

A SURVEY ON THE THEORY AND TECHNOLOGY OF CONTEMPORARY CARTOGRAPHY

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Abstract The human have never stop exploring and understanding the nature in order to improve the ability of fitting in with the variety of nature since their birth. The map is one of the main means by which people investigate and study their living environment and abstract the change trend. By the map the world is represented in graphics such as points, lines and polygons after generalization and abstraction. With the increase of map kinds and the extension of map applications, cartography, the theory basis of map, has also get rapid development in recent years. And being up against the contemporary digital wave, cartography faces a new developing opportunity. In nature the map is a tool for transmitting the information of reality from the producer to the user, and that course could be formed of spatial cognition, mapping language and map interpretation. Through spatial cognition people get the knowledge of objects , phenomena in around environment, and at last shape a imago map in heart. Map language includes symbol system and mapping rule, and it is used to transform the imago map into real map, by which people present the world on paper or computer screen using graphics and color. The traditional map represented nature on a two-dimensional plane, for that our world is three-dimensional in fact, so how to found 3D map is a new research task. Map interpretation means the process that users derive the information what they care for from map. And Spatial data mining is a new and efficient interpretation means to get more useful knowledge.

1.THE HISTORICAL CHANGES OF CHINESE CARTOGRAPHY'S DEVELOPMENT

People have been constantly hoping to enhance cognition of living space to cope with various changes of the objective world better since human being appeared on the Earth .The cognition has three ways: field survey, text and tabulation , the map. Field Survey actually is cognizing geographical space one-to-one which is a laborious and time-consuming work in highly developed vehicle today .In addition, it is fragmentary and exiguous in despite of detailed and correct, therefore it's not enough to summarize and abstract rules of the world's development and changes. Description of geographical space through text and tabulations is not intuitionistic .The connotation of map is that, the reappearance of objective world in graphics mode by abstraction and expression on the basic of people's knowledge of the world .It is the primary manner to cognize living environment and abstract laws of the objective world so far.

Map has a long history. People had learnt to describe living environment of themselves by drawing to satisfy working needs , which is the germination .The Cartography had developed more and more quickly with the better cognition of nature and politics and military needs along with the foundation of nation since class society .GuanZi Atlases was the first map works in china in Spring and Autumn and Warring States periods of China。 Maps were in wide use for agriculture , farming , military and city planning in Western Zhou period . In Western and Eastern Jin period, Six Objects in Cartography which was founded by PeiXiu established theoretical foundation for map, traditional

cartography reached the zenith in Song, Yuan, Ming and Dynasty. In early Qing Dynasty, the introduction of occidental surveying and mapping technique broke traditional theoretics, promoted the third reformation of Cartography. In 1990s, our level kept the same step with international technique.

In despite of social progress and emergence of digital age, maps as the representation of space thinking cannot but exist as long as the mode of thought doesn't disappear and theoretical fundament, Cartography, is capable of developing. The Cartography will make progress with deeper cognition of world and development of scientific instrument.

2. THEORETICAL ISSUES OF MODERN CARTOGRAPHY

2.1 Digital Age's Effect on Traditional Cartography

It is well known that the realistic world is true three-dimension. Predecessor used papery plane maps to describe the three-dimension world, there are a small quantity of micromodel of course. This method has already formed integrated system, including abstraction of realistic world; expression of map factors; usage of map. There are six main factors abstracted from realistic world in regard to traditional maps. The contents of factors of all kinds of scale and type have detailed instructions for expression. Map-Readers can read these maps through these map languages, shape the reflection of objective world in their brains. It is no doubt that maps are basic data on national economic infrastructure and security of the country, and play an important role in all kinds of fields.

With the medium of maps has transformed from papers to magnetic matters, however, maps' pattern, intension and extension are being changing. Terrain and topography used to be projected onto a plane as a series of contour lines, buildings used to be expressed by foundation together with texts and symbols. Nowadays, people have three-dimension visualization and visual realism that traditional expression ways of map factors must adapt themselves to these change. Digital maps can not only zoom in and out at any scale, but also store information as attributes into database, which breach the limitation of traditional mediums, make a strong impact on Cartography.

2.2 Philosophical thinking to Cartography

Following are theoretical and technical issues of Modern Cartography to be solved in digital age from the point view of information. In essence, map is a way to transmit information on geographical space world, Cartography is a subject studying processes and principles of the transmission. As early as 1970s, experts in and out doors put forward a few of info-transmission models, the main of them including: forming imago maps by cartographers' cognition of impersonal objects; drawing maps through expressing imago maps in map language; users' acquirement of objects' concepts and cognitions through maps, as Fig.1 shows.

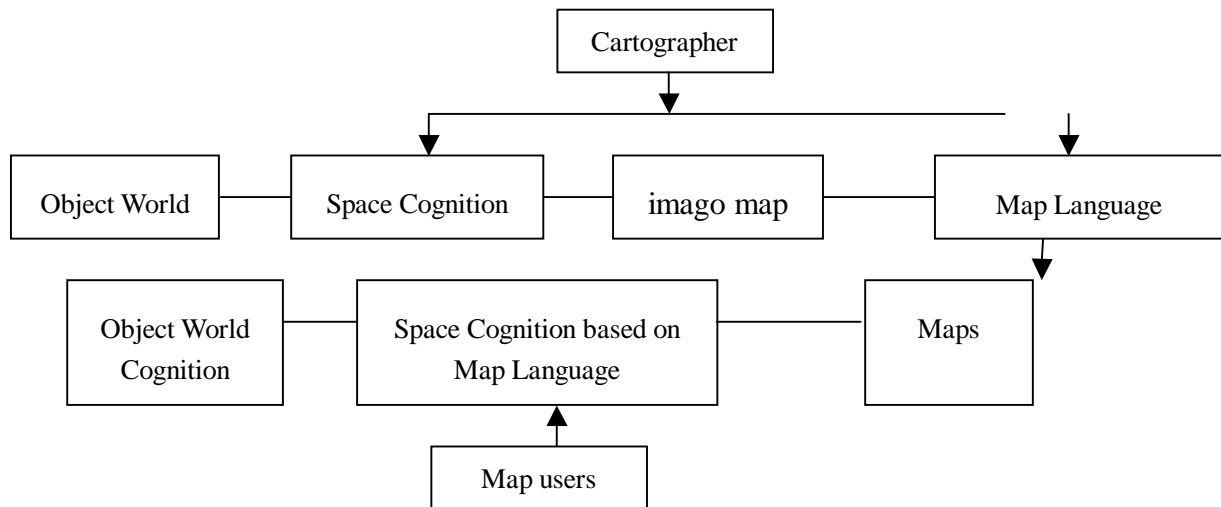


Fig.1 information transferring model of map

From the view of philosophic theory on cartography, the process is just like writing literatures .At first , fictionists cognize things to be written deeply; then describe them by exquisite language to become a literature works , from which readers can know these things indirectly .The fictionsts are similar to cartographers, readers to map users ,and map language to literature language in this analogy . In the sense of science ,there are three primary research fields : map space cognition ,map language and map understanding (map translation) .

2.3 Space Cognition of Map

Cognition ,belongs to the psychology domain ,is people’s aptitude activity and also a thinking result in brain. Space Cognition is a process and capability to cognize existence ,change and relative position of various things and phenomena in ambience , and also a foundation to analyze and study occurrence ,influence and cause and effect of kinds of objects^[5]. Space Cognition of Map is activities of Space Cognition aimed at map drawing . It consist of cartographers’ and map readers’ cognitions ,the former is the basic for cartographers to describe objective world and make finely atlases ,the latter is the basic for map users to know objective world through maps. Space Cognition of Map becomes the foundation of Modern Cartography.

The development of correlative subjects drives the progress of Cartography’s production and expression . On the other hand , Cartography achievement deepens people’s cognition of objective world. How to cognize living space of human being should base on these achievements . Describing objective things , construction and anatomy inside , relation between them and sorts of attributes in the semantic level with mathematical languages. These are the theoretical foundation of Graphics ,and also basic for map users to comprehend maps deeply. The important study issues involve cognition model of objective world, mathematical abstract of objective world, anatomy theories and semantic description of relation and so an .

2.4 Map Languages

Map languages is a means to express and transmit cognition results of objective world space by graphics ,including symbol system and drawing rule . Cartographer describe world in map language ,make a kind of atlases ,users read them through map language combined with practice activities ,then form indirect comprehension of objective world , program and guide social activities .

Traditional language is two-dimension expression . With the emergence of three-dimension visualization and visual realism technique ,it is confronted with severe proof actually . In three-dimension environment , house which has a base ,texture , attachment and height , is far from itself in two-dimension . Additional traditional language is used in hand drawing , symbol system and drawing rule are convenient for handwork .As a result the whole map language should be improved to meet information in the information phase .The elementary study aspects are establishing three-dimension map language (3D symbol system ,3D texture database and 3D drawing rule), perfecting and standardization image map language (expression ways ,symbol , drawing rule) and improvement of vector map language to meet information .

2.5 Map Interpretation

Map not only has geometrical information of six main factors , but also abundant laws and knowledge about nature .Just like reading literary works ,the level of readers and Weltanschauung directly influence comprehension of works .For the same reason , the level of map users also influence understanding of maps . Generally , users can only gain information through map legend and map languages ,which is superficial and wasteful of map resources .In digital instance ,information on a map is a great deal , a effective suit of map translation methods must provided for map users to deeply understanding ,which is Map Interpretation .At present , Map Interpretation is also called map data mining .

Data Mining is a process abstracting useful information and knowledge which is latent and unknown to people beforehand from a great lot of incomplete , fuzzy, random and noisy datum ^[7].Space Data Mining is discovering latent knowledge from space datum .Map Data Mining is discovering datum that is inexistent originally ,which has three aspects including producing new data through combining relief maps with other data , generating new models from relief maps , discovering knowledge. For the sake of avoiding shortcoming of traditional study ways, a theory system and a technique system based on three fields (space field ,time field and attribute field) of map data mining are put forward .

3 . MAP APPLICATION

Coming into digital age , objects of drawing are more and more abundant ,such as graphs, images ,voices, texts, kinescope etc. .Therefore it is necessary to study methods and principles of multimedia visibility based on space-time information , discuss theory and thinking system of multimedia visibility ,study expert-resource shared system , exploit kinds of digital productions for various application domains .

China National cartography projects and relative techniques are studied from the point view of the system theory based on current map languages ,such as : national atlases ,wall maps of westward cities (countries) and the organization of great special atlases from various industries ,whole system design , technique courses and arts and crafts scheme , integrative application of new materials and new crafts ,quality control and regulations of check and accept . This is also one of important study aspects of map applications

4 . CONCLUSION

At the present time , map information theory ,map transmission theory ,map cognition theory and map model theory are studied in and out doors ,which have already had achievements to a certain extent .Whereas all studies make use of fruits in other fields not from map-self in the view of system theory .Domestic Cartography emphasize on

drawing projects , Symbols are not in system , map languages aren't analyzed sufficiently at the level of information , such as which contents are suitable ,which need to be modified and which need to be reedited .When it comes to map space cognition ,fruits of data mining are fewer ,which influence the Sustainable Development of Cartography directly.

Biography

LI Cheng-ming received the B.S. degree, the M.S. degree and the Ph.D. degree in photogrammetry in 1990, 1994 and 1998 from Wuhan University of Surveying and Mapping, Wuhan, China. He is currently the director of institute of GIS in Chinese Academy of Surveying and Mapping, Beijing, China. His research interests include GIS, Remote Sensing, and their applications.