

# The Present Condition of the Building at Syowa Station

Zenkichi HIRAYAMA\*

## 昭和基地に於ける建物の現状

平山善吉\*

1956年以来昭和基地の建築は毎年、改造、増築等を行いつつ現在(1960年)に至っている。その間1957年から58年迄の基地放棄の1年間があったにせよ、建物は充分にその機能を発揮しつつ、健全な成長をとげている。

ここでは、初期の平面計画の問題からおし広げられた、現在迄の様子を、新めて基地の立地条件、輸送の問題にふれながら、年ごとにその成長の過程を述べてある。

この中では1956年当時の建築面積が、250.6 m<sup>2</sup> から413.0 m<sup>2</sup> (1960年)と飛躍的な発展を

したものの、これらのうちの多くは、現地で建設された、簡易建築物であることも見のがすことはできない。またその是非については色々と問題もあろうが当然なされるべき処置であると同時に、その結果は今後の参考にならうと考えられる。

最後に1959年、すなわち基地再開時の建物の考察の結果を述べてある。最後にこの建物について検討を加えるならば、そこには若干の不備があったにせよ、南極大陸に立ち自然の威に抗しつつ、充分にその目的を達し得たと思う。

### 1. Preface

The building at Syowa Station has been remodeled and added by new huts by and by since it was built for the lives of the members of the wintering party at the leave of the first expedition in 1957; and now, in 1960, its space is 413.0 m<sup>2</sup> that is more spacious by 64% than that at first, 250.6 m<sup>2</sup> (see Fig. 1).

All the new huts above except the Aurora Hut and the Garage are simplified buildings built there with packing and other materials sent from Japan. Judging from the condition there, the use of simplified buildings has been good on the whole though it contained many problems.

The ground plan of the spacious base should be drawn according to the planning for grouped buildings. From this point of view, the plan was not perfectly good unfortunately, even if we take account of the fact that it was for the first time for us to built on an island in the Antarctic.

The main huts such as the Mess Hut, the Living Hut, the Radio Hut, etc. are those of panel system prepared by the Architecture Committee in Tokyo. They were built by the members of the expeditionary party, who had no experience in building,

\* Graduate Student, Department of Architecture and Civil Engineering, School of Science and Engineering, Nihon University. Member of JARE 1956-57 and 1957-58. Member of the Wintering Party, JARE 1958-60.

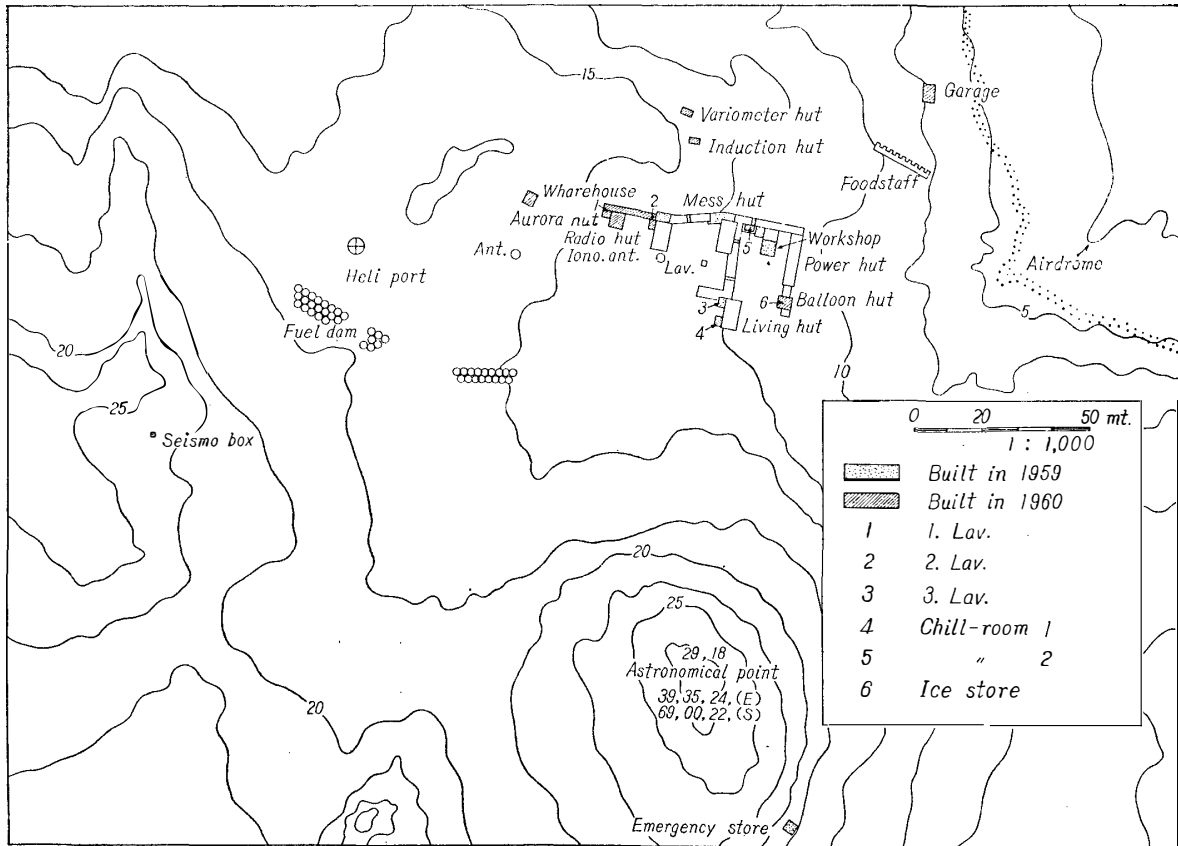


Fig. 1. Syowa Station (20, Feb. 1960)

with their overcoming of great difficulties. And yet, these huts endured unbroken after a year's absence from 1958 to 1959. These facts seem to have contributed to a great degree for the unknown field of the construction though these huts had several defects.

## 2. Factors that affect the building

### On the location

The Ongul Island where Syowa Station stands is located at Lat.  $69^{\circ}00'$  S. and at Long.  $39^{\circ}35'$  E.; and lies near the northeast mouth of the Lützow-Holm Bay. It is only a small island which is 2.2 km long from east to west and 2.0 km wide from north to south, and its highest point is 43 m above sealevel. The moderate undulations of this island slopes down on the whole from south to north. The Base is on the coastal terrace in the northeastern part of this island, opening to the north and the east, and blocked by low hills to the west and the south.

The island consists of gneiss, which is extremely weathered. Where the huts were built was mostly covered with sandlike pebbles, under which there lied rocks showing their small projections here and there, which were frail enough to be taken away by hand.

Table 1. Meteorological record at Syowa Base in 1959.

	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Number of days having the wind velocity of over 15 m.	0	17	9	10	14	22	5	9	5	9	5
Number of fine days.	3	2	5	5	8	10	8	6	3	3	6
Number of snowy days.	13	20	17	16	11	13	13	23	18	19	7
Number of cloudy days.	16	20	16	21	15	13	14	18	21	21	16
Number of days having snowstorm.	2	16	11	11	12	19	7	12	10	14	2
Percentage of possible sunshine.	—	28	33	23	—	28	40	32	32	37	58
Number of days of blowing snow.	0	9	6	5	3	8	4	6	4	7	0
Maximum wind velocity.	NE 14.2	NE 33.9	NE 31.4	NE 19.6	ENE 31.6	ENE 30.3	ENE 40.6	NE 22.2	NE 24.1	NE 32.9	NE 19.6
Minimum temperature.	-10.7	-16.3	-27.4	-36.2	-35.1	-35.8	-34.4	-42.1	-28.8	-23.9	-10.2
Vapour pressure.	3.2	3.1	2.4	1.6	1.8	1.4	1.2	1.1	1.8	2.6	3.6

And yet the glittering mica separated from rocks often flied hitting the building with pebbles around when the wind blew hard.

The weather at Syowa Station has been recorded only for two years. According to the record, the weather there has scarcely been different from that expected beforehand. Consequently, the building will be safe enough for the outdoor conditions unless it should change greatly.

The wind at Syowa Station blows mostly from the northeast; especially a strong one is always from this direction. The maximum wind velocity (the maximum of the mean velocity) was observed 40.6 m/sec. in August. The minimum air-temperature was  $-42.1^{\circ}\text{C}$  in September. Both of them were within the limits of the outdoor conditions expected first (*see* Table 1).

As for the influence that the air-humidity affects, many questions are still remained; but anyway the absolute humidity is considerably small and this fact may affect materials for building very much. The problem on the weight of the lying snow had been the most important one to be considered for the outward condition as well as the wind pressure. But actually, it was not important because snow scarcely stayed on the roofs by the strong wind.

On the other bases in the Antarctic, it snows about 350 mm deep; on Syowa Base it snows about 300 to 600 mm. The snow there is very compacted, namely, having has the specific gravity of 0.4 to 0.5. As the snow always falls with strong wind, it on the roofs is completely blown off. Consequently, it forms a very deep snowdrift on the leeward side of the building.

From these points of view, we can see that the choice of the location is very

important and that we need no consideration on the snowfall by the good choice.

#### On inside conditions

Without doubt the huts are the place for living, working, and sometimes resting for over 10 members for a year. The Living Hut should be made under considerations of their feelings, sentiments, and so on. If we take account of them, is the building there not too small? At first "to live there" was considered to be the only requirement, and then that space was enough. But they had to obey in scientific researches as well as they live, those huts had to be the place both for the observation and for the living. And a private room had to be prepared for every member even if it was small.

### 3. The construction of Syowa Station

The history of the building of the Syowa Station can be divided into three periods, 1957, 1959 and 1960, as shown in Table 2. In 1958 the Station was left uninhabited.

Table 2. Space for construction by year.

	1957	1958	1959	1960
Construction	250.6 M <sup>2</sup>	—	48.6 M <sup>2</sup>	95.5 M <sup>2</sup>
Remodelling	—	—	48 M <sup>2</sup>	21.6 M <sup>2</sup>

The first period 1957 was the memorable year when Syowa Station was founded in the Antarctic and when the plan which would be the base for the future one, was realized. The building

at the Station was built centering the Mess Hut under the T-shape plan. All the building except the Corridor and the Workshop was prepared beforehand in Tokyo, only put together at the Station. The building was completed afterward by the addition of the Corridor and the Workshop built by the members of the wintering party.

As for the future ground plan, the huts that will be built hereafter must be either in the direction of the west or in the north far from the present building. And yet, if built in the former, the huts will have the danger to be burned when there is a fire in the Power Hut that is the first one to catch fire. Because fire will undoubtedly run straight through the Corridor and the huts that will be connected with the Corridor will surely burn out: this is not only the problem for the future huts but also those already built.

Among the building in this year shown in Table 3, what we are particularly interested in may be the Corridor rather than the huts. It was built for the purpose of the place for the store as well as the passage. These two uses were expected before the first expedition. At bases of other countries this idea had already been carried out. It was built in the following way: the empty packing-cases that had been standardized for this aim, were piled along the north side of the huts in two lines, one of which was tightly contact with the huts. They were covered with a flat roof. The Corridor made as abovementioned had been expected to succeed in its objects. However, in late summer through early autumn the snow was blown into it, and in spring the melted snow swept in freezing at night. As the result of it, stored articles often got wet or damp. Though these defects have been improved

Table 3. List of Buildings (1959).

Buildings	Construction work started in :	Building system	Size (m)	Building area (m <sup>2</sup> )
Radio Hut	Jan., 1957	Permanent panel building.	8.48×4.85	41.15
Mess Hut	"	"	"	"
Living Hut	"	"	"	"
Power Hut	"	Permanent pipe building.	15.3×3.94	59.75
Corridor	"	Simplified building by piling up empty boxes.	Length 61.8 Width 1.21	75.0
Workshop	Mar., 1957	Simplified building by using panels.	4.85×3.64×2.12	17.64
Lavatory	"	Wooden and triangular.	1.21×1.21×1.82	1.46
Garage	Mar., 1959	Pillars and beams are of wood part of roof is of glass-lights.	4.85×4.55×3.33	22.05
Chill room II	Jan.,	Wall of living hut is utilized. Veneer lining.	1.82×2.73×2.12	4.96
Laboratory III	Feb., 1959	Veneer, roof is of glass-light.	1.67×2.73×2.42	4.55
Warehouse	Mar., 1959	Drum can walls. Zinc roof.	4.85×2.73×1.82	13.25
Emergency Store	"	Cellar, stones are piled up zinc plates are put on top.	2.73×2.73×1.82	7.46

Note : 1. Permanent building : Materials were processed in Tokyo and they were assembled at the Base.

to a certain degree by the adoption of an inclined roof and the use of glasslight, still more efforts should be made hereafter.

In 1958, the next year, the Station was left absent by the unexpected withdrawal. During all this year, here in Tokyo, some members had feared lest the building should have been broken, considering from the fact that a door had been carelessly left unshut, until they found with their own eyes all the building safe next year. The building had endured many outward forces. It was not only because of the rational construction but also because of the good position of the Corridor: as the Corridor stood along the windward side of the building, a big snowdrift was made on the leeward side. It made the building streamlined, and lowered the wind pressure on the building. In addition to them, the foundations of the huts and the Corridor were firmly frozen to the ground. By these facts Syowa Station might be kept safe for the year.

Condition when the Base was reopened (Jan., 1959)	Maintenance, repairing and remodelling	Present condition and purpose
Paint on the windward wall has come off. Snow has been blown into the door.	Leaky places were repaired. One private room with two beds was made.	4 private rooms (for 5 members), radio room, meteorological observation room and ionospheric observation.
Paint on the windward wall has come off.	Leaky places were repaired. One private room was made. A part was remodelled. Range was repaired.	3 private rooms, dining-room and kitchen and recreation room.
Roof beam has strained. (maximum: 9 m/m)	Leaky places were repaired. Observation instrument was equipped. Panels were repaired.	6 private rooms, dark room, observation room and saloon.
Canvas got frail greatly and its color faded.	Canvas was repaired. Water gathered was drained.	2 generators, water tank, bath etc.
Much snow has been blown in and water has leaked. Snow as high as 30-60 cm from the ground was frozen.	Snow and ice were removed. Leaky places were repaired. 6 emergency exits were made.	Passage. Both sides of passage are lumber rooms.
Snow has been blown in and water has leaked.	Leaky places were repaired. Ice was removed. New passage to store house was constructed.	Lathe, yammer, drilling machine, working table etc.
Snow has been blown in.	Crevices were repaired.	For use during winter.
	Snow at the door was removed.	For 2 snow-cars. Shifter is equipped.
	Refrigerator was in operation in Jan.-Mar. Outside of chamber was covered with piled ice blocks.	Frozen foods are stored. Average temperature is $-6^{\circ}\text{C}$ .
	Observation instruments were equipped.	Utilized for low temperature research.
	Boring-tower (5 m high) were equipped.	Instruments and equipment are stored.
	Snow was removed twice (in Mar. and Apr.)	For emergency living. Foods and equipment are stored.

2. Simplified building: Materials that can be utilized were processed at the Station for building.

In 1959 the Station was reopened. There were little differences between the conditions of Syowa Station before the unexpected withdrawal in 1957 and those at the time of reopening in 1959 though a little snow removal and remodelings had to be done.

But the transport of building materials was not satisfactory. The carried building materials including those for the Power Hut of 850 kg are only 1.3 t weigh in all.

In this year three private rooms had to be added as members increased by three, and the arrangement of every observation room had to be done as the observation began on a full scale from then. A bed attached in the dining room and a two-decked one made in the Radio Hut served the private rooms well, but fixed boxes in the open air in which the machines were to be settled and the wet Corridor had to serve the observation room though it was not satisfactory at all.

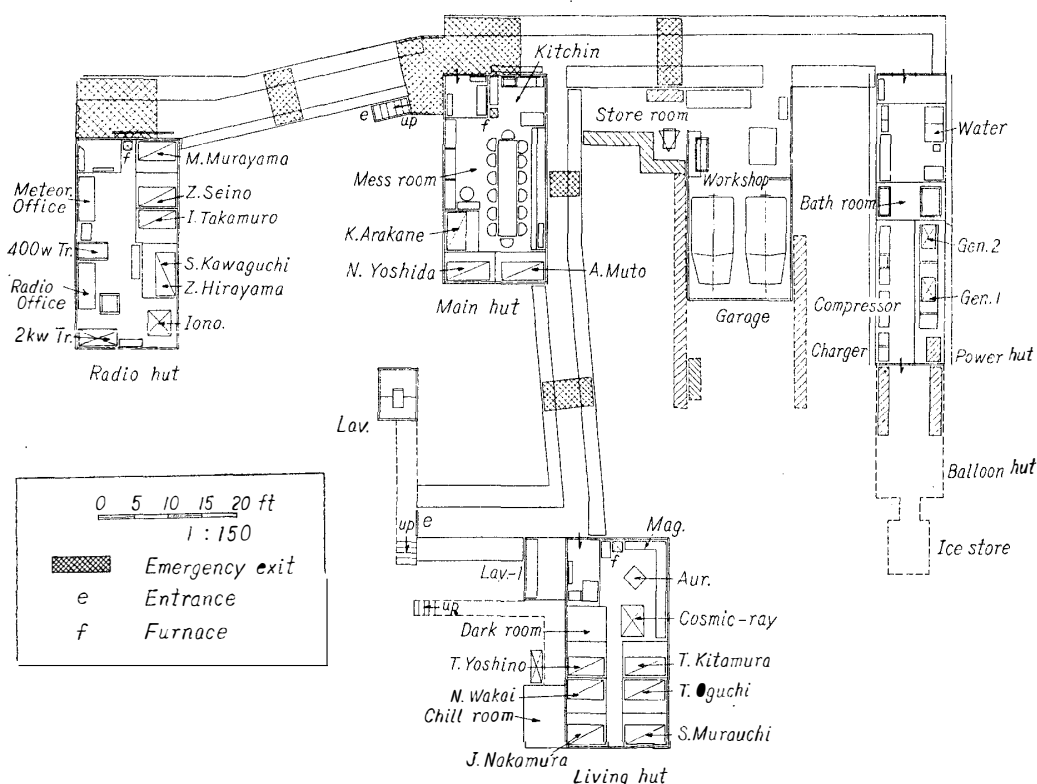


Fig. 2. Plan of living area, 1959.

While, efforts for the comfortable life were made. The blown snow was shut out by pieces of boxes, and panels were corked up by the painting of grease.

The most remarkable construction in this year might be a Garage which admitted to put two snow-cars and which was equipped with a carrier for engine. It was completed with the addition of a 18 *shaku* (=5.4 m)-long I-section steel and 5 *sun* (=15 cm)-square timber after the work of the members in 1957. In this year a shelter for emergent occasions was made by the boring of a rock. In addition to them, glasslight hut was used to got quite a good result though it was as a trial (Table 3).

In this year the building did not get much larger, but its inside was much improved. The setting of emergency exits which also served as lighting windows, and improvement of the doorways were examples of it (see Fig. 2).

In 1960, materials for new building were transported as much as 3.3 t in weight including those for the panel system Aurora Hut and the pipe system Garage. This amount was much greater than the transport before.

This time, new huts were built more strongly than before. For the Chill Room, panels were arranged and adiabatic material was put inside. The Research Rooms attached to huts were made of double veneer. For the independent huts, 9 mm thick veneers were used.

The aspect of the Station in 1960 has been so improved in appearance as to be difficult of recognition.

Table 4. List of buildings (1960).

Building	Construction work started in	Building system	Size (m)	Building area (m <sup>2</sup> )	Present condition and purpose
Laboratory II	Jan., 1960	Wall of Radio Hut is utilized. Veneer lining. Ceiling is of glass-light.	1.67×2.73×2.42	4.55	Utilized for oceanographic research and chemical analyses.
Laboratory I	Mar., 1960	Wall of Aurora Hut is utilized. Veneer lining. Ceiling is of glass-light.	"	"	Utilized for Aurora and ionospheric research.
Aurora hut	Feb., 1960	Permanent panel building.	4.85×4.85	23.5	3 private rooms, a dark room and an ionospheric observation room.
Variometer hut	Jan., 1960	Concrete bed placing. Veneer lining. Simplified building.	1.82×2.73	4.96	Geomagnetism observation room.
Induction hut	Feb., 1960	Veneer lining. Simplified building.	1.52×3.03	4.60	Atmospheric electricity observation room.
Store room	"	"	2.73×3.64	9.85	Travelling goods are stored.
Garage	Mar., 1960	Permanent pipe cabin.	"	"	Garage.
Balloon hut	Feb., 1960	Veneer lining. Simplified building having opening and shutting roof canvas.	3.34×3.34×2.73	11.13	Balloon house.
Chill room I	Jan., 1960	Veneer panel system. Use of adiabatic materials.	1.82×2.73	4.96	Frozen foods are stored.
Corridor	Feb., 1960	Veneer lining. Zinc roof. Glass-light in parts.	Length : 10 Width : 0.91	9.10	Passage.

There stand now the Laboratory II attached to the north side of the Radio Hut; the Aurora Hut and the Laboratory I which are connected with them by a new Corridor; and the Balloon Hut and the Chill Room I which were newly built where the old building was pulled down. In addition to them, the Store Room, the Variometer Hut, the Atmospheric Electricity Observation Hut, and the Garage stand independently on the north slope, painted orange like the huts already built.

#### 4. Conditions of the station when it was reopened in 1959

On the whole, the station was reopened in 1959 in almost the same condition as at the leave. No heavy damages of the building were found though we had to remove snow blown a little into the Radio Hut through the unshut door and into the Corridor. In it the snow had been frozen at 30 to 60 cm above ground level. Slight damages of the building are as follows:

- (1) As for the Mess Hut, the Living Hut, and the Radio Hut.



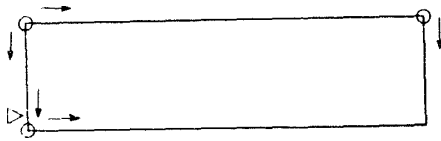


Fig. 3. Strain of building.

These three huts had strains a little on the windward sides. As for the second, corners marked "o" had deviated in the directions of arrows as shown in Fig. 3.

The fading of the paint color of the outsides of the panel huts was very conspicuous, and the snow line drew a clear distinction between the faded and the unfaded. The paint color had, however, not come off but only in a few parts on the windward sides. While, the wooden part of the roof panels on the windward side was weathered in spite of the soaking of the phenolic resin.

As for the inside, the aluminium or the linoleum for the facing of floor panels was damaged a little. The floor panels of the kitchen had been loosened by the soaking of water. This is thought to be because the springboards had come off.

A great attention have to be paid on the stay of the building. We need, how-

ever, no care for it as far as the present building, as its foundation and floor beams are firmly fixed to the ground by freezing.

Beams were bent by the tention of the bracing.

As mentioned above, various structural strains were seen quite fairly. No causes

of them are, however, found out, as the original conditions of those parts of the building when it was built are not known to us.

As for the furniture, some expansion and contraction, and two splits on the back side were

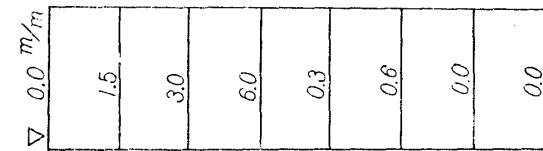


Fig. 4. Strain of the roof panel (central part of the roof m/m).

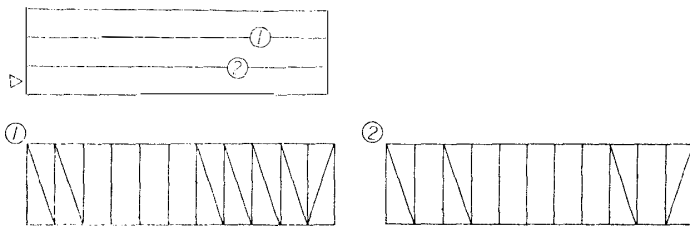


Fig. 5. Tension of a bracing in the roof beam (central part of the roof m/m).

seen. The leak (of the melted snow) in the roof of the Radio Hut was remarkable. The corking materials were tattered on the whole. The fluorescent lamps did not fit for use without exception. The ovens and the driers became usable after some mendings. The furnace and the duct were a little rusty.

(2) As for the Power Hut and Others.

The frame of the Hut was all right, but the canvases, especially on the windward side, were nearly worn out. Their color faded much. It will, however, hold somehow for another year. The Corridor and the Lavatory were ready for use after snowdrifts were removed.

### 5. The remodeling of the inside

Every time when the Station was taken over by a new party, the inside of the building should have greatly been remodeled. It might partly be because of differences of the members, but mostly, it was because the present building at the Station have no room to spare and at the increase of members and the change of items for observation it was not ready for use without remodeling. While, as the cabinets, the partition boards, etc. in the building had been standardized, the remodelings were done very easily. A remodeling once a year might be even effective for the fresh spirits of the members.

Here you can see the description in 1960 (Fig. 6).

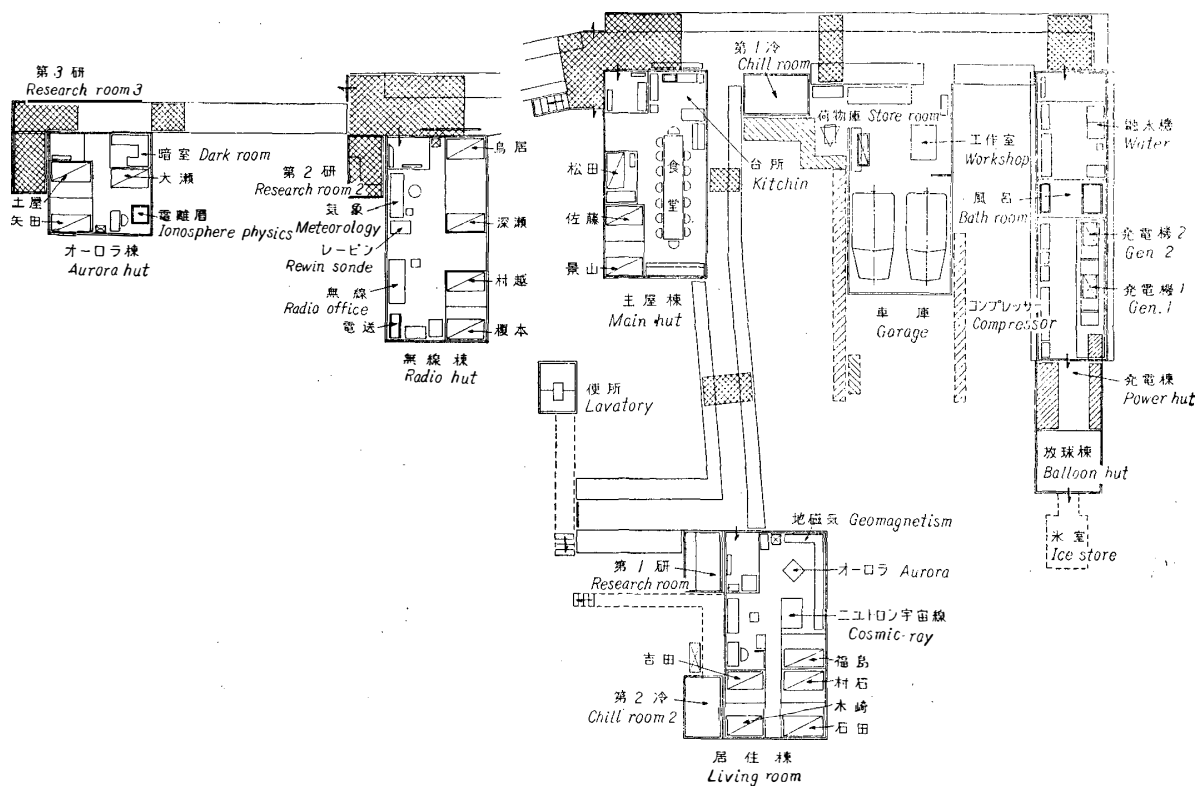


Fig. 6. Plan of living area, 1960.

### 6. General view and countermeasures

As above-mentioned, from the structural viewpoint the outward conditions at Syowa Station are not so severe as expected before.

Snowdrifts which usually increase from around March help the stability of the buildings; and yet, the perpetual snow has frozen to fix the foundation and beams of the floor to the ground as already mentioned.

But we can not neglect that on the whole the building has strains caused by a little lack of care at the construction. Snow scarcely lies on the roof as it is blown off by the strong wind.

As for the Living Hut, works were skimped in some parts and corkings were not satisfactory; and as the result of it, the leak at the thawing season is heavy. A great improvement is necessary. The inside connectors were covered with frost in winter. The frame of the wall panel was sometimes wet with dew.

The indoor temperature was able to be mostly kept about 10°C (=50°F) throughout the year at the height of 110 cm from the floor. In some places, however, it dropped down to about 0°C (=32°F); and sometimes even in a same room, the temperature at the floor was 20° to 30°C lower than that at the ceiling.

The air condition in the room was not always kept well. The air at the floor and behind the furnitures was never warm enough. Each hut has only an air ventilator. Consequently, a hut got quite smoky whenever only a few members smoked there. At least one more ventilator is necessary for each hut. A ventilator above the entrance of each hut had been stopped up because much snow had been blown inside through it. A chimney for the same purpose was so long that the air might have been frozen in it before exhausted into the open air; so it was cut down as short as possible.

The condition of the furnace was quite good, but when the wind velocity was over 20 m/sec NE, never did it work because of the blizzard blown into it.

In addition to them, beds got very damp and mouldy.

These above-mentioned defects have been improved, but still, the following works may be necessary hereafter:

Renewing of the lenoleum for the floor—once a year.

Renewing of the duralmin for the floor—once in three years.

Repainting of the outside.

Refilling-up of the corkings.

Replacement of the canvas of the Power Hut.—once in four years.

Countermeasures for the floor panels over which washing is done.

## 7. Postscript

The above is the outline of the present condition of Syowa Station and of our work done. We admit that we have rather placed emphasis on defects as to do so might be better for this paper. We believe that the present building is good enough for the observation work for several coming years. If, however, the Station has to be abandoned in a near future, all the building should be given up and a restart under a new conception for construction should be made.