

Analysis on the Current Status and Trend of Domestic Bronze Sword Research——Based on Bibliometrics and Information Visualization Analysis

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Abstract: *In order to promote the further study of bronze sword, the knowledge graph is used to visualize the literature related to bronze sword. The journal paper data of bronze sword related research included in the CNKI database is used as a sample. The literature output, keyword clustering, highly cited literature and other contents in this field are generated into a visualized knowledge graph using software such as Endnote X9 and VOSviewer. The relevant data are combined for comprehensive analysis to explore the hot spots and future trends in the field of bronze sword research.*

Keywords: Bronze sword, Bibliometrics, Information visualization analysis.

1. Introduction

Bronze ware was popular during the Shang and Zhou dynasties. From the current archaeological excavations, the number of unearthed bronze weapons is far greater than the number of ritual vessels. War has always accompanied the development of human society. Bronze swords, as an important type of weapon, have been unearthed in large numbers from the relics of the Shang and Zhou dynasties. In recent years, the research results on bronze swords have become more and more abundant, but there are relatively few reviews of bronze sword research in China. In order to effectively evaluate the current research status and gain insight into future trends, we need to use special means to systematically summarize and analyze massive literature. Using bibliometrics and information visualization technology to systematically analyze a field is a common research method and means in the fields of metrology and medicine. In recent years, this method has gradually emerged in the field of archaeology. The purpose of this paper is to sort out and summarize the domestic literature related to bronze swords by combining bibliometrics with information visualization analysis, and to systematically analyze the current research status and future publication trends, in an effort to find new research ideas and provide data support for the discovery of relevant hotspots.

2. Literature Sources and Research Methods

2.1 Literature Sources

In the academic field, high-level research results are often reviewed by peer experts and strictly screened by journals to ensure their academic quality and disciplinary influence. These high-quality scientific literature plays an important role in promoting disciplinary development and knowledge innovation [1]. The literature data of this article comes from China National Knowledge Infrastructure (CNKI). To ensure the comprehensiveness of the data, the search range is the literature included in the database from March 1960 to May 1,

2024. To ensure the accuracy of the results, the search conditions are set in the search interface as: "Topic = Bronze Sword" or "Article Abstract" = "Bronze Sword". A total of 461 Chinese literatures were retrieved. After deduplication and sorting of the search results, 383 valid sample documents were obtained after deleting non-research literature such as journals, conferences, newspapers, and works.

2.2 Research Methods

Based on bibliometrics and information visualization analysis, this paper conducts quantitative and qualitative analysis of bronze sword-related articles included in CNKI from 1960 to 2024 from the perspective of literature, and analyzes eight aspects: publication time and quantity, discipline, publication type, journal, scientific research institution, excavation area, keyword clustering, and high-impact literature. The 383 valid documents retrieved were analyzed and statistically analyzed using software such as Endnote X9 and VOSviewer. VOSviewer is a powerful visualization analysis tool that can perform keyword co-occurrence analysis, co-citation analysis, and other analyses on big data documents. It has advantages in clustering technology and can be used to draw visualization maps of various disciplines [2]. By making full use of the above software, we can more clearly grasp the progress and development trend of bronze sword research in my country.

3. Results and Discussion

3.1 Time and Quantity of Literature Publication

The time and quantity of literature publication can reflect the research dynamics of a field to a certain extent. Based on the selected data, a trend chart of the number of publications in the field was drawn with a five-year period (see Figure 1).

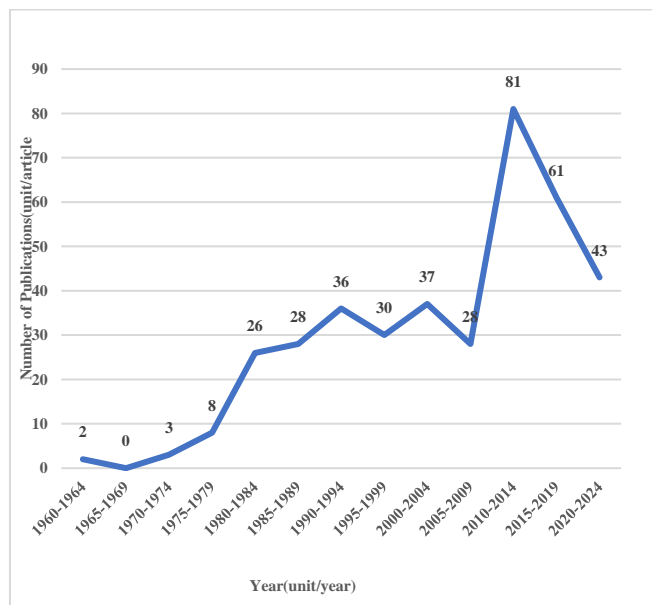


Figure 1: Trend chart of the number of posts

The output trajectory of Chinese scholars' research on bronze swords can be divided into four stages: the first stage is from 1960 to 1979, during which the output of literature is relatively small, with a total of 13 papers. Since 1960, my country has carried out excavations of sites of various dynasties to varying degrees, and the study of bronze swords has begun. The second stage is from 1980 to 1994, and the number of papers published has shown an explosive growth compared with the first stage, with a total of 87 papers published. During this stage, the enthusiasm of scientific researchers for the discussion of bronze swords continued to rise. The third stage is from 1995 to 2009, during which the total output of literature has slightly fluctuated, with a total of 95 papers published, but the academic community still maintains its enthusiasm for the study of bronze swords. The fourth stage is from 2010 to 2024, although the output of literature shows a decreasing trend, the total number of papers published exceeds the previous stages. The output of literature reached its peak between 2010 and 2014, with 81 papers. In recent years, General Secretary Xi Jinping has attached great importance to archaeological and cultural relics protection work. With the vigorous development of military archaeology, bronze swords, as an important research object, will continue to show an unprecedented good trend in future research.

3.2 Distribution of Literature Disciplines

The advantages of interdisciplinary research are playing an increasingly important role in scientific research. By analyzing the subject categories of bronze sword-related research, we can intuitively understand the subjects most closely related to them, accumulate basic knowledge related to research in this field, and thus make Produce diversified research. Table 1 statistics the distribution of the top 10 disciplines in my country's research literature on bronze swords from 1960 to 2024. It can be seen from the statistical results that related research on bronze swords is mainly in the directions of archeology, tourism, sports, etc. Among them, archeology has the largest number of publications, accounting for about 70.5% of the total number of publications, making it a hot research direction in this field; the number of publications in the tourism direction is second, accounting for

about 5.22% of the total number of publications; and the number of publications in the sports direction ranks third. Three, accounting for approximately 4.7% of the total number of published articles; the disciplines related to archeology, namely ancient Chinese history, archives and museums, and world history, published 24 articles, accounting for approximately 6.27% of the total number of published articles. On the whole, the research field on bronze swords is relatively concentrated, and archeology has assumed important tasks and mission of the times as an independent discipline.

Table 1: Distribution statistics of the top 10 disciplines

Subject Classification	Quantity/article	Percent age
Archaeology	270	70.50%
Tourism	20	5.22%
Sports	18	4.70%
Ancient Chinese History	13	3.39%
Archives and Museums	10	2.61%
Fine Arts, Calligraphy, Sculpture and Photography	10	2.61%
Weapons Industry and Military Technology	8	2.09%
Culture	5	1.31%
Chinese Literature	4	1.04%
Metallurgy and Metalworking	4	1.04%

3.3 Distribution of Publication Types

The types of documents reflect the depth and breadth of academic research in a field to a certain extent. Table 2 lists the distribution of publication types of documents on bronze sword research in my country from 1960 to 2024, with a total of 5 document types. Among them, research documents are the most commonly published document type, accounting for about 56.4% of the total number of publications; followed by excavation briefing documents, accounting for about 20.1% of the total number of publications. This type of document is the basis of all research types; the third is degree thesis, accounting for about 12.01% of the total number of publications. It can be seen that the relevant research on bronze swords is a hot topic for degree thesis; scientific and technological documents account for about 9.92% of the total number of publications; review documents are rare, accounting for only 1.57% of the total number of publications. Therefore, it is very necessary to conduct a systematic research review in this field at present.

Table 2: Statistics on the proportion of literature publication types

Type	Quantity	Percentage
Research	216	56.40%
Dissertation	77	20.10%
Science and Technology	46	12.01%
Review	38	9.92%
Research	6	1.57%

3.4 Distribution of Literature and Journals

There are a large number of journals that accept literature in the field of bronze sword research, with a total of 153. The research direction of journals is mainly concentrated in the field of history. There are 48 historical journals, with a total of 200 articles, accounting for about 52.22% of the total number of articles. In addition, the journals of various universities are

also the focus of collecting relevant articles in this field. According to statistics, 26 university journals in my country have included literature on bronze sword research, with a total of 29 articles, accounting for about 7.57% of the total number of articles. Table 3 counts the number and proportion of the top 10 journals in this field collected by CNKI. It can be seen that the journals that accept more literature in this field are "Archaeology", "Cultural Relics" and "Sichuan Cultural Relics". Among them, "Archaeology", sponsored by the Institute of Archaeology, Chinese Academy of Social Sciences, ranks first with an overwhelming advantage in the number of articles published, accounting for about 11.23% of the total number of articles, and is the most influential journal in this field. Overall, the research results on bronze swords are very rich, and the journals that accept research results in this field show a trend of diversified development.

Table 3: Statistics of the number of articles published in the top 10 journals

Journals	Quantity	Percentage
Archaeology	43	11.23%
Cultural relics	26	6.79%
Sichuan cultural relics	15	3.92%
Cultural relics identification and appreciation	10	2.61%
Journal of Archaeology	9	2.35%
Cultural relics protection and archaeological science	9	2.35%
Southeast culture	8	2.09%
Jiangnan archaeology	8	2.09%
Cultural relics	7	1.83%
China's collective economy	7	1.83%

3.5 Distribution of Scientific Research Institutions

Among the selected documents, 263 documents come from 176 institutions, and 120 documents do not contain institutional information. Among them, the top three institutions in terms of the number of publications are Jilin University, Shanghai Museum, and Anhui University. Jilin University is the institution with the largest output of documents, accounting for about 3.39% of the total number of publications. Many experts and scholars engaged in archaeology at Jilin University have deep attainments in the research of bronze swords and other weapons. Table 4 summarizes the types of scientific research institutions, the number of publications, and the proportion of the research documents on bronze swords. From the perspective of the types of institutions, seven types of scientific research institutions, namely universities, museums, archaeological institutes, cultural relics management institutes, cultural centers (bureaus, departments), social science academies and cultural heritage research institutes, are the main institutions for bronze sword research. Among them, 66 universities have published 123 papers, accounting for about 32.11% of the total number of papers published; 49 museums have published 72 papers, accounting for about 18.8% of the total number of papers published; and 11 archaeological institutes have published 16 papers, accounting for about 4.18% of the total number of papers containing institutional information. It can be seen that universities are the main battlefield for bronze sword research at present, which is closely related to the fact that universities generally offer majors such as archaeology, cultural relics, and museums.

Table 4: Statistics on the number of papers published by scientific research institutions

Institutional Classification	Number of institutions	Number of posts	Percent age
Colleges and universities	66	123	32.11%
Museums/museums	49	72	18.80%
Archaeological institutes	11	16	4.18%
Cultural relics management offices	10	10	2.61%
Cultural centers (bureaus, departments)	8	9	2.35%
Schools of Social Sciences	4	4	1.04%
Cultural Heritage Research Institute	2	2	0.52%
Others	26	27	7.05%
Unknown	-	120	31.33%

3.6 Bronze Sword Unearthed Areas

my country has a vast territory, and the bronze swords discovered by archaeologists are very unevenly distributed in different regions. Bronze swords unearthed in different regions have their own characteristics. Exploring the unearthed areas of bronze swords will help us understand the position of bronze swords in various bronze civilizations. According to statistics, 44 documents studied the unearthed areas of bronze swords that were unknown or had unclear regional characteristics. Most of the documents have regional characteristics, so it is possible to accurately analyze and study the hot spots of unearthed bronze swords. Table 5 is a statistical table of the unearthed areas of bronze swords in the selected documents. The top three regions where bronze swords were unearthed in the selected documents are Jiangsu, Zhejiang, Anhui, Sichuan, Chongqing, Jilin, Liaoning, and Heilongjiang, accounting for 21.15%, 7.83%, and 7.31% respectively. In addition, another hot spot in the study of bronze swords is regional comprehensive research, which accounts for about 11.47% of the total number of publications. Comprehensive research can analyze the similarities and differences, evolution laws, spatial rheology, etc. of bronze swords unearthed in various parts of my country from a macro perspective, and explore the formation process and cultural exchanges of regional styles.

Table 5: Statistics on the distribution of unearthed areas

Unearthed areas	Quantity	Percentage
Jiangsu, Zhejiang, Anhui	81	21.15%
Sichuan, Chongqing	30	7.83%
Heilongjiang, Jilin, Liaoning	28	7.31%
Yunnan, Guizhou	19	4.96%
Hubei	18	4.70%
Shandong	17	4.44%
Shaanxi	11	2.87%
Jinan	10	2.61%
Gansu, Qinghai, Ningxia, Xinjiang, Inner Mongolia	8	2.09%
Guangdong, Guangxi	8	2.09%
Fujian	7	1.83%
Henan	7	1.83%
Hunan	6	1.57%
Jiangxi	6	1.57%
Beijing, Tianjin, Hebei	5	1.31%
Tibet	1	0.26%
Regional comprehensive research	77	20.10%
Unknown unearthed areas or unclear regional characteristics	44	11.49%

3.7 Keyword Co-occurrence Analysis

Use VOSviewer to perform keyword co-occurrence analysis on the selected documents, and filter them with the minimum number of keyword occurrences of 3 as the threshold. As shown in Figure 2, it can be clearly seen that the keywords extracted are divided into 5 different colors in the figure, that is, 5 different clusters.

Cluster 1 (red): unearthened artifacts and age. It contains a total of 11 keywords, mainly including unearthened, bronze dagger, bronze, Spring and Autumn Period, archaeology, and decoration. The artifacts and ages unearthened by archaeological excavations are the basis for studying bronze swords. Bronze swords appeared as early as the Shang Dynasty. Bronze daggers from the Shang Dynasty have been unearthened in Zhukaigou, Inner Mongolia [3], Linzhayu, Baode, Shanxi [4], and Gaohong, Liulin [5]. Bronze daggers have also been unearthened in Western Zhou tombs such as Zhuyuangou, Baoji [6] and Baicaopao, Lingtai [7]. Most of the bronze swords unearthened from the Shang to Western Zhou periods were daggers with a blade of only 17-18 cm. Regarding the use of this bronze short sword, the "Explanation of Names and Explanations of Soldiers" states that "it is also a retractable weapon, because it is on the body and in the arm when arched" [8], indicating that the sword was originally a weapon carried on the body for defense. The sword began to be valued and used as a weapon in battle after the Western Zhou Dynasty. Archaeological excavations have proved that the shape of the sword has undergone new changes after the Western Zhou Dynasty. The bronze swords unearthened from the Guo State Cemetery are all "pillar ridge swords" [9]. In the Spring and Autumn Period when chariot warfare was popular, this type of sword played a good role in stabbing. In general, this type of research on bronze swords is still in its infancy. It mainly focuses on archaeological research on unearthened artifacts and their ages, exploring the diversity of their uses, and their strong characteristics of the times. It provides valuable physical materials for understanding the production and life of the society at that time and restoring the historical features of ancient times.

Cluster 2 (blue): Regional culture and typology. It contains a total of 8 keywords, mainly including bronze culture, curved-blade bronze short sword, typology, Karasuk, etc. My country's bronze civilization is rich and colorful, and the bronze swords unearthened in the north and south have obvious regional characteristics. The bronze daggers in the northern region are famous for their unique one-piece casting process and curved blade and dagger-shaped daggers [10]; while the southwestern region presents a completely different style, with willow-leaf-shaped swords being the most representative [11]. The bronze swords unearthened in various places show significant diversity in shape, which is a direct reflection of regional cultural differences. Based on typology, in-depth

exploration of the uniqueness of bronze swords in different regions will help reveal the rich and colorful cultural features of ancient society.

Cluster 3 (yellow): Documents and ancient characters. It contains a total of 7 keywords, including Zuo Zhuan, inscriptions, etc. In 1925, Wang Guowei proposed the double evidence method, which is to use "new materials from underground" and ancient document records to verify each other and consider the true face of ancient history and culture. The newly unearthened bronze swords complement and verify the contents of ancient books such as "Zhou Li", "Zuo Zhuan" and "Han Shu", and can obtain a dual judgment of archaeological discoveries and document records. The inscriptions on bronze ware are particularly precious materials for studying ancient history. They are a window to understand ancient Chinese civilization and are of great significance for restoring the original appearance of history.

Cluster 4 (purple): Tomb shape and tomb owner's identity. It contains 6 keywords, mainly including tomb, King Yue, Gou Jian, etc. The ancient Chinese tomb ritual system has a very distinct social hierarchy. The size, shape, and number of burial objects of the tomb can directly reflect the status and wealth of the tomb owner. The bronze sword is one of the important references. The sword was a symbol of aristocratic status in the Shang and Zhou dynasties and had strict regulations. The "Zhou Li Kao Gong Ji" divided swords into three grades. The sword body was five times the length of the sword stem as the upper grade, four times the length as the middle grade, and three times the length as the lower grade, corresponding to the specifications of swords for different grades [12]. Archaeologists can infer the tomb grade and the status of the tomb owner by the grade of the unearthened bronze swords. The study of tomb shape and tomb owner's identity helps us to explore the ancient social system, living customs, and ideological concepts in depth.

Cluster 5 (green): Hegemony war. It contains 9 keywords, including bronze sword, weapons, Wu State, Yue State, China, etc. During the Spring and Autumn Period, the various states fought against each other for hegemony, and bronze swords played an important role in this process. During the Wu-Yue hegemony struggle, due to the special geographical features of the Wu-Yue region, the troops of the two countries were mostly infantry, and long weapons such as spears and halberds were not suitable for the region, while swords suitable for close combat became the main weapons in the region [13]. Therefore, the number of bronze swords unearthened in the Wu-Yue region is far greater than that in the Central Plains region of the same period, and the quality and modeling of the bronze swords also surpass those of other regions. Throughout history, the bronze sword, as an important weapon in ancient wars, has a close relationship with the frequency and intensity of wars.

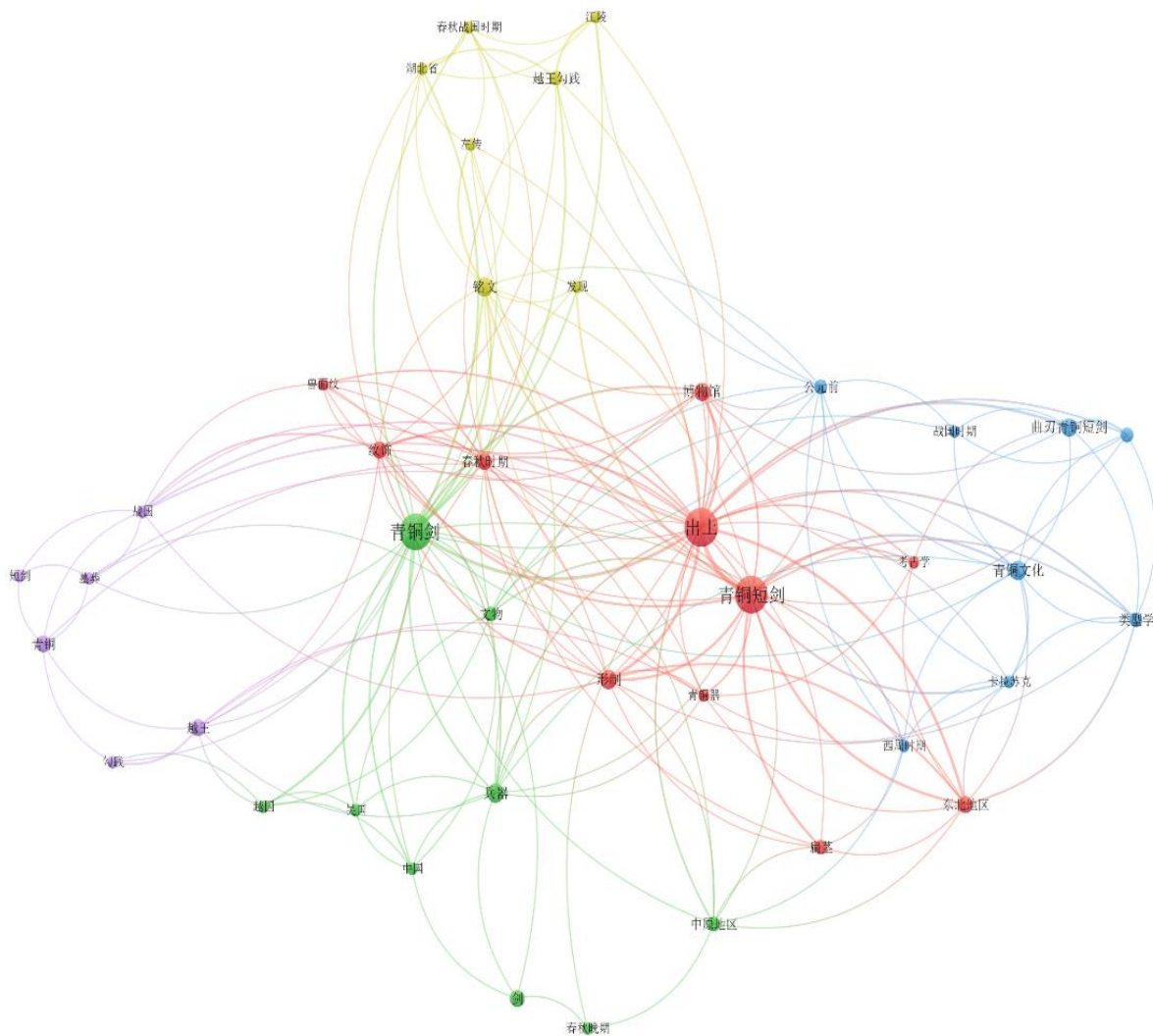


Figure 2: Keyword co-occurrence clustering map

3.8 Analysis of Highly Influential Literature

Highly cited literature is an important source of knowledge in the research field. It can not only clearly reflect the development context and direction of the discipline, but also reveal the core research themes and the most cutting-edge exploration areas. When writing a paper, making full use of and citing these highly cited literature can not only enhance the persuasiveness and authority of the paper, but also help readers to have a more comprehensive understanding of the research status and development trends in the field. Table 6 extracts the top 10 most cited literature. No. 1, 5, 7, 8, and 9 are all literature on bronze swords in a certain region of my country. No. 2 and 10 are literature on bronze swords in a certain period of time. No. 3 is a brief report on archaeological excavations. No. 4 and 6 are literature on the same type of bronze swords.

In the research of No. 1, 5, 7, and 9, based on the collection and collation of archaeological data, the origin, popularity, development process, and cultural interaction of bronze swords in southwest my country were sorted out. No. 1 Mr. Tong Enzheng [14] divided the bronze swords in the southwest into two major systems: Bashu and "Southwest Yi", and discussed the shape evolution and origin of the bronze swords of these two systems respectively. No. 5 Mr. Duan Yu

[15] studied the origin of willow-leaf-shaped bronze swords in the southwest region. He believed that this type of sword was introduced to my country via Iran and India. No. 7 and 9 were both written by Mr. Zhang Zengqi [16][17]. He classified and dated the bronze swords in western Yunnan and concluded that the ancient people of Shi and Kunming were the main makers and users of the swords. He also conducted in-depth research on the copper-handled iron swords in Yunnan and explored their production process and origin on the basis of typology. No. 8 Mr. Mao Bo [18] studied the shape, age, origin and dissemination of the Wuyue bronze swords and analyzed their practicality. No. 2 Mr. Tian Wei [19] sorted out the origin and development of bronze swords in the Western Zhou Dynasty. No. 10 Tan Derui, Lian Haiping [20] and others analyzed the matrix structure and microhardness of the diamond-patterned bronze weapons of the Eastern Zhou Dynasty and made an in-depth analysis of their production technology. No. 3 is a brief report on the excavation of the Gong (Huyu) King bronze sword discovered in Yishui County, Shandong Province. No. 4 Mr. Song Zhimin [21] sorted out and studied the three-pronged copper-handled iron swords unearthed in my country. No. 6 Mr. Zhong Shaoyi [22] defined the concept of flat-stem swords, studied the origin of flat-stem swords, and made a typological classification.

Table 6: Statistics of high-impact papers

Ranking	Title of the article	Author	Journals	Release time	Number of citations	Comprehensive impact factor
1	Research on bronze swords in southwest my country	Tong Enzheng	Journal of Archaeology	1977.10	117	1.047
2	On bronze swords in the Western Zhou Dynasty	Tian Wei	Journal of Archaeology	2013.10	52	1.047
3	The discovery of the Gong (Huyu) King bronze sword in Yishui County, Shandong	YiShui County Cultural Relics Management Station	Cultural relics	1983.12	45	0.768
4	Discussion on the trident-shaped copper-handled iron sword and related issues	Song Zhimin	Archaeology	1997.12	35	1.536
5	The origin of bronze swords in southwest China during the Shang Dynasty	Duan Yu	Social science research	2009.3	30	1.757
6	On the flat-stem sword	Zhong Shaoyi	Journal of Archaeology	1992.4	30	1.047
7	A brief discussion on bronze swords in western Yunnan	Zhang Zengqi	Archaeology	1983.7	29	1.536
8	Research on Wuyue bronze swords	Mao Bo	Journal of Archaeology	2016.10	27	1.047
9	Preliminary discussion on Yunnan copper-handled iron swords and related issues	Zhang Zengqi	Archaeology	1982.1	25	1.536
10	Research on diamond pattern technology of bronze weapons in the Eastern Zhou Dynasty	Tan Derui	Journal of Archaeology	2000.1	23	1.047

4. Conclusion

Through the visualization analysis of 383 documents on bronze sword research included in CNKI from 1960 to 2024, the research hotspots of bronze swords were sorted out, and the following conclusions were drawn:

- 1) From the perspective of the number of documents published, the total output of bronze sword research has increased rapidly in the past fifteen years, reaching a peak in 2010-2014.
- 2) From the perspective of the distribution of documents by discipline, the research in this field is mainly concentrated in the discipline of archaeology.
- 3) From the perspective of the type of document publication, there are mainly five categories: research, excavation briefs, dissertations, science and technology, and reviews, among which research accounts for the largest proportion.
- 4) From the perspective of literature journals, "Archaeology" is a journal that accepts more documents in this field.
- 5) From the perspective of the publishing institutions, Jilin University is the main force in the study of bronze swords.
- 6) From the perspective of the areas where bronze swords were unearthed, the research hotspots of bronze swords unearthed in Jiangsu, Zhejiang, and Anhui are.
- 7) From the perspective of keyword clustering, the current research on bronze swords can be divided into five major clusters: unearthed artifacts and age, regional culture and typology, literature and ancient characters, tomb structure and tomb owner identity, and hegemony war.
- 8) From the perspective of highly cited literature, there are

roughly three research paradigms for bronze swords, namely, mainly focusing on a region, a period of time or a type of research.

"The most important affairs of a country are sacrifices and wars." As a symbolic artifact of the Shang, Zhou, Qin and Han dynasties, bronze swords have attracted much attention from the academic community. At present, my country's research on bronze swords is still in the initial accumulation stage, and its research is not as mature as that of bronze ritual vessels [23]. Therefore, there is still a lot of room for exploration in the future research on bronze swords.

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