Aircraft of the Pacific War*, 566–70.

<sup>579</sup> *Strategic Bombing Survey: Aircraft Division Industry Report European war* (Washington, DC: U.S. G.P.O., 1947), 106.

national standards associations. In 1917 the German Standardization Committee (*Deutscher Normenausschuß*) was established under the motto of industrial standards being a “logical product of the common human urge for order.”<sup>580</sup>

Japan founded its Investigation Committee for the Unification of Standards of Industrial Products (*kōgyōhin kikakutōitsu chōsakai*) in 1921. The committee was in charge of issuing the so-called Japanese Engineering Standards (*Nihon hyōjunkikaku*) that were to be followed by Japan’s industry. Japan joined the efforts for worldwide standardization and hosted the 1929 World Engineers’ Conference where questions of scientific management and international industrial standards were discussed. In the same year, Japan became a member of the International Standardization Committee and adopted the metric system. Standardization was an issue of high priority for Japan’s Industrial Rationalization Council, which included it on the list of the top five principles of its rationalization policy in 1930.<sup>581</sup>

Technical standards can, of course, be effective only if they are universally implemented. Japan’s large civil enterprises like shipbuilding, the electrical industry, and rolling stock companies adopted the general standards for their design specifications. However, mid-size and small enterprises widely ignored the new standards. For an economy whose ancillary industry was still made up of countless small subcontractors, this incomplete standardization continued as a persistent problem.

---

<sup>580</sup> M. Hellmich, *DIN, 1917–1927* (Berlin: Deutscher Normenausschuss, 1927), 17, quoted in Brady, *The Rationalization Movement in German Industry*, 27.

<sup>581</sup> Nihon Kagakushi Gakkai, “Sangyōgōrika kara sono gunjika e” [From industrial rationalization to militarization] in Nihon Kagakushi Gakkai, *Nihon kagaku gijutsushi taikei, 18, Kikai gijutsu* [A survey of the history of Japanese science and technology, vol. 18: Machine technology] (Tokyo: Daiichi Hōki Shuppan, 1966), 316–38.

Even more importantly, the Japanese Army and Navy showed little inclination to surrender any jurisdiction to civil authorities; each insisted on maintaining their own independent aviation standards that did not conform to the Japanese Engineering Standards. Initially, the two branches made an effort to cooperate in the field of aviation and signed an Agreement on Military Aviation (*rikukaigun kōkūkyōtei*) in 1922. But the arrangement was of little consequence—Japanese historians called it “mere scrap of paper” (*shibun*)—and the parallel development of the army’s and navy’s air forces continued.<sup>582</sup> In a second attempt, the Cooperation Committee of the Army and Navy Aviation Headquarters (*rikukaigunkōkūhonbu kyōchōiin*) was established in 1936. The committee was responsible for setting up uniform standards specifically for the design, adoption, and production of military airplanes. It was also in charge of increasing aircraft production efficiency and of promoting the economical use of material.<sup>583</sup> However, in spite of the committee’s ambitious agenda, neither the army nor the navy could overcome their long-standing antagonism, and the two services restricted their cooperation to “training and information exchange.”<sup>584</sup>

The authors of the 1938 Aircraft Manufacturing Industry Act were also concerned over the persistent problem of standardization. Paragraph six explicitly empowered the government’s Aircraft Technology Committee to compel the standardization of aircraft bodies, engine propellers, parts, and accessories by banning the use of non-standardized parts in the production

---

<sup>582</sup> Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 157.

<sup>583</sup> Army Ministry, “Rikukaigunkōkūhonbu kyōchō jishshi ni kan suru ken” [On the implementation of an cooperation between the army’s and navy’s Aviation Headquarters Aircraft Manufacturing Industry Act], 1936, JACAR Ref. C01001427100.

<sup>584</sup> Bōeichō, *Rikugun kōkū no gunbi to un’yō* 1, 495.

of aircraft.<sup>585</sup> For the first time Japan's industry had to meet the legal obligation to observe the standards set by the government. However, at the same time, the regulation permitted the government to "grant exceptions," a privilege which the government officials then delegated to the Army and Navy Ministry. Therefore, instead of cooperating and developing unified standards, the two services could continue to jealously protect their spheres of influence. The ongoing army-navy rivalry led to some bizarre results. As one historian has pointed out, the navy and army used thirteen different sizes of cartridges for their aircraft guns. Only one of these cartridge types could be interchanged between the two services.<sup>586</sup> Furthermore, due to different standards and specifications, aircraft makers like Mitsubishi and Nakajima, which produced for both the army and the navy, had to manage two separate design, prototype construction, and production lines.<sup>587</sup>

In spite of several attempts by high-ranking bureaucrats and military officials, the problem of deficient standardization was never fully solved. In 1941, in the wake of a mission to Germany led by General Yamashita Tomoyuki (1885–1946), the army and navy started another effort to cooperate in the adoption of unified standards for weapons and matériel.<sup>588</sup> In the following year the newly established Technology Board (*gijutsuin*) became responsible for setting up aeronautical standards. Nevertheless, even major companies continued using their own standards for their airframes and main wing rivets until the end of the war.<sup>589</sup>

---

<sup>585</sup> "Kōkūkiseizōjigyōhō" [Aircraft Manufacturing Industry Act], 1938, JACAR Ref. A03022163100.

<sup>586</sup> William D. O'Neil, *Military Transformation as a Competitive Systemic Process: The Case of Japan and the United States Between the World Wars* (Alexandria, VA: Ft. Belvoir Defense Technical Information Center, 2003), 2.

<sup>587</sup> Nihon Kōkū Kyōkai, *Nihon kōkūshi, Shōwa zenkihen*, 887.

<sup>588</sup> Bōeichō, *Rikugun kōkū heiki no kaihatsu seisan hokyū*, 224–25.

<sup>589</sup> Nihon Kōkū Kyōkai, *Nihon kōkūshi, Shōwa zenkihen*, 865 ff.

### *Interchangeability and Japan's Dual Economic Structure*

Standardization is closely related to the concept of interchangeability. Both are important features for the makers and users of military hardware. Weapons and machinery that consist of standardized and therefore interchangeable parts can be easily repaired and maintained even under battlefield conditions. Interchangeability also speeds up mass production by eliminating the need for additional fitting before final assembly. As mentioned before, the “American system” of manufacturing interchangeable parts emerged from U.S. armories during the first half of the nineteenth century. U.S. civil manufacturers further developed this production process using jigs and gauges together with special-purpose machine tools that enabled them to mass produce sewing machines, bicycles, and automobiles.

However, the implementation of interchangeability in the aviation industry met with a number of difficulties that arose from the complexity of aircraft.<sup>590</sup> Complicated surfaces curved in three dimensions, flexible large-size structures, and fluctuating manufacturing tolerances made it difficult to produce absolutely identical parts. These problems could be resolved, at least in part, by replacing manual welding with drop forging<sup>591</sup> and by consistently using precision tools, jigs, and fixtures during production.

Yet, for Japan's emerging aircraft industry, the procurement and operation of such sophisticated machinery was an expensive endeavor. It also would have required the Japanese aircraft makers to completely reorganize their production process that had, since its beginnings, relied on a large number of small subcontractors. As numerous historians have pointed out, starting from the 1880s, this dual economic structure of advanced large industrial monopolies

---

<sup>590</sup> Courtney J. Hertel, “The Interchangeability in the Present Aviation Industry,” *Aircraft Engineering*, January 1940.

<sup>591</sup> The drop-forging method shapes a piece of metal by dropping a heavy hammer on it.

and small manufacturing workshops had developed into an enduring feature of Japan's economy.<sup>592</sup> Still in 1929 small firms with fewer than ten employees made up more than 50 percent of the country's factories.<sup>593</sup> While the capital-intensive oligopolies and cartels of the chemical, metal, machinery industries could rely on the government's support, these small-size enterprises did not have the funds for the training of their workers or for the purchase of advanced machinery.<sup>594</sup> As a result, they were in no position to provide the standardized parts the large manufacturers would have needed for efficient mass production. Subcontracting in Japan continued throughout the war. An analysis of the U.S. Strategic Bombing Survey showed that in 1944 subcontractors were involved in 29 percent of Japan's aircraft production.<sup>595</sup>

### ***Mechanization and the Machine Tools Industry***

In spite of their uninspiring names and appearances, machine tools like lathes and drilling, grinding, and boring machines are an indispensable element of large-scale industrial production. These power-driven "machines to make machines"<sup>596</sup> can cut or shape metal with high precision and speed. They allow the massive manufacturing of standardized and interchangeable

---

<sup>592</sup> See, for instance, Yamamura Kozo, "Japanese Economy, 1911–1930: Concentration, Conflicts, and Crises," in *Japan in Crisis: Essays on Taisho Democracy*, ed. Bernard S. Silberman et al. (Princeton, NJ: Princeton University Press, 1974), 299–329, and Sydney E. Crawcour, "Industrialization and Technological Change, 1885–1920," in *The Cambridge History of Japan, Vol. 6: The Twentieth Century*, ed. Peter Duus et al. (New York: Cambridge University Press, 1988), 385–450.

<sup>593</sup> Teikoku Tsūshinsha, *Meiji Taishō sangyōshi I* [Meiji and Taishō industrial history 1] (Tokyo: Kuresu Shuppan, 1999), 323–24.

<sup>594</sup> Nihon Kagakushi Gakkai, "Sangyōgōrika kara sono Gunjika e," 315–38.

<sup>595</sup> *Strategic Bombing Survey, Vol. 15*, 28. Cohen even gives the following numbers for subcontracting in the aircraft industry: Mitsubishi, 32 percent; Nakajima, 42 percent. Jerome Bernard Cohen, *Japan's Economy in War and Reconstruction* (Minneapolis: University of Minnesota Press, 1949), 223.

<sup>596</sup> I take this expression from "Kikaikōgaku no Seiritsu to Gunbikakuchō" [The establishment of mechanical engineering and its expansion into armaments], in *Nihon kagaku gijutsushi taikai*, 162.

components. Specialized machine tools with their “built-in skill” can also help to compensate for a shortage of skilled labor.

Japan started the production of its own machine tools during the 1904–5 Russo-Japanese War. These machines helped to cover the increasing demand for munitions and became known as the “mothers of weapons” (*heiki no haha*).<sup>597</sup> During World War I production numbers increased. However, Japan could not catch up with the fast advances of Western machine tools, and its dependence on imported specialized machine tools continued. In 1932, 73 percent of Japan’s total investment in specialized machine tools still went into the import of foreign machinery.<sup>598</sup>

Several reasons account for this slow development. According to one source, the Japanese military was skeptical of mechanized production of weaponry because it believed that automatic machines, unlike human workers, could not instill the “Japanese spirit” into the munitions that they produced.<sup>599</sup> A more plausible hindrance to the widespread use of machine tools was Japan’s wide availability of manual workers. For example, when sheet metal working—one of the most basic processes of aircraft manufacturing—was already automated in the West, it was still largely handled manually in Japan. Furthermore, the continuing import of advanced machinery left little incentive for the build-up of a domestic production.

During the 1910s and 1920s American and British machine tool makers dominated the Japanese market. However, after World War I German machine tool technology made fast

---

<sup>597</sup> Nagao Katsuko, *Kōsakukikai gijutsu no hensen* [Changes in machine tools technology] (Tokyo: Nikkankōgyōshinbunsha, 2002), vi.

<sup>598</sup> Toyosaki Minoru, *Nihon kikai kogyo no kiso kozo* [The basic structure of Japan’s machine industry] (Tokyo: Nihon Hyoronsha, 1941), 266.

<sup>599</sup> Quoted in Kōda Ryōichi, “Technology Transfer from Germany to Japan in the Machine Tool Industry before the Second World War,” in *Japan and Germany: Two Latecomers to the World Stage, 1890–1945*, ed. Akira Kudō et al. (Folkestone, UK: Global Oriental, 2009), 524.

progress when the machine tool industry played an increasingly important role in Germany's rationalization movement. Key inventions like cemented carbide, an extremely hard material that accelerated cutting speed, helped the industry catch up with the United States by the end of the 1920s. During this period, imports, reverse engineering, and the employment of German engineers made the Japanese aware of the advances in German machine tool technology. Initially, German machine tool makers showed little interest in the Japanese market. Their products were needed for domestic production or were sold to the Soviet Union, where the rapid industrialization in the wake of the First Five-Year Plan, launched in 1928, generated a growing demand for machine tools.<sup>600</sup> Only during the second half of the 1930s did business with Japan begin to increase to an extent that Germany became one of the biggest suppliers of machine tools to Japan, second only to the United States.<sup>601</sup>

For many years the government showed little interest in the promotion of Japan's domestic machine tool sector. Only after the outbreak of the war with China in 1937 did the machine tool industry receive its first substantial state support. The Law for Machine Tool Enterprises (*kōsakukikai seizōjigyōhō*) was passed in March 1938, the same month as the Aircraft Manufacturing Industry Act. Acknowledging the industry's importance for national defense, the law appointed licensed factories and provided them with state subsidies, material, and workforce priority.<sup>602</sup>

---

<sup>600</sup> Ibid., 525.

<sup>601</sup> Kōda Ryōichi, "Technologietransfer in der Werkzeugmaschinenbauindustrie von Deutschland nach Japan vor dem Zweiten Weltkrieg," in *Technologietransfer Deutschland-Japan von 1850 bis zur Gegenwart*, ed. Erich Pauer (München: Iudicium Verlag, 1992), 194.

<sup>602</sup> For the original text of the law, see "Zairyō to kōsakukikai no hattatsu" [The development of materials and machine tools], in *Nihon kagaku gijutsushi taikēi*, 448–51.

However, problems with the products even of these licensed manufacturers continued well into the 1940s. A report by the historian Okumura Shōji about his wartime experience when he worked in an armaments factory illustrates the relative backwardness of Japan's machine tool technology.<sup>603</sup> Okumura noticed a huge performance gap between made-in-Japan and imported machine tools. According to his account, the wear and tear of Japanese machines was about ten times faster than that of imported machines. The accuracy of made-in-Japan machine tools declined rapidly already after one or two months. The Japanese firms, which totally depended on a limited number of imported machine tools, guarded these devices "as their treasures."<sup>604</sup> A wry remark of the Japanese aviation engineer Sanuki Matao conveys how Japanese specialists were also aware of the wide gap in production technology between Germany and Japan. After having seen a jig-boring lathe during a visit to a German factory in 1941 he commented: "If our company owned such a machine tool it would be treated with great care. We would put it in a special room into a glass case and offer holy sake to it."<sup>605</sup>

One of the biggest problems was the lack of machines for the forging of hardened steel parts like crankshafts, cams, rods, and valves, all of them critical parts for aircraft engines. Japan had to rely on the manual skills of workers who needed several hours to forge one workpiece, while U.S. and German factories used machines that produced these parts within minutes and with much greater accuracy.

Japan's dual economic structure was a major factor in the relative backwardness of Japanese machine tools. While the 1938 Law for Machine Tool Enterprises supported the big companies, it did little for the large number of medium- and small-size machine tool makers. In

---

<sup>603</sup> Okumura, *Gijutsushi o miru me*, 64–79.

<sup>604</sup> Ibid., 65.

<sup>605</sup> Sanuki Matao, *Sanuki Matao no hitorigoto*, 136

1937, the year before the law was passed, more than one thousand machine tool makers had fewer than two hundred employees.<sup>606</sup> In a 1940 journal article, Okaniwa Hiroshi, a researcher in the employ of the Industrial Bank of Japan, expressed his worries about the widening gap between the five biggest and the small- to middle-size companies.<sup>607</sup> Okaniwa pointed out that, with their limited funds, these companies could neither afford foreign licenses nor engage in research and development that would improve their existing technology. In a saturated market for low-grade machine tools, competition increased, and working conditions at the small factories deteriorated.

Cheap, substandard machine tools at the base of a production chain increased the aircraft industry's problems. Its dependence on the dual economic structure became a liability, especially when the supply of adequate raw material dwindled. A countless number of small, backstreet workshops manufactured aircraft components from inferior material with second-rate machines. Their limited capacity and the often low-grade quality of their products not only impaired the performance and reliability of airframes, engines, and armaments but also seriously interfered with the principles of efficient mass production.

## Conclusion

In the previous chapters we have seen the central role of German aviation specialists in Japan's successful endeavor to gain technological independence in the design and construction of advanced military aircraft. In 1937, when the war with China started, Japan had a powerful fleet of made-in-Japan aircraft that were designed by Japanese engineers. This chapter has shown why

---

<sup>606</sup> "Zairyō to Kōsakukikai no Hattatsu," 455.

<sup>607</sup> Okaniwa Hiroshi, "Kōsakukikai ni okeru chūshōgyōsha ni tsuite," *Kōsakukikai* 3, no. 10 (1940): 361–63.

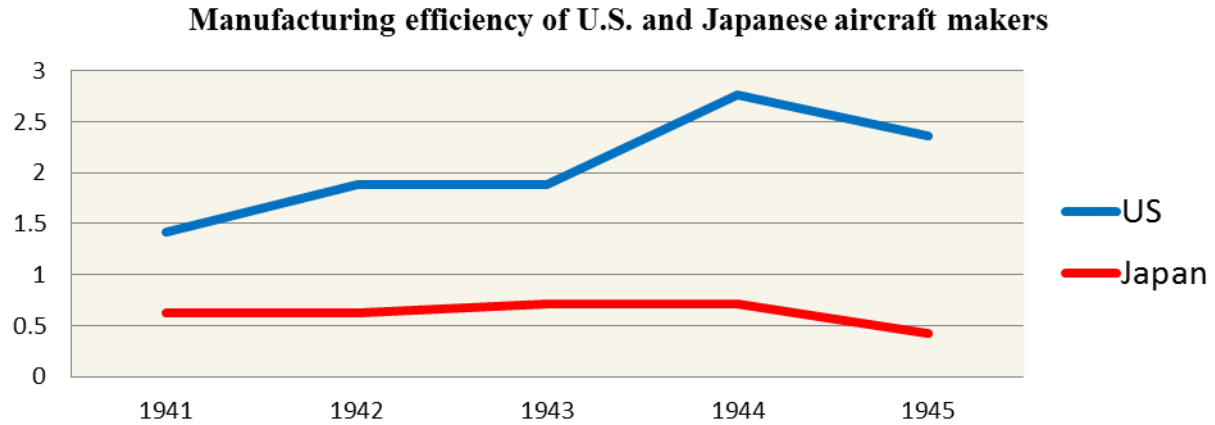
German industrial development and organizational change did not wield a similar influence on the advance of the Japanese aircraft makers' production technology. Even though Japanese observers, both civilian and military, closely followed the German rationalization movement, the Japanese aircraft industry never fully implemented the principles of mechanization, standardization, and interchangeability.

The country's most advanced industry could not shake off the burdensome traditions of its shipbuilding origins and its reliance on a dual economic structure. Referring to their shipbuilding legacy, most major Japanese aviation companies adopted the principle of job production, where groups of skilled workers assembled aircraft piecemeal. Rather than employing labor-saving machine tools they continued to rely on manual labor, which made the production process ineffective and expensive. Furthermore, Japan's firmly entrenched dual economic structure that encompassed the outsourcing of large parts of the production to small and medium enterprises aggravated this problem. In order to raise the overall standard of the highly integrated aviation industry, it would have been necessary to improve the level of all related enterprises. However, with little help offered from outside, these small workshops had hardly any chance to improve their low-grade machinery and to produce the high-quality standardized parts that were required for the production of functional advanced weaponry.

Although the principles of German industrial rationalization found little response among Japanese aircraft makers, the Japanese government and military explicitly referred to Germany's tight control of its aviation industry as a model for Japan. The 1938 Aircraft Manufacturing Industry Act established such a control in order to promote a massive expansion of Japan's aircraft production. Even though the law consolidated the industry and ensured government protection, it also increased the power of military officers and bureaucrats to interfere with every

aspect of aircraft design and production. Installed in key positions, these self-styled specialists often lacked the appropriate expertise. By jealously guarding their spheres of influence they effectively obstructed inter-service standardization and interchangeability. Moreover, their single-minded focus on a new aircraft type's performance caused them to ignore the concerns of the production engineers for an aircraft design suitable for mass production.

A look ahead into the 1940s shows that the problem of low productivity continued (see Figure 26). Nevertheless the Japanese aircraft industry could expand its annual output to a peak of nearly 24,000 aircraft in 1944. As mentioned above, such a massive growth in aircraft production was the result of an enormous increase of workforce and floor space. Such a type of expansion made the industry extremely vulnerable. Continuing dependence on a large workforce became especially troublesome when, during a time of mass-conscription, qualified technicians and workers had to be replaced by college students and high school pupils. Large factory complexes meant increased exposure to bombing. U.S. air raids intensified the already pressing problems of mismanagement, poor quality control, and material shortage. Ignoring these problems, Japan's engineers still overextended themselves with the design of jet and rocket aircraft until the last weeks of the war. At the same time, "headless" (*kubinashi*) airplanes without engines piled up in many factories, while other plants that did not even receive their allotment of aluminum reverted to the construction of wooden aircraft.



**Figure 26: 1943 was the decisive year. While the U.S. workers' productivity rose steeply, Japanese productivity stagnated at an already low level and began to decline in the following year.<sup>608</sup>**

---

<sup>608</sup> Source: *Strategic Bombing Survey, Vol. 15: The Japanese Aircraft Industry*, 4. Efficiency is measured in "pounds of airframe produced per employee working day."

## Conclusion

The history of Japanese aviation is often told as a tale of a rapid rise followed by a catastrophic fall. Accordingly, many accounts either concentrate on the miraculous ascent of Japanese airpower or on the final years of World War II, when massive bombing and the lack of resources and personnel crippled Japan's aircraft industry and reduced its airpower to insignificance. This concluding chapter aims to sidestep these narratives of miracles and apocalypse. It begins with a multi-layered synopsis of Germany's rise to prominence in Japan's emerging aviation. A subsequent balance sheet of German influence will reveal that already in 1937 Japan's aviation had reached a critical juncture that closed off many other potentially more fruitful lines of development. By 1937 German aviation technology had exerted such a strong and enduring impact that its effects would last until the end of World War II. It shaped Japan's air strategy and became a major cause for the army's technology-induced complacency and the navy's technology-driven hawkishness. Equally important, significant contributions from Germany brought the Japanese aircraft industry to a point where it could design and build some of the world's best aircraft, while at the same time neglecting the development of an adequate production technology to produce these planes efficiently in large numbers.

### A Window of Opportunity and the Dynamics of Technological Choice

Before assessing Germany's wide-ranging role in the development of Japan's aviation I want to address the question of why German as a defeated nation—and as Japan's former World War I enemy—could wield such an influence. My thesis examined Japan's aviation history in the context of public mobilization, international diplomacy, geostrategy, and technology transfer.

Such a contextual approach has allowed me to go beyond any monocausal explanation for the German impact on the progress of Japan's aviation. I have rather proposed that a peculiar mix of visions and anxieties together with a shift in international relations and the timely availability of a new technology opened a "window of opportunity" through which German aviation matériel and know how-could enter Japan.

During the early period of Japanese aviation, technological choice was guided more by visions and anxiety than by purely rational considerations. As we have seen in the first chapter, fears of backwardness and dreams of national grandeur proved instrumental in the introduction of a new, expensive technology that had not yet proven its worth. These visions and anxieties became a powerful means to secure the public's support. The enormously popular Yoyogi Flight, the reports on the Qingdao Air War, and the display of giant German aircraft and Zeppelin hangars as war trophies effectively included the public in Japan's aviation project. The initial joy over Japan having become the "fifth member of the international aviation world" soon gave way to worries about the poor state of Japanese airpower, thus paving the way for the invitation of foreign experts and the import of aviation technology.

The Japanese press was eager to exploit a novel source of news and to capitalize on the drama of flight. It reinforced popular apprehension about the backwardness of Japan's aviation with articles about Japanese dependency on Western technology and the rise of Western airpower. At the same time the newspapers soothed the fears of their readers and fostered Japanese national pride. Glowing reports about the fast progress of Japan's aviation highlighted the introduction of new technologies, the setting of new world records, and the military's advance in protecting the Japanese homeland.

The Japanese aircraft makers, for their part, sought to advance their business by persistently warning of the dangers of a dependency on foreign imports and emphasizing the need for more made-in-Japan aircraft. By the mid-1920s Japanese worries about an over-reliance on Western know-how prompted the country's aviation industry to employ German specialists for establishing their own research and design divisions. With these endeavors the Japanese manufacturers hoped to overcome mere copying of Western products and to catch up with the rapid progress of aircraft design in the West.

As laid out in the second chapter, several unforeseen consequences of World War I had a powerful impact on Japan's aviation. The Versailles Treaty unexpectedly advertised the high standard of German technology to the Japanese. The scramble for war trophies added a sense of urgency that accelerated the acquisition of German aviation technology. When in the early 1920s the state-sponsored French and British aeronautical missions came to Japan, their priority was not the transfer of state-of-the-art technology but the sale of World War I surplus aircraft. By contrast, German companies could offer access to the advanced all-metal technology that their engineers had developed and refined during the war. Furthermore with the severe limitations that the Versailles Treaty imposed on the German aircraft industry, German aircraft makers were eager to procure license contracts with Japan and to send their engineers abroad. Thus the international competition for capturing the Japanese aviation market advanced to a new round.

Several key individuals, both military and civilian, further opened the window of opportunity for German technology. The ambitions of the military's modernizers, many of whom had obtained first-hand experience of German technology, spurred the growth of Japan's aviation after World War I. Army officials like Kusakari Shirō, Koiso Kuniaki, and Inoue Ikutarō were able to convince the army's leadership to expand Japan's airpower even during a period of troop

reduction. At the same time, they were aware of the latest advances in German all-metal technology and urged the Japanese aircraft makers to cooperate with German companies for the design and production of a new generation of aircraft that culminated in the making of the “Superbomber.”

Far from just obediently carrying out the military’s orders the Japanese aircraft makers played an active role in the industry’s evolution toward independent design and production. During license negotiations with their German counterparts Kawasaki’s and Mitsubishi’s managers insisted on the transfer of know-how and the establishment of a “made-in-Japan” production line. They had to overcome the Germans’ worries about patent infringements and about the future capability of the Japanese to set up an independent production system. The determination of the Japanese, together with their lucrative offers, made the German industrialists reconsider and finally comply with the wishes of their Japanese customers.

Japanese engineers trained at German aviation factories were equally instrumental in the transfer and diffusion of skill and know-how. At a time when the formal education of aeronautical engineers in Japan was still at an early stage, Japanese companies sent a large number of their designers and workmen to the design offices and factory floors of German aircraft makers. Knowledge and skill transfer intensified with the arrival of German specialists like Richard Vogt and Alexander Baumann in Japan and their systematic instruction of Japanese engineers. Many of these German-trained experts advanced their careers to key positions in the Japanese aircraft industry. The influence of German mentors continued with the work of Japanese aircraft designers like Doi Takeo, Andō Nario, and Horikoshi Jirō, who were to shape Japanese aviation until the end of World War II.

## **A Balance Sheet of German Influence: Benefits, Drawbacks, and Legacies**

With substantial contributions from Germany the Japanese Army not only expanded its air fleet but also successfully replaced its obsolete bombers, fighters, and reconnaissance aircraft with a new generation of all-metal airplanes. Already by 1931 the Japanese Army's airpower had caught up with—and in many cases surpassed—that of the West. When the army launched its extensive modernization program in the mid-1920s Kawasaki began to produce, in cooperation with Dornier, the army's new all-metal bomber at a time when Western powers still depended on wooden biplanes for bombing missions. In 1930 Kawasaki set a speed record with its new fighter aircraft, which was to be outdone only two years later by a U.S. aircraft. In autumn 1931 the army added a heavily armed four-engine flying fortress to its bomber fleet. The Ki-20, a joint Junkers-Mitsubishi project, outperformed the bombers of all other countries with its unmatched bomb load and flight range.

Japan's naval aviation took a similar leap. Heinkel's aircraft allowed the Japanese Navy to explore a new catapult technology that made effective airborne reconnaissance available to its battleships. The innovative technology of Rohrbach prompted a series of outstanding made-in-Japan flying boats. In the mid-1930s the impact of German design on Japan's naval aviation was forcefully demonstrated with the introduction of new carrier- and land-based bombers that surpassed their predecessors in performance and fighting power and significantly expanded the navy's strike power. By 1937, with its six hundred aircraft and five aircraft carriers, Japan's naval aviation clearly had outdone that of Britain and Germany. Even more importantly, the Imperial Japanese Navy's airpower had caught up with the United States.

During the mid-1930s Japanese aeronautical engineers made the important transition to independent aircraft design. After Richard Vogt's return to Germany in 1933 Kawasaki

employed no other foreign expert for the design or construction of aircraft. Doi Takeo, who had developed his skills under the guidance of his German mentor, became Kawasaki's chief designer. Doi and his team of Japanese engineers were responsible for the design of Kawasaki's new aircraft that included the advanced fighter Hien and the Ki-108, a high-altitude interceptor for repelling U.S. bombers. We have also seen that by the mid-1930s Aichi's engineers successfully improved upon Heinkel's latest designs. Aichi's prototype of the dive bomber D3A clearly demonstrated that the company no longer depended on imports from the German aircraft maker. Mitsubishi proved its capacity for independent design in 1935. Based on the experience gained from the cooperation with Junkers, Mitsubishi presented a prototype of its new G3M bomber to the navy, an outstanding airplane that was to write aviation history during the first months of the Pacific War. In 1937 Mitsubishi's expertise had reached a level where the Navy decided to entrust the company with the design of the A6M, also known as the Zero-sen, that was to make its designer, Horikoshi Jirō, world-famous.

Thus, for an interim balance, we can assess that in 1937 the Japanese armed forces could count on an air fleet of world-class aircraft and on a corps of well-trained and inventive aeronautical engineers eager to design any aircraft according to the military's wishes. However, as laid out in chapters three and four, we also have to take into account that the actual impact of any novel military hardware depends on the development of an equally innovative strategy that implements technological change effectively. We therefore also have to consider how German aviation technology shaped the air strategy of both the Japanese army and navy.

The influence of German technology on Japanese air strategy manifested in itself two dramatically different ways that deserve to be labeled as technology-induced complacency and technology-driven hawkishness. When the Japanese Army began its aerial armament it showed

more openness toward the new technology than did the navy. During the first two decades of Japan's aviation the army air force's strategy kept pace with the fast progress of its technology. The proponents of an "all-powerful air force" successfully promoted a rapid air force expansion and the implementation of an air strategy that included advanced concepts like the battle for air superiority and the strategic bombing of the enemy's hinterlands. However, when modernizers like Koiso and Inoue left the Army Aviation Bureau by the late 1920s, this development stagnated. The concept of strategic bombing suffered additional setbacks from the production delays and cost overruns of the "Super Bomber" project. When the Japanese Army invaded Manchuria in 1931 there was no need to fight for air superiority or carry out strategic long-range bombing missions. The army put its advanced aircraft, most of them based on German design, under the command of ground commanders who used them for the direct support of their ground troops. The army air force's reconnaissance airplanes, fighters, and bombers fulfilled these tasks with considerable success, and the army's leaders had little incentive to revise or expand their air strategy. Clearly the high level of the army air force's technology together with its early successes in Manchuria made the army's air strategists complacent. They fell into a doctrinal slumber that continued under the new Army Minister Araki who emphasized spiritual mobilization and fighting morale over advanced technology and matériel. When the war with China began, the deficiencies of the army's air doctrine became obvious, and the Army General Staff had to rely on the navy's airpower for carrying out long-range bombing missions over the Chinese mainland.

The Japanese navy's air strategy evolved much more consistently with technological advances. New German designs and hardware triggered a series of breakthroughs that went hand in hand with an increasingly aggressive naval airpower doctrine. During the early years of

Japan's naval aviation the navy used floatplanes for reconnaissance and artillery support. In the mid-1920s the character of Japanese naval aviation changed with the arrival of large size flying boats that could be deployed over long distances for transport, patrol, and bombing missions. Then, by the mid-1930s, the navy's new dive-bombers transformed its aircraft carriers into highly effective tools for long-range attacks. As a result the strategists of the "aircraft first" faction could successfully challenge the navy's traditionalists and their "big-ship, big-gun policy." Equally important, an initially defensive deployment of aircraft for observation flights gave way to patrolling and bombing operations and culminated in an air strategy of preemptive air strikes at the opening phase of a short, decisive war.

In spite of all their differences the army and navy had one important and fateful point in common: By 1937 any considerations for enduring a protracted war had been superseded by the doctrine of the "first decisive battle." Initially Japanese military planners studied the course and aftermath of World War I carefully. They became familiar with the concepts of total war and the effects of a long war of attrition. They also learned about the importance of an efficient industry whose output was able to outdo the production of the enemy. Furthermore, as we saw in chapter six, the principles of Germany's post-World War I industrial rationalization became well known in Japan and could have served as a blueprint for the Japan's own industrial development. However, most efforts to raise the Japanese aircraft makers' efficiency suffered continuous setbacks from military interference, inter-service rivalry, and a continuing reliance on an armada of small subcontractors. German aircraft makers for their part also showed little interest in the transfer of an efficient production technology to Japan. Instead, in order to stay in business, they nurtured and satisfied the Japanese military's craving for ever more advanced aircraft. This situation continued even when the Japanese aircraft industry no longer depended on foreign

assistance. In response to the military's obsession for the latest technology Japanese engineers continued a design tradition that focused on an aircraft's outstanding performance and paid little attention to its suitability for mass production. Japan's aeronautical engineers and military officers thus had become victims of their own propaganda of air-mindedness. From their offices they preferred to look up into the skies rather than down into the factory halls; for them the rolling thunder of an experimental jet engine held a much more powerful appeal than the rumble of the drop hammer or the screeching of the boring lathes.

## Works Cited

### Archives

Asahi Shinbun 聞蔵 II ビジュアル(Kikuzō II bijuaru) <http://database.asahi.com/library2e/>

Diplomatic Archives of the Ministry of Foreign Affairs of Japan 外務省外交史料館 (Gaimushō gaikō shiryō-kan), Tokyo.

Ishikawajima Archives 石川島資料館 (Ishikawajima Shiryōkan), Tokyo.

Japan Center for Asian Historical Records <http://www.jacar.go.jp>

Kakamigahara Aerospace and Science Museum 各務原航空宇宙科学博物館 (Kakamigahara kōkūuchukagaku hakubutsukan), Kakamigahara (Gifu).

Kobe University Library Newspaper Clippings Collection 神戸大学附属図書館新聞記事文庫 (Kōbodaigaku fuzoku toshokan shinbunkijibunko)  
<http://www.lib.kobe-u.ac.jp/sinbun/index.html>

Mitsubishi Archives 三菱史料館 (Mitsubishi shiryōkan), Tokyo.

Mitsubishi Nagoya Aerospace Museum

三菱重工名古屋航空宇宙システム製作所 小牧南工場・史料室

(Mitsubishijūkō Nagoya kōkūuchūshisutemuseisakusho Komaki minami kōjō shiryōshitu)

Mitsui Bunko Business Archives 三井文庫 (Mitsui bunko), Tokyo.

National Institute for Defense Studies 防衛省防衛研究所 (Bōeishō bōeikenkyūsho), Tokyo.

National Showa Memorial Museum 昭和館 (Shōwakan), Tokyo.

Yomiuri Shinbun Yomidasu Rekishikan (ヨミダス歴史館)  
<https://database.yomiuri.co.jp/rekishikan>

Archive of the Deutsches Museum, München.

Archive of the Deutsches Technikmuseum, Berlin.

Department Military Archives (Bundesarchiv-Militärarchiv), Freiburg.

Dornier Unternehmensarchiv EADS Corporate Heritage, Friedrichshafen.

Mercedes-Benz Classic Archiv Daimler AG, Stuttgart

Political Archive of the Federal Foreign Office (Politisches Archiv Auswärtiges Amt), Berlin.

Smithsonian National Air and Space Museum, Archives Division, Washington, DC.

Stadtarchiv Heilbronn, Germany.

The National Archives Kew, U.K.

## Primary and Secondary Sources

- 50 Jahre Dornier 1914–1964. Ein unvollständiges Bilderbuch zur Geschichte des Hauses Dornier.* Friedrichshafen: Dornier-Werke, 1964.
- Abe Ichisuke. *Kawasaki Zōsenjo yonjūnenshi* [A 40-year history of Kawasaki Dockyard Company]. Kōbe Kawasaki Zōsenjo, 1936.
- Ader, Clément. *L'aviation militaire*. Nancy: Berger-Levrault, 1911.
- Aichi no kōkūshi* [Aviation history of Aichi prefecture]. Nagoya: Chūnichi Shinbun Honsha, 1978.
- Aikawa Haruki. *Gijutsu oyobi ginō kanri: taryō seisan e no tenkan* [Management of technology and technical skill – conversion to mass production]. Tokyo: Tōyō Shokan, 1944.
- Aizawa Kiyoshi. *Kaigun no sentaku: Saikō Shinjuwan e no michi* [The navy's choice: Reconsidering the road to Pearl Harbor]. Tokyo: Chūō Kōron Shinsha, 2002.
- Akimoto Minoru. *Kyojinki monogatari: shirarezaru nihon no kūchū yōsai* [The story of giant airplanes: Japan's unknown flying fortresses]. Tokyo: Kōjinsha, 2002.
- Almond, Peter, and Sally Bald. *Aviation the Early Years*. Königswinter: H.F. Ullmann, 2007.
- Anderson, John David. *A History of Aerodynamics and Its Impact on Flying Machines*. Cambridge; New York: Cambridge University Press, 1997.
- . *The Airplane: A History of Its Technology*. Reston, VA: American Institute of Aeronautics and Astronautics, 2002.
- Andō Nario. *Nihon rikugun-ki no keikaku monogatari* [A story of the design of military machinery]. Tokyo: Kōkūjaanarusha, 1980.
- Andō Yoshio. *Kindai Nihon keizaishi yōran* [An outline of modern Japan's economic history]. Tokyo: Tōkyō Daigaku Shuppankai, 1979.
- Asada Sadao. *From Mahan to Pearl Harbor: The Imperial Japanese Navy and the United States*. Annapolis, MD: Naval Institute Press, 2006.
- Bersing, Gert. "Hugo Junkers." In *Neue deutsche Biographie 10*, edited by Otto zu Stolberg-Wernigerode, 4-5. Berlin: Rohmer-Schinkel, 2005.
- Biermann, Kai, and Erhard Cielewicz. *Flugplatz Döberitz Geburtsort der militärischen Luftfahrt in Deutschland*. Berlin: Links, 2005.
- Bijker, Wiebe E., Thomas P. Hughes, and Trevor J. Pinch, eds. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*. Cambridge, MA: MIT Press, 2012.
- Bōeichō Bōei Kenshūjo Senshishitsu. *Kaigun kōkū gaishi* [An outline of the history of naval aviation]. Tokyo: Asagumo Shinbunsha, 1976.
- . *Rikugun kōkū heiki no kaiatsu seisan hokyū* [The development of the army's aerial weaponry, its production and supply]. Tokyo: Asagumo Shinbunsha, 1975.

- . *Rikugun kōkū no gunbi to un'yō 1* [The army's aerial armament and operations 1]. Tokyo: Asagumo Shinbunsha, 1971.
- Brady, Robert Alexander. *The Rationalization Movement in German Industry: A Study in the Evolution of Economic Planning*. Berkeley: University of California Press, 1933.
- Braun, Hans-Joachim. "Fertigungsprozesse im deutschen Flugzeugbau 1926–1945." *Technikgeschichte* 57, no. 2 (1990): 111–35.
- Bry, Gerhard. *Wages in Germany, 1871–1945*. Princeton, NJ: Princeton University Press, 1960.
- Budraß, Lutz. *Flugzeugindustrie und Luftrüstung in Deutschland 1918–1945*. Düsseldorf: Droste, 1998.
- . "Rohrbach und Dornier. Zwei Unternehmen aus dem Zeppelin-Flugzeugbau in der Weimarer Republik und im Nationalsozialismus." In *Zeppelins Flieger: Das Flugzeug im Zeppelin-Konzern und seinen Nachfolgebetrieben*, edited by Wolfgang Meighörner, 202–35. Berlin: Wasmuth, 2006.
- "Close-hauled." *Flight*, November 6, (1924): 714.
- Cohen, Jerome Bernard. *Japan's Economy in War and Reconstruction*. Minneapolis: University of Minnesota Press, 1949.
- Corn Joseph J. *The Winged Gospel: America's Romance with Aviation, 1900–1950*. New York: Oxford University Press, 1983.
- Cox, Jafna L. "A Splendid Training Ground: The Importance to the Royal Air Force of its Role in Iraq, 1919–32." *Journal of Imperial and Commonwealth History* 13, no. 2 (1985): 157–84.
- Crawcour, Sydney E. "Industrialization and Technological Change, 1885–1920." In *The Cambridge History of Japan Vol. 6: The Twentieth Century*, edited by Peter Duus, John Whitney Hall, Donald H. Shively, 385–450. New York: Cambridge University Press, 1988.
- Daniels, Gordon. *A Guide to the Reports of the United States Strategic Bombing Survey: I, Europe; II, the Pacific*. London: Royal Historical Society, 1981.
- de Bary, William Theodore, Carol Gluck, and Arthur E. Tiedemann, eds. *Sources of Japanese tradition. Volume 2, 1600–2000*. New York: Columbia University Press, 2005.
- Demetz, Peter. *Die Flugschau von Brescia*. Wien: Paul Zsolnay Verlag, 2002.
- Dickinson, Frederick R. *War and National Reinvention: Japan in the Great War, 1914–1919*. Cambridge, MA: Harvard University Press, 1999.
- Doi Takeo, "Sekkei wa aato ofu conpuromaizu" [Design is the art of compromise] *In-house newsletter of Japan Airlines*, June 16, 1997.
- . *Hikōki sekkei 50 nen no kaisō* [Reflections on fifty years of aircraft design]. Tokyo: Kantōsha, 1989.
- Doitsu Sangyō Gōrika Kyōkai. *Ryūdō sagyō ni kansuru keiken* [Experiences in assembly-line work]. Tokyo: Tōkyōshōkōkaigisho, 1930.

- Dornier, Claude. *Aus meiner Ingenieurlaufbahn*. Zug / Schweiz: published by the author, 1966.
- “Dornier Flugzeuge in Japan.” *Dornier-Post*, no. 3 (April 1973): 54–55.
- Drea, Edward J. *Japan’s Imperial Army: Its Rise and Fall, 1853–1945*. Lawrence: University Press of Kansas, 2009.
- Duppler, Jörg, and Heinrich Forsmann. *Marineflieger: Von der Marineluftschiffabteilung zur Marinefliegerdivision*. Herford: E. S. Mittler, 1988.
- Ebert, Hans Joachim. “Rohrbach.” In *Neue deutsche Biographie*, edited by Otto zu Stolberg-Wernigerode, 4–5. Berlin: Rohmer-Schinkel, 2005.
- Edagawa Ryūsuke, *Aichi Tokei Denki 85–nenshi* [85 years of history of Aichi Tokei Denki]. Nagoya: Aichi Tokei Denki Kabushiki Kaisha, 1984.
- Edgerton, David. *England and the Aeroplane: Militarism, Modernity and Machines*. London: Penguin, 2013.
- Eilon, S. “The Production Smoothing Problem.” *Production Engineer* 51, no. 4 (1972): 123–29.
- Esakabe Yonichirō. *Yūhi sora no makuake Tokorozawa* [Launching out: Tokorozawa and the opening of the skies]. Tokorozawa: Daiichi insatsu, 2005.
- Evans, David C., and Mark R. Peattie. *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887–1941*. Annapolis, MD.: Naval Institute Press, 1997.
- Fearon, Peter. “The Formative Years of the British Aircraft Industry, 1913–1924.” *Business History Review* 43, no. 4 (1969): 476–95.
- Ferguson, Robert G. “Airframe Manufacture and Engineering Exchange.” In *Atmospheric Flight in the Twentieth Century*, edited by Peter Galison, and Alex Roland, 259–85. Boston: Kluwer, 2000.
- Ferris, John. “A British ‘Unofficial’ Aviation Mission and Japanese Naval Developments, 1919–1929.” *Journal of Strategic Studies* 5, no. 3 (1982): 419–39.
- Francillon, René. *Japanese Aircraft of the Pacific War*. Annapolis, MD.: Naval Institute Press, 1987.
- Fritzsche, Peter. *A Nation of Fliers: German Aviation and the Popular Imagination*. Cambridge, MA: Harvard University Press, 1992.
- Fuji Jūkōgyō sanjūnenshi [A thirty-years history of Fuji Heavy Industry]. Tokyo: Fuji Jūkōgyō, 1984.
- Fujii Tadatoshī. *Kokubō fujinkai: hinomaru to kappōgi* [The Women’s Society for National Defense: The Hinomaro and cooking aprons]. Tokyo: Iwanami Shoten, 1985.
- . “Shōwashoki sensōkaishiji ni okeru taishūteki gunjishien kyanpeen no ichitenkei: gun’yōki ‘aikokugō, hōkokugō’ ken’nōundō no katei ni tsuite” [The contribution of the warplanes ‘aikoku-go’ and ‘hōkoku-go’ to the war: A typical campaign for wartime mass support at the beginning of the war in early Shōwa Japan], *Surugadai University studies* 6 (1992): 39–55.

- Fujitani Takashi. *Splendid Monarchy: Power and Pageantry in Modern Japan*. Berkeley: University of California Press, 1996.
- Genda Minoru. "Evolution of Aircraft Carrier Tactics of the Imperial Japanese Navy." In *Air Raid, Pearl Harbor!*, edited by Paul Stillwell, 23-28. Annapolis, MD: Naval Institute Press, 1981.
- Gin'yoku haruka: Nakajima hikōki gojūnen me no shōgen* [Far away silver wings: Eye-witness testimonies of 50 years of Nakajima aircraft]. Ōta: Ōtashi, 1995.
- Giyū zaidan kaibō gikai no mokuteki shimei* [The Maritime Defense Volunteer Association's purpose and mission]. Tokyo: Kaibō Gikai, 1927.
- Goldman, Emily O., and Leslie C. Eliason. *The Diffusion of Military Technology and Ideas*. Stanford, CA: Stanford University Press, 2003.
- Haddow G. W., and Peter M. Grosz. *The German Giants: The Story of the R-Planes, 1914-1919*. London: Putnam, 1969.
- Hagiwara Mitsuru. "The Japanese Air Campaigns in China, 1937-1945." In *The Battle for China: Essays on the Military History of the Sino-Japanese War of 1937-1945*, edited by Mark R. Peattie, Edward J. Drea, and Hans J. van de Ven, 237-55. Stanford, CA: Stanford University Press, 2011.
- Hartmann, Gérard. "Les premiers Farman." In *Dossiers historiques et techniques aéronautique française*. Accessed January 13, 2014. <http://www.hydroretro.net/etudegh/index.php>.
- Harvard-Smith, Gibbs Charles. *The Wright Brothers: Aviation Pioneers and Their Work, 1899-1911*. London: Science Museum, 2002.
- Hata Ikuhiko. *Nihon riku-kaigun sōgō jiten* [A general dictionary of the Japanese Army and Navy]. Tokyo: Tokyo Daigaku Shuppankai, 2005.
- Hata Shunroku, Itō Takashi, and Hara Takeshi. *Gensui Hata Shunroku kaikōroku* [The memoirs of Marshal Hata Shunroku]. Tokyo: Kinseisha, 2009.
- Heinemann, Ulrich. "Rationalisierung in der Sackgasse: Technologiediskussion und Rationalisierungsprozeß in der Weimarer Republik." *WSI-Mitteilungen* 38, no. 3 (1985): 151-60.
- Heinkel, Ernst. *Stürmisches Leben*. Stuttgart: Mundus-Verlag, 1953.
- Hellmich, M. *DIN, 1917-1927*. Berlin: Deutscher Normenausschuss, 1927.
- Hertel, Courtney J. "The Interchangeability in the Present Aviation Industry." *Aircraft Engineering*, (January 1940): 21-23.
- Higgins, George J. "The Characteristics of the N.A.C.A. M-12 Airfoil Section." *Technical Notes National Advisory Committee for Aeronautics* No. 343 (1926): 1-7.
- Hinnenthal, Hans. *Doitsu ni okeru gōrika undō to doitsu sangyō gōrika kyōkai* [The German Rationalization Movement and the National Board for Economy and Efficiency]. Tokyo: Tōkyō Shōkō Kaigisho, 1930.
- Hiraki Kunio. *Baron Shigeno no shōgai* [The life of Baron Shigeno]. Tokyo: Bungei Shunjū, 1990.

- Hirschel Ernst-Heinrich, and Horst Prem, *Aeronautical Research in Germany: From Lilienthal until Today*. New York: Springer-Verlag, 2004.
- Homze, Edward L. *Arming the Luftwaffe: The Reich Air Ministry and the German Aircraft Industry, 1919–39*. Lincoln: University of Nebraska Press, 1976.
- Hounshell, David A. *From the American System to Mass Production, 1800–1932: The Development of Manufacturing Technology in the United States*. Baltimore: Johns Hopkins University Press, 1984.
- Inoue Ikutarō Kankōkai. *Inoue Ikutarō den* [The life of Inoue Ikutarō]. Tokyo: Kōbun shoin, 1966.
- Ishida Keigo, and Hamada Hide, “Kyūnihongun ni okeru jinji hyōkaseido” [The evaluation of personnel matters in the former Japanese military]. *Bōeikenkyūshokiyō* 9 (2006): 43–82.
- Ishikawajima Jūkōgyō Kabushiki Kaisha 108–nenshi* [A 108 years' history of Ishikawajima Heavy Industries]. Tokyo: Ishikawajima Harima Jūkōgyō, 1961.
- Iwaya Sazanami. *Hikō shōnen otogi ebanashi* [The young aviator, an illustrated picture story]. Tokyo: Bun'undō, 1911.
- Izawa Yasuho. *Nihon Rikugun jūbakutai* [The heavy bomber squad of the Japanese Army]. Tokyo: Gendaishi Shuppankai, 1982.
- James, Harold. *The German Slump: Politics and Economics, 1924–1936*. New York: Oxford University Press, 1986.
- Jauneaud, Marcel. *L'aviation militaire et la guerre aérienne* [Military aviation and aerial warfare]. Paris: E. Flammarion, 1923.
- Jōhō Yoshio. *Rikugunshō gunmukyoku shi, Jōkan (Meiji Taishō)* [The history of the Bureau of Military Affairs vol. 1 (Meiji and Taishō)]. Tokyo: Fuyō shobō shuppan, 2002.
- Joint Chiefs of Staff. *Department of Defense Dictionary of Military and Associated Terms*. Ft. Belvoir: Defense Technical Information Center, 2010.
- Jones, H. J. *Live Machines: Hired Foreigners and Meiji Japan*. Vancouver: University of British Columbia Press, 1980.
- Kakamigaharashi rekishi minzoku shiryōkan. *Kakamino no fūdo* [The natural features of Kakamino]. Kakamigahara: Naka insatsu, 2004.
- Kariya Masai. *Nihon rikugun shisakuki monogatari* [About the Japanese Army's experimental machines]. Tokyo: Kōjin sha, 2007.
- Kármán, Theodore von. *The Wind and Beyond*. Boston: Little, Brown, 1967.
- Katsuragi Yōji. *Rekishi no naka no Nakajima hikōki* [A history of Nakajima's aircraft]. Tokyo: Guranpurishuppan, 2002.
- Kawasaki Heavy Industries. *Kawasaki Jūkō Gifu kōjō no omoide* [Kawasaki Heavy Industries: Recollections of the Gifu factory]. Kakamigahara: Kawasaki Jūkōgyō, 1988.
- Kawasaki jūkō gifu kōjō gojūnen no ayumi* [The 50-year development of Kawasaki's Gifu factory]. Kakamigahara: Kawasaki jūkōgyō kōkūkijigyōhonbu, 1987.

- Kawasaki jūkōgyō kabushiki gaisha. *Kawasaki jūkōgyō kabushiki gaisha hyakunenshi: Yume o katachi ni: 1896 1996* [100 years of Kawasaki Heavy Industries: Like a dream: 1896–1996]. Kobe: Kawasaki Jūkōgyō, 1997.
- Kern, Stephen. *The Culture of Time and Space, 1880–1918*. Cambridge, MA.: Harvard University Press, 2003.
- Kimura Hidemasa, and Tanaka Shōichi. *Nihon no meiki hyakusen* [A selection of one hundred famous Japanese airplanes]. Nagoya: Chūnichi Shinbunsha, 1985.
- Kishi Nobusuke, Yatsugi Kazuo, and Itō Takashi. *Kishi Nobusuke no kaisō* [The memoirs of Kishi Nobusuke]. Tokyo: Bungei Shunjū, 1981.
- Kōda Ryōichi. “Technologietransfer in der Werkzeugmaschinenbauindustrie von Deutschland nach Japan vor dem Zweiten Weltkrieg.” In *Technologietransfer Deutschland-Japan von 1850 bis zur Gegenwart*, edited by Erich Pauer, 185–206. Munich: Iudicium Verlag, 1992.
- . “Technology Transfer from Germany to Japan in the Machine Tool Industry before the Second World War.” In *Japan and Germany: Two Latecomers to the World Stage, 1890–1945*, edited by Akira Kudō, Tajima Nobuo, and Erich Pauer, 511–29. Folkestone, UK: Global Oriental, 2009.
- Koiso Kuniaki, and Musha Kinkichi. *Kōkū no genjō to shōrai* [The present and future of aviation]. Tokyo: Bunmei Kyōkai, 1928.
- Koiso Kuniaki. *Katsuzan Kōsō* [Arrowhead mountain, wild goose claw]. Tokyo: Koiso Kuniaki Jijoden Kankōkai, 1963.
- Kōkūkōgyōshi hensan iinkai. “Mitsubishi ni okeru kitaisekkei shisaku no hensen” [Changes in Mitsubishi’s aircraft body design trial manufacture]. In *Minkan kōkūki kōgyōshi* [The history of civil aircraft manufacturing], 156. N.p.: Kōkū kōgyōshi hensan iinkai, 1948.
- Kōri Katsu. *Fifty Years of Japanese Aviation, 1910–1960*. Tokyo: Kantosha, 1961.
- Kusakari Shirō. “Kōsen shokoku rikugun hikōkai no gensei” [The belligerent nations’ current state of army aviation], *Doboku gakkai shi* [Journal of the civil engineering society] 4, no. 5 (1918): 977–1007.
- . *Taiō nikki* [The diary of my stay in Europe]. N.p.: Shinozaki Masaru, 2008.
- Kuwabara Torao. *Kaigun kōkū kaisōroku* [Recollections of the navy air force]. Tokyo: Kōkū Shinbunsha, 1964.
- Launius, Roger D. *Innovation and the Development of Flight*. College Station: Texas A & M University Press, 1999.
- Layman, R. D. *Naval Aviation in the First World War: Its Impact and Influence*. London: Chatham, 1996.
- Le Corbusier. *Aircraft. The New Vision*. New York, N.Y.: Universe, 1988 [1935].
- Ludendorff, Erich. *Der totale Krieg*. Munich: Ludendorffs Verlag, 1935.
- Maema Takanori. *Asahi shinbun hōō daihikō. jō, Shiberia ōdan* [The Asahi newspaper’s great visit—Europe—flight. Vol.1: Crossing Siberia]. Tokyo: Kōdansha, 2004.

- Maema Takanori. *Asahi shinbun hōō daihikō. ge, Senko no miyako rōma e* [The *Asahi* newspaper's great visit—Europe—flight. Vol.2: Toward the eternal city Rome]. Tokyo: Kōdansha, 2004.
- Mainichi Shinbun sha. *Nihon kōkū shi* [The history of Japanese aviation]. Tokyo: Mainichi Shinbun sha, 1979.
- Matsumoto Miwao. "Reconsidering Japanese Industrialization, Marine Turbine Transfer at Mitsubishi." *Technology and Culture* 40, no. 1 (1999): 74–97.
- Matsuoka Hisamitsu. *Mitsubishi hikōki monogatari* [The story of Mitsubishi aircraft]. Tokyo: Atene Shobō, 1993.
- Meilinger, Phillip S. "Giulio Douhet and the Origins of Airpower Theory." In *The Paths of Heaven: The Evolution of Airpower Theory*, edited by Phillip S Meilinger, 1–40. Maxwell AFB, AL: Air University Press, 1997.
- Mikesh, Robert, and Abe Shorzoe. *Japanese Aircraft: 1910–1941*. London: Putnam, 1990.
- Militärgeschichtliches Forschungsamt. *Die Militärluftfahrt bis zum Beginn des Weltkrieges 1914 Textband*. Berlin: Mittler, 1966.
- Millet, Allan R. "Patterns of Military Innovation in the Interwar Period." In *Military innovation in the interwar period*, edited by Williamson Murray, and Allan Reed Millett, 329–368. New York: Cambridge University Press, 1996.
- Mimura, Janis. *Planning for Empire: Reform Bureaucrats and the Japanese Wartime State*. Ithaca, NY: Cornell University Press, 2011.
- Misato Shūhei. *Obake to yobareta kyojinki: aru rikushi jūkyūkisotsu gijutsusha no kiseki* [The giant aircraft that was called a monster: The tracks of an army engineer who graduated from the 19th class]. Tokyo: Chūō Kōron Jigyō Shuppan, 2005.
- Mitsubishi Jūkōgyō Kabushikigaisha shi* [The history of Mitsubishi Heavy Industries Ltd.]. Tokyo: Mitsubishi Jūkōgyō, 1956.
- Mitsubishi Jūkōgyō KK. *Ōjibōbō: Mitsubishi jūkō Nagoya 50 nen no kaiko* [Memories of the past: 50 years of recollections of Mitsubishi Nagoya]. 3 vols. Nagoya: Ryōkōkai, 1970.
- Mitsubishi Nainenki KK. *Baumann kyōju kōgi hikōkiyō zairyō oyobi sekkei* [The lectures of Prof. Baumann: Material for Aircraft and Aircraft Design]. N.p.: Mitsubishi Nainenki KK, 1927.
- . *R kata hikōtei zumenyō goi* [A dictionary for blueprints for the R-type flying boat]. N.p.: Mitsubishi Nainenki, n.d.
- "Mitsubishi ni okeru kitai sekkei" [Airframe design at Mitsubishi]. In *Minkan kōkūki kōgyōshi* [The history of civil aircraft manufacturing], 152–156. N.p.: Kōkū kōgyōshi hensan iinkai, 1948.
- Mitsubishi no hyakunen* [One hundred years of Mitsubishi]. Tokyo: Mitsubishi Sōgyō Hyakunen Kinen Jigyō Iinkai, 1970.
- Mitsubishi shashi* [History of the Mitsubishi Company]. 41 vols. Tokyo: Tōkyō Daigaku Shuppankai, 1979.

- Miyamoto Mataji, and Togai Yoshio. *Sōgō shōsha no keieishi* [A history of the management of general trading companies]. Tokyo: Tōyō Keizai Shinpōsha, 1976.
- Moore, Aaron Stephen. *Constructing East Asia: Technology, Ideology, and Empire in Japan's Wartime Era, 1931–1945*. Stanford, CA: Stanford University Press, 2013.
- Mori Ōgai. *Kokura nikki* [The Kokura Diary]. Kitakyūshū: Kitayūshū Mori Ōgai ki'nenkai, 1999.
- Morikawa Hajime. *Sora no ei'yū Fujita Yūzō chūsa* [Wing Commander Fujita Yūzō, the hero of the skies]. Tokyo: Shōwa Shobō, 1939.
- Moriya Gakuji. *Meikōkōsakubu no senzensengoshi* [The pre- and postwar history of aircraft construction at the Nagoya factory]. Nagoya: Mitsubishijūkōgyō kabushikigaisha Nagoya kōkūkiseisakujo, 1988.
- Morrow, John H. “Die deutsche Flugzeugindustrie im Ersten und Zweiten Weltkrieg. Ein Vergleich.” In *Luftkriegführung im Zweiten Weltkrieg: Ein internationaler Vergleich*, edited by Horst Boog, 51–80. Herford: E.S. Mittler, 1993.
- Munson, Kenneth. *Bombers Between the Wars, 1919–39*. New York: Macmillan, 1970.
- Nagao Katsuko. *Kōsakukikai gijutsu no henshen* [Changes in machine tools technology]. Tokyo: Nikkankōgyōshinbunsha, 2002.
- . *Nihon kōsaku kikaishi ron* [A history of Japanese machine tools]. Tokyo: Nikkan kōgyō shuppan purodakushon, 2004.
- Nakamura Mitsuo, ed. *Nihon no kōkū runsansu* [The renaissance of Japan's aviation]. Tokyo: Kantōsha, 2000.
- Nihon Kagakushi Gakkai. “Sangyōgōrika kara sono gunjika e” [From industrial rationalization to militarization]. In *Nihon kagaku gijutsushi taikai. 18, Kikai gijutsu* [A survey of the history of Japanese science and technology vol. 18: Machine technology], edited by Nihon Kagakushi Gakkai, 315–38. Tokyo: Daiichi Hōki Shuppan, 1966.
- Nihon Kaigun Kōkūshi Hensan Iinkai. *Nihon kaigun kōkūshi 1 Yōhei hen* [The history of Japanese naval aviation 1 (strategy)]. Tokyo: Jiji Tsūshinsha, 1969.
- . *Nihon Kaigun kōkūshi 2 Gunbi hen* [The history of Japanese naval aviation 2 (armaments)]. Tokyo: Jiji Tsūshinsha, 1969.
- . *Nihon Kaigun kōkūshi 3 Gijutsu seido hen* [The history of Japanese naval aviation 3 (technology)]. Tokyo: Jiji Tsūshinsha, 1969.
- Nihon minkan kōkūshiwa* [Stories of Japan's civil aviation]. Tokyo: Nihonkōkūkyōkai, 1966.
- Nihonkōkūkyōkai. *Nihon kōkūshi* [The history of Japanese aviation]. 2 vols. Tokyo: Nihonkōkūkyōkai, 1936.
- . *Nihon kōkūshi Meiji Taishō* [The history of Japanese aviation in the Meiji and Taishō periods]. Tokyo: Nihonkōkūkyōkai, 1956.
- . *Nihon kōkūshi. Shōwa sengo hen* [The history of Japanese aviation in the postwar Shōwa period]. Tokyo: Nihon Kōkūshi Hensan Iinkai, 1992.
- . *Nihon kōkūshi. Shōwa zenkihen* [The history of Japanese aviation in the early Shōwa period]. Tokyo: Nihonkōkūkyōkai, 1956.

- Nish, Ian. "Japan and the Outbreak of War in 1914." In *Collected Writings of Ian Nish. Pt. 1*, edited by Ian Nish, 173–187. Richmond, Surrey: Japan Library, 2001.
- Nohara Shigeru. *Nihon gun'yōki jiten. Kaigun hen, 1910–1945* [Encyclopedia of Japanese warplanes (Navy) 1910–1945]. Tokyo: Ikarosu Shuppan, 2005.
- . *Nihon gun'yōki jiten: Rikugun hen, 1910–1945* [Encyclopedia of Japanese warplanes (Army) 1910–1945]. Tokyo: Ikarosu Shuppan, 2005.
- . *Nihon kaigun gun'yōkishū* [Warplanes of the Japanese Navy]. Tokyo: Guriinarō Shuppansha, 1994.
- . *Nihon rikugun gun'yōkishū* [Warplanes of the Japanese Army]. Tokyo: Guriinarō Shuppansha, 1997.
- . *Nihon rikukaigun shisaku keikakuki 1924–1945* [Experimental planes of the Japanese Army and Navy 1924–1945]. Tokyo: Guriinarō Shuppansha, 1999.
- . *Zukai sekai no gun'yōkishi. 8, Nihon rikukaigun shisaku keikakuki 1924–1945* [An illustrated history of the world's warplanes, vol. 8: Experimental planes of the Japanese Army and Navy, 1924–1945]. Tokyo: Guriinarō shuppansha, 1999.
- Nowarra, Heinz J. *Die Flugzeuge des Alexander Baumann*. Friedberg (Dorheim): Podzun-Pallas-Verlag, 1982.
- Nozawa Tadashi. *Nihon kōkūki sōshū: Aichi, Kūgishō hen* [Encyclopedia of Japanese aircraft: Aichi, Navy aviation technology arsenal]. 8 vols. Tokyo: Shuppanyōdōsha, 1959.
- . *Nihon kōkūki sōshū: Kawanishi hiroshō hen* [Encyclopedia of Japanese aircraft: Kawanishi and Hiro Navy Arsenal]. Tokyo: Shuppan kyōdōsha, 1959.
- . *Nihon kōkūki sōshū: Kawasaki hen* [Encyclopedia of Japanese Aircraft: Kawasaki]. Tokyo: Shuppanyōdōsha, 1960.
- . *Nihon kōkūki sōshū: Mitsubishi hen* [Encyclopedia of Japanese Aircraft: Mitsubishi]. Tokyo: Shuppanyōdōsha, 1961.
- . *Nihon kōkūki sōshū: Mitsubishi hen* [Encyclopedia of Japanese Aircraft: Mitsubishi]. Tokyo: Shuppanyōdōsha, 1961.
- . *Nihon kōkūki sōshū: Nakajima hen* [Encyclopedia of Japanese Aircraft: Nakajima]. Tokyo: Shuppanyōdōsha, 1963.
- . *Nihon kōkūki sōshū: Yu'nyūki hen* [Encyclopedia of Japanese aircraft: Imported aircraft]. Tokyo: Shuppanyōdōsha, 1972.
- Odagiri Hiroyuki, and Gotō Akira. *Technology and Industrial Development in Japan: Building Capabilities by Learning, Innovation, and Public Policy*. Oxford: Clarendon Press, 1996.
- Ogasawara Kazuo. *Kōkū senjutsu kōjuroku* [Lecture notes on air strategy]. Tokyo: Rikugundaigakkō shōkō shūkaijo, 1922.
- Okamura Jun. *Kōkū gijutsu no zenbō 1* [An overall picture of the aviation technology 1]. Tokyo: Hara Shobō, 1976.
- . *Kōkū gijutsu no zenbō 2* [An overall picture of the aviation technology 2]. Tokyo: Hara Shobō, 1976.

- Okaniwa Hiroshi. "Kōsakukikai ni okeru chūshōgyōsha ni tsuite" [On the small and mid-size machine tool makers]. *Kōsakukikai* 3, no. 10 (1940): 361–63.
- Okumiya Masatake, and Horikoshi Jirō. *Zero! The Story of Japan's Air War in the Pacific: 1941–45*. New York: Dutton, 1956.
- Okumura Shōji. *Gijutsushi o miru me: jidōsha kara kyōyūzen e* [An eye on the history of technology: From the automobile to the Kyoto Yūzen process]. Tokyo: Gijutsu to Ningen, 1977.
- O'Neil, William D. *Military Transformation as a Competitive Systemic Process: The Case of Japan and the United States Between the World Wars*. Alexandria VA: Ft. Belvoir Defense Technical Information Center, 2003.
- Palmer, Scott. *Dictatorship of the Air: Aviation Culture and the Fate of Modern Russia*. New York: Cambridge University Press, 2006.
- Pauer, Erich. "The Transfer of Technology between Germany and Japan from 1890 to 1945." In *Japan and Germany: Two Latecomers to the World Stage, 1890–1945*, edited by Kudō Akira, Tajima Nobuo, and Erich Pauer, 466–510. Folkestone, UK: Global Oriental, 2009.
- Peattie, Mark R. *Sunburst: The Rise of Japanese Naval Air Power, 1909–1941*. Annapolis, MD: Naval Institute Press, 2001.
- Peukert, Detlev. *The Weimar Republic: The Crisis of Classical Modernity*. London: Penguin Books, 1993.
- Plüschow, Gunther. *Die Abenteuer des Fliegers von Tsingtau, meine Erlebnisse in drei Erdteilen*. Berlin: Ullstein & Co., 1916.
- . *My Escape from Donington Hall, Preceded by an Account of the Siege of Kiao-Chow in 1915*. London: John Lane, 1922.
- Polak, Christian Philippe. *Fude to katana: nihon no naka no mō hitotsu no furansu 1872–1960* [The brush and the sword: Yet another France in Japan, 1872–1960]. Tokyo: Zainichi furansu shōkō kaigisho, 2005.
- Porte, Rémy. "L'échec de la Mission militaire française d'Aéronautique au Japon 1918–1920." *Revue historique des armées* 236 (2004): 88–96.
- Rider, Christine, ed. *Encyclopedia of the Age of the Industrial Revolution, 1700–1920*. Westport, CT: Greenwood Press, 2007.
- Rinji Gunji Chōsaiinkai. *Kokka sōdōin ni kan suru iken* [An opinion on national mobilization]. Tokyo: Rikugunshō, 1920.
- Ruttan Vernon W., and Yujiro Hayami. "Technology Transfer and Agricultural Development." *Technology and Culture*, 14 (1973): 119–51.
- Samuels, Richard J. *"Rich Nation, Strong Army": National Security and the Technological Transformation of Japan*. Ithaca, NY: Cornell University Press, 1994.
- Sanuki Matao. *Sanuki Matao no hitorigoto: kōkū no sekai o horiokoshite hakkutsu shita jijitsu* [Sanuki Matao's monologue: Facts unearthed from the aviation world]. Tokyo: Gurin Arōshuppansha, 1997.

- Sawamoto Mōko. *Kokka sōdōin no igi* [The meaning of national mobilization]. Tokyo: Aoyama Shoin, 1926.
- Schatzberg, Eric. *Wings of Wood, Wings of Metal: Culture and Technical Choice in American Airplane Materials, 1914–1945*. Princeton, NJ: Princeton University Press, 1999.
- Schivelbusch, Wolfgang. *The Railway Journey: The Industrialization of Time and Space in the 19th Century*. Berkeley: University of California Press, 1986.
- Schmitt, Günter, Angelika Hofmann, and Thomas Hofmann. *Hugo Junkers und seine Flugzeuge*. Stuttgart: Motorbuch Verlag, 1986.
- Sekigawa Eiichiro, *Pictorial History of Japanese Military Aviation*. London: Allan, 1974.
- Sekiguchi Eiji. *Nihon minkan kōkūshiwa* [Stories of Japan's civil aviation]. Tokyo: Nihon Kōkū Kyōkai, 1966.
- Sekkeisha no shōgen: Nihon kessakuki kaihatsu dokyumento* [The testimony of designers: Documents of the development of Japanese technological masterpieces]. 2 vols. Tokyo: Kantōsha, 1994.
- Senba Tadashi. *Hikōki ni miserarete* [Fascinated by aircraft]. Gifu: Chūbu senkōkai, 2000.
- Shibuya Atsushi. *Hino Kumazō den* [The life of Hino Kumazō]. Kumamoto: Tamakina Shuppansha, 2006.
- Shin Meiwa Kōgyō Kabushiki Kaisha Shashi Henshū Iinkai. *Shashi* [Corporate history]. Nishinomiya: Dōsha, 1984.
- Shinozaki Masaru. *Kōkū sōmeiki no senkusha Kusakari Shirō* [Kusakari Shirō, a pioneer of early aviation]. Tokyo: Kōyō shuppan, 2005.
- Smethurst, Richard. "The Creation of the Imperial Military Reserve Association in Japan." *The Journal of Asian Studies* 30, no. 4 (1971): 815–828.
- Smith, Thomas M. "The Development of Aviation." In *Technology in Western Civilization*. Vol. 2, *Technology in the Twentieth Century*, edited by Melvin Kranzberg, and Carroll W. Pursell, 153–180. New York: Oxford University Press, 1967.
- Sugita Ichiji. *Nihon no seisenryaku to kyōkun: Washington Kaigi kara shūsen made* [Japan's political war strategy and lessons: From the Washington Conference to the end of the war]. Tokyo: Hara Shobō, 1983.
- Takano Tatsumi. *Hino Tokugawa ryō tai hikōki daikyōsō shōka* [The song of the big contest between the two Captains Hino and Tokugawa]. Tokyo: Hotta Wataru Morikan, 1911.
- Tanaka Giichi. *Chihō to guntai tonō kankei ni tsuite* [The relation between regions and the army]. Tokyo: Zaigō gunjinkai, 1911.
- Teikoku Tsūshinsha. *Meiji Taishō sangyōshi. I* [Meiji and Taishō industrial history 1]. Tokyo: Kuresu Shuppan, 1999.
- Tokugawa Yoshitoshī. *Nihon kōkū koto hajime* [The beginnings of Japanese aviation]. Tokyo: Shuppan Kyōdōsha, 1964.
- Tooley, T. Hunt. "The Hindenburg Program of 1916: A Central Experiment in Wartime Planning." *The Quarterly Journal of Austrian Economics* 2, no. 2 (Summer 1999): 51–62.

- Toyoda Jō. *Hikōki-ō Nakajima Chikuhei* [Nakajima Chikuhei, the king of aircraft]. Tokyo: Kōdansha, 1992.
- Toyosaki Minoru. *Nihon kikai kōgyō no kiso kōzō* [The basic structure of Japan's machine industry]. Tokyo: Nihon Hyoronsha, 1941.
- Tsuji Hideo, and Kurita Masatada. *Hondo bōkū sakusen* [Strategy for the air defense of the mainland]. Tokyo: Asagumo Shinbunsha, 1968.
- Tsukamoto Yoshitaka. *Gōrikaseru doitsu* [Rationalization in Germany]. Osaka: Shinbun Rengōsha Ōsaka Shisha, 1930.
- . *Gōrikaseru doitsu no denryoku jigyō* [Rationalization in the German electrical industry]. Osaka: Shinbun Rengōsha Ōsaka Shisha, 1930.
- . *Kinrō to kyōraku senjō no doitsujin* [Germans straddling the line between work and leisure]. Osaka: Shinbun Rengōsha Ōsaka Shisha, 1931.
- . *Sangyō gōrika no jitsurei doitsu no tankō* [An example of industrial rationalization, German coal mining]. Osaka: Shinbun Rengōsha Ōsaka Shisha, 1929.
- Umbra, Apollonio, ed. *Futurist Manifestos*. London, 1973.
- United States Strategic Bombing Survey. *Aircraft Division Industry Report European War*. Washington, DC: GPO, 1947.
- . *Aircraft Division. The Japanese Aircraft Industry*. Washington, DC: GPO, 1947.
- Van der Mey, Michiel. *Dornier Wal: "A Light Coming Over the Sea."* Vicchio, Firenze: LoGisma, 2005.
- Vogt, Richard. *Weltumspannende Memoiren eines Flugzeug-Konstrukteurs*. Steinebach/Wörthsee: Luftfahrt-Verlag W. Zuerl, 1976.
- Wachtel, Joachim. *Claude Dornier: ein Leben für die Luftfahrt*. Planegg: Aviatic Verlag, 1989.
- Wada Kazuo, and Shiba Takao. "Nihonteki seisan shisutemu no keisei" [The formation of a Japanese-style production system]. In *Nihonteki keiei no renzoku to danzetsu* [Continuities and discontinuities in Japanese-style management], edited by Yasuoka Shigeaki, Yamazaki Hiroaki, Kikkawa Takeo, 125-157. Tokyo: Iwanami Shoten, 1995.
- Wagenführ, Rolf. *Die Flugzeugindustrie der Anderen: Weltkriegserfahrungen, gegenwärtiger Stand, wirtschaftliche Mobilmachung*. Berlin: Hanseatische Verlagsanstalt Hamburg, 1939.
- Weckbach, Hubert. *Heilbronner Köpfe*. Heilbronn: Archiv der Stadt Heilbronn, 1998.
- Williamson, Murray. "Innovation: Past and Future." In *Military innovation in the interwar period*, edited by Williamson Murray, and Allan Reed Millett, 300-28. New York: Cambridge University Press, 1996.
- Wohl, Robert. *A Passion for Wings: Aviation and the Western Imagination, 1908-1918*. New Haven, CT: Yale University Press, 1994.
- Yamamura Kozo. "Japanese Economy, 1911-1930: Concentration, Conflicts, and Crises." In *Japan in Crisis; Essays on Taisho Democracy*, edited by Bernard S. Silberman, Harry

- D.Harootunian, and Gail Lee Bernstein, 299-329. Princeton, NJ: Princeton University Press, 1974.
- Yokota Junya. *Kumo no ue kara mita Meiji* [The Meiji era seen from above the clouds]. Tokyo: Gakuyō shobō, 1999.
- Yokoyama Hisayuki. "Military Technological Strategy and Armaments Concepts of Japanese Imperial Army—Around the Post-WWI Period." *NIDS Security Reports*, No. 2 (March 2001): 116-59.
- Young, Louise. *Japan's Total Empire: Manchuria and the Culture of Wartime Imperialism*. Berkeley: University of California Press, 1998.
- Yui Masaomi, and Fujiwara Akira. *Guntai, heishi* [Armed forces and military personnel]. Tokyo: Iwanami Shoten, 1989.

# Index

- Ader, Clément, 22  
Aeronautical Research Institute, 185  
Aichi D1A1, 134  
Aichi D3A1, 135  
Aichi Tokei, 108  
Aikawa Haruki, 238  
*aikoku-gō*, 178  
air superiority, 56  
Aircraft Manufacturing Industry Act, 232  
*Akagi*, 128  
Akeno Flight School, 165  
all-metal airplanes, 81  
all-metal technology, 144  
*Amerikaprogramm*, 224  
Andō Nario, 174, 201, 240, 259  
Araki Sadao, 214  
Army Aviation Bureau, 71, 96, 97, 203  
Army Aviation Department, 70  
Army Aviation Headquarters, 139, 176  
Army Type 87 Heavy Bomber, 151, 176  
Army Type 88-II Light Bomber, 163  
Army Type 92 Fighter, 170  
Army Type 92 Superheavy Bomber, 210  
Army Type 93 Heavy Bomber, 217  
Army Type 93 Light Bomber, 217  
aviation ideology, 53
- Baumann, Alexander, 153–59, 163, 171–72, 258  
big-ship, big-gun policy, 100  
Blériot, Louis, 22  
BMW, 79, 145  
Boeing B-29 Superfortress, 182
- capacity transfer, 9  
catapult, 111  
Caudron, 49  
cemented carbide, 249  
Costruzioni Meccaniche Aeronautiche S. A., 145  
Curtiss Aeroplane and Motor Company, 133  
Curtiss F8C Helldiver, 133  
Curtiss P-6 Hawk, 169
- D’Annunzio, Gabriele, 38  
design transfer, 9  
dive bombing, 132  
Do C reconnaissance airplane, 149  
Do N, 150, 183  
doctrinal slumber, 140, 261  
Doi Takeo, 163, 174, 258, 260  
Dornier Do X, 208  
Dornier, Claude, 79, 144–53, 259  
Douhet, Giulio, 142, 177  
Driant, Émile, 37  
dual economic structure, 247  
duralumin, 81, 113  
*Dürener Metallwerke*, 113
- Eight-Eight Fleet, 101  
Experimental Kūshō 6-Shi Special Bomber, 134
- Falke fighter aircraft, 149, 166  
Farman F-50 bomber, 75, 144  
Farman III biplane, 23  
Farman, Henri, 23, 49  
Faure, Jacques-Paul, 73, 141  
Fernbrugg, Benno Fiala von, 204  
first decisive battle, 262  
Flugmaschine Wright GmbH, 22  
flying boats, 112  
Ford, Henry, 118, 234  
Funakoshi Kajishirō, 120, 122
- Gnome, 49  
Göring, Herrmann, 229  
Grade, Hans, 29  
Grade, Hans, 24
- H8K “Emily”, 124  
Hansa Brandenburg W-29, 108  
Hara Takashi, 69  
Hattori Jōji, 117, 130  
HD 23, 131  
He 118, 135  
He 25, 110  
He 26, 110

He 66, 134  
 He 70, 135  
 Heinkel, Ernst, 79, 107, 130, 135–37, 259  
 Hien, 260  
 Hindenburg, Paul von, 65  
 Hino Kumazō, 27, 39  
 Hiro Naval Arsenal, 121, 124  
 Horikoshi Jirō, 202, 219, 259, 260  
*Hōshō*, 126  
 hypothetical enemy, 190

Imperial Defense Policy, 189  
 Imperial Flying Association, 68  
 Imperial Maritime Defense Volunteer Association, 106  
 Important Industries Control Law, 228  
 independent air force, 70  
 Inoue Ikutarō, 68, 164, 192, 213, 258  
 Inoue Nirō, 42  
 Inter-Allied Commissions Control, 77  
 interchangeability, 246–48  
 inter-service rivalry, 263  
 Ishikawajima, 161, 235–39  
 Itō Shūjirō, 229  
 Iwaya Sazanami, 36

Japanese Aviation Bureau, 187  
 Japanese Engineering Standards, 243  
 Jauneaud, Marcel, 142  
 job production, 237  
 Jordan, William, 127  
 Junkers, 259  
 Junkers F 13, 106, 187, 188  
 Junkers G 38, 194, 209, 211  
 Junkers J1, 185  
 Junkers K-37, 216  
 Junkers, Hugo, 79, 182, 184–90  
 Just, Erich, 150, 167

*Kaga*, 128  
 Kamikaze, 1  
 Katō Hiroharu, 76  
 Katō Tomosaburō, 102  
 Kaumann, Gottfried, 203  
 Kawanishi, 124  
 Kawasaki, 140, 235–39, 258, 259  
 Kawasaki Dockyard, 144  
 Kawasaki Type 88, 163, 176  
 Kawata Akiharu, 25  
 Kazumi Kensuke, 161, 201

KDA-5 fighter, 168  
 Ki-108, 260  
 Kishi Nobusuke, 228  
 Koiso Kuniaki, 78, 95, 186, 191, 213, 257  
 Kōkenki, 2  
*kōkūbannōron*, 141, 142  
 Kusakari Shirō, 15, 47–59, 67, 257  
 Kwantung Army, 175  
 Kwantung Army Flying Corps, 176

Lachmann, Gustav, 163  
 Law for Machine Tool Enterprises, 250  
 Law for the Encouragement of Shipbuilding, 235  
 Law for the Protection of Military Secrets, 240  
 Le Corbusier, 11  
 license contract Dornier-Kawasaki, 147  
 license contract Junkers-Mitsubishi, 199  
 Lilienthal, Otto, 21  
 Lindbergh, Charles, 194  
 London Naval Treaty, 131  
 Ludendorff, Erich, 65  
 Ludwig, Paul, 119

machine tools, 248–52  
 Mahan, Alfred Thayer, 101  
 Manchurian Incident, 175, 214  
 Marie, André, 166  
 Marinetti, Filippo, 11  
 Martin, Rudolf, 37  
 Masumoto Toshisaburō, 130  
 material transfer, 9  
 Matsukata Kōjirō, 147  
 mechanization, 248–52  
 Mitsubishi, 139, 235–39, 258, 259  
 Mitsubishi G3M, 218, 260  
 Mitsubishi Ki-1, 152  
 Mitsubishi Nainenki, 116, 120  
 Mitsubishi Shōji, 88  
 Mitsubishi Type 10, 129  
 Mitsubishi Type 92 Heavy Bomber, 182  
 Mitsui Bussan, 87  
 monocoque technology, 152

Nagahata Jun'ichirō, 133  
 Nagaoka Gaishi, 26  
 Nakajima, 129, 139, 157  
 Nakata Nobushirō, 166  
 National Advisory Committee for Aeronautics, 168

national mobilization, 67  
 Navy Type 10 fighter, 127  
 Navy Type 3 Carrier Fighter, 131  
 Navy Type 90-1 flying boat, 124  
 Navy Type 96 Attack Bomber, 218

occupation of the Philippines, 191  
 Ogasawara Nobuo, 143  
 Ōshima Hiroshi, 229  
 Ōshima-Sugawara report, 229  
 Ōtsuka Keisuke, 116, 201

*Panay*, 135  
 Plüschow, Gunther, 44  
 prototype competition, 140, 156  
 Provisional Committee for Military Balloon  
 Research, 26  
 Provisional Industry Rationalization Bureau,  
 228  
 public air-mindedness, 58

Qingdao, 39–47, 256

Rathenau, Walther, 63  
 Rationalization Movement, 225  
 Reimers & Co, 195  
 Reims Air Meet, 23  
 Rich Nation Strong Army, 10  
*Riesenflugzeug*, 88  
 Ro II flying boat, 118  
 Robin, Maxime, 166  
 Rohrbach, Adolf, 154  
 Rohrbach, Adolf, 92, 114  
 Rohrbach, Adolf, 259  
 Rumpler Taube, 44, 88

Saitō Makoto, 26  
 Sanuki Matao, 122, 251  
 scientific management, 226  
 Sempill, William Francis, 103  
 Shibuya Yonetarō, 195, 200  
 Shidehara Kijūrō, 93  
 Shōda Taizō, 117  
 Sino-Japanese War, 235  
 Smith, Herbert, 126, 154, 171  
 Solf, Wilhelm, 147  
 Standardization, 243–46  
 stressed-skin design, 123, 162

Sugawara Michioo, 229  
 Sugiyama Gen, 144  
 Suisei (Comet), 135  
 Sumitomo, 205  
 Super Bomber, 117, 212, 261

Taka (falcon) fighter, 130  
 Takano Tatsumi, 35  
 Tanaka Giichi, 66, 69, 164  
 Taylor, Frederick, 118  
 Technology Board, 246  
 Terauchi Masatake, 25  
 Tirpitz, Alfred von, 76  
 Tobi reconnaissance aircraft, 158  
 Tōjō Hisashi, 146, 162  
 Tokorozawa, 35, 89  
 Tokorozawa Flight School, 98  
 Tokugawa Yoshitoshi, 27, 38  
 Tondern raid, 125  
 Transocean Program, 194  
 Treaty of Rapallo, 188  
 Tupolev TB-3, 219  
 Type 92 Heavy Bomber, 183

Ugaki Disarmament, 94  
 Ugaki Kazushige, 14, 94, 147  
 United States Strategic Bombing Survey, 5, 242

Versailles Treaty, 83, 90, 112, 185, 189, 226,  
 257  
 Versailles-Washington Treaty system, 13  
 Vogt, Richard, 151, 159–64, 173–75, 258

Wada Misao, 116, 121, 124  
 Wagner, Herbert, 123  
 Wal flying boat, 146  
 Washington Naval Treaty, 14, 93, 107  
 Washi-type Light Bomber, 157  
 Wells, H. G., 37  
 Wright brothers, 19

Yamamoto Eisuke, 24  
 Yamamoto Isoroku, 217  
 Yamanashi Disarmament, 94  
 Yamanashi Hanzō, 94  
 Yamashita Tomoyuki, 246  
 Yamato spirit, 95  
 Yamaya Tanin, 24

Yonai Mitsumasa, 136  
Yoyogi parade ground, 30, 256

Zeppelin bombing, 56  
Zeppelin, Ferdinand von, 24

Zeppelin-Staaken, 115  
Zeppelin-Staaken R.XV, 88, 154  
Zero-sen, 260  
Zimmermann, Wilhelm, 210