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Research on the Evolution and Technical Appraisal of Pigment Use in Chinese Painting in the Late Ming and Early Qing Dynasties

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ABSTRACT

The traditional pigments of Chinese painting are taken from the mountains and used naturally, and have been accompanied by the artistic belief of the Chinese nation in the unity of nature and man for thousands of years. These crystal brilliant, stable nature of inorganic ores and organic plants, in the hands of ancient Chinese painters fine grinding, dense glue, layer by layer dye, transformed into the Chinese people's imitation and expression of all things color. From the initial direct selection of color substances from nature as pigments to the peak of heavy color painting in Tang and Song dynasties, the traditional pigments of Chinese painting embodied too much time value and human wisdom. The material of these mountains contains the painting stories of human beings, which is ancient and new and unchanged, and is an important and irreplaceable carrier of ancient information. At the end of the Ming Dynasty and the beginning of the Qing Dynasty, modern organic synthetic pigments were brought from the West by Western missionaries. These bright colors and simple colors quickly captured the hearts of people and had the meaning of competing for national colors. However, the nature of organic synthetic pigments is very unstable, and structural changes will occur in many cases such as high temperature, direct exposure, climate, acid and base changes, resulting in a large degree of discoloration and decolorization. At present, raw materials of traditional Chinese painting are scarce and techniques are lost, so it is urgent to get extensive attention and rescue from the painting circle.

Keywords: Traditional Colors, Chinese Painting, Comparative Study on Pigments, Technical Appraisal, Late Ming and Early Qing.

INTRODUCTION

Chinese color and the spirit of Chinese painting come down in one continuous line (C. Zhang, 2018). Natural stones, natural plants, mountains, and valleys, Chinese artists have had an ethereal and pious childlike feeling for the nature of the universe since ancient times. Western color painting has almost broken down for thousands of years from the discovery of painted murals in Altamira Caves in Spain to the invention of oil painting pigments, while Chinese colors have left their increasingly gorgeous figures in every dynasty, and the traditional pigments that have been updated for a long time irreplaceable record the language of the years (Bichell, Krzyszczyk, Patterson, & Mann, 2018). From the painting of the first red iron powder in the Paleolithic Age to the magnificent green of Wang Ximeng in the Northern Song Dynasty, Chinese traditional pigments have gone through thousands of years of development history along with the peaks of Chinese art one after another (Lu, Li, Jing, Pei, & Huang, 2023).

After the Anshi Rebellion in the Middle Tang Dynasty, with the decline of feudal society and the intensification of social contradictions, Chinese cultural spirit began to develop a substantial turning point, from self-confidence, openness, expansion, and high spirits from Qin and Han Dynasties to the prosperous Tang Dynasty to introspection, closure, emptiness, indifference, and detachment. In the aesthetic taste of art, realistic, prosperous, and dramatic color aesthetics are replaced by freehand brushwork, simplicity, and mystery ink

aesthetics (Chang et al., 2019). Ink painting has stepped onto the historical stage since the beginning of Wang Wei in the late Tang Dynasty. Although Xuanhe Painting Academy in Song Huizong turned the tide in the Northern Song Dynasty, the general trend has gone after all, and the Chinese art stage in the Southern Song Dynasty was an era when ink painting played the leading role (Wu et al., 2022). When the wheel of history drove into the late Ming Dynasty, Mo Shilong, Chen Jiru, Dong Qichang, and others came out with the theory of the North and South Clans, which hit the heavy color Seiko until it broke down (Cruz, Eires, Dias, Desterro, & Rego, 2018). So far, color has officially withdrawn from the mainstream position of Chinese art (Jovanovic, Eric, Colomban, & Kremenovic, 2019). At the end of the Ming Dynasty, western chemical synthetic pigments entered China with the arrival of missionaries. Colorful and low-priced synthetic pigments catered to the needs of middle and lower-class artists and widely replaced mineral pigments in architecture, painting, and other art fields. Subsequently, a single spark can start a prairie fire, and modern synthetic pigments quickly compete with traditional Chinese painting pigments on a systematic and large scale (H. Tang et al., 2019).

As a new thing, modern pigments were once sought after by Chinese painters. They are rich in color scales, low in price, and convenient to use, so they do not have to search at high prices, grind hard, and adjust as complicated as traditional pigments. However, just as there is no real shortcut in life, it takes hard work to lead to natural beauty (Lorquin, Molouba, & Dreyfus, 2022). After all, the advantages of convenience and quickness cannot cover up its unsatisfactory durability, weatherability, expressive force, and other aspects. After a hundred years of silence, traditional pigments have been removed from the veil of history and gradually returned to people's fields of vision (Wagner et al., 2019).

This article has carried on the effective integration of the predecessor achievement and has combed each kind of pigment production development process, it is advantageous for the researcher to make the judgment from the ancient painting pigment composition and thus carries on the corresponding anachronism analysis. It is another supplement and inspiration to the scientific appraisal of painting and calligraphy methods.

CULTURAL IMPLICATION OF CHINESE PAINTING PIGMENTS IN LATE MING AND EARLY QING DYNASTIES

History of Chinese Painting Pigments

Chinese national painting (that is, Chinese painting) has a long history and fine tradition and is the mainstream of oriental painting. A large number of ancient paintings prove that China's skilled craftsmen and masters of art have made outstanding achievements in the excavation and development of pigments (Zhang & Gethin, 2021). At that time, painters made their pigments. According to the Records of Famous Paintings of Past Dynasties, "The boat of Wuling well grinds the sand. There are nine colors, namely, the emptier, the green, the flat green in Wuchang, the lead in the Shu group, the exhaustion of the beginning, the yellow in Kunlun, and the ant riveting in the South China Sea. According to the research of Gates of Fogg Museum of Harvard University in the United States on the pigments used in Dunhuang Thousand Buddha Cave frescoes, there are 11 kinds of pigments, such as smoke food, kaolin, ochre, azurite, stone green, cinnabar, lead powder, lead Dan, indigo, gardenia yellow and safflower (rouge). By the 1980s, when the pigments used in the early and prosperous Tang Dynasties were analyzed, only white (kaolin), turquoise, azurite, ochre, cinnabar, and lead pigments with brown, brown, red-brown, and black brown were left. Other plant pigments cannot be analyzed (Ding, Yu, & Wang, 2021).

Development of Modern Chinese Painting Pigments

Pigments are selected, processed, and refined by the painter himself, which is time-consuming and affects the painting effect (Ding et al., 2021). Most painters still want to buy ready-made ones, which leads to the development of pigment manufacturers. According to records, workshop-style production existed in Suzhou one or two hundred years ago, and then Shanghai and Beijing also developed one after another (Rui, 2019). Figure 1 shows the development of modern Chinese painting pigments. In the early days of liberation, due to the promotion of national culture, Chinese painting was paid more attention, and pigment workshops developed more rapidly. There were nearly ten in Shanghai alone, and their raw materials and production methods basically followed the tradition, such as selecting ore, lead, and mercury to process pigments such as cyanine, gamboge, and rouge extracted from animals and plants and importing western red pigments, which were sold in flakes and powders (X. Y. Liu, M. Q. Lv, M. Liu, Wu, & J. F. Lv, 2021).

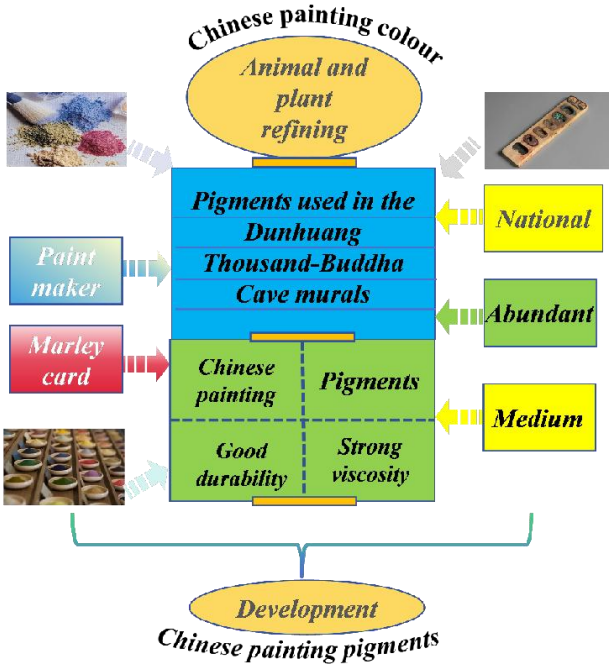

Figure 1. The Development of Modern Chinese Painting Pigments

Compared with ancient paintings, its durability, composition, and performance are basically the same in color retention, color change, and color escape. In this paper, the existing Chinese color chromatography is selected for detection one by one. The detection method is to use the traditional color comparison table compiled and published in Japan and Photoshop software to test the Lab value and Hsb value. The detection results are shown in Table 1, one by one.

Table 1. Comparison of Color Value Data of Cyan, Red and Yellow

Modern pigment	L	a	b	H	S	B
Green	Elevated lightness	Greener	More bluer	Hue attenuation	Rich in saturation	Increased brightness
Red	Elevated lightness	Redder	More yellow	Add a weak Hue	Rich in saturation	Increased brightness
Yellow	Rich in brightness	Redder	Slightly cold	Rich in hue and Enhanced	Rich in saturation	Rich in brightness and shade

Present Situation of Chinese Painting Pigments

After the commercialization of Chinese painting pigments, they must be soaked in water before being used (Zhang & Gethin, 2021). For silty pigments, it is time-consuming and troublesome to make glue juice first and then grind it. Shanghai Fine Arts Pigment Factory, the predecessor of Shanghai Industrial Mali Painting Materials Co., Ltd., was instructed by the Ministry of Light Industry in 1962 to create convenient Chinese painting pigments that not only have the antifreeze and deodorization of colloid but also have the essential characteristics of Chinese painting pigments-water resistance (Han, 2019). At the same time, using traditional chromatography, the first hose-filled slurry Chinese painting pigment can be applied by squeezing excellent slurry and transferring water, which plays a significant role in the popularization and development of Chinese painting, with a market share of over 90% (X. Wang, 2019).

In 1980, the Ministry of Culture appropriated funds and entrusted the Shanghai Fine Arts Pigment Factory to establish a project to develop advanced Chinese painting pigments. Through the trial painting of more than 60 famous painters in China, it was unanimously recognized. Master Liu Haisu wrote the name of the new product specifically.

Mali brand advanced Chinese painting pigment has good durability, firm adhesive viscosity, and proper color variety coordination (Y. Wang & Zhang, 2018). The color is calm and conforms to traditional chromatography. The paste is delicate, and the painting is smooth. There is Strong water resistance and no color loss in mounting. It is the most ideal variety in the market at present. If you use it to draw treasures, you will no longer have the danger of discoloration.

EVOLUTION OF PIGMENTS IN CHINESE PAINTING IN THE LATE MING AND EARLY QING DYNASTIES

Characteristics and Schools of Chinese Painting in Late Ming and Early Qing Dynasties

The Ming and Qing Dynasties are the last two feudal dynasties in China, and they are also the periods when Chinese art declined in some aspects and made unprecedented developments in others. In the early Ming Dynasty, court paintings were mainly used, which were aesthetically in line with aristocratic tastes in appreciation. In the mid-Ming Dynasty, with the economic development of the Jiangnan area, citizens' culture and aesthetic consciousness gradually grew. New culture and aesthetic orientation were integrated into literati paintings and calligraphy, forming many schools of literati paintings full of original spirit. The commercialization of literati painters' works and their work are almost professional, which helps the development of literati painting and calligraphy in this system (X. Liu, 2018). The rulers of the Qing Dynasty implemented a literary inquisition, which caused the prosperity of textual research and brought up a large number of literati painters and art writers who took the ancients as their basis.

Missionaries came to China in the late Ming Dynasty, bringing Western classical art and opening up the horizons of Chinese people. The rulers of the Qing Dynasty appointed European painters, which made a new step in the integration of Chinese and Western painting methods (F. Li, & Niu, 2018). At the beginning of the Ming Dynasty, the painting was mainly based on the court, which came down in one continuous line from the tradition of the Song Dynasty. The Zhejiang School mainly represented landscape painting. The Northern Song Dynasty followed Dai's enterprising works, and there were many followers in the early Ming Dynasty. Wu Weiyuan learned from Ma and Xia and recently took the method to wear in, forming a branch of Zhejiang School. After Hongzhi, Zhejiang School painting became romantic and straightforward and then declined (A. Li, 2018). The painting of court figures mainly obeys the needs of politics, plays the role of propaganda and education, and the subject matter is relatively narrow. Flower-and-bird paintings not only have a unified style but also present a variety of features. They inherit the delicate and decadent works of the Song Dynasty and also have works written by part-time workers, which are rich without losing simplicity and strictness.

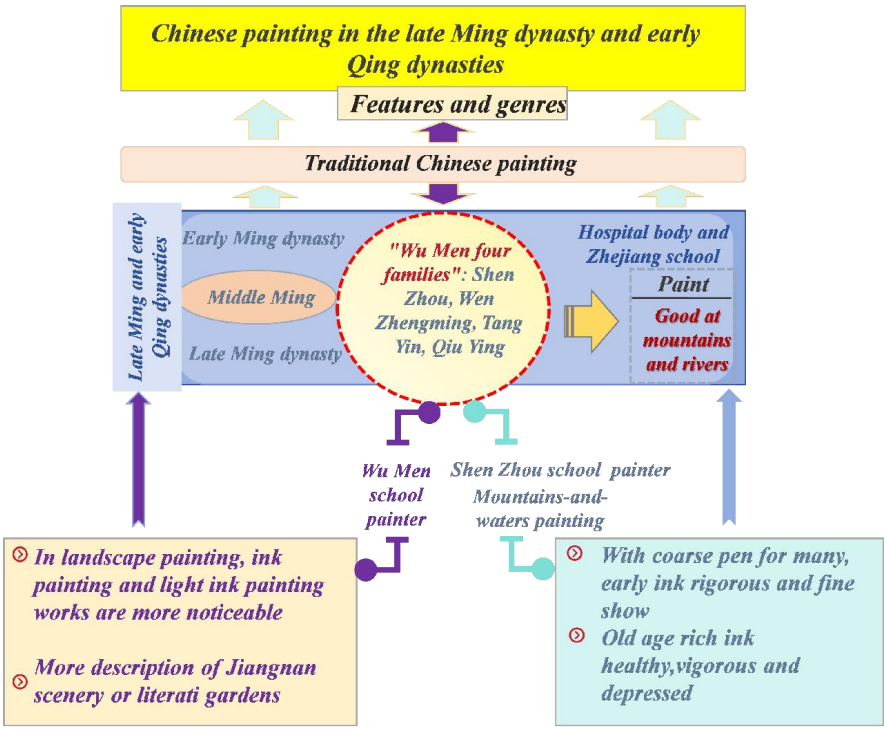

Figure 2. Characteristics and Schools of Chinese Painting in the late Ming and early Qing Dynasties

Figure 2 shows the characteristics and schools of Chinese painting in the late Ming and early Qing Dynasties. In the middle Ming Dynasty, Wu School rose rapidly, replacing Yuan Style and Zhejiang School in painting circles. Wu School flourished in Shen Zhou and became in Wen Zhiming, and its prominent members were mainly celebrities with three unique poems, paintings, and calligraphy. The objective factors of the rise of painting

schools lie in economic prosperity, sinister official careers, geographical distance from Beijing, loose politics, and other factors (Q. Liu, 2018). The internal factor is from the literati landscape painters in the early Ming Dynasty, such as Wang Fu, Du Qiong, and other literati traditions, which laid the style foundation for the rise of literati painting in the Ming Dynasty. At the same time, there are Tang Yin and Chou Ying in Wu School, which started the trend of integration of literati and professional painters.

Paintings in the late Ming Dynasty have significant development and variation in flowers, birds, and figures. "Baiyang Qingteng" appeared on flowers and birds, and their paintings had a significant influence on freehand flower and bird paintings in the Ming and Qing Dynasties. Figure paintings have exaggerated and deformed styles and new features. In addition, with the increase of folk demand, there are photo experts among folk painters, such as "Bochen School" represented by Zeng Whale. New features also appeared in landscape painting from the late Ming Dynasty to the early Qing Dynasty. During this period, Wu School declined day by day and had many disadvantages. In order to reverse this situation, landscape painting schools emerged in Shanghai, such as Yunjian School, Susong School, and Huating School, among which Huating School in Dong Qichang had the most significant influence. They mainly seek to copy the ancient times, pay attention to pen and ink, and pursue "morale" because the areas under the jurisdiction of the three schools are all under the jurisdiction of Songjiang House, which is also called Songjiang School.

Types and Sources of Chinese Painting Pigments

The earliest known record of the concept of five colors dates back to the Shun Di era (22nd century BC). The construction of the five-color system originated from the five elements promoted by the Xia, Shang, and Zhou Dynasties (X. Tang & Liu, 2018). The five elements of wood, fire, earth, gold, and water are regarded by the ancients as the essential elements that make up the world. The number five is used to simplify the nature. The most direct reference is the five fingers of human beings. "The palm circle method is used to move; Refers to five, five elements of law" ("Taiping Yulan Personnel Department") Eastern Han Dynasty Song Note: "Soil is virtue, should thumb; Fire is dry, should refer to the second time; Metal is wide and beneficial, should be the middle finger; Underwater performance, it cannot go up, it cannot be closed, and it has no name; Wood and Soil are not as good as it is, so it should be a little finger. The five are used differently, so the five elements are also used." At the same time, "East, West, North and South" also has five directions as well as Jupiter, Mars, Saturn, Venus, and Mercury. Therefore, the ancients took the "five" rules to rule everything in heaven and earth. "The five-color system is outside the five-element system, which presents the limitations and absurdity of the civilization process to the present, and also presents the wisdom contained in the limitations."

"Zuo Zhuan Xi Gong Twenty-four Years" "If you do not listen to the sum of five voices, you are deaf, if you do not have a five-color chapter, if you do not have a heart, you will be stubborn in virtue and righteousness, and if you do not speak faithfully." "Zuo Zhuan Huang Gong Two Years": "Five colors are better than images, singing things." Du Yu's note in the Western Jin Dynasty: "There are five colors of car clothes and equipment, all of which are like heaven, earth, and four directions." Kong Yingda Shu: "Kao Gong Ji says: There are five colors in painting poison. Dongqing, Nanchi, Xibai, Beihei, and Tianxuan Rehmannia glutinosa are more like heaven and earth. Things are not in name only; they must be like something. Everything is like five colors, so it is bright with five colors." "Each of the five colors is famous, with green as the head, red as the glory, yellow as the main, white as the foundation, and black as the end. The first is the forerunner, glory is the color, the Lord is the manager, this is the foundation, and it is the result."

Table 2. Chemical Composition of Red Color of Traditional Chinese Painting Pigment

Pigment	Composition	Hue	Characteristic
Cinnabar	Mercuric sulfide HgS	Bright and red	Stable in nature and lasting
Iron red	Iron oxide Fe_2O_3	Red/dark red/partial Yellow red	The color is stable, which was made before Wei and Jin Dynasties Use
Ochre	Iron hydroxide FeOOH	Dark red, light-yellow red	Stable properties, fine grinding presentation Transparent color
Zhu Purine	Mercuric sulfide HgS	Fresh and tender yellow lining belt Red	The color is stable and the texture is extremely fine and transparent Bright effect
Silver vermilion	Lead oxide PbC	And cinnabar hue Near	The nature is unstable and turns black with age
Lead Dan	Lead tetroxide Pb_3O_4	Orange	Unstable properties, high humidity and light It changes color to black lead dioxide under illumination

Table 3. Chemical Composition of Chinese Traditional Painting Pigment Cyan

Pigment	Composition	Hue	Characteristic
Azurite	$2CaCO3{\cdot}Cu\ (OH)_2$	Dark blue to light blue	Stable in nature and lasting
Lapis lazuli	$(Na,Ca)_{4\text{-}8}\text{-}(AlSiO_4)s(SO_4,S,Cl)_{1\text{-}2}$	Bright blue	Exotic pigment with stable properties
Chinese blue	$BaCuSi_4O_{10}$	Blue, purple	The earliest synthetic blue in China /Purple pigment
Ultramarine	$Na_{6.9}(Al_{5.6}Si_{5.4}O_{24})$	Tibetan blue, red in color	Unstable, unable to grind and bleach

Table 4. Chemical Composition of Yellow Color in Traditional Chinese Painting Pigment

Pigment	Composition	Hue	Characteristic
Khaki yellow	Hydrated ferric oxide, Iron hydroxide	Light yellow, positive yellow, Golden yellow, dark brown	It is easy to take off the crystal water for a long time, showing ochre and obvious Color is related to iron hydroxide content
Realgar	Arsenic monosulfide	Orange yellow	Oily luster, slightly smelly and slightly poisonous
Stone yellow	Lead chromate	Positive yellow	Full and pure hue, soft, odorless and nontoxic
Orpiment	Arsenic trisulfide	Golden yellow	Mica luster, fragile twist "four or two females" Yellow Melaleuca Tablets ", can be used as fading agent
Huang Dan	Orthorhombic system and tetragonal system Crystalline lead oxide PbO	Orange	Long-term oxidation discoloration, avoid calling with lead powder Chemical change to brown and black
Garcinia cambogia	Rattan gum yellow liquid	Medium yellow, light yellow	Sunlight exposure, diluted color, foreign pigments, After Tang Dynasty, it became the yellow subject of Chinese painting

Table 2, Table 3, and Table 4 show the chemical constituents of red, cyan, and yellow pigments of traditional Chinese painting, respectively. The five-color system is divided into cheerful colors and intermediate colors, among which cyan, red, yellow, white, and black are cheerful colors, and the five favorable colors that are harmonious with each other are green, red, yellow, and blue-purple. Blue, red, yellow, white, and black are used in modern chromatics, but there are differences between blue, red, yellow, white, and black.

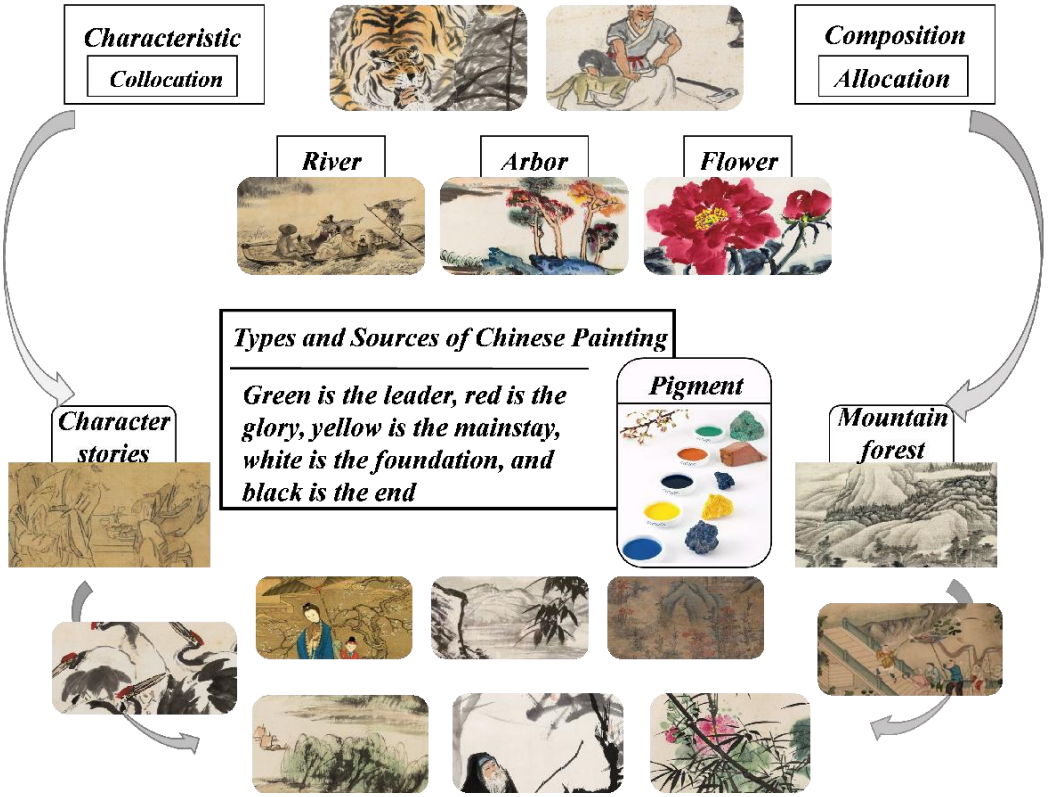

Figure 3. Types and Sources of Pigments in Chinese Paintings in the late Ming and early Qing Dynasties

Figure 3 shows the types and sources of pigments in Chinese paintings in the late Ming and early Qing Dynasties. "Su Wen Five Generation": "Those who are as green as Cui Yu are born, those who are as red as the crown of chickens are born, those who are as yellow as the belly of crabs are born, those who are as white as the cream of pigs are born, and those who are as black as feathers are born." ; Wang Yi's "Zhengbu Theory" in the Eastern Han Dynasty: "Red is like a cocktail crown, yellow is like steamed chestnut, white is like fat, black is like pure lacquer, and the symbol of jade is also." Sui Xiaoji's "Five Elements of Great Meaning," Volume 3, "On Matching Five Colors": "Green as an emerald feather, black as a black feather, red as a chicken crown, yellow as crab belly, and white as pig cream, these five colors can give birth to gas. Green as grass, black as water moss, yellow as embarrassment, red as blood, and white as skeleton. These five colors are dead." Tang Li's "Taibai Yinjing" Volume 3 "Jianren": "White is like coagulated fat, black is like Fu lacquer, yellow is like steamed chestnut, red is like inflammation fire, and green is like bath blue." Ming Tu Dalong's "Tea Notes and Water": "White as fat, red as chicken crown, blue as snail dai, yellow as steamed chestnut, black as yuan paint (Jia et al., 2023)." It seems that the descriptions of five colors in past dynasties can be summarized as follows: cyan is like kingfisher feathers or bathed in bluegrass juice, red is like a comb, yellow is like steamed chestnut or crab roe, white is like pig fat, and black is like crow feathers or cooked paint.

Methods and Skills of Using Pigments in Chinese Painting

Different pigments have different granularity due to their different sources and properties, and the color development principle of pigments is closely related to this physical property of raw materials. It is found that the higher the refractive index, the lower the transparency (Eumelen, Bosco, Suiker, & Hermans, 2023). Refractive indices of pigments: gold: 242, silver: 233, graphite: 87, quartz: 21.55, lead: 3.4, cinnabar: 2.91-3.27, ochre: 2.91-3.27, cloudy: 2.91-3.27, realgar and stone yellow: 2.4-3.02, crystal: 2.0, lead white: 1.94-2.09, azurite: 1.73-1.84, calcite: 1.68, stone green: 1.66-1.88, olivine: 1.670, mica: 1.58-1.6. 6, clay: 1.56, amber: 1.546, crystal powder: 1.544, chalk: 1.510, obsidian: 1.48 Correspondingly, from the physical point of view: "Compared with small particle pigments, large particle pigments have strong light resistance, opacity, dispersion, and rough texture; On the contrary, fine particles have relatively weakened light resistance, transparency, delicate surface, and flowing sense. However, the fineness of pigments is not as fine as possible, and how small the particles are will lead to dispersed tea, poor compatibility, increased color matching cost, and also cause floating colors to make colors blossom without luster".

For pigments themselves (especially mineral pigments), the change of particle size, lightness, and purity will change from deep to light, such as stone green. With the change of particle size from large to small, the color will change from emerald green with high lightness and high purity to pink green with low lightness and low purity (Lee, Yun, & Kim, 2023). When traditional pigments are dyed layer by layer, they can achieve a natural, coordinated, and lasting sense of layering and richness through the combination of different pigment particle thicknesses. Glue alum binds pigment particles with particles, and the part with glue does not reflect light and is opaque. There are gaps in the unbonded parts between the particles, and the gaps will reveal the refracted light of the underlying color. The refracted light emitted by each particle itself and the reflected light given by the outside, combined with the refracted light and concentrated light of the following color, penetrated the pigment gap and interweaved with each other, resulting in a transparent and opaque mixing effect. A good color setting will make each pigment particle emit its unique light.

Usually, the size arrangement of pigment particles should follow: "From the bottom layer to the surface layer, the particles should be from fine particles to coarse particles, that is, the bottom layer should be as delicate as possible, the glue solution should be thick, and the upper layer should be thicker, and the glue solution should be lighter. Only in this way will each color layer not block the color development of the bottom layer, which can not only exert its light but also achieve the effect of combination level." This rich picture effect, which depends on different particle sizes, is much better than modern synthetic pigments with fixed particle sizes.

In the physical properties of pigments, Chinese pigments are similar to gouache pigments in the West, containing more gum. The high colloid content allows the pigments to adhere better to Chinese paper and silk, enabling the artwork to be wet-pasted in Chinese roll mounting without blurring or staining. Among the painting techniques, traditional Chinese painting is divided into two main techniques, meticulous brushwork and freehand brushwork. Gongbi is a meticulous painting style with rich colors and detailed strokes. Xieyi is a more relaxed style, often used in landscape painting, designed to express the artist's emotions. In the art form and spirit, Chinese painting emphasizes the unity of the art form and the spirit of the painted object. The use of brush, ink and rice paper constitutes a unique theoretical system of Chinese painting.

TECHNICAL APPRAISAL OF PIGMENTS IN CHINESE PAINTINGS

Principle and Method of Pigment Identification

Traditional Chinese painting pigments are generally divided into two categories: mineral pigments and plant pigments. From the history of use, there should be minerals before plants, just like pine smoke before oil smoke with ink (Lazic et al., 2023). After testing, it was found that mineral pigments (such as cinnabar) were used for the bright colors left on ancient rock paintings. The remarkable characteristics of mineral pigments are that they are not easy to fade and have bright colors. Most of those who have seen Zhang Daqian's colorful paintings in his later years have this impression. Large areas of azurite, turquoise, and cinnabar can make people feel refreshed. Plant pigments are mainly extracted from trees and flowers.

Table 5. Principle and Method of Pigment Identification

Pigment type	Principle of identification	Identification method
Blue and white pigment	The chemical composition, crystal structure, color and spectrum of pigments were used for identification	Raman spectroscopy, X-ray diffraction, scanning electron microscope energy spectrum, etc.
Underglaze red pigment	The molecular structure, color and spectrum of pigments were used for identification	Raman spectrum, infrared spectrum, ultraviolet-visible spectrum, etc.
Tri-color pigment in glaze	The chemical composition, color, spectrum and other characteristics of pigments were used for identification	Raman spectrum, scanning electron microscope energy spectrum, etc.

Table 5 presents the principle and method of pigment identification. Traditionally, it is believed that the color should be thin, but to show the feeling of heavy, it is often colored repeatedly with thin colors over and over again, and finally, a heavy effect of multi-layer superposition is formed. The thin coloring method is best to grasp when painting with silk; put your hands on the silk surface and touch the rough feeling of color, but also clearly feel the warp and weft of spun silk. Many ancient paintings we see today have delicate and heavy colors, and the texture of colors is lovely. In fact, the color is heavy, which means it is not a thick color.

Therefore, the more colors you paint, the more you meet the need for heavy colors. Today, with the rise of rock color painting, some painters pursue the thick painting method of color and make a texture like oil painting, which is another technique, but it is limited to the use of rock color painting. In most paintings today, it should be better to combine thickness with thinness. In my paintings, I try my best to combine thick painting with thin painting.

Testing of Conventional Color Values

The raw materials of Chinese traditional painting pigments are determined, and the components are fixed. Even if the transformation of different color scales is realized by controlling the particle thickness, the types of colors are limited (Richards, 2023). Modern organic synthetic pigments can significantly change their structures, thus realizing more decadent color creation. Organic synthetic pigments are one of the most important contributions to the expansion of China's color system.

The methods of traditional Chinese painting mainly include the following aspects:

Pen technique. Chinese painting emphasizes the application of brushwork, including center, side, and reverse strokes. The outline of the center is the foundation of the double hook drawing method, while the ink painting principle of using both the center and side forwards emphasizes the use of the pen as the bone, ink as the flesh, and color to enhance its charm.

Ink color. Chinese painting is mainly based on ink, expressing the layering and three-dimensional sense of the picture by controlling the intensity, dryness, and wetness of ink. Ink techniques include the thick ink method, light ink method, broken ink method, splashing ink method, accumulated ink method, burnt ink method, and final ink method. one thousand two hundred and thirty-five

Lines. The lines in Chinese painting are very important, as their thickness, curvature, rigidity, and flexibility can all reflect the shape and texture of objects. The use of lines is particularly prominent in line drawing, known for its neatness and meticulousness, with a decorative style.

Composition. The composition of Chinese painting follows basic principles such as "distance and proximity method", "density method", and "opening method". Composition should consider the overall layout and visual focus of the image, as well as how to express the depth and breadth of the image through spatial relationships and the interrelationships between objects.

Color. The color style of Chinese painting is fresh and elegant, emphasizing the decorative nature of colors. In the use of colors, follow the principles of "color does not hinder ink", "ink does not hinder color", "light but not thin", and "bright but not vulgar". The use of color in double hook painting is mainly focused on heavy colors, while in ink painting, light colors are mainly used.

Fundamentals of Styling. The basic form of Chinese painting is the technique of using pens and ink. Use a pen to wrap brackets, dots, surfaces, grooves, and erases, with lines being the main focus. The use of ink includes changes such as dry, wet, thick, light, and burnt.

Conventional color value test: Pigment hue: Hue is one of the inherent properties of color, which is often used as a color measurement and distinction term, such as red, yellow, blue, green, and purple, which are the different hues of colors. Pigment brightness: Brightness, also known as brightness, is the eye's feeling of light source and object surface brightness, which is mainly a visual experience determined by light intensity (Fan, Zhu, Marković, & Zhang, 2023). Different colors have different lightness. For example, yellow is brighter than blue. Purity/saturation: Purity usually refers to the brightness of a color. From a scientific point of view, the brightness of color depends on the single degree of light emitted by this hue.

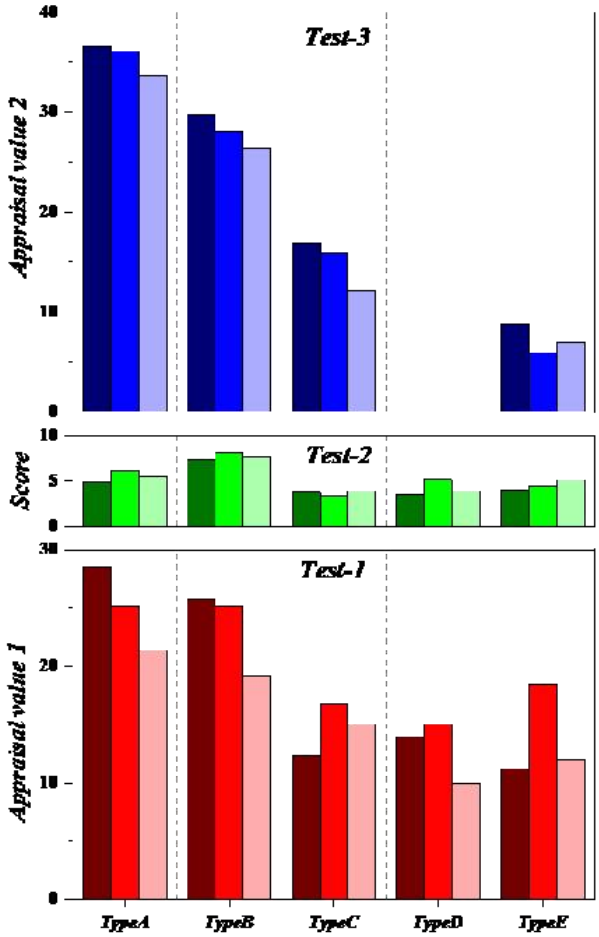

Figure 4. Test of Normal Color Values

Figure 4 shows the test of conventional color values. For the colors that can be observed by the vision, two standards are generally adopted internationally: the CIELAB system and the HSB system. CIE is the abbreviation of the International Lighting Association, which has formulated the international standard for measuring color value by L*, A*, and b*. CIELAB is generally referred to as Lab. L* stands for lightness, which varies from bright (L*=100) to dark (L*=0). The a* value represents a change in color from red (+a*) to green (-a*), while the b* value represents a change in color from yellow (+b*) to blue (-b*). HSB system is based on human perception of color and uses H (hues) to represent hue, s (saturation) to represent saturation, and B (brightness) to describe color. H stands for hue, which is represented by degrees (degrees), and the hue it represents is a 360-degree circular hue ring; S denotes saturation (sometimes called chroma), which refers to the intensity and purity of color. Saturation denotes the proportion of gray component in hue, which is measured by a percentage of 0% (gray) to 100% (full saturation). Figure 5 shows the results of pigment proportion in color. On the standard color wheel, the

saturation increases from the edge of the central island; B represents brightness, which is the concept of brightness and shade. It is expressed as a percentage. The greater the value, the higher the brightness, and the smaller the value, the lower the brightness, the darker the hue. It is usually measured by the percentage of 0% (black) to 100% (white).

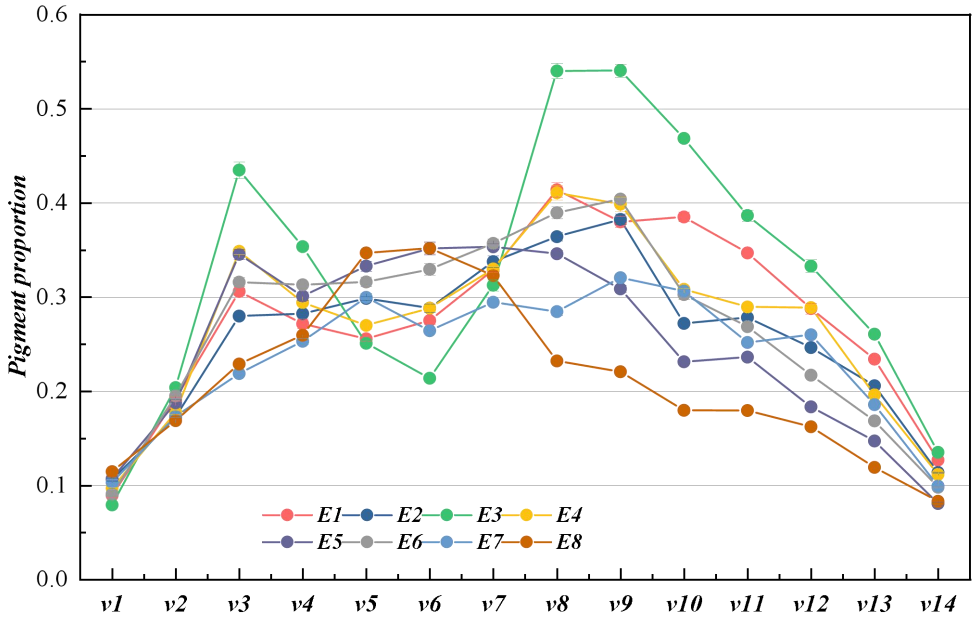

Figure 5. Pigment Proportion in Color

Traditional Pigment Production Methods

The production of traditional pigments generally includes two parts: raw material processing and alum blending. Raw material processing is divided into two major processes: material selection and grinding and bleaching. Glue alum blending also includes the selection of glue alum and the blending skills of glue, alum, and raw materials. Every step of them is full of the painstaking efforts and wisdom of Chinese painting artists.

Material selection is to go to nature and select raw materials with good quality and suitable hue in the market. The selection of raw materials often follows the experience left by many ancients. Here, the selection of cinnabar and ochre raw materials is listed as a representative and a glimpse of the fineness and attention in the selection of traditional pigments. Material selection of cinnabar: The raw materials are deep red and fresh. The color tone and quality of cinnabar mines from different producing areas are often very different. Zhang Yanyuan recorded alone in Tang Dynasty: "The Dan of Wuling Well, the Sand of Grinding" shows that the cinnabar in Changde, Hunan Province, and Xianfeng, Hubei Province is of good quality. In the Qing Dynasty's "Mustard Seed Garden Painting Biography", "Cinnabar is better than hibiscus research," Zou Yigui's "Hill Painting Spectrum", "Cinnabar is better than a mirror". Qing Dynasty's "Redwood Porch," said: "Sand should be clear and clean, and if it is not clean, iron should be sandwiched. I do not know if it is someone who mentioned mercury after burning the square soil. It is best to be cautious."

Selection of Ochre: Generally speaking, the color of Ochre with hard mineral and soft texture after elegance is darker red and lighter. Smooth and delicate, yellow Ochre is the first class. Qing Zou Yigui's "Hill Painting Spectrum": "Ochre, with bright yellow and red as the top, iron as the bottom, takes its tender and fine grind, mashes it with micro-glue, scours it, dries it in a dish, and can also become ink." Mustard Garden Painting Spectrum "also has records on the selection and production of ochre:" Ochre is the best choice of Ochre. It is hard as iron and smoke as mud, which are not selected. Grinding with water in a mountain sand basin, fine as mud. Throw in highly light glue, fly it broadly, and discard those that are clear and thick at the bottom. Ochre has always been the best in Daizhou, with smooth and delicate raw materials, yellow color, and transparency. Adding glue also has good adhesion and is not easy to fall off. Daizhou refers to Wutai County, Xinxian County, and Fan Shi County in Shanxi Province. Because of the excellent quality of ochre in Daizhou, Japan still calls it ochre Daizhou, which shows its influence.

Table 6. Traditional Pigment Production Methods in the Late Ming and Early Qing Dynasties

Pigment type	Raw materials	Manufacturing method
Tri-color pigment in glaze	Iron yellow, iron green, iron black	Grind iron yellow, iron green and iron black into fine powder, add water and gelatin, boil and precipitate, dry and cut into small pieces, then grind into fine powder, and put into a hose or porcelain bottle.
Anthocyanine pigment	Bluegrass Polygonum	Harvesting Polygonum hydropiper, drying in the sun, soaking in water, mashing and filtering to obtain a blue liquid, adding gelatin, boiling and precipitating, drying, cutting into small pieces, grinding into a fine powder, and putting into the hose or porcelain bottle.
Gamboge pigment	Garcinia cambogia	Sun-dried gamboge fruit, peeled, took out seeds, ground into a fine powder, added water and gelatin, boiled and precipitated, dried, cut into small pieces, ground into a fine powder, and put into a hose or porcelain bottle.
Mud gold pigment	Gold	Beat gold into gold foil, grind it into gold powder with a palm, add water and gelatin, boil it, precipitate it, dry it, cut it into small pieces, grind it into fine powder, and put it in a hose or porcelain bottle.

Table 6 shows the traditional pigment production methods in the late Ming and early Qing Dynasties. Grinding and bleaching include four steps: "Amoy, grinding, clarification, and flying." Amoy: cleaning, which is the process of cleaning and washing pigments to take their impurities and dirt. General raw materials can be washed in water, and particular impurities need to be targeted with unique cleaning methods. For example, no matter where cinnabar is produced, it will contain impurity stones or iron slag, which is difficult to remove in the general water system, so it is necessary to use magnets to adsorb repeatedly and carefully pick impurity stones. Grinding: Put the washed raw materials into a bowl, mash, and dry grind (a small number of raw materials can be ground in a milk bowl, and a large number of pigments can be ground to a certain extent in a ball mill), and add glue to continue to grind until extremely fine. Clear: When the color is ground to extremely fine, add glue. After a certain period of clarification and precipitation, the coarser color sinks, and the light and delicate color floats on it. Fly: Skim out the floating part above (it cannot be discarded at will; it is an excellent raw material for intermediate color), grind the sunken powder again, and then repeat the previous step so as to get different colors gradually.

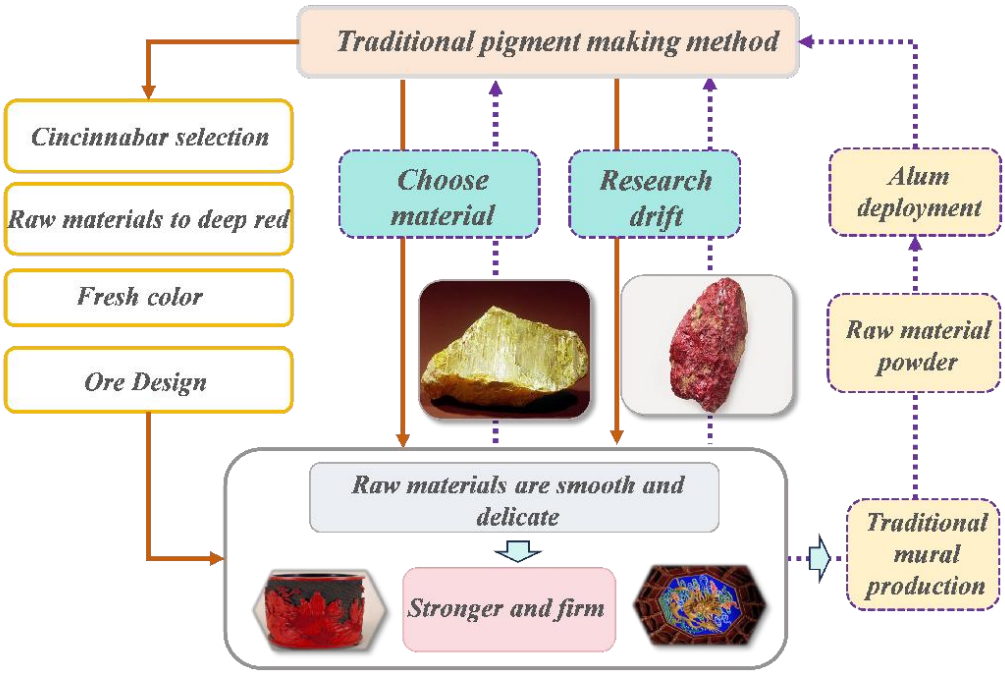

Figure 6. Traditional Pigment Production Method

Figure 6 shows the traditional pigment production method. In the blending of alum, the raw material processing results in raw material powders with different thicknesses and different color scales. Only by blending alum in an appropriate proportion can these powders have rich vitality and expressive force. The "three alum and nine dyes" in Chinese traditional meticulous heavy color painting refers to the fixation effect of glue alum on each

layer of background color in the layer-by-layer cover dyeing of heavy color painting, which plays an irreplaceable role in the realization of color level, rich hue, and exemplary depiction. In the process of making traditional murals in China, the use of glue and alum is more critical. Before the mural wall is treated well and the clay powder is painted, it is necessary to brush glue alum water. Its function is to make the wall surface firmer under the action of glue and alum so that the color can better attach to the wall surface without penetrating the wall or falling off downward. In addition to adding glue alum water layer by layer to firm color in mural painting, more importantly, glue alum still needs to be brushed again after painting. Glue alum water here can not only fix the overall effect but also effectively isolate the picture from humid air and protect it. Seemingly inconspicuous glue and alum are actually the critical media for traditional pigments to develop and fix colors, complete multi-level TINT, and maintain rich picture effects. Like pigment raw materials themselves, they need special attention.

CONCLUSION

Traditional Chinese painting pigments have been formed after thousands of years of development, and their chemical and physical properties are superior to modern organic synthetic pigments. Except for ancient chemically synthesized pigments such as lead, silver, and Zhu, and a few vegetable pigments, traditional pigments are all stable mineral and stone substances, which have outstanding advantages in light and heat resistance, oxidation resistance, acid, and alkali resistance, etc., which are conducive to the long-term preservation and embodiment of painting features, are treasures in the history of Chinese science and technology, and are also significant contributions of Chinese people to the treasure house of world art. In addition, in terms of picture expression, traditional pigments show stable and prosperous color due to their excellent physical properties. By controlling the particle size and color setting techniques of layer-by-layer dyeing, they can grasp the superb color and shape the rich layers.

Compared with traditional pigments, modern synthetic pigments exist for a short time, so it is not easy to make a final evaluation of their properties. However, through the analysis of its chemical composition, it can be inferred that its organic combination property has decided its instability. At present, several museum-level paintings have severe discoloration and decolorization, which is closely related to the unstable nature of modern pigments.

At present, the selection, production, and use of Chinese traditional pigments have yet to form a revival climate in China, and only a few traditional Chinese painters and theorists have mastered the mystery. Different from our country's emphasis on traditional pigments, Japan has always adhered to and developed the use skills of traditional pigments in China. When we walk into the Japanese painting creation classroom, we can see that young students and teachers make pigments called natural rock painting tools in containers with their own hands. These color powders, which are ground by stones, the temperature of hands, and the love of eyes, form new emotions and understandings in the painter's heart. Every stroke in the picture will be different. Pigment is limited, and human wisdom is infinite.

Painters of all ages have integrated their thinking and creation on the basis of limited material pigments, giving full play to the charm of pigments themselves and opening up more possible spaces for them. Combing the development of heavy-color painting, we can see that the pigments used in successful paintings for hundreds of years are only concentrated in the most basic colors of cinnabar, rouge, ochre, azurite, turquoise, gamboge, clam powder, and dark black. However, through the continuous progress of color setting and sketching techniques, the limited material conditions can always glow with the eternal charm of the times. Therefore, the progress of material conditions is closely related to the expansion of spiritual civilization. Today, with the influx of various chemically synthesized pigments and foreign pigments, painters may be faced with more convenient and faster coloring conditions. We omit the time of grinding and glue blending and also omit the skill of water and blending, but this does not mean that we can also omit our love for color itself and our awe of pen tip and paper. Looking back on the arduous and glorious course of Chinese color, we need to stand firm, stick to the traditional foothold, and guard the soul, looking forward to rejuvenation.

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