

AERONAUTICAL PERIODICALS (1783–1945) – A REFLECTION OF AIR POWER

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Summary. Periodical publications have played an important role in the development of aeronautics, providing a platform for scientific exchange and informing the public about the ongoing progress. This study analyzes periodicals covering the issues related to aeronautics from 1783 to 1945 on a worldwide scale. It assumes that the number and diversification of periodicals dedicated to aeronautics published in a given country depend directly on the level of development of air power in that country. The result shows that periodicals from only four countries dominated, three fourths of all titles published coming from France, Germany, Great Britain and the United States. In 1945, by the end of the period under study, these four countries, together with the Soviet Union and Japan, were also the world's dominant air powers in terms of both civil and military air activities. The study also analyzes the development of periodicals over time, the diversification of periodicals by major subject areas and the interdependence of information flows between the four major air powers.

Keywords: Aeronautical periodicals, periodicals from 1783 to 1945.

Purpose and Scope of the Study

National air power is a useful concept for analyzing the status and future potential of aviation (civil and military) in different countries, although it has generally come out of use in today's increasingly globalized world. According to the classic definition by John Cobb Cooper (1887–1967) from the mid-1940s formulated following Alfred Thayer Mahan's (1840–1914) definition of sea power, air power comprises both short and long-term elements. Short-term factors include the level of a nation's Aeronautical Industry, Aeronautical Facilities, Civil Air Establishment and Military Air Establishment; in the long term, the level of air power

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depends on Geographic Conditions, Resources, Population, Industrial Development and Political Intent [1; 2].

The present study maps and analyzes periodical publications (journals, serials, etc.) covering the issues relevant for the development of aeronautics published between 1783 and 1945 worldwide, the overriding hypothesis being that aeronautical publications in any given country, both quantitatively (numbers) and qualitatively (spread over relevant subjects), vary depending on the level of national air power.

In addition to monographs and newspapers, advances made in aeronautics have traditionally been communicated by means of scientific and other periodicals, lately also online media. Articles dealing with aeronautics started to appear already in the 17th–18th centuries in the journals issued by early scientific societies. In 1678, for example, the French «*Journal des Sçavans*» published by a circle of scientists in Paris took notice of «*une Machine ... pour voler en l'air*» (a machine to fly in the air) proposed by the blacksmith Jacob Besnier (?–?) [3]. Some decades later, in 1716, the Swedish scientist Emanuel Swedenborg (1688–1772) presented «*en Machine at flyga i wädret*» (a machine to fly in the air) in Sweden's first technological journal, the «*Dædalus Hyperboreus*» published in Uppsala [4]. In contrast to Besnier's rather impractical apparatus, Swedenborg's «Machine» was based on a fixed-wing design, possibly it was the first time this idea was ever presented in print (Figure 1). The breakthrough of lighter-than-air flight in 1783 witnessed an upsurge of articles about balloons both in the daily press and periodical literature.

DÆDALUS HYPERBOREUS.
 Eller
 Några Nya
 MATHEMATISKA och PHYSICALISKA
 Förföf
 OCH
Numereringar
 För åhr 1716:
 Som
 Utsolne Uer: Afsefl. Pålheimer
 OCH
 Andre Skrifte i Skrivetige
 hafwa gjordt
 OCH
 Nu till efter annan till sinen nyttö lamma.
 DÆDALUS en auras carpit, ridetqve superne
 QUIS sibi Rex Minos sruxit in orbe dolos.
 AURAS abire: sed sic tu, ni Dædale! carpe,
 Atqve dolos ride quos Tibi turba sruet,
 Sifiles of Besnians.

U P S L A
 hos Kongl. March och Upsala Academiæ Hoff.
 JOHAN. HENR. WERNER 1716.

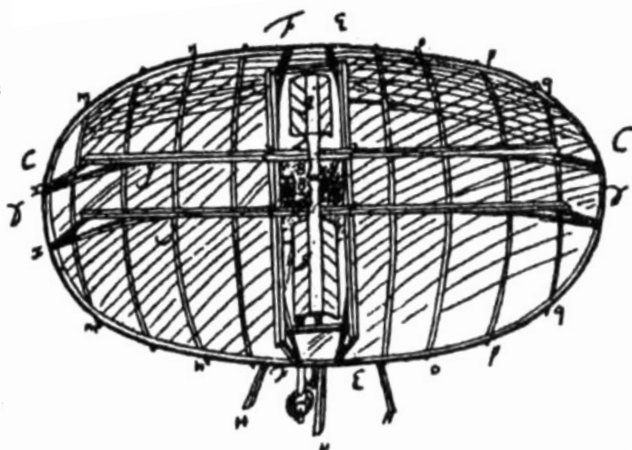


Figure 1. Swedenborg's Aerial Machine, published in the *Daedalus Hyperboreus*. Uppsala (1716).

A modern register of scientific and other periodicals, *Ulrich's Periodical Directory 2012* (50th edition), lists not less than 220 562 «serials» published worldwide under 903 subject-based headings, including periodicals, irregular serials and annuals [5]. 859 publications are listed under the heading «Aeronautics and Space Flight»; excluding the ones about space flights from this list, the resulting number is 682 serials from 48 countries. Country-wise, the distribution of these publications turns out to be highly skewed, 85% of all publications originating in only 11 countries, 279 (41%) in the USA alone. As a national air power, the USA still remains the dominant player, which is clearly reflected in these figures. It might be of interest to find out whether this trend can be traced also in the historical context, whether and to what extent periodical literature on aeronautics was concentrated in certain countries during the first century of aeronautical development.

The term «periodical» has been defined in different ways [6]. In the present analysis, a broad approach is adopted, similar to the one underlying the most comprehensive bibliography of aeronautical periodical literature compiled to date, the *Aeronautical and Space Serial Publications: A World List (1962)* compiled by Arthur George Renstrom (1905–1991) at the United States Library of Congress [7]. A. Renstrom's bibliography, which lists 4551 periodical titles from 76 countries, defines serials «in accordance with general library practice to include periodicals, documents, annuals, numbered monographic series (including publisher's series) and certain other publications issued under a single title» [8]. Certain military publications, air-raid titles and personnel, labor and school journals, as well as technical journals and publications of a more general nature were excluded. However, Renstrom kept a back-door open for materials contributing «something of historical, technical, or other reference value».

The present analysis is based on two main sources:

1) periodicals listed in aeronautical bibliographies and other relevant literature published in 1783–1945, as well as periodicals published before 1946 and listed in the bibliographies published after that date (e.g. *World List, 1962*);

2) periodicals published before 1946 and registered in the online data-bases of some 20 major libraries under keywords as *aero**, *air**, *avia**, *luft**, *fly**, *flight**, *lot**, *lucht**, *аэро**, *авиа**, etc.¹

A search in those sources resulted in the retrieval of 84 aeronautical bibliographies published in 1884–2005. Given that several of these

¹ The list of libraries includes the Library of Congress, New York Public Library, Staatsbibliothek zu Berlin, Bibliothèque National de France, British Library, Kungliga Biblioteket (Sweden), Biblioteca Nacional d'España, Servizio Bibliotecario Nazionale (Italy), Switzerland Nationalbibliothek, Bibliothèque Royale de Belgique, Koninklijke Bibliotheek (Netherlands) and Library and Archives Canada.

bibliographies were published over a number of years, the number of actual volumes is 312. As mentioned previously, added to this material has been library data retrieved online.

Distribution by Country and Continent

In the period under study, from the start of lighter-than-air flights in 1783 in France to the end of World War II, a total of 10 248 aeronautical periodical publications from 65 countries have been identified, 7702 in the printed bibliographies and 2546 in the online data systems. Over this long period, several countries such as Russia/Soviet Union, Austria-Hungary/Austria or Italy underwent substantial geopolitical changes, especially after World War I. However, this does not significantly distort the clear picture, which emerges considering the country-wise distribution of publications over the period under study.

As shown in Table 1, out of the total of 10 248 publications not less than $\frac{3}{4}$ originated in five countries – the United States of America, Germany, France, Great Britain and Italy, the United States of America alone being responsible for $\frac{1}{4}$ of all publications. Looking at the ten largest nations regarding the number of publications together having published 87 % of all periodicals, it may be noticed that the Top Ten list includes also Russia/Soviet Union, Austria, Sweden and Switzerland, as well as then British Dominion Canada. Adding five more countries to this list, it may be noticed that all except Australia are located in Europe, resulting in the saturation level of 92 %.

In sum, from the end of the 18th century and until the end of World War II, publication of aeronautical periodicals was mainly concentrated in just a few countries in North America and Europe, the rest of the world playing a marginal role.

Considering the distribution of periodicals by continent (Table 2), a similar preponderance can be identified, North America (US) and 20 countries in Europe dominating with 93 % of all publications. Adding the British dependencies (dominions, colonies, mandates, etc.) to this list, it may be noticed that a mere 3 % of all aeronautical periodicals worldwide were published outside what might be generally called the industrialized western world.

Table 1

Number of Aeronautical Periodicals (1783–1945); Distribution by Country

Countries	Total Number of Publications	Distribution (%)
United States (US)	2445	23.9 %
Germany (DE)	2154	21.0 %
France (FR)	1316	12.8 %
Great Britain (GB)	1175	11.5 %
Italy (IT)	667	6.5 %
Russia / Soviet Union (RU/SU)	359	3.5 %
Austria (AT)	239	2.3 %
Sweden (SE)	199	1.9 %
Switzerland (CH)	173	1.7 %
Canada (CA)	170	1.7 %
Belgium (BE)	156	1.5 %
Netherlands (NL)	131	1.3 %
Spain (ES)	119	1.2 %
Australia (AU)	104	1.0 %
Total	9407	92 %
Other	841	8 %
TOTAL	10 248	100 %

Table 2

Number of Aeronautical Periodicals (1783–1945); Distribution by Continent

Continents, British dependencies	Number of countries	Number of periodicals	Distribution, (%)
Europe	29	7065	69 %
USA	1	2445	24 %
South America	14	212	2 %
Asia and Middle East	4	98	1 %
British dominions and colonies etc.	17	428	4 %
TOTAL	65	10248	100 %

It could be argued that these highly skewed distributions by country and continent are caused by the underlying data. To some limited extent this argument holds true, especially with regard to Eastern Europe (foremost Russia/Soviet Union) and Japan, the regions with substantial aeronautical activities, which due to practical reasons (accessibility, language) could not be properly analysed. Again, even the addition of several hundred periodicals from either the Soviet Union and/or Japan would not distort the general picture; it would rather result in the change of the relative standing of the respective country. As to the countries in South America and Asia / Middle East, the data at hand do not indicate any (hidden) existence of large numbers of aeronautical periodicals in those regions; therefore, it may be assumed that the publishing activities in these countries compared to Europe and North America were at a comparatively insignificant level.

Exchange of Aeronautical Information

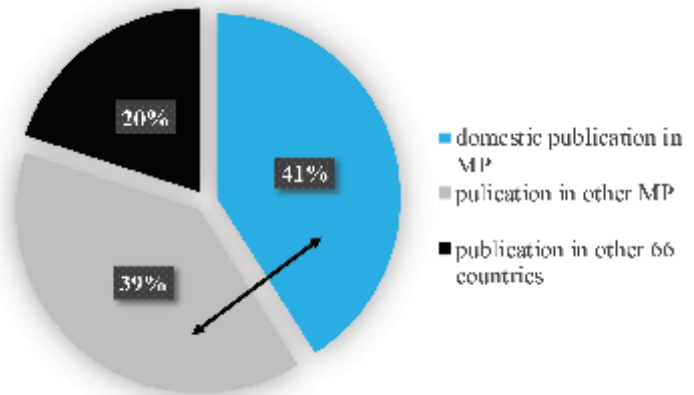
From the earliest days forward, aeronautics has been an international phenomenon. National advances made in aircraft manufacturing or the operations of aircraft (civil and military), personnel training practices or the regulation of air traffic were quickly spreading between countries and continents. It can be assumed that this exchange of aeronautical know-how and practice should also be somehow reflected in the bodies of aeronautical literature included in the aeronautical bibliographies published in different countries.

Looking at the number of journals and other periodical literature published in different countries according to Table 1, it is shown that the United States (US), Germany (DE), France (FR) and Great Britain (GB) – each with a relative share exceeding 10 % – together were responsible for almost 70% of all periodical literature published. An important question that thereby can be asked concerns the distribution of journals etc. in the different bibliographies underlying this data according to their country of origin. Taking a random sample of 21 bibliographies from these four countries (referred to as major powers: MP) and sorting their references by country of origin, it was found that 80% of all entries referring to journals and other periodicals had originated either in the host country (41 %) or were publications coming from one of the remaining three MPs (39 %); that means that only 20 % of all references had originated in one of the remaining 66 countries² (Figure 2). Only few bibliographies deviate from this general pattern: in one specialized

² The total number of entries in this analysis is 13 288 periodicals, which deviates from the number 10 248 considered above due to the fact that various journals are listed in several data-bases (see below).

bibliography, for example, published in 1938 and dedicated to aviation medicine, only 56 % of all journals and other periodical literature had originated in one of the four MPs as compared to 44 % of journals etc. that came from the remaining 66 countries.

Figure 2. Distribution of journals and other periodicals in 21 select bibliographies according to their countries of publication (MP – Major powers US, DE, FR, GB).



This result indicates that the international interchange of aeronautical information via periodical literature to a very large extent took place within an exceedingly small circle of advanced countries in North America and Western Europe, countries in other parts of the world thereby remaining as bystanders.

Aeronautical Periodicals: Core and Allied Subjects

As noted by J. C. Cooper in his discussion of the air power, any country's present and future ability to operate aircraft (civil and military) for its own purposes in addition to such factors as aircraft fleet, aviation infrastructure, trained personnel, etc., also depends on its long-term outlook with regard to scientific and industrial development, demography and geopolitical factors. The larger and more geographically beneficially located a country is, the more developed its industrial base, the more advanced its scientific establishment and the more focused its air policy is, the greater is its future potential to defend its aeronautical interests against other countries. The situation in Germany after World War I can thereby serve as a valid example: having been deprived of most its aeronautical assets by the Treaty of Versailles in 1919, after only one decade, Germany had again moved into the top position among the European air powers, its long-term capacity to fly had not been dwarfed by the Treaty. Thus, analyzing air power in the context

of periodical literature one must take notice not only of aeronautical journals proper but also of the publications from the relevant allied subject areas. This wide perspective was also adopted compiling most aeronautical bibliographies published before 1946.

In the present analysis, the data about periodicals retrieved from bibliographies and online data systems were categorized according to seven major subject areas along two dimensions: (1) Core Aeronautical Subject Areas; and (2) Allied Aeronautical Subject Areas (Table 3). Thereby, core aeronautical periodicals specifically deal with aeronautical issues (e.g. 11: «Journal of Aeronautical Medicine», 31: «Journal of Aeronautics»), while allied periodicals cover subject matters relevant for aeronautics (e.g. 19: «Journal of Physics», 29: «Automobile Journal»).

Table 3

Categorization of Aeronautical Periodicals

Major subject areas	CORE	Distribution (%)	ALLIED	Distribution (%)
Research and Development	11	9 %	19	10 %
Aircraft, Engines and Equipment	21	6 %	29	14 %
Civil Operations	31	19 %	39	4 %
Military Operations	41	6 %	49	6 %
Legal and Regulatory	51	4 %	59	6 %
Other specialized periodical literature	-	-	69	9 %
General periodical press	-	-	99	7 %
TOTAL		44 %		56 %

Table 3 shows the distribution of periodicals according to seven categories and two dimensions mentioned, whereby 44 % of all periodicals fall under the CORE subjects and 56 % under the ALLIED subjects. Considering the core and allied subjects it has been found out that about 20 % of all periodicals deal with scientific research and development, 20 % – with aircraft including industrial processes and materials, about 25 % – with civil air operations and other means of transport, 12 % – with military air operations, 10 % – with political and legal matters relevant

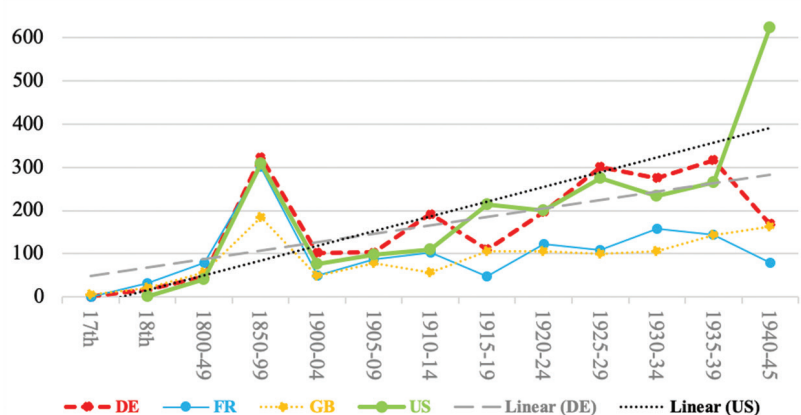
for air operations, 9 % of publications were published by different organizations concerned with aeronautics and 7 % fall into the remaining category of general periodical print.

With some exceptions, the distributions along two dimensions and categories in the scheme are quite similar for the four major powers the US, DE, FR and GB; Germany can be considered an exception with a small lead in Category 11 and France – in Category 31. Comprising 19 % of all periodicals and thus being the largest category, Category 31 includes publications generally referred to as aeronautical journals. As it may be noticed, this category makes up barely one-fifth of the total number of publications covering the issues related to aeronautics found in many other subject areas.

Aeronautical Publication Rates

As mentioned previously, periodicals started to include information about aeronautics already in the 17th–18th centuries. The first break-through regarding the number of publications had to wait until the second half of the 19th century, when balloons and around the turn of the century also airships started to spread in different countries. The next break-through occurred during World War I, when tens of thousands military airplanes from both Central and Allied Powers started to take an increasingly active part in combat. Considering the four major air powers – the US, DE, FR and GB, after the World War I the differences in publication activities between the US and DE on the one hand and FR and GB on the other, became more and more pronounced in the course of time (Figure 3). The US demonstrated an impressive growth of the number of relevant publications during World War II.

Figure 3.
Publications
rates from the
17th century to
1945, USA, Germany,
France and
Great Britain.



Top-10 Aeronautical Periodicals

Periodicals included in the bibliographies used as sources were listed more or less frequently, the extreme case being one entry (article or journal title) in one of the bibliographies. On the other extreme one finds periodicals found in several of 53 bibliographies analyzed in detail, often in combination with many individual entries per bibliography. Analysis of the latter issue, i.e. calculating the number of total entries per journal in each of the bibliographies, would take immense effort and cannot be attempted within the framework of the present study. What can be shown, in its turn, is the number of bibliographies holding the data on one and the same periodical, resulting in the Top-10 list of periodicals (Table 4).

Table 4

Top-10 Aeronautical Periodicals

Number of Bibliographies	Journal	Location	Start	End
35	« <i>Flight</i> »	London	1909	after 1945
35	« <i>Aérophile (L)</i> »	Paris	1893	after 1945
32	« <i>Scientific American</i> »	New York	1845	–
29	« <i>Aero Digest</i> »	New York	1924	–
29	« <i>Journal of the Royal Aeronautical Society</i> »	London	1923	after 1945
29	« <i>Aéronautique (L)</i> »	Paris	1919	1940
29	« <i>Aeroplane</i> »	London	1911	after 1945
29	« <i>Zeitschrift f. Flugtechnik und Motorluftschiffahrt</i> »	Berlin	1910	1933
29	« <i>Zeitschrift des Vereins deutscher Ingenieure</i> »	Berlin	1857	after 1945
29	« <i>Comptes rendus de l'Académie des Sciences</i> »	Paris	1835	after 1945

As shown in Table 4, in the period from 1783 to 1945 the periodicals in the Top-10 originated in Great Britain (3), France (3), Germany (2) and the United States (2). While three out of these ten publications, namely,

the «*Scientific American*» (US), «*Zeitschrift des Vereins deutscher Ingenieure*» (DE) and «*Comptes rendus de l'Académie des Sciences*» (FR) are not CORE periodicals according to the definition presented above, the other seven are directly attributable to the core aeronautical activities, some of them were issued by aeronautical societies (e.g. «*Journal of the Royal Aeronautical Society, l'Aérophile*»), some were published as an aeronautical journal proper (e.g. «*Flight, Aeroplane*»). It can be pointed out that the journal «*Flight*» is still published today.

Conclusions

Two of the most comprehensive aeronautical directories published right before the outbreak of World War II in 1939, «*Interavia ABC*» and «*Handbuch der Luftfahrt*», provide summaries of the ongoing aeronautical activities (civil and military) that year in 56 sovereign states and 80 dependencies (dominions, colonies, protectorates, etc.) [9]. One gets a first indication of the importance of aeronautics for different countries looking at the number of pages allotted in the directories to different countries. For example, in «*Interavia ABC*», Gdańsk (a Free City) and Gibraltar (a colony) received less than one page each compared to 114 pages for the United States, 68 for Great Britain, 66 for France and 41 for Germany. These two directories, in addition to a wealth of organizational and flight-operational data, also contain quantitative information about basic elements included in Cooper's definition of air power – the number of aeronautical firms, number of civil airlines, number of plane-miles flown by civil airlines and number of civil and military aircraft.

Out of the total of 500 aeronautical firms active worldwide in 1939 not less than 333 (67 %) were located in the US, DE, FR and GB, 28 % in the US alone. None of the other countries with the exception of the Soviet Union (24) and Japan (16) came close to these numbers; the manufacturing of aircraft equipment was largely concentrated in those 4–6 countries. Therefore, it should be kept in mind that the industrial set-up for aircraft manufacturing and operations differed widely between the countries involved. The state-run Soviet system, which consisted of numerous production and operation units under one and the same «administration», differed greatly from the western systems.

Considering the numbers of civil airlines presented in Table 5, it may be stated that these figures are partly misleading: DE, for example, shows one airline as compared to GB's 15. By the late 1930s, the German carrier *Lufthansa* had developed into one of Europe's largest air carriers, while the large number of British airlines included several small regional carriers. Considering the number of aircraft registered by civil air

operators as well as plane-miles flown in 1938, one finds DE and GB at similar levels. In general, scheduled airlines in the US, DE, FR and GB together operated more than 1/3 of the world's civil aircraft fleet, accounting for close to 50 % of all plane-miles flown. These numbers clearly indicate their dominance³.

Table 5

Indicators of Air Power 1939⁴

Continents	Countries	Aeronautical firms	Civil airlines	Number of civil aircraft [10]	Plane-miles flown (000) [11]	Military aircraft ⁵
Europe	26	309	44		88 334	25 982
Africa	1	-	-		-	60
Asia/Middle East	9	30	9		(6893 ⁶)	3785 ⁷
North/Central America	10	142	42		(78 047 ⁸)	8695
South America	10	4	18		(15 462 ⁹)	960
Dependencies	80	15	30			605
TOTAL	136	500	143	2 388	228 535	40 087
United States		141	23	345	78 047	8500
Germany [12]		62	1	146	12 230	4100
France		62	5	159	9000	4200
Great Britain		68	15	173	12 987	2400
TOTAL		333	44	823	112 264	19 200

³ The number of German military aircraft for 1939 was not listed in the (German) «*Handbuch der Luftfahrt*». The number was instead taken from Volker, Karl-Heinz. «*Die Deutsche Luftwaffe 1933-1939*» (Beiträge zur Militär- und Kriegsgeschichte herausgegeben vom Militärgeschichtlichen Forschungsamt.). Stuttgart: Deutsche Verlagsanstalt, 1967, pp. 188-190.

⁴ The table is based on «*Interavia ABC 1939*» and «*Handbuch*» 1939 (see above).

⁵ The only sovereign countries in Europe without military aircraft in 1939 were Iceland, Luxemburg and Albania.

⁶ Includes Egypt.

⁷ Of which Japan 2600 aircraft.

⁸ Includes only the United States.

⁹ Includes Mexico and Central America.

The third indicator, the number of military aircraft, shows that 48% of all aircraft worldwide were operated by the US, DE, FR and GB, closely followed by the Soviet Union with 6000 aircraft and Japan with 2600; the US alone operated 22 % of all military aircraft.

Air power as circumscribed by these five indicators clearly puts the US, DE, FR and GB into the top positions, followed by the Soviet Union and Japan. This picture gets strengthened when analysing more closely the long-term potential of these countries in terms of air power, considering their geographic locations, demographic development, basic resources, industrial bases and political visions.

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2019/3

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Ginters Zolingers

Periodika aeronautikā (1783–1945)

Aeronautikas attīstībā nozīmīga loma ir arī publikācijām periodikā, nodrošinot zinātniskās apmaiņas platformu un informējot sabiedrību par progresu konkrētajā jomā. Raksta autors analizē pasaulē izdotos aeronautikas periodiskos izdevumus no 1783. līdz 1945. gadam, pieņemot, ka attiecīgajā valstī publicēto aeronautikai nozīmīgo periodisko izdevumu skaits un dažādība ir atkarīga no gaisa spēku attīstības līmeņa tajā. Pētījuma rezultāti liecina, ka dominē četru valstu – Francijas, Vācijas, Lielbritānijas un Amerikas Savienoto Valstu – periodiskie izdevumi, un tas ir trīs ceturtdaļas no visiem aeronautikai veltītajiem izdevumiem pasaulē. 1945. gadā, pētāmā perioda beigās, šīs četras valstis kopā ar Padomju Savienību un Japānu bija dominējošās valstis pasaulē gan civilajā, gan militārajā gaisa spēku jomā. Pētījumā analizēti ne tikai periodiskie izdevumi dažādos laika periodos, bet arī to iedalījums pa galvenajām tēmām.

Atslēgas vārdi: periodiskie izdevumi aeronautikā, periodika no 1783. līdz 1945. gadam.

*Гюнтер Золлингер**Aeronautical
Periodicals
(1783–1945) –
a Reflection of
Air Power*

Периодические издания по авиации (1783–1945)

Периодические издания играют важную роль в развитии авиации, обеспечивая платформу для научного обмена и информирования общественности о прогрессе в этой области. Автор статьи анализирует периодические издания, вышедшие в свет с 1783 по 1945 гг., учитывая тот факт, что количество и разнообразие периодических изданий по авиации, публикуемых в соответствующей стране, зависит от уровня развития военно-воздушных сил. Результаты исследования показывают, что периодические издания четырех стран – Франции, Германии, Великобритании и США – доминируют и составляют три четверти всех изданий по авиации во всем мире. В 1945 году, в конце периода исследования, эти четыре страны, вместе с Советским Союзом и Японией, были доминирующими странами в мире в области как гражданской, так и военной авиации. В исследовании анализируются не только периодические издания разных периодов времени, но и их разбивка по основным темам.

Ключевые слова: периодические издания по авиации, периодические издания с 1783 по 1945 год.