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# PEACOCK FEATHERS AND JAPANESE COSTUME CULTURE: EVALUATIONS FROM SPECTRUM IMAGES AND MICROSCOPIC OBSERVATIONS

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**Abstract**

The iridescent and brilliance due to the optical anisotropy of peacock feathers attract humankind and cause a feeling of "KIREI (ethereal)". As a result of investigating the spectral characteristics of each part on the upper tail covert feather, it was confirmed that different spectral characteristics between greenish and brownish appear to depend on the lighting related to the weaving technique and design. The design of JINBAORI or OBI, which is weaved with peacock feathers, could be divided into two types: hilarious DATE, which peculiarity is the eccentric multiplex ovals shape, and austere DATE, which peculiarity is the complex optical anisotropic changes of the barbules. Though both show each <peacock-ness>, classification shows that JINBAORI tended to hilarious DATE designs in early medieval Japan. Its motivation would be inferred from the expectations for faith to originate from the peacock's symbolism. Interestingly, the austere DATE design appeared later.

**Keywords**

structural colour, optical anisotropy, peacock, symbolism, costume design

## *1. Introduction*

### *1.1. Optical anisotropy arises a sense of ethereal (KIREI)*

Colours in nature are roughly classified into pigments and structural colours. The latter are optical phenomena due to the nanostructures of the surface layer. A characteristic of structural colour is optical anisotropy, which is explained by diffraction or interference.

The iridescence (also called goniochromism) that appears here, the colour of the glittering light, would have been mysteriously reflected in the eyes of ancient people. It continues to fascinate also people in modern. The origin of the Japanese word KIREI includes preferring to shade gradation as otherworldly graceful, and we speculate it is near as ethereal in English.

The occurrence of a sense of beauty requires the decorativeness of movement, which is an unexpected change. In addition to the transition of wind and light, it also corresponds to the movement of creatures with structural colour bodies. Woven fabrics characterized by optical anisotropy, such as silk damask, show changes in shape, lustre and shadow in time and space in response to the environment and constantly attract interest. Thus these impress act on the sensitivity of KIREI.

Why does the emotion of desire for KIREI occur? The phenomenon of appearance, change, and disappearance in optical anisotropy suggests this question. The key is the imagination that connects encounters with rare events with good luck. Optical anisotropy can be said to be a visual manifestation of mystery that transcends humanity. In other words, it is the visual phase of KIREI. The phenomenon of appearance, change, and disappearance in optical anisotropy suggests the clue for this question. In search of such comfort, many expressions use natural optical anisotropy colour materials like a mother of pearl, an elytron of jewel beetle or Morphinae wings since ancient era around the world. The history of the artificial design of shapes or patterns is the track of exploring to enhance these effects better than the natural condition of the original material. Biomimicry materials and techniques that apply natural structural colours are utilized in industrial products to add a sense of luxury and premium.

Those facts appear to the evidence of aesthetic empathy existence for the structural colour

appearance. The long-lived design that has been traditionally inherited is a continuation of preference, so it can be said that it shows the spirit and faith peculiar to the community.

To consider the influence of optical anisotropy on the sensibility of KIREI, we have observed the microstructure and the geometric illumination conditions on Japanese traditional silk textiles (technique of RINZU, DONSU, similar to damask) or the avant-garde textiles woven with decorative feathers of male Indian peacock with a laser confocal microscope or a digital microscope, measurements with a variable-angle spectroscopic imaging device, and investigated its optical characteristics of the reflectance distribution and the distribution in CIELAB space. Through those experiments, it was estimated that silk thread or peacock feathers have optical anisotropy that unexpectedly changes the shape, lustre, and shadow in response to the environment, such as light and wind, bringing a different visual effect on texture impression and stimulus a sensibility of KIREI (Awano & Osumi,2020).

### *1.2. Peacock and the peacock feather woven fabric*

The appearance of a male Indian peafowl or green peafowl, which has a long neck covered with bright and shiny feathers and about 1m upper tail covert feathers that is 1.5 times the length of the body, attracts even humans, not only females of the same species. Therefore, it is loved as an eye-catching and artistic motif in ancient and modern east and west (Jackson.2006). In this paper, male Indian peafowl is referred to as peacock.

Peacock feather woven fabric, which is one of the subjects of our research, is produced by the technique of weaving feather parts into weft, not the woven fabric of twisted yarn. Fabrics woven with bird feathers and villi are often present in history (Hosokawa.2019; Charbonnier.Ed.2018; Foley.1992.), but the appearance of peacock feathers is unique among bird feathers with the eccentric multiplex ovals, so the textile finish also be a characteristic surface layer. Though in the Western culture, a male peacock image is connected to femininity sometimes, in Japan, these unique peacock JINBAORI or KABUTO were sometimes manufactured as a costume for male warlords at least from the medieval war era. The motive of his demeanour, showing off with the eccentric costume by the peacock feather in the battle field infers the spirit of DATE. DATE is Japanese that a genealogy of mental concepts formed around medieval Japan's 12th and 13th centuries. It might be similar to dandyism in English.

This research had inspired by the whole woven with peacock barbules OBI manufactured by Kondaya, the long-established OBI workshop (Fig.1-1). Though Kondaya has manufactured peacock motif OBI several times in its over 280 years of history, this OBI that the current patriarch produced in 2008 embodies the spirit of DATE that we explain in this paper. Though it is challenging to recognize that it is woven from peacock feathers at first glance, changing colour indicates the characteristics of structural colour and encourages attention to imagine the material. By the way, the OBI is wrapped around the body over the KIMONO and tied behind to shape it (Fig 1-3). Among the women's OBI format include the whole woven with peacock barbules OBI by Kondaya, the standard dimensions of the type FUKURO-OBI are 31 cm width and 430 cm length. The coordination of OBI and KIMONO textures, colours, and patterns express the messages for time, place and opportunity. Since no one has ever worn this obi, no photographic evidence is available. However, it can be expected that a greenish and brownish

1. 2. 3.

**Fig 1:** 1. Texture and colour of the whole woven with peacock barbules OBI which manufactured by Kondaya. 2. Detail of 1. 3. The shape and optical anisotropic texture of OBI wore.

iridescence appears vertically and horizontally in direction when this obi is worn, as way as shown in Figure 1-3. It will change according to the gesture of the person. The appearance is sober and delicate, but it shows the deep and luxurious KIREI. In other words, its existence is a more sophisticated beauty of <peacock-ness> than the beauty of natural peacock. Such a hidden aesthetic sense can also be said to be the spirit of DATE (Awano & Osumi,2021, p817-822).

Though the eccentric multiplex ovals pattern of the peacock's upper tail covert feather is its most prominent and well-known feature, the optically anisotropic colour phenomenon of each part of the feathers covering the peacock's whole body is also an important feature. In this paper, the peacock's upper tail covert feather will call as a peacock feather.

We examined the appearance factors of the optically anisotropic colour phenomenon on upper tail covert feather with the observation of optical characteristics and consider the aesthetic sense of <peacock-ness> on the peacock feather textile in Japanese costume culture.

## 2. *Experiment and results*

### *2.1. Observation and measurement*

We used an optical microscope, a laser confocal microscope, and a scanning electron microscope for observation (Fig. 2). Following the above visual confirmation, we investigated the spectral characteristics of structural colours with a variable-angle spectroscopic imaging device in which illumination conditions changed from the vertical direction of the sample to three angles of

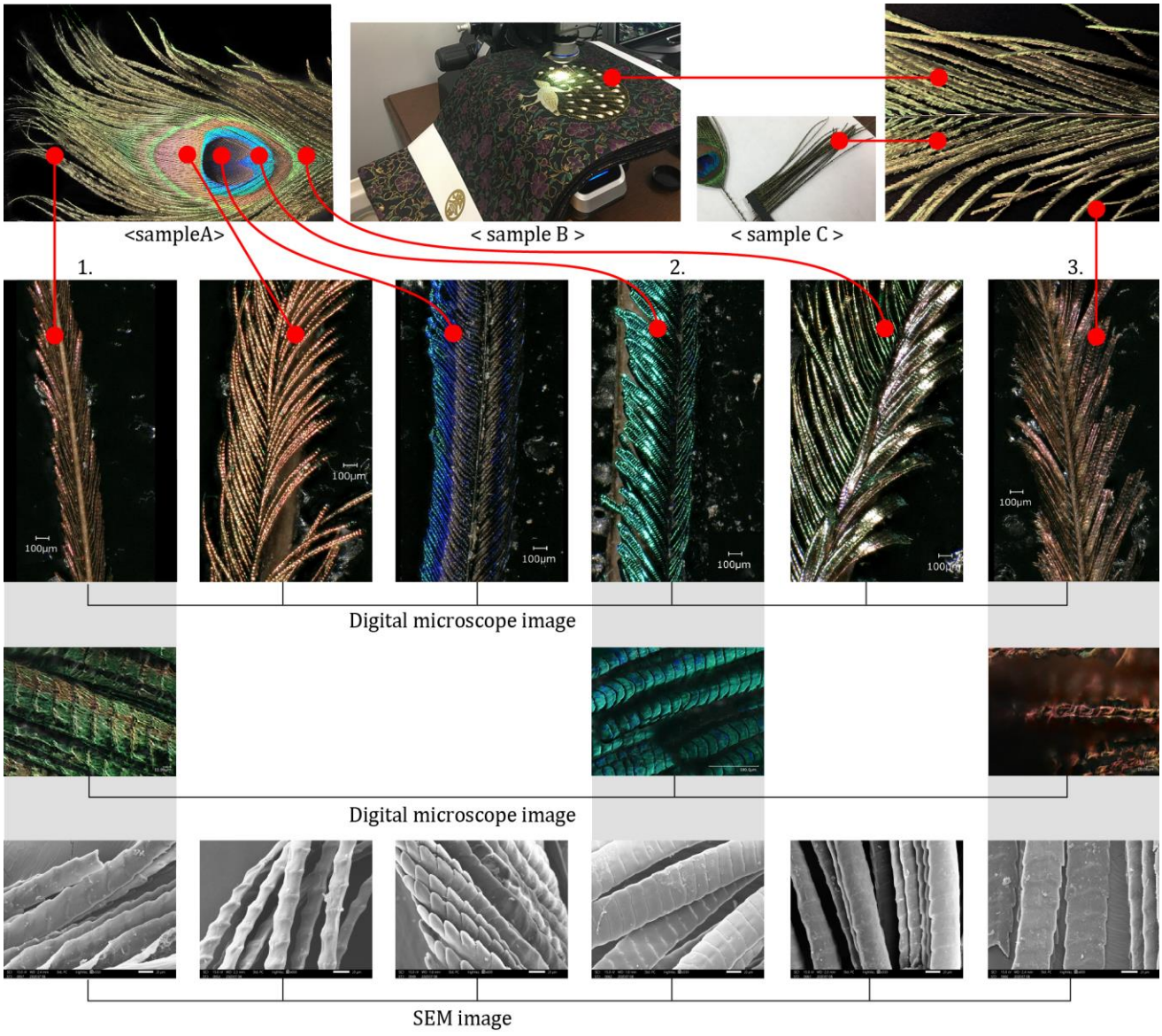


**Fig 2:** Microscopic observation of peacock feathers which divided into each coloured parts.

15°, 45°, and 75° (Fig. 3). It is hardly expected discoveries from the observation using an optical microscope capable of three-dimensional measurement since the microstructure of the structural colour, including the peacock feathers, has already been clarified in previous studies (Kinoshita & Yoshioka, 2005). The purpose of us was to get the primary data by ourselves.

First, we observed and measured various parts of barbules that made up the upper tail covert feathers of peacocks microscopically with these types of equipment and confirmed the characteristics of each detailed shape (Fig.2). Observation with a scanning electron microscope is omitted from this paper. Next, we prepared samples for measuring spectral characteristics. Sample A is a peacock feather in a natural condition divided into each coloured part around the eccentric multiplex ovals of an upper tail covert feathers. Sample B is another edition OBI; the partly peacock feather weaved OBI, manufactured with a similar technique as the whole woven with peacock barbules OBI (Fig.1-1) by Kondaya. Microscopic observation confirmed that Sample B was DONSU (satin damask) with peacock feathers woven into the weft. Sample C is the parallel arranged barbules (Fig.2-3) like the whole woven with peacock barbules OBI (Fig.1-1). Then we evaluated obtained from the gonio photometric spectrum analysis and microscopic observation to understand the sensitivity to artificial appearance like figure 1-1, how different from peacocks as a bird.

## *2.2.Results*

The peacock feather has a part that shows a high saturation colour and a part that shows a brown colour, and the surface condition of each part is slightly different. As shown in Figure 2, in sample A, the difference in the density of the feather branches is clear between the barbule as like 1 and the ovals as like 2. The difference in cross-sectional shape can be confirmed visually. Furthermore, the difference in the shape of the barbule of each part can be confirmed from the magnified image. In the cortex of this barbule, granules of melanin pigment are regularly arranged at intervals satisfying the light interference condition in the visible light region, and different colours are developed when the intervals between the granules are different. In addition, the cross-section of the barbule is crescent-shaped, the twisting of the barbule has a significant influence on the light reflection characteristics, and the black colour of melanin is other than the reflected light related the expression of structural colour. Previous studies have shown that it cuts the light and produces vivid colours.

Figure 3 shows the results of visualizing the colour appearance range distribution for each angle calculated for each pixel in the CIELAB space from the spectral reflectance information obtained by spectral imaging measurement.

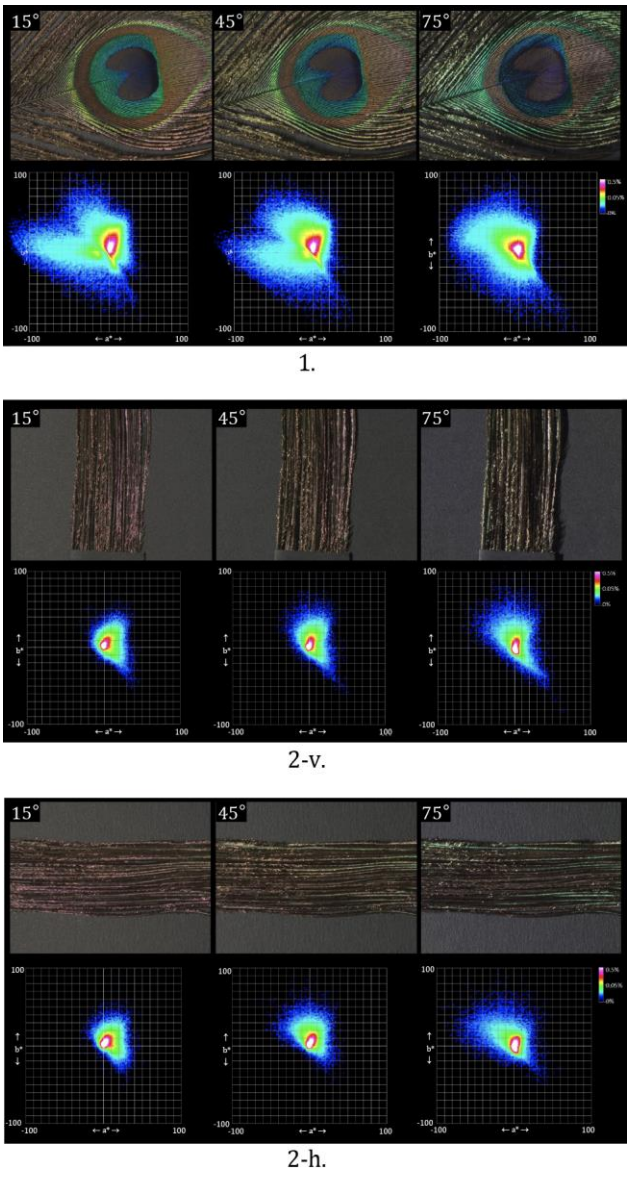


**Fig 3**: The results of visualizing the colour appearance range distribution for each angle calculated for each pixel in the CIELAB space. 1. The eccentric multiplex ovals part of peacock feather, shown in Fig.2. sample A. 2-v. Vertically parallel arranged barbules, shown in Fig.2. sample C. 2-h. Horizontally parallel arranged barbules.

Figure 3 -1 is the result of sample A in Figure 2, and Figure 3-2-v and 2-h are the result of sample C in Figure 2. The profile changed continuously and significantly due to the change in angle, and the peak wavelength also shifted to the short wavelength side as the angle increased. It is a characteristic that accompanies changes in the geometrical conditions of typical structural colours (Medina et al.,2015). At 15°, many appearances were observed in the negative region where a* exceeded -100. It is prevalent and shows that it develops a fairly high-saturation green colour. As the illumination angle from the sample normal direction increases, this high green saturation distribution c region gradually shrinks, and conversely, the blue-purple region with a hue angle of around 300° increases. It is consistent with the change as mentioned above in the distribution of spectral reflectance. At any angle, the appearance range extends to a considerably high saturation range, and a wide Gamut is required to cover it, and it is presumed that the sRGB area is exceeded.

It had found that sample B uses a different part than Figure 1-1 by this analysis. Sample B uses the barbule of the shaft (Fig.2-3), but Kondaya says that F1-1 used the tip of the oval (Fig.2-1). However, each OBI's visual impression and tactile have similar textures because they were made with the same technique. The dense overlap of bulging twigs visually creates shadows and gives a lustre and brilliance to the matte base on the surface carpeted with long barbules. It is tactilely smooth and soft, and this impression is reminiscent of the fact that the name TENGAJYU, which refers to the soft hair growing on deer horn buds, has changed to the name of velvet, which is a pile fabric. It radically altered the traditional view of peacock motif fabrics by bringing a charm by using the fine structure of the structural colour since it is made by weaving the soft and bushy parts of the tips of the peacock feathers. Although this material is derived from peacock, this technique brings out the KIREI of peacock with a completely different approach from the generally easy-to-understand recognition of <peacock-ness>, which is a graceful worth design as an artificial natural representation.

## *3. Discussion: visual effects and symbolism*

Among the artistic expressions in visual arts such as paintings and decorative arts, those draw a whole-body image of a peacock, and many cases are particularly emphasized as the eccentric multiplex ovals parts depicted. In other words, there is the fact that this eccentric multiplex ovals part has been established as a symbol as a peacock. Unlike paintings with static object colour, the shape (the eccentric multiplex ovals like the eye) and changing iridescence that considers three-dimensionality, movement, and changes in the lighting environment are valuable elements in costume design. It may say wearing peacock feathers is a human desire to become a new peacock. Next, we classified the trends from Japanese costume design cases to consider what kind of design can be perceived as <peacock-ness> in Japan.

### *3.1. Two tendencies of design and weaving techniques with peacock feathers in Japanese culture.*

Some of KABUTO and JINBAORI, the combat equipment of military commanders in the 16-17th centuries, has been produced with real peacock feathers (Fig.6-1). Those can be classified into two tendencies; one weave with the eccentric multiplex ovals and the other with the peripheral or tip part of barbules (Fig. 4). We named the former as hilarious DATE, and the later as austere DATE. "Hilarious" is named in light of the ease of appearance and the strength of the impact due to the eccentric multiplex ovals as eye, which can be said to be a symbol of peacock-ness (typical design is fig. 4-1). "Austere" was named depending on the complexity of implying the material with the microscopic feature of optical anisotropy that occurs in response to changes in light reception. It has hidden the shape of the eye that macroscopic characteristics of the peacock feather (typical design is fig. 4-8=fig.1-1). The appearance of the peacock as a bird can classify as hilarious DATE, and austere DATE is an expression of human creation. Though the English words "hilarious" and "austere" used in this paper are expected to mean YANG and YIN, HARE and KE, and OMOTE and URA in Zen and Japanese culture, it is necessary to discuss in the other manuscript about correspondence between the words and concept. We will proceed with the discussion based on these definitions; hilarious means displayed clearly, and austere means implied concealment.

In figure 4, -1, -3 and -8 were manufactured by Kondaya in the past 20 years. Figure 4-2, -4 -5, -6 and -7 were manufactured in medieval Japan. Figure 4-3 is the replica manufactured to verify the technique of the original piece handed down to the Ii family, Figure 4-2. Figure 4-2 shows the processed feathers, those trimmed long barbules around the oval to make the "eye" stand out are sewn together without gaps. Figure 4-4 use the feathers without trimming but sewn with gaps to stand out the oval as an "eye". Since Figure 4-3 used the ovals surrounded by long barbules without trimming sewn at a density of 4-2, the "eyes" are hidden by barbules and are barely visible. Though it is similar to Figure 4-6 when in the static condition, it could define as hilarious DATE because the eyes suddenly reveal themselves when exposed to the wind or human gestures, for example, on the battlefield. Figure 4-5 has a similar concept of surprise but sparsely


**Fig.4:** Classification of the designs of JINBAORI and OBI using the real peacock feathers.
1. Manufactured by Kondaya. Collection of Kondaya. 2. Handed down one from the Ii family. Nagaoka City Yoita History and Folklore Museum Collection. 3. Reprica of 3 Manufactured by Kondaya. Nagaoka City Yoita History and Folklore Museum Collection. 4. Took over at the Harada family in Kaga. Taigan Historical Museum Collection. 5. Tradition unknown. Private collection. *DAIMYO Seigneurs de la guerre au Japon*. (p188). 6. Sendai feudal lord Date Shigemura supplies. Sendai City Museum Collection. 7. Jimbaori decorated with peacock feathers. Tradition unknown. V & A Museum collection, Given by T. B. Clarke-Thornhill. East Asia Collection, Accession Number.628-1905. Source: https://collections.vam.ac.uk/item/O119987/surcoat-unknown/ 8. The whole woven with peacock barbules OBI made with a peripheral barbule of the eccentric multiplex ovals part, manufactured by Kondaya. Collection of Kondaya.

mixes peacock ovals (eyes) with other bird feathers to create an otherworldly eeriness. JINBAORI has an area sufficient to determine the impression of the entire costume, is close to the face, and is an item that responds to the large movements of the upper body. Designs in which the density of long barbules shakes randomly make the "eyes" appear and hide randomly, and there is a dynamism in which unexpected movements break the balance of the situation with iridescence in an unexpected moment. The characteristic eye pattern common to these has a stronger impression of shape than iridescence colour. Figure 4-6 incorporates only the long hanging barbules of Fig. 2-3. The concept seems similar to 4-8 since it expresses the manifestation of brown and green change due to optical anisotropy and the rough texture of the barbules but between 4-3 and 4-8. Figure 4-7 is a complex artificial pattern combining different parts of the peacock. The barbules in Fig. 2-3 are placed between the flat, lustrous ovals part and the fluffy feathers to create a gradation of texture, creating a clever design. Figure 4-8 has twigs of the softest part at the tip of a peripheral barbule of the eccentric multiplex ovals part woven as wefts while being layered so that the surface layer of the weave is short twigs. Though the tactile texture is like soft animal hair, recognize that it is different from villi due to the green-to-brown iridescence caused by the angle of the spotlight. These phenomena can be described in Fig 3-2-h; the left (irradiation 15°) shows brown, and the right (irradiation 75°) shows green. Since this weaving technique forms the texture of the surface rather than the shape, iridescence plays a significant role in the expression of what we call austere DATE.

### *3.2. symbolism and visual effects*

Many of the existing costumes on the battlefield in medieval Japan have decorative elements added to their functionality as armour. In the religious worldview, decoration was expected to pray a magical role. The shape of the decoration has been created by the imagination related to the appearance and ecology of the subject to be quoted. In a life-or-death situation, the expectations are even more significant.

Peacocks are creatures contrary an ethereal appearance to strong vitality. A crest is erected on a small head at the tip of an elongated neck covered with bright blue indigo feathers, followed

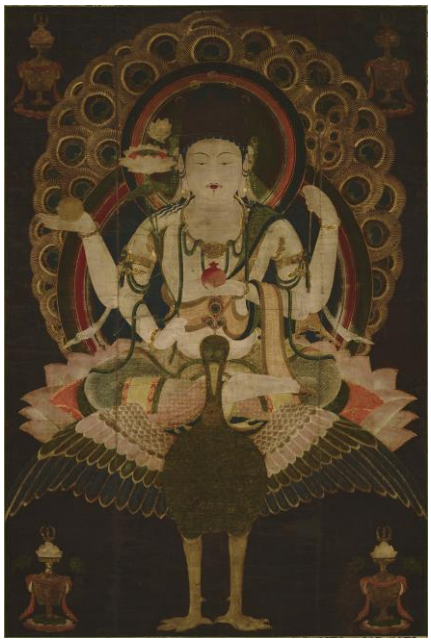

**Fig 5:** "KUJAKU-MYOUO", hanging scroll coloured on silk, Heian Period, 12th century, National Treasure of Japan, owned by Tokyo National Museum.
Source: https://colbase.nich.go.jp/collection_ items/nm/A-11529?locale=ja


**Fig 6:** The battle attire of BUSYO.
1. IYO-ZANE OKEGAWA-DO GUSOKU. Inheritance by the Mouri family. Private collection. *DAIMYO Seigneurs de la guerre au Japon*. (p61) 2. SYUURUSHI-NURI FUZUBEGAWAODOSHI NUINOBE KOSHITORI NIMAI-DO GUSOKU. Inheritance by the Ii family. Hikone Castle Museum Collection. 3. A part of "Shizugatake war Folding Screen". Osaka Castle Museum collection.

by fluttering branches and feathers every time the body shakes to move. The appearance of long crests that sway with delay is reflected in a gorgeous appearance and elegant behaviour. Other hand, peacocks have been resistant to small amounts of toxins and often had been witnessed wrestling with venomous snakes that kill people in their habitat.

In Japan, around A.D.538, a peacock was recognized as KUJAKU- MYOUO in Buddhism introduced (Fig.5). Peacock is referred to as KUJAKU in Japanese. The allegory spread before it was known as a real animal through overseas trade or greeting gifts (Chaiklin. 2020; Minagawa.2021). The dignity in Buddhism is expressed through an anthropomorphic appearance. Fundamentally, the figure of the Buddha is a figurative representation of a concept (merit) and is not based on a human of either gender being as a prototype. Some of its forms are feminine, and others emphasize masculinity, but basically, Buddha is a concept that is not biased towards either male or female, nor is it biased towards either good or evil. Several sects (manners) of Buddhism spread from India to the Eurasian continent to Japan. MYOUO, one of the visualizations of Vajrayana (Tantric Buddhism), basically represents a figure with the masculine as an embodiment of power, but the statue of KUJAKU- MYOUO is exceptionally a female-shaped bodhisattva dignity (Izumi.1993; Sonoda.2020). Peacock has been believed to have the power to turn poison into honeydew from the ecology of attacking and eating snakes that symbolize hatred, one of the three evils (greed, hatred, foolishness) in Buddhism, and revered as a beneficial bird. From this ecology, the peacock is believed to have the merit of removing evil, fear, pain and disasters and extended inter-pret as dispelling anxiety and illness. It is also a symbol of bringing rain since believed to have the ability to call water (Iwamoto. 1984).

Another point of ability is the faith with the eccentric multiplex ovals part. The eccentric multiplex ovals are recognized as eyes of magic insight not limited to Buddhism but other faith. For example, at Skanda in Hinduism and Mahamayuri in Buddhism (who is related to HATOMARATEN or KU¬JAKU-MYOUO), the peacock is depicted as a heavenly vehicle that seems to escort with the eyes that fill the space. It appears the expectin with the power of the eye goes wishes for guardian, martial luck and “longevity”. Buddhism, which was introduced during the Asu-ka period and had the role of a guardian state and the aspect of scholarship and education, settled in the knowledge class and aristocratic class, eventually permeated the samurai, who replaced the government, and the ordinary people. In the war era, Buddhism also performed a role in spiritual salvation in the cruel world, forming the basis of the samurai's view of life and death. The decoration with animal and plant motifs on the battle attire means possession and amulet, and it shows off the view of the aspect of life and death that can find (Nagasaki .2013).

Figure 4-2 is said to have been given by SHOGUN Ieyasu Tokugawa (1543-1616) to Naomasa Ii (1561-1602) for his battle achievement. During the warring states pe-riod, the AKAZONAE army, equipped with red ar-mour that stood out on the battlefield, was recog-nized and feared as an elite troop with great cour-age (Fig.6-2). Naomasa Ii, who later formed one of the Tokugawa's four heavenly kings, also led the AKAZONAE army. His name gets well known as the AKAONI (the red ogre) from around the war in 1584. We have not found the document that leads to why Ieyasu chose the peacock feather JINBAORI as a prestigious reward, but it can infer from the following other cases.

The existing paintings of the EDO era depicting the "Battle of Shizugatake (1583)" caused by the successor problem of the Oda clan (Fig.6-3), there depicted Nagahide Niwa (1535-1585), who wore a peacock feather JINBAORI on a red armour, beside Hideyoshi Toyotomi (1537-1598), who wore a tiger's fur JINBAORI. Although the battle map is based on the biography, there is no proof whether it was worn in the actual battle because exaggeration and creativity cannot be excluded. However, the painters and biographers would have imagined the peacock feather JINBAORI swaying on a red, hard armour, changing the glow of the green iridescent. It can infer that they had determined an appropriate metaphor for the victorious army; the spirit of DATE with impressive exotic rare animal clad as a possession driven the military fortune.

## *4. Conclusion*

Even in modern and contemporary European fashion, compared to the gorgeousness of women's costumes, men's costumes are achromatic and dark tones, and the modesty of controlling the atmosphere with materials rather

than colours has been recognized as sensible dandyism. On the other hand, DuPont's campaign for colourful men's clothing, coinciding with the psychedelic movement that arose in Europe and the United States in the 1960s, is called the Peacock Revolution. The term peacock used here refers to a man with a striking appearance. It is a metaphor, but there are also designs featuring real peacock feathers or their patterns. This spirit is similar to the concept of DATE, which uses the visual effects of peacock feather costumes in medieval Japan as a means of expression. However, the symbolism of the peacock in medieval Japan had meanings derived from Buddhism. The allegory of the peacock is a concept born due to exaggerating the characteristics of appearance and ecology. The symbolism of the peacock that is delivered from its ecology is to get rid of evil, fear, pain and calamity. For the Japanese samurai who was always ready their mind to stand at the edge of their swords, the battle attire with peacock feather can be thought that the unrealistic divinity of the peacock existing on their side and promising to achieve the power to break through difficulties.

Then consider the relationship between DATE spirit and <peacock-ness>. The two types of peacock feather-weave costume designs are associated with two types of DATE spirit, indicating that there are also two types of <peacock-ness>. The peacock-ness is transformed by whether or not the shape of the eccentric multiplex ovals or the texture of the optically anisotropic colour change is characteristic. In this paper, JINBAORI (Fig.4-1) and Obi (Fig.4-8), manufactured by Kondaya that symbolize each type of design, were placed at opposite ends of each kind of DATE, were examined the factor of <peacock-ness>.

The peculiarity of austere DATE is complex three-dimensional texture from structural colour. It could define as the artificial peacock, which created a new appearance and texture by disassembling and reconstructing the parts of the peacock feather. Those are a discovery of KIREI ever not existing in the natural state of the creature. It could say the peacock feather, separated from the living peacock and becomes a fibre material, is treated and transformed into the surface layer of an artificial object, becoming another <peacock-ness>. Though we observed it by the OBI (Fig.1-1) in this paper, if the battle attire is manufactured with this method, it will surely add values that bring a sense of thoughtful, intelligent luxury, not only as an amulet. However, we have not confirmed the existence of a type such as the austere DATE (Fig. 4-8) in medieval Japanese peacock feather textiles at this time. It could be considered that the appearance of austere DATE is so dedicated and undefined against the necessity of battle attire which appears to have a strong impression that is easily identifiable on the battlefield. In contrast, the peculiarity of hilarious DATE is the illusion of "eyes" staring and a strong impression by the vividly shining colour. The motive for this design to JINBAORI is also enhancement of the ability to bounce off the evil eye from the enemy with the illusion of staring by the plenty of "eyes". These relentless shapes would overwhelm the mind who sees. It can be surmised that many of the hilarious DATE designs are used in the battle attire because it was a wish to acquire the vitality of a peacock and the supernatural power of a hundred eyes at the same time as the power to break through stagnation.

Between the above contrasts, Figure 4-7 is an exciting design born after the hilarious DATE (Fig. 4-2). It may be evidence of the development of the DATE spirit, multi-layered and complex. Since it is expected to have different characteristics from Figure 2-sample A and Figure 2-sample C, which are the basis of this research, it is necessary to investigate in the future.

## *5. Acknowledgements*

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## REFERENCES

Awano, Y. (2012). Kazaru. In Japanese society of culture of katachi (Ed), *Encyclopedia to read the Japanese form & imagination* (pp.413-416). Tokyo, Japan: Kosakusha

Awano, Y., & Osumi, M. (2020). Gonio-photometric spectrum analysis and texture evaluation of structural colour design :Considerations on "Peacock feather weave" by Kondaya-Genbey. In *AIC2020, Proceedings of the International Colour Association Conference 2020* (pp. 99-104).

Awano, Y., & Osumi, M. (2021). Consideration on the symbolism and visual influence on costume design with natural constructional colour. In *The Colour Science Association of Japan, Proceedings of the International Colour Association Conference 2021*, 45(3), 817-822.

Chaiklin, M. ( 2020). The Flight of the Peacock, or How Peacocks Became Japanese. In Martha Chaiklin , Philip Gooding and Gwyn Campbell(Ed), *Animal Trade Histories in the Indian Ocean World* (pp277-314). London, UK: Palgrave Macmillan.

Charbonnier, J-C. (Ed). (2018). *Daimyo: Seigneurs de la guerre au Japon.* Paris, France: ToriiLinks Editions.

Foley, V. (1992). The Jinbaori: Oneupmanship on the Battlefield. In *Textile Society of America Symposium Proceedings 1992* (pp. 90-98).

Hosokawa, H. (2019). Use of birds. In *Cultural magazine of people and birds*. Retrieved from https://haruaki.shunjusha.co.jp/posts/2537.(2022.08.29)

Iwamoto, Y. (1984). On the formation of Mahayana Buddhist scriptures: Especially with the theme of influence from paganism. *The Journal of Oriental Studies. The Institute of Oriental Philosophy*, 23(1), 124-140.

Izumi, T. (1993). Kujaku Myoo. *Kyoto National Museum bulletin*, 15, 95-101

Jackson E.C. (2006). *Peacock*. London: Reaktion Books Ltd.

Kinoshita, S., & Yoshioka, S. (2005). Structural Colors in Nature: The Role of Regularity and Irregularity in the Structure. *ChemPhysChem*, 6 (8), 1442-1459. https://doi.org/10.1002/cphc.200500007

Medina, J. M., Díaz, J. A., & Vukusic, P. (2015). Classification of peacock feather reflectance using principal component analysis similarity factors from multispectral imaging data. *Optics Express*, 23(8), 10198-10212.

Minagawa, M. (2018). Ancient and medieval history of imported animals as seen from literature materials. In *Course materials of Fukuoka City Archaeological Center Archeology Course* (pp. 1-28).

Nagasaki, I. (2013). The Characteristics of Modern War Uniforms and Their Cultural Historical Significance：Focusing on the influence of foreign dyeing and weaving. *Bulletin of Kyoritsu Women's University Research Institute for Cultural Studies*, 19(3-3),9-30.

Ogura, S., & Ohyabu, M. (2003). Structural Color in Nature. *Kogaku Japanese Journal of Optics*, 33(4), 221-237.

Sonoda, S. (2013). Pancaraksa and Goddesses in Indian Esoteric Buddhism: Mahamayuri and Marici. *Bulletin of The Institute of Oriental Philosophy*, 167-188.

Yanagisawa, T. (1982). A Mahamayuri Painting with Exceptional Iconography. *Bijutsu Kenkyu*, 322, 1-15.