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Preservation of Materials in Outdoor Museums

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Preservation of Materials in Outdoor Museums

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ABSTRACT: Historical Village of Hokkaido (*Hokkaido Kaitaku no Mura*) is a regional outdoor museum of popular life. Opened in 1983, its 27 houses now exhibit some 15,000 folk materials. This report describes the activities and conservation problems of this outdoor exhibition, with special reference to variations in interior climate caused by the differences in construction materials, results of the application of different anti-corrosive agents to iron tools, tests on the fading of dyed fabrics and the control of insects, dust and visitors.

[**KEY WORDS:** HOKKAIDO, HISTORICAL VILLAGE, OUTDOOR MUSEUM, CONSERVATION, DETERIORATION, CLIMATE CONTROL, ANTI-CORROSIVE TREATMENT, IRON, DYED FABRICS]

1. INTRODUCTION

Unlike artistic handicrafts, archaeological evidence and old buildings, the techniques of preservation of folk materials in historical museums and outdoor museums are fields which seem not yet to have been fully systematized.

In many outdoor museums, including the Historical Village of Hokkaido (*Hokkaido Kaitaku no Mura*), artifacts are exhibited as a "Display of a Mode of Life"; *i.e.,* they were used in everyday life, regardless of whether they are inside or outside the original dwellings. Some are placed directly on the ground, and others in a window. They are thus exposed to rain, snow and direct sunlight, all very harsh conditions. Moreover, all artifacts are affected, as doors or windows are opened, by the direct impact of outside air.

Since May 1985, we have been conducting an investigation into the problems of preserving artifacts at the Historical Village of Hokkaido (Fig. 1). Since the investigation is still on-going we can present the results here as only a tentative outline of our observations on material changes during the exhibition and the treatment.

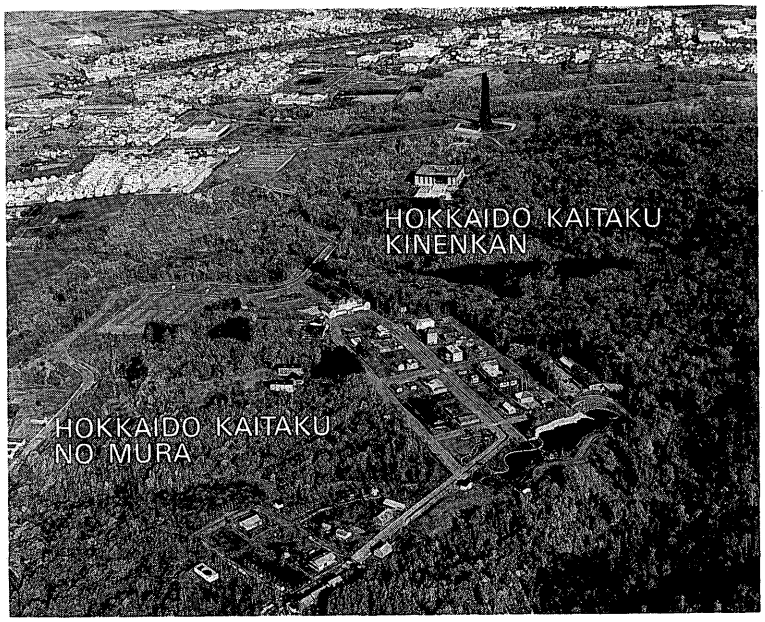

Fig. 1. An aerial view of the Historical Museum of Hokkaido (*Hokkaido Kaitaku Kinenkan*) and the Historical Village of Hokkaido (*Hokkaido Kaitaku no Mura*).

2. THE HISTORICAL VILLAGE OF HOKKAIDO

The Historical Village of Hokkaido, opened in April, 1983, is the first outdoor museum in Hokkaido. It consists of four blocks: Town, Farm Village, Mountain Village and Fishing Village (Fig. 2).

Wooden, stone, earthen and brick buildings have been removed from their original sites and reconstructed in this museum. In addition, a village to depict life between the Meiji and Taisho eras (late-19th century and the first quarter of the 20th century) is now under construction.

In this outdoor museum people can experience history for themselves; they can enter the old buildings and see what it must have been like to live at that time. And since the museum itself is a living and amusing place, where traditional festivals are performed and handicrafts manufactured, visitors can themselves participate in the past. The Historical Village of Hokkaido, where everything is an exhibit, is also a place to experience directly the lifestyles of some decades ago.

3. ON THE CONSERVATION OF FOLK MATERIALS

Scientific research in conservation is generally divided into three types: on materials and structure (including the technique of making); on environmental studies to prevent degradation; and technical studies on repair and restoration

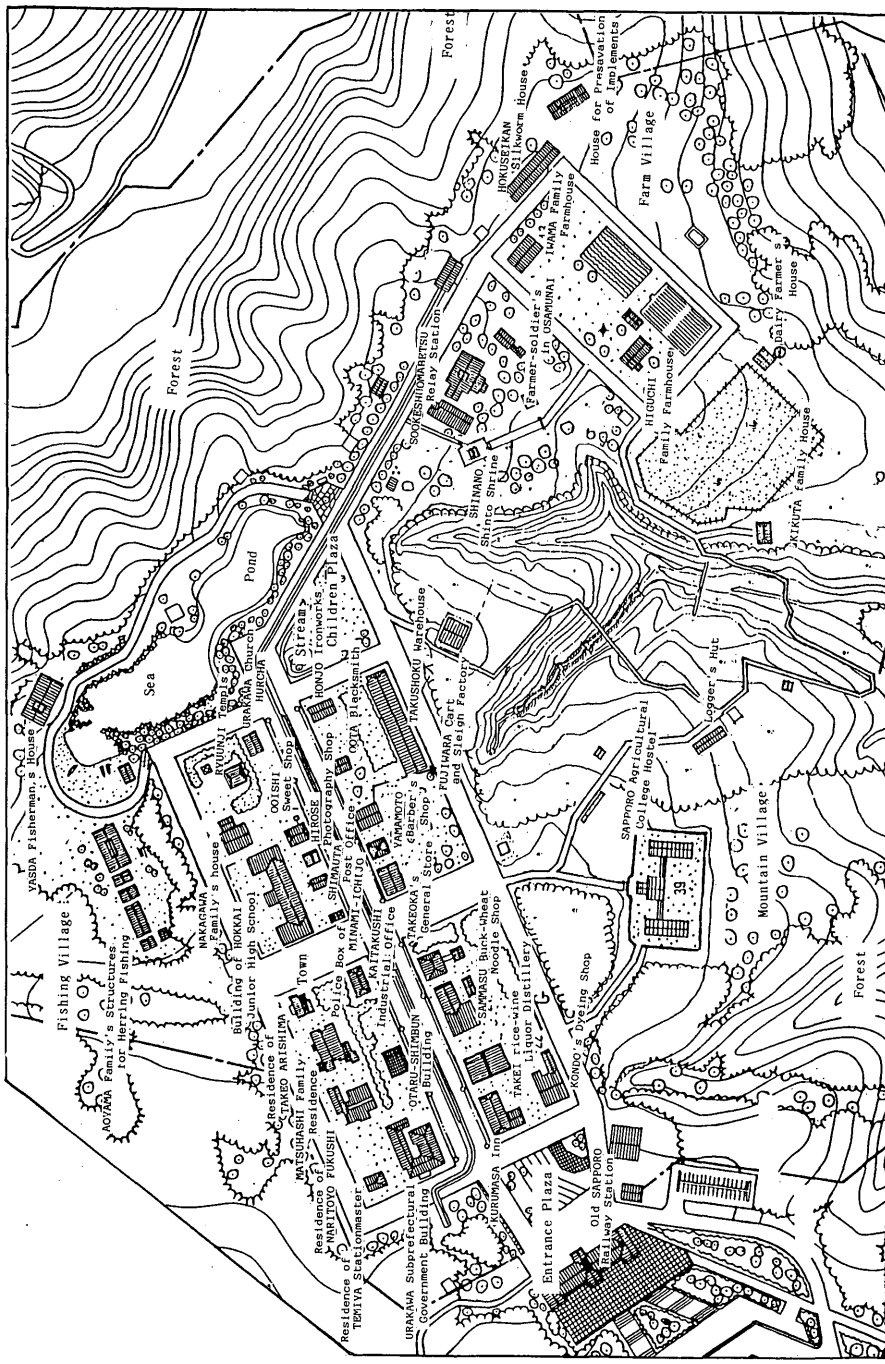

Fig. 2. Plan of the Historical Village of Hokkaido.

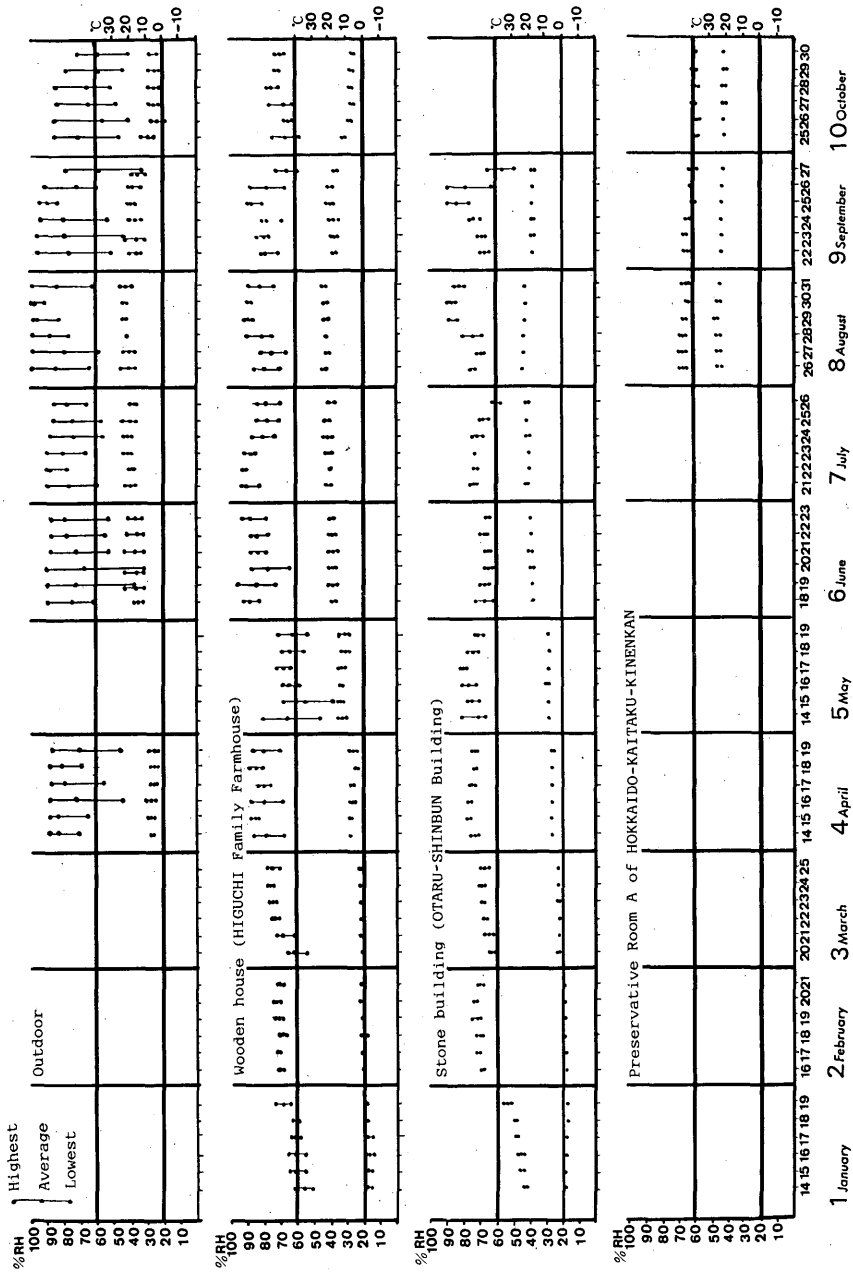

Fig. 3. Temperature and relative humidity changes in various locations of the site.

methods.

Recent work in this field is highly developed for artistic handicrafts and archaeological remains. Those results can, of course, also be applied to folk materials. But, in addition, original research and systematization is also required for the conservation of folk materials.

Folk materials are different from artistic handicrafts, and only seldom is a folk artifact of great value. However, there are occasions when the collection of artifacts increases their value. In the historical museum we attach importance to the local and systematic character of folk materials, and use these criteria to collect many groups of artifacts. In some cases we collect entire inventories of household furniture, tools and appliances, to show the lifestyle or productive activities of a particular private household. Thus, in the historical museum many similar artifacts, which have various qualities and forms, are kept in a storage room.

For the preservation of artifacts it is important to adjust the bio-physical environment surrounding the materials on display and in storage. Moreover, it is important to prepare the systematic arrangement of materials and equipment for storage so that the artifact can be accessed efficiently and without damage.

Outdoor museums in particular are often characterized by poor environments for preservation, as a result of insufficient insulation from variable outdoor climates. Thus the display of replica was introduced to protect originals which are valuable and difficult to replace from severe damage. In particular this was done for as those made of paper, textile and other fragile materials. Also, the need to preserve traditional art and craft techniques has become of critical importance.

4. THE STATUS OF PRESERVATION IN THE HISTORICAL VILLAGE OF HOKKAIDO

Some 15,000 artifacts in 27 buildings are on display in the Historical Village of Hokkaido. Future plans to call for the exhibition of about 45,000 artifacts in 40 buildings.

Since the museum was opened only recently, the preservation of the artifacts is just now being considered. An outdoor museum is different from a conventional one, because in the former it is difficult to control accurately the environment surrounding the artifacts. There is no option, therefore, but to attempt to mitigate as much as possible damage from the environment. We have investigated climatic conditions (temperature and R.H.) in buildings, and have tried to provide the best possible environment for the artifacts.

4.1 Temperature and Relative Humidity (R.H.)

The temperature and R.H. inside 8 wooden and stone buildings was measured 6 days/month, using hygrothermographs (hair type). The measurements were tabulated and compared with those of the Higuchi's farmhouse, a typical wooden building, and the Otaru Newspaper Publishing Company, a stone building. The

parameters of the external climate and the storage room at the Historical Museum of Hokkaido (*Hokkaido Kaitaku Kinenkan*) were also used as a control. Some of the average, the highest and the lowest temperature and R.H. data, by days, are demonstrated in Fig. 3.

Wooden buildings tend to be seriously affected by air, whereas stone ones are comparatively unaffected. However, both are under conditions of high temperature and high R.H. in summer, and low temperature and dry weather in winter. Sometimes R.H. exceeds 80% in summer, and falls to less than 40% in wooden buildings at the middle of May. In 1985, extreme variations in humidity were recorded during one day. Such an extreme variation of temperature and R.H. depends on the opening of a door or window. We have not yet observed thoroughly how temperature and R.H. affect artifacts. Nevertheless it can be said that humidity and dryness exert a bad influence on most of the exhibits, except for ceramic and glass materials, and the like.

4.2 Rusting of Iron

As mentioned above, the exhibits are displayed under extremely harsh conditions. Many of the iron artifacts are rusted, and particularly some in the outdoors are heavily rusted. Many artifacts displayed buried under ashes in a hearth and a brazier are also heavily rusted (Table 1). Those displayed elsewhere are much less rusted. This tendency can be demonstrated for both the artifacts treated with an anti-corrosive chemical and those not so treated.

The effects of three kinds of anti-corrosive agent were tested on steel samples, to understand their protective effect on iron. Carbon Tool Steel SK-4(JIS G-4401) was cut into $100 \times 200 \times 1.2$ mm pieces, and polished thoroughly with a metal abrasive paste. Foreign matter was removed from the samples using an organic sol-

Table 1. The rusting of iron materials on display in the Historical Village of Hokkaido.

Presence of Rust	Treatment with anticorrosive oil	Rust Situation	Number of materials	Locations
Present	Treated	Entire area	5	Eaves
		Partial areas	4	Dirt floors
	Total		9	
	Untreated	Entire area	15	Sills exposed to snow and rain, or on dirt floors
		Partial areas	42	Dirt floors or in fireplace ashes
	Total		52	
Absent	Treated	n.a.	5	Various
	Untreated	n.a.	157	
	Total		162	
Grand Total			228	

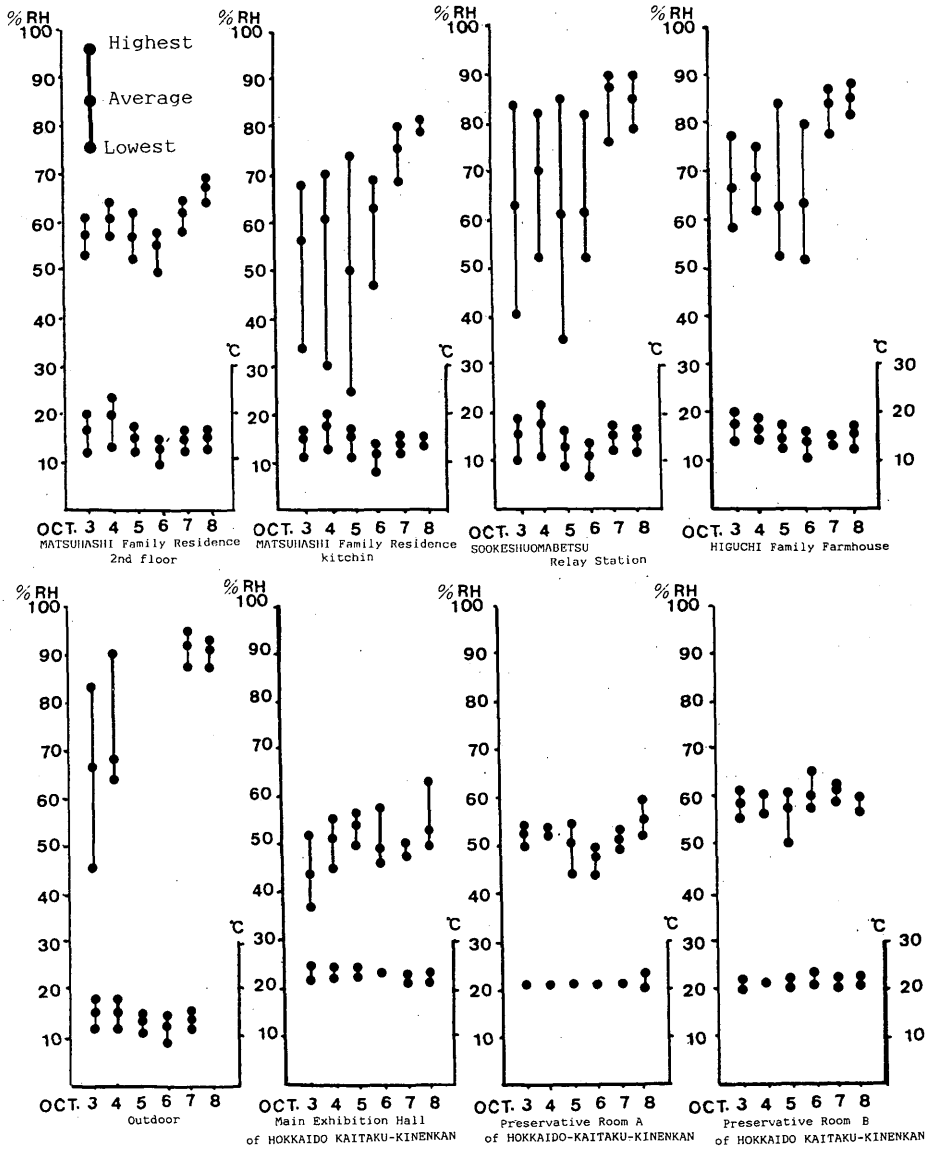

Fig. 4. Temperature and relative humidity changes at the location of the test samples.

vent. Then they were treated by applying with cotton three commercial anticorrosive chemicals: (A) Nissan Metalex-DH4 (Nippon Oil & Fats); (B) Silicone Spray II (Sony Chemical); and (C) Acrylic resin Primal-MV2 (Rohm & Hass).

The percentage of rust area on the steel samples was determined as follows. A measuring board with 100 square holes of 5 × 5 mm was placed over a sample, the number of holes showing rust was then counted with the naked eye. This was then converted to a rust percentage.

The samples were then placed in Higuchi's farmhouse, Sookeshuomabetsu relay station, Matsuhashi's house, and in the exhibition hall and storage rooms A and B of the Historical Museum of Hokkaido. The rust condition of the examples was examined after 300 days (Table 2), in relation to temperature and R.H. parameters (Fig. 4). Samples exposed outdoors, on the unfloored part, and at the window of every house were rusted. But those set on the second floor of Matsuhashi's house and in the storage rooms were not.

Samples treated with anticorrosive A were less rusted than the others. As a result, this product has been used for the treatment of iron materials in our museum for the past decade.

Table 2. Rusting ratio of steel pieces treated with an anticorrosive chemical (after 300 days of Exposure)[1].

(%)

Location of steel test pieces	Untreated	Treated with anticorrosive chemical		
		A	B	C
Outdoors	100	100	100	100
Storage A of HMH[2]	100	0	0	39
Storage B of HMH	0	0	0	0
Main exhbt. hall of HMH	0	0	0	0
Kitchen of house 1[3]	100	0	6	35
Upstairs of house 1	32	0	1	14
Window sills of house 2[4]	100	100	100	100
Dirt floor of house 2	100	98	100	100
Inner wall of house 3[5]	100	0	100	39
Dirt floor of house 3	100	0	100	100

[1] Percentage of rust area on a 50 × 50 mm of each steel piece
[2] HMH : Historical Museum of Hokkaido
[3] House 1: The Matsuhasi's residence
[4] House 2: Sookeshuomabetsu relay station
[5] House 3: The Higuchi's farmhouse

4.3 Fading of Dyed Fiber Materials

The fading rates of dyed fiber materials are indicated in Table 3. Some fading is illustrated (Fig. 5). Dyed fiber materials exposed to strong sunlight have faded. Cotton and hemp materials dyed dark blue and red have faded remarkably. The Standard Specification of Color (JIS Z-8721) was used to determine the *Y-xy* value in the colorimetry of dyed cloths. Variation of *Y-xy* value was observed by compar-

ing a non-faded part with one which was faded. Fading tests were conducted by placing cotton test samples dyed with commercial direct and vat dyes in various levels of sunlight. Small pieces (30 × 50 mm) of broadcloth (or poplin) #100 were each dyed 10 colors with direct and vat dyes, as test samples. These were placed for 300 days in locations with various levels of light, and their rates of fading were measured. The Standard Specification of Color was used for colorimetry.

The rates of fading in each location were different, but the fading of samples exhibited the same tendency (Table 4). The fading of red and dark green was the highest in direct dyes, and dark blue and brown was the highest in vat dyes (Figs. 6 and 7). A small amount of fading occurred in other colors, but it was impossible to determine their colorimetry using the Standard Specification of Color method.

4.4 Damage from Insects

Exhibits have not been damaged by insects owing to the regular fumigation of stored artifacts with methyl bromide. Some buildings, however, were damaged by insects, probably *Lyctus brunneus*, judging by its excrement.

4.5 Dust

Exhibits have been soiled by dust blown from unpaved streets, cultivated- and vacant land. Clothes and fiber materials are, in particular, apt to be soiled every June, July and August, when it rains but little.

4.6 Theft and Damage by Visitors

All artifacts on display are recorded in files on the exact state of display in every building and every room. Artifacts are checked every two months for their state of their preservation and display, as well as for damage or theft by visitors. Materials are displayed openly in the Historical Village of Hokkaido, so that visitors can touch them. This is educationally valuable since it imparts a sense of realism and leads visitors to take an interest in history. However, since there is no permanent guard, a dozen of artifacts were either damaged or stolen (Table 5). But from among 15,000 exhibits this is only a minor percentage and is of little serious concern.

5. CONCLUSIONS

Results of our study have been described, but several problems remain to be solved, and particularly those facing outdoor folk museums. These are:

1) mitigation of the direct impact of the external climate;
2) development of effective anticorrosive chemicals and their application methods on artifacts, especially on those displayed in the open;
3) complete elimination of ultra-violet radiation from sunlight, at windows and near doorways, for interior artifacts;
4) fumigation of the reconstructed historical buildings; and

Table 3. Fading of clothes on display.

	Cloth	Fiber	Color*	Color change (*Yxy*)	Illum. (lx)	Notes**
1	kimono	hemp	blue	6.555, .1908, .1799 →59.10, .2974, .3039	~4,000	displays exposed to morning sunlight in House 1
2	kimono	silk	dk. blue	unnoticeable faded parts	~ 500	displays in House 1
3	kimono	cotton	dk. blue	6.555, .2520, .2319 →12.00, .2861, .2819	~ 800	displays exposed to morning sunlight in House 2
4	suit	wool	dk. blue	unnoticeable faded parts	~ 200	displays in House 2
5	kimono	cotton	dk. blue	3.126, .2592, .2675 →12.00, — , —	~4,000	displays exposed to morning sunlight in House 3
6	kimono	cotton	dk. blue	3.126, .2420, .2146 →12.00, .2782, .2876	~1,200	*idem*
7	lining of kimono	cotton	dk. blue	3.126, .2420, .2146 →30.05, .2955, .2963	~ 600	*idem*
8	*obi* (belt)	silk	dk. blue	3.126, .2592, .2675 →12.00, .2487, .2597	~ 950	*idem*
9	kimono	cotton	blue	12.00, .2235, .2343 →30.05, — , —	~1,200	displays exposed to afternoon sunlight in House 3
10	*obi* (sash)	silk	red	12.00, .4690, .3209 →19.77, .4403, .3240	~1,200	*idem*
11	*obi-jime* (sash band)	silk	yellow	30.05, .3622, .4438 →43.06, .3437, .3929	~1,200	*idem*
12	*obi-age* (sash bustle)	silk	yellow	59.10, .3360, .3710 →59.12, .3394, .3518	~1,200	*idem*
13	suit	wool	gray	unnoticeable faded parts	~1,500	displays exposed to afternoon sunlight in House 3
14	coat	wool	dk. blue	unnoticeable faded parts	~1,600	displays exposed to afternoon sunlight in House 3
15	lining of kimono	cotton	red	12.00, .5734, .3057 →30.05, .4320, .3118	~1,500	displays exposed to afternoon sunlight in House 4
16	*obi* (sash)	silk	yellow	43.06, .3864, .4305 →59.10, .3862, .4175	~1,500	*idem*
17	*obi-jime* (sash band)	silk	red	6.555, .4218, .2864 →43.06, .3446, .3125	~1,500	*idem*
18	kimono	silk	black	unnoticeable faded parts	~1,500	*idem*
19	Ainu-kimono	cotton	dk. blue	6.555, .2393, .2361 →59.10, .3684, .3751	~ 600	displays under fluorescent and tungsten light in House 5
20	Ainu-kimono	cotton	red	19.77, .4927, .3399 →43.06, .3888, .3336	~ 200	displays under tungsten light in House 5

*Color: dk. = dark

**House 1: Residence of Noritoyo Fukushi
**House 2: Residence of Temiya stationmaster
**House 3: Sookeshuomabetsu relay station
**House 4: Hokuseikan silkworm house
**House 5: Main exhibition hall of Historical Museum

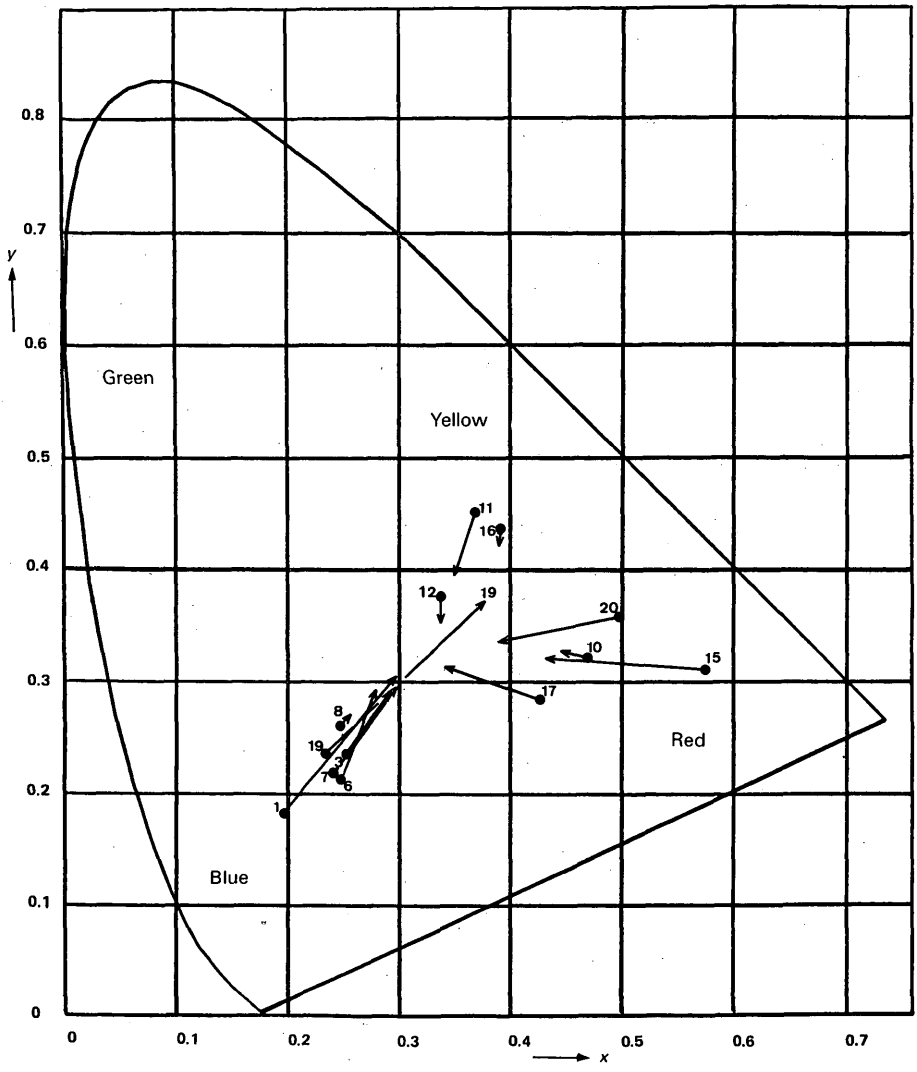

Fig. 5. Degree of fading of dyed cloths, using the CIE 1931 Standard Colorimetric System.

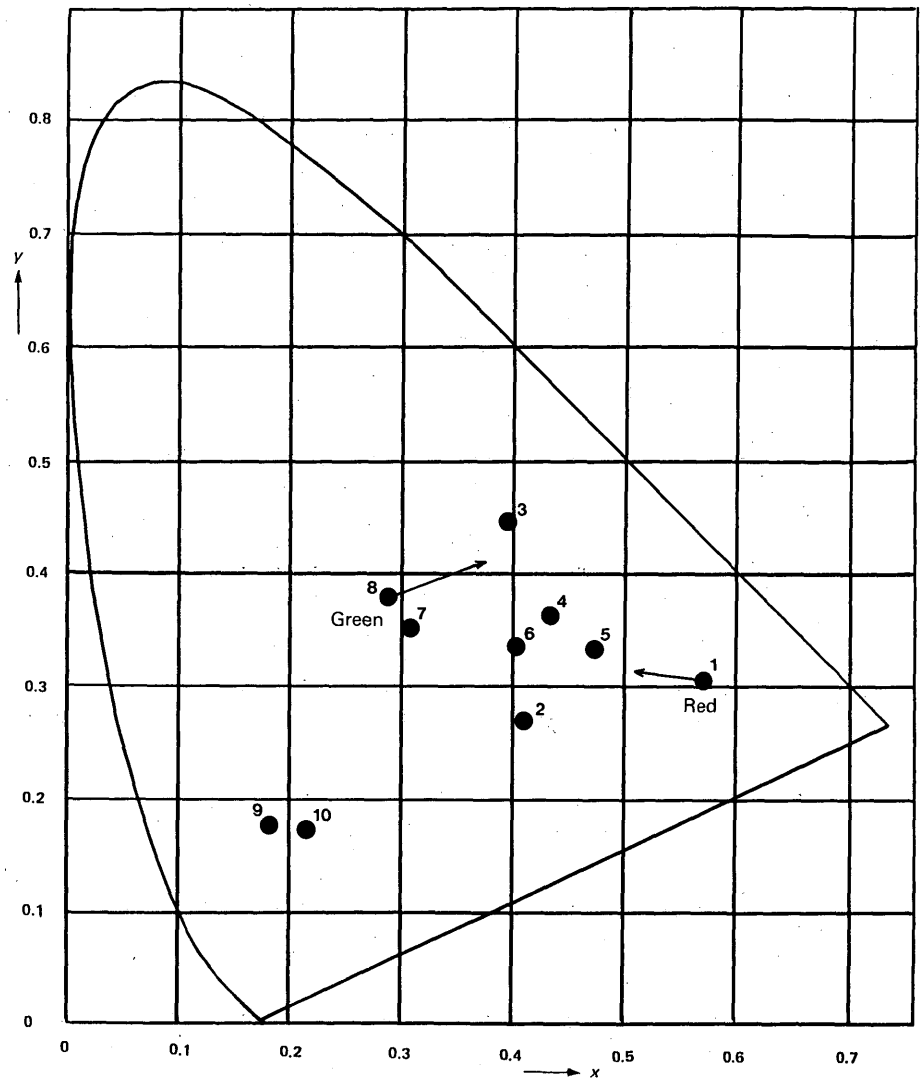

Fig. 6. Degree of fading of direct dyed cloths after 300 days of exposure in the Higuchi's farmhouse.

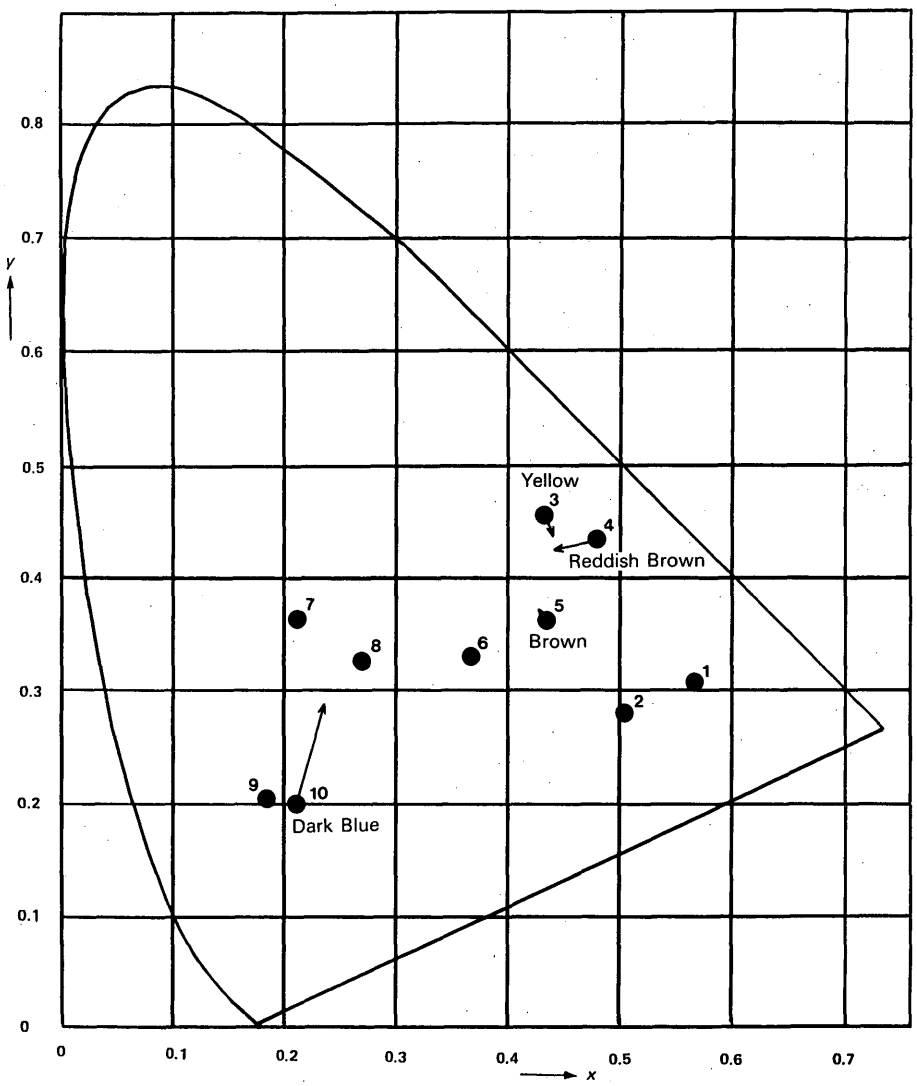

Fig. 7. Degree of fading of vat dyed cloths after 300 days of exposure in the Higuchi's farmhouse.

Table 4. Fading of dyed cloth samples after 300 days of exposure.

	No	Location and illuminance (lux) of Historical Museum		The Higuchi's farmhouse		The Matsuhashi's residence		Main exhibition hall
		Color*	Original Yxy	more than 1200 Lux	more than 80 Lux	more than 800 Lux	more than 30 Lux	more than 500 Lux
Direct dyed cloth samples	1	red	12.00, .5734, .3057	19.77, .5071, .3194	++	19.77, .5071, .3194	12.00, .5385, .3129	12.00, .5385, .3129
	2	dk. blue	12.00, .4072, .2750	++	+	+	+	+
	3	yellow	78.66, .3957, .4450	++	+	+	+	+
	4	y. brown	19.77, .4365, .3640	++	+	++	+	++
	5	brown	6.555, .4738, .3316	++	+	++	+	++
	6	dk. brown	6.555, .402 , .336	++	+	+	+	+
	7	lt. green	12.00, .3069, .4550	++	+	+	+	+
	8	green	12.00, .2891, .3821	19.77, .3762, .4158	19.77, .4482, .4092	19.77, .3470, .3640	12.00, .342, .398	12.00, 3100, .4018
	9	blue	12.00, .1925, .1843	++	+	++	+	++
	10	dk. blue	6.555, .2149, .1761	++	+	+	+	++
Vat dyed cloth samples	1	red	12.00, .5734, .3057	+	+	+	+	++
	2	dk. red	12.00, .5072, .2897	+	+	+	+	+
	3	yellow	59.10, .4376, .4607	59.10, .4469, .4423	++	++	+	+
	4	r. brown	30.05, .4843, .4416	43.06, .4667, .4335	+	++	++	++
	5	brown	6.555, .4376, .3715	19.77, .4420, .3868	+	+	+	++
	6	dk. brown	6.555, .3757, .3391	+	+	+	+	+
	7	green	12.00, .2124, .3799	+	+	+	+	+
	8	olive	6.555, .2799, .3271	+	+	+	+	+
	9	blue	12.00, .1893, .2160	++	+	+	+	++
	10	dk. blue	6.555, .2122, .2052	12.00, .2384, .2984	+	12.00, .2103, .2050	+	12.00, 2325, .2300

Color: dk. = dark
lt. = light
r. = red
y. = yellow

++: very few changes
+: small change

Table 5. Theft and damage of materials by visitors.

Year	Numbers of thefts	Number of exhibits damaged by visitors	Notes
1983	5	14	teacup, ashtry, pail, wooden clogs
1984	5	15	brush case, horseshoe
1985	2	18	model of silkworm
Total	12	47	

5) dust reduction by planting vegetation.

It would be difficult to protect completely from theft and damage by visitors. We wish to continue this research, and to use the data derived for solving problems. Such research will be made more comprehensive by adding that on the fading of paper materials, degradation of fiber materials and cracks in lacquer and wood.

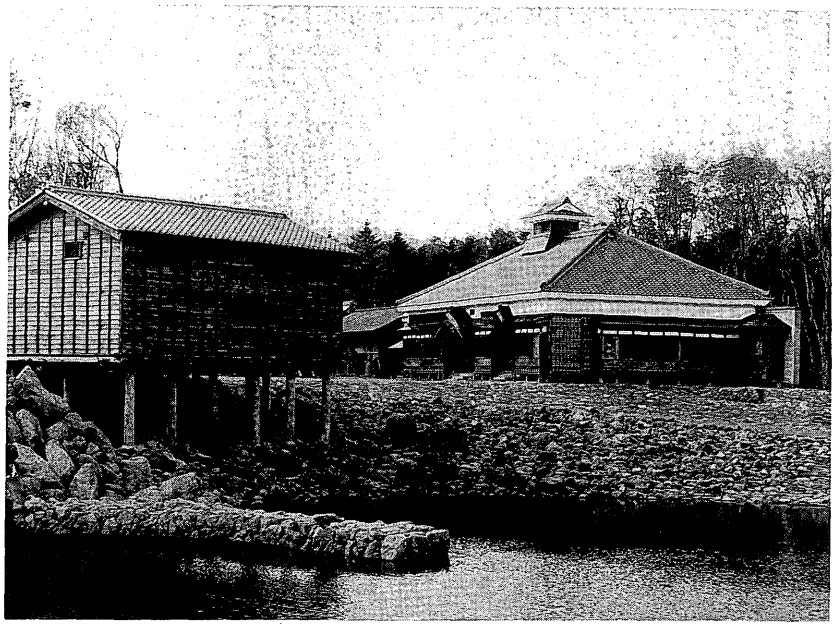

Fig. 8. A herring fisherman's houses; the Aoyama family.

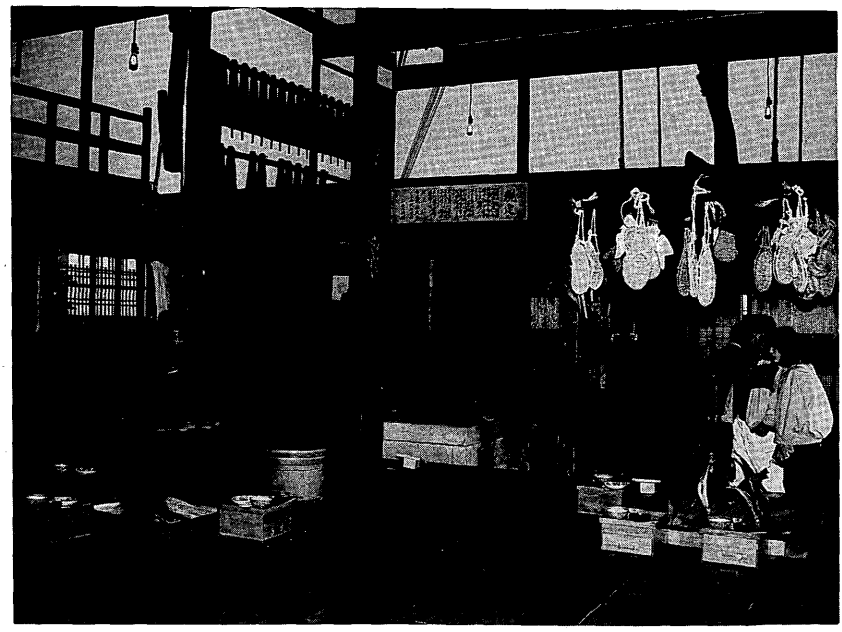

Fig. 9. Display (reconstruction) of the inside of a herring fisherman's house; the Aoyama family.

Fig. 10. Takeoka's general store.

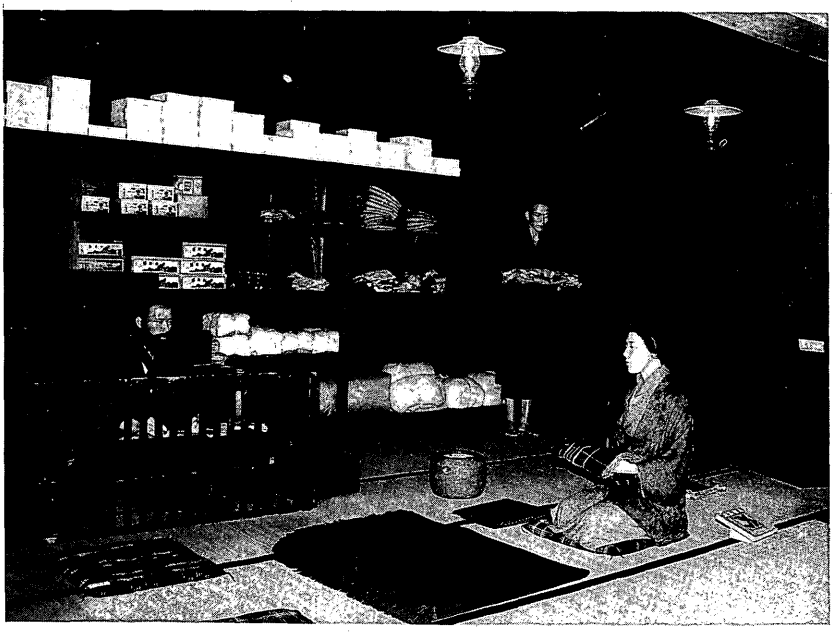

Fig. 11. Display of the inside of Takeoka's general store.

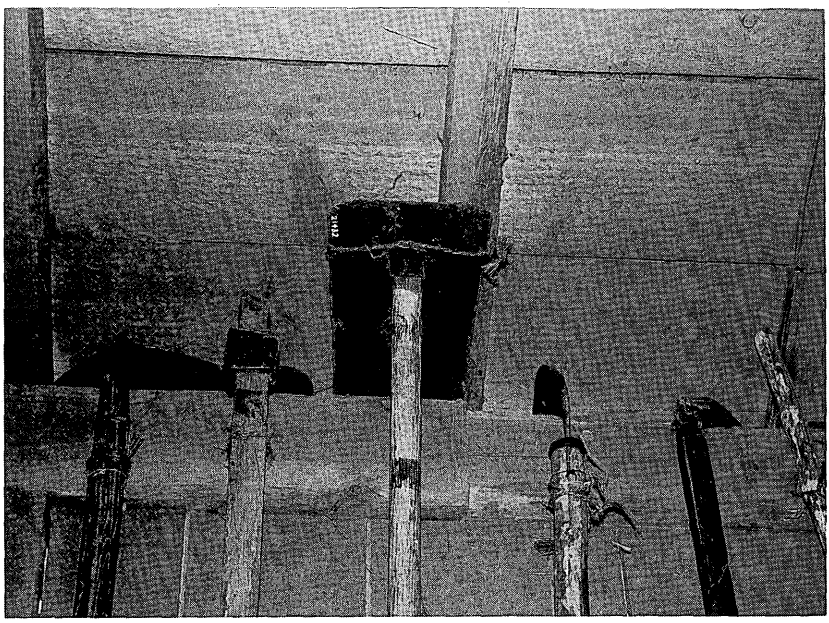

Fig. 12. The rusting of iron tools stored under eaves.

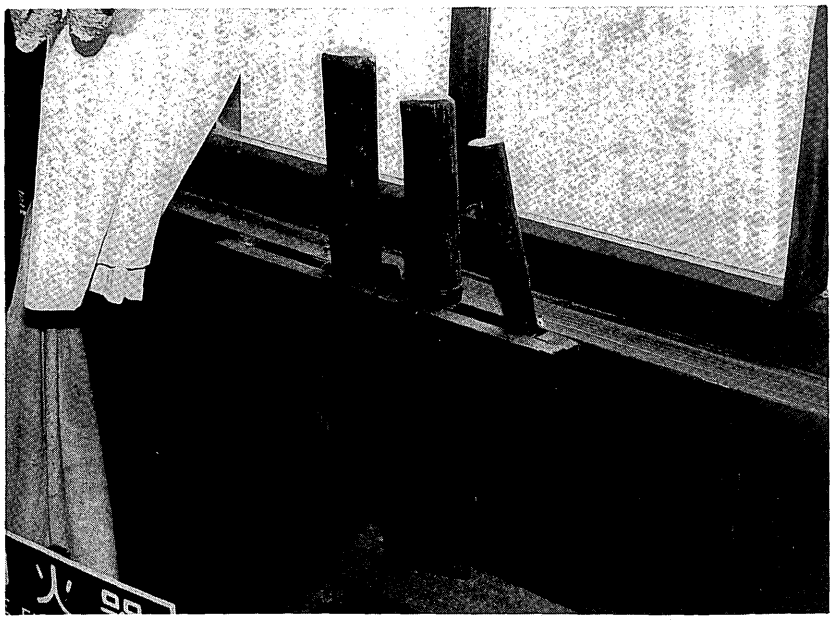

Fig. 13. The rusting of iron knives in a window rack.

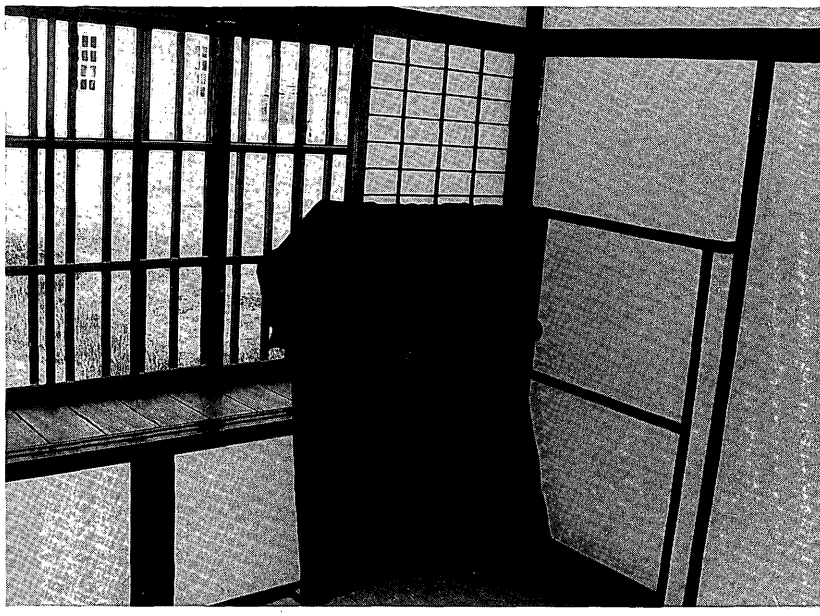

Fig. 14. *Kimono* display.

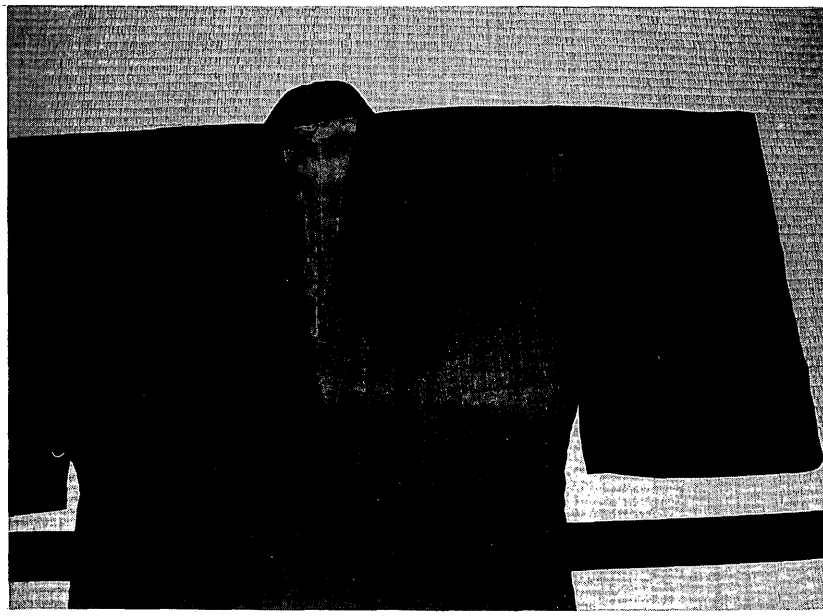

Fig. 15. Fading of *kimono,* after long display.