

## MAP USE SCIENCE AND ITS SUBJECT STRUCTURE, CONTENTS AND RESEARCH TASKS

Wan hua Huang  
The Institute of Geography, Henan Academy of Sciences, Zhengzhou China  
Yuxiao Guo  
Department of Economics, Zhengzhou University, Zhengzhou China

### Abstract

This article consists of four sections. In the first section are narrated the history of the formation and development of Map Use Science (MUS) and enumerated the academic thoughts and the most main scholastic attainments of representative cartographers in the field of map use, just which forms the basic frame of the subject system of MUS. In the second section authors give the definition of MUS and put forward the subject structure of MUS, which includes the basic theories on map use, usages of maps and practical applications of maps. In the two latter sections are expanded the three basic contents of MUS and listed the four urgent research tasks of MUS at present. To write and publish the monograph « Map Use Science » as soon as possible should be the common responsibility for all cartographers.

Under the support of modern science and technology, the craft and technology of map-making have improved a lot. And the improvements make it possible for all kinds of map works (products) to be published in large quantities. Map products have a large variety and their quantities are increasing rapidly. Also, the field of map use is expanded quickly. All these factors make the map makers and readers begin to pay more and more attention to the studies techniques and methods of map use, and solving practical problems using maps. During the last half century, the theories and methods of map use made considerable progress. On the whole, "Map Use Science", as an independent branch subject of cartography, has formed.

### 1. Formation of Map Use Science

The formation of MUS underwent a long history of development. It is demonstrated in two aspects.

#### 1.1 *Establishment of the status of map use in cartography*

The establishment of the status of map use in cartography, from point of view of the evolution of the definition of cartography, underwent three stages. Before 1970's, most cartographers regarded cartography as the technology and craft of map-making. Not until the end of 1960's, some cartographers began to bring map use into the research contents of cartography. Since 1970's map use researches has drawn great attention and has been strengthened. « The Great Russian Encyclopedia » [1] wrote: "Cartography is the science about map-making and the usages of maps." This definition raised the status of map use in cartography to same level as map-making. At the end of 1970's Chinese cartographers pointed out clearly that map use is one of the main research tasks of cartography and cartography is the subject which studies the nature of map, map-making theories and technologies and map use. Since 1980's the researches in map use have got into the third stage of its development. The status of map use in cartography has been affirmed unanimously in the field of cartography in the world. Most of cartographers thought that cartography is the science on map composition and map use and that map use is one of the two fields of cartography.

## 1.2 Formation of the subject system frame of Map Use Science

Since 1970's some cartographers have begun to shift their emphasis of research works to map use and extensively researched in their respective interested aspects, and made positive contributions to the formations of MUS. They are K.A.Salishev, A.M.Berliant, E.E.Shiryayev, A.H.Robinson, P.C.Muehrcke, F.Töpfer, D.H.Maling, Chen Shupeng, Lu Shufen and other.

K.A.Salishev, the founder and originator of MUS of the former Soviet Union, wrote many theses and works expounding specially map use [2] and first put forward the term "map research method". His researches have theorized and systemized MUS. A.M.Berliant and E.E.Shiryayev, the two Russian scholars, also have made great contributions in the researches on map use. A.M.Berliant has engaged in the researches of map use for a long time and were published his monographs on map use [3,4]. In his works he made an all-sided and systematic exposition of methodology and technical methods of map use. E.E.Shiryayev's work [5] show his contributions to MUS in the automation of map analysis and use. His research achievements pushed map use into an automation and intellectualization stage.

A.H.Robinson, a famous American cartographer, in his representative work [6] discussed the features, functions, uses and application of maps. He regards map reading, map analysis and map interpretation as the three related stages in the whole process of map use. P.C.Muehrcke's academic achievements in map use researches are amassed in his monograph « Map Use: Reading, Analysis and interpretation » [7]. His distribution and creation lie in that he researched greatly the scope and methods of use of thematic maps and mathematic-statistical method in map analysis and interpretation, etc.

F.Töpfer's representative work is his dissertation titled « Map use » [8], in which are expounded systematically the five comprehensive tasks of map, the five fields of map use, the five contents of map reading, the five basic methods of map use and the five forms of map use. D.H.Maling, a British cartographer, in his book « Measurements from maps » [9] discussed in great detail principles and various methods of map measurements and calculation, such as sampling statistical method, space sampling method, probability method, computer method and so on.

Chinese cartographers' contributions in map use are notable. They strengthened the teaching of map use in colleges and universities, paid more attention to the work of popularizing the knowledges and methods of map use and expanded the usages of maps to many studies and trades other than geography; They especially stressed the benefits of map use and made lots of breakthroughs in promoting the practicability of atlases and the measures and technical means of raising benefits of map use [10,11]; They strengthened the research works on the practical uses of maps in geology, education, agriculture and so on [12,13,14]; The monograph « Map Measurement » [15], which has great practical significance, came out.

The above-mentioned academic achievements constitute the fundamental frame of the structure and basic contents of MUS.

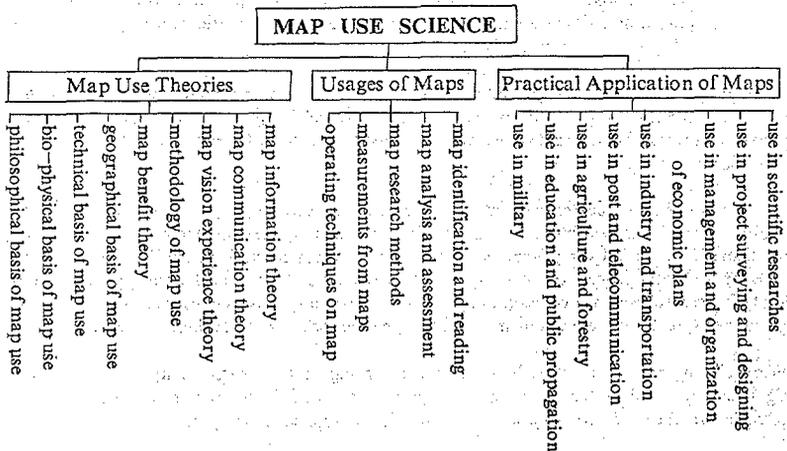
## 2. Definition and subject structure of Map Use Science

### 2.1 Definition of Map Use Science

Although the researches of map use have made great achievements, the term "Map Use Science" has not been used in the existing scientific literatures. Therefore its definition has not been given. We put forward this concept for the first time. According to the principle for defining subject and its research objects and contents we try giving MUS a scientific definition as the following: "Map Use Science" is an independent branch of cartography, which studies the theories and methodologies of map use, the methods of map analysis and usages of map and the applications of maps in social and economical practices. First of all, this definition stresses that MUS is an independent subject and points out its important status in cartography. Secondly, it affirms the relationship between MUS and cartography. The former is an inseparable component of the latter. Thirdly, it sets the research objects and tasks of MUS. Maybe this definition is not accurate and perfect enough. It still leaves some rooms for us to go on research, to revise and complement it.

## 2.2 Subject Structure of Map Use Science

During the last 20 years, scholars at home and abroad have made a great deal of academic preparation for the formation of MUS and laid the foundation of its theory and technology. Synthesizing some famous cartographers' leading academic ideas and subject division and the names of subjects advanced by them, here, we give a three-step structure system of MUS. (see the diagram)



From the above diagram, we see that MUS includes three first-degree branch subjects. They are the fundamental theories of map use, the usages of map or the techniques and methods of map use and the applications of maps in social activities. There are internal relations and logical connections among these three parts and in the inner of each one.

### 3. Basic Contents of Map Use Science

#### 3.1 Basic theories on map use

In his part are included the essence and nature of map, map function theory, cartographical information theory, map vision experience theory, semiology of cartographic theory, map use benefit theory and geographical basis (geographical analysis of map contents, geographical relative analysis and comprehensive researches of the contents from the multi-sheet maps with different contents, insertion and extension of map contents), technical basis (characteristics and semantics of map symbol; influence of cartographical generalization on map contents and accuracy, equipments for reading, analysis, measurement and their usages, etc) bio-physical basis and philosophical basis of map use.

#### 3.2 Usages of Maps

-Map identification and reading      map symbol system and its identification; contents, procedures, regulations of map reading; reading principles and methods of various types of maps, etc.

-Evaluation of the quality of maps (including single map, series maps, atlases, sand table, terrestrial globe, aerial photomaps, satellite image mosaics and other special maps)      the general purposes, basis and standards, contents, methods and steps of map evaluation; principles, methods and procedures of evaluations of scientific property, completion, detail degree, geographical correspondence and reality of maps; mathematic accuracy, appearance quality, usability and use value of maps.

-Operating techniques on maps and map measurements      map orientation, calculating map scale, determination of points' coordinates and height; plotting geographical types, regions and advancing routes; measuring distance or length among points, surface area and volume on maps and so on.

-Map analysis and research methods      the concepts, uses, principles and methods of map analysis (visual analysis method, graphic analysis method, measuremental analysis method, mathematic-statistical analysis method, cartographic-mathematical modeling analysis method, etc); methods and procedures of analysis and researches on maps in different types of regions; analysis, researches and prediction of space-time distribution characteristics of substances and phenomena, relations between them and their dynamic change and development trends.

-Compiling thematical deverbative maps according to the existing maps      uses and significances of deverbative maps; the principles, procedures and techniques of their compilation; the characteristics and main fields of their applications in practices.

-Combined use of maps with other materials      the common characteristics of map and remote sensing image, the geographical and technical basis (Geo-image processing) of combined use of maps with remote sensing images, combined use of maps with measuremental data and statistical materials.

#### 3.3 Applications of Maps in Practices

In this part, based on the former two parts, especially are studied the functions, effects, significance, application fields, degree of being used and using forms and methods of various map products and materials relevant to map in social practices of mankind; suggestion for improving map contents, map composition methods and raising map quality and so on from the point of view of industry and trade. This part is the combination on the borderlines of research fields of cartography and other applied sciences. It requires thorough and thematical researches by using integrative knowledges of various subjects and experiences.

#### 4. Research Tasks of Map Use Science at Present

At present, researches of MUS are concentrated on the following three aspects:

##### 4.1 Structure System of MUS, Research Objects and Tasks of Each Branch

All-round and systematic analysis and summary of trend, achievements and experiences of research works of various countries in map use must be carried out. Then on this basis, the compilation outline of MUS should be made and the first « Map Use Science » in the world history should be edited and published as soon as possible.

##### 4.2 Fundamental Theories of Map Use Science

The contents of this part are very wide-ranging and required to be researched profoundly one by one. Except cartographical information theory and cartographical communication theory, up to now researches in other aspects are very weak and should be greatly strengthened.

##### 4.3 Automation in Map Use Science

This is the trend of researches in map use and one of the most important contents of MUS. Lots of research works in this field have been carried out in some advanced countries. They should be synthesized, sorted out and systematized and existing techniques, methods and equipments should be widely used in practices. Also new progress should be made both in hardware and software.

##### 4.4 Interpretation, Analysis and Applications of Thematical and Special Maps

It requires two aspects processing synchronously. One is the study on the fundamental theories and methodology of reading and interpretation of thematical maps. The other is independent researches on the reading, usages and applications of a few kinds of thematical maps. The researches in these two aspects requires the exchange of achievements and the close coordination of cartographers with other experts for mutual advances.

#### References

- [1] Большая советская энциклопедия. Том 11, 3-е изд., Изд-во « Советская энциклопедия », М., 1973.
- [2] Г.И.Рычагова : Географическая картография. Взгляд в будущее. Изд-во МУ, М., 1986.
- [3] А.М.Берлянт: Картографический метод исследования. 2-е изд., Изд-во МУ, М., 1988.
- [4] А.М.Берлянт: Итоги наук и техник. Картография, Том 12. Использование карт в

науках о Земле, М., 1986.

- [5] Е.Е.Ширяев: Картографическое отображение, преобразование и анализ геоинформации. "Недра", М., 1984.
- [6] A.H.Robinson: Principles of Cartography (5th edition, 1985; Chinese translation). China Surveying and Mapping Press, Beijing, 1988.
- [7] P.C.Muehrcke: Map Use: Reading, Analysis and Interpretation. JP. Publications, Madison, WI, 1978.
- [8] F.Töpfer: Die Kartennutzung / Vermessungstechnik, 20, n. 10, 11.
- [9] D.H.Maling: Measurements from maps (Principles and methods of Cartometry), Formerly University, Vales Pergamon Press, 1989.
- [10] Lu Shufen: We should treat the cartography as an implemental science (In Chinese). The proceedings of the 4th China Symposium on Cartography. China Cartographic Publishing House, Beijing, 1992.
- [11] Chen Shupeng: Information current and cartography (In Chinese). The proceedings of the 4th China Symposium on Cartography. China Cartographic Publishing House, Beijing, 1992.
- [12] Zheng Dingqian: Applications of Topographical Maps in Geology (In Chinese). China Petroleum Industry Press. Beijing, 1957.
- [13] Hu Shanmei: Applications of Maps in Geographical Education (In Chinese). Shanghai High Education Press. Shanghai, 1960.
- [14] Huang Wanhua, Guo Yuxiao: Applications of Maps in Agriculture (In Chinese). China Surveying and Mapping Press. Beijing, 1989.
- [15] Gong Jianwen: Map Measurements (In Chinese). China Surveying and Mapping Press. Beijing, 1989.