

# Reconstruction of sound and light in the installation work *Blikket* (1970)

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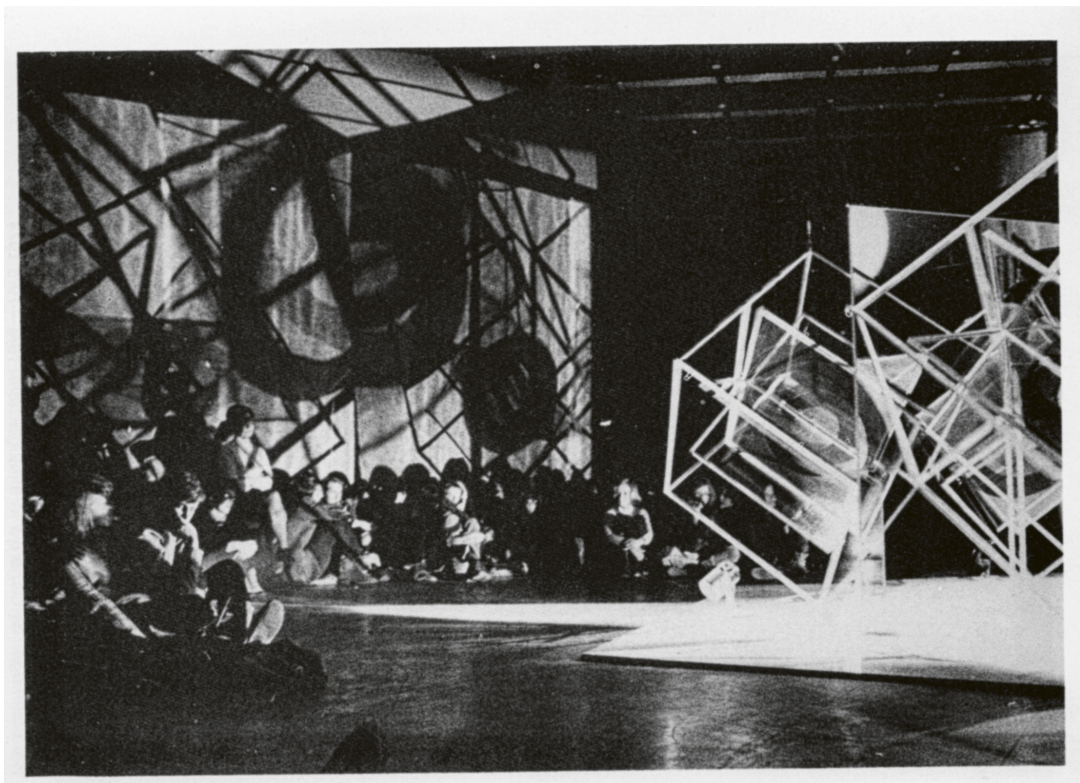


Figure 1: Photo from a performance of *Blikket* in 1970, at Henie Onstad Art Center.

## Abstract

This text describes the installation *Blikket* (*The gaze*), its components, logic, and the original version from 1970. Furthermore, the work is contextualised with a short description of the commissioning institution and other significant works of the same character from the same period in Norway.

A new reconstruction, completed in 2022, has been made for the National Museum, and the main part of the text describes the restoration and reconstruction process, with detailed accounts of the different decisions that have had to be made for the realisation. The reconstruction has been based on fragmented source materials and recollections of both artists and engineers, plus what we know about the historical context.

The aim for this text is to provide information in documentary form for the museum's archive and conservationists, and to shed light on the academic and artistic deliberations the project has depended on, all with the hope that this information might be useful for future projects of similar nature.

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## 1 Introduction

*Blikket* is a multi-media work from 1970, commissioned by the Henie Onstad Art Center (HOK) in 1969. The center director Ole Henrik Moe wanted a work that integrated different expression types and pointed towards the future, in order to signal the center's ambition and profile of being a location where art *happened*, and was not merely *exhibited*.<sup>1</sup>

*Blikket* consisted of kinetic sculptures, light, recorded text and electroacoustic music, and was presented to the public in the form of performances from April 17 to May 4, 1970. Irma Salo Jæger (b. 1928) was responsible for the kinetic sculptures, the texts were selected from Jan Erik Vold's (b. 1939) readings of his own poetry, made by Sigurd Berge (1929 - 2002), who combined these recordings with electroacoustic compositions. The compositions were made with different techniques and from different source materials, and included layered montages of Jan Erik Vold's readings. *Blikket* unfolded along a timeline of approximately 83 minutes, and audiences could come and go as they wanted.

Since the first realisation in 1970, a simplified section of the work toured Iceland, Norway, Denmark, Sweden and Finland in 1990 as part of an exhibition on Nordic art from the 1960s. In 2005-2007, a further mutation of the 1990 version was shown at the Museum of Contemporary Art in Oslo.

## 2 Henie Onstad Art Center - context and ambition

Henie Onstad Art Center opened its doors in 1968, and was highly unusual in the Norwegian context because it was built around the private collection of ice skating star Sonia Henie and her shipowner husband Niels Onstad. Private donations was (and still is) rare in the Norwegian art context, and the donation of an entire center was unheard of. In addition, the focus was on modern art, and radical also in the presentation of performances, installations, contemporary art music and multimedia works. The opening work for the center, with King Olav V as the most prominent guest, was Arne Nordheim's *Solitaire*, a four-channel work for electronic sound and light performance (by Terje Lie). *Blikket* was the next large production, followed by Kåre Kolberg's (and Anders Kjær's) installation work *Nova*. (Fig. 2) Performances and installations were organised in HOK's large concert space; the studio.

The three artist in *Blikket's* were well established within the modern art scene in Oslo; Irma Salo Jæger with sculpture, painting and kinetic works, Sigurd Berge as one of the pioneering composers within technology-based music in Norway, and Jan Erik Vold with challenging poetry that he had published since the mid 1960's in the collections *mellom speil og speil* (1965), *Blikket* (1966) and *Kykelipi* (1969). His perhaps most well-known poem *Kulturuke* (*Culture Week*) (1969) is a good example of concrete poetry, consisting of a systematic shuffling of the letters that compose the word "kulturuke," so that new words

<sup>1</sup>Ole Henrik Moe in "Et museum for fremtiden." In *Prisma* 1/1968. Høvikodden: Henie Onstad Kunstsenter, pp. 18-24.



Figure 2: Henie Onstad Art Center.

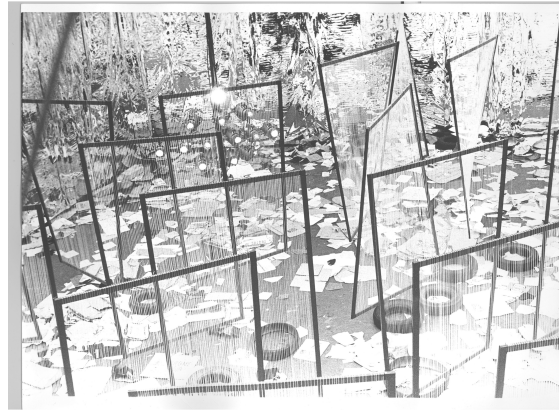
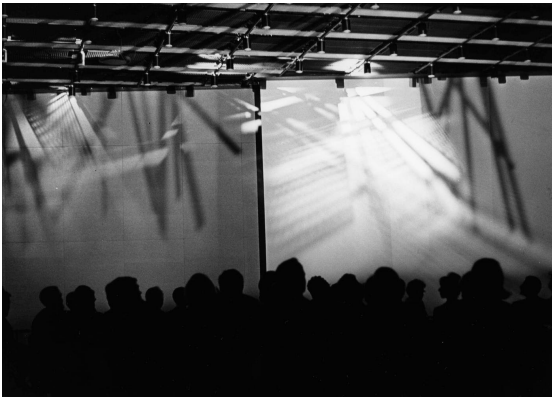


Figure 3: Solitaire (1968), Nova (1972)

and associations emerge with each permutation throughout the poem. A reading of this poem is also part of *Blikket*.

Sigurd Berge was among those best informed about how the electronic music was developing internationally, and had recently visited studios in Poland and Holland, where he also worked for nine months in the Gaudeamus foundation studio at Bilthoven. From Berge's letters written while in Holland, we know that he made use of the advanced equipment of the studio, and in his notebooks, he also listed the electronic tools made available to him. The studios in Bilthoven and Warsaw were on the top tier as far as composers' studios went in the 1960s and 1970s, and while Berge chose to work in Holland, Arne Nordheim and Kåre Kolberg worked in the studio of the Polish radio in Warsaw.

The director of HOK was very interested in investigating how technology could be useful in the arts, and had invested significantly in equipment for sound and light. The ambition was also to establish a studio for electronic music, and that happened a few years later, when Norwegian Studio for Electronic Music (NSEM) opened in 1975, with a Buchla hybrid synthesizer as its core technology, and the Canadian composer Harold Clark as head of studio. In those years, audio technology was not as commonplace as it is today, and HOK ordered custom mixing consoles from the large military contractor Kongsberg Våpenfabrikk, who for many years pioneered audio technology development in Norway. In addition, twenty otoacoustic loudspeakers were ordered from Stig Carlsson in Sweden, at the recommendation of Knut Wiggen, director for the Electronic Music Studio (EMS) at the Swedish radio in Stockholm. 60 spotlights in the studio ceiling completed the package. HOK was bristling with technology optimism, and *Blikket* was planned for showing it off.



### 3 Artistic ideas in *Blikket*

The artists were keenly aware that the complexity of a multimedia work could quickly become too large for full audience perception, and they voiced that concern in the program booklet. In order to avoid overload, they decided to use only “simple colours and forms, simple music and simple words,” and to develop the formal aspects of the installation by only using the number five - from the five words of the poem *Blikket* - *Blikket du fanger ikke meg* (The gaze, you don't/can't catch me.) in different ways. Physically, the installation consisted of five equal sections organised separated by mirror walls and organised as a pentangle. Each section included a rotating aluminium frame cube with a rotating paddle wheel mounted inside. The paddle wings were made from plexiglass and foliated with circles in primary colours, and a fan drove the rotation of both paddle wheel and aluminium frame. The cubes were simply hanging from the ceiling in fishing tackle, barely touching the floor. Each of the five sections included a spotlight mounted above and a spotlight mounted at floor level, and the lights would be turned on and off according to a permutation pattern derived from all possible combinations of the five words in the poem - 320 in all. [Berge \(1970b\)](#) A booklet made for the installation described the use of permutation patterns, gave brief introductions to the musical elements, and listed them with precise starting times, adding up to a total of 83 minutes. Excerpts from the poem *Blikket* were also included, and a score for the light sequence completed the booklet.

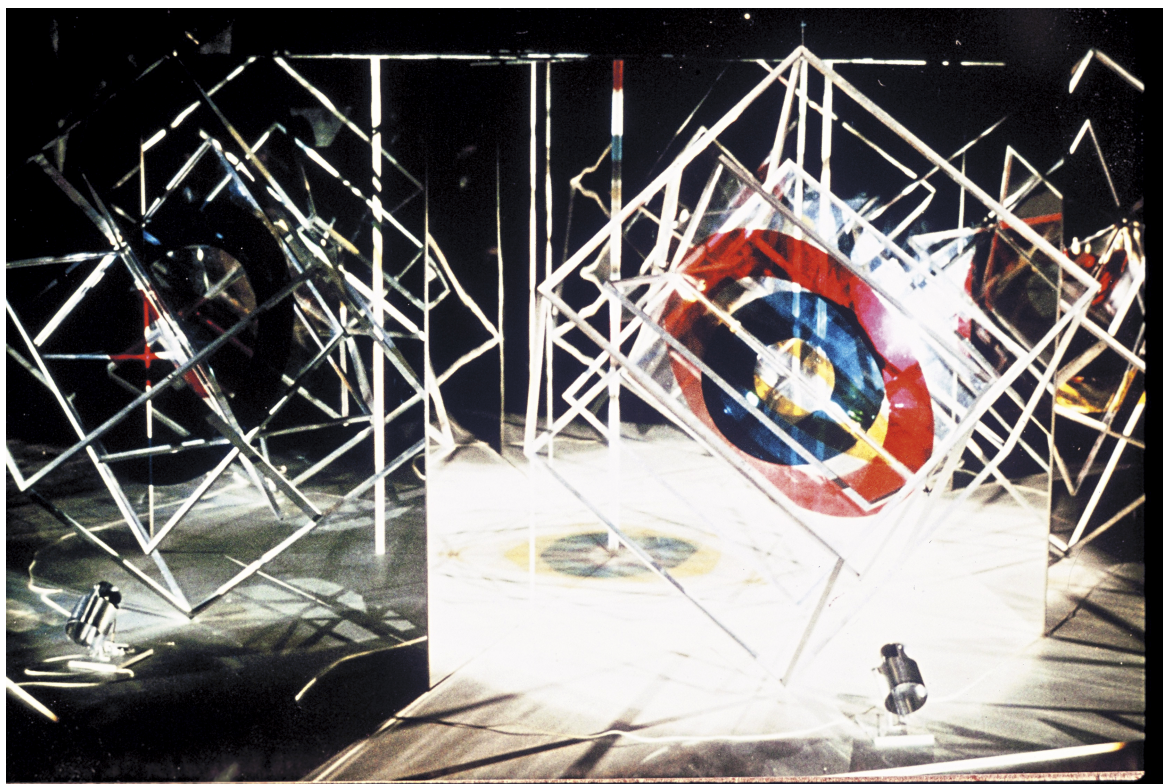


Figure 4: A section of *Blikket* from 1970.

The use of mirrors in the physical installation was important. The sections were separated by mirror walls at 72 degrees angles, and in combination with the lighting from above and below, large shadows in continuous motion were thrown up on the walls, as seen in fig. 1. The walls were 200 cm \* 200 cm. The duration of the installation performance was 40 + 3 + 40 minutes, so that the second part mirrored the the first part, following the brief middle section. The lighting score in the program book showed symmetry as well, with the second part being a mirror image of the first part. The middle section represented an interruption, and was musically entirely different from the rest of the sounding material - all spotlights were turned off, and a laser beam drew images on an entire wall in the studio. This has been described as the first laser show in Norway.

In his book *Mot det totale museum (Towards the total museum)* [Finborud \(2012\)](#), Lars Finborud provides a good rendering on how the work must have appeared from the audience perspective, and he also describes how the artists were influenced by contemporary media theoreticians Norbert Wiener and



Marshall McLuhan. In his book about Irma Salo Jæger, Erik Dæhlin [Dæhlin \(2002\)](#) quotes the artist: “Our motivation was in cybernetics, the liberation of humanity from trivial work for becoming creative. McLuhan wrote enthusiastically and convincingly about the necessity of making use of the senses...” Furthermore, in his description of the installation, Finborud also provides interesting factual information about the types of technical equipment available at HOK, about the control system for the light, and about the institution’s position on the new technology romanticism.

Sigurd Berge was arguably the most experimental composer of the pioneering generation in Norwegian contemporary music at the time HOK was opened, and his music was also the first music heard at the Henie Onstad Center. (When king Olav arrived for the opening, he was welcomed by a fanfare by Berge which was played from the roof above the entrance - and inside, Arne Nordheim waited with *Solitaire*.) From his position as chairman of the Norwegian Society of Composers, Berge also argued strongly that Norway would fall behind the international development if technological facilities for composers were not developed, and at Sagene teacher college in Oslo, he established the first music lab in the country for teaching technology-based music and sound [Rudi \(2019\)](#).

Berge often experimented and played with different sound material where other composers made more straightforward use of sound archives and conventional musical sounds. For example, in his work for *Blikket*, Berge included sound experiments with running, dripping and splashing water, bird song and sound synthesis. As in archives from many other composers at the time, his tape archive includes several versions of the same material, often in different combinations with other material. For *Blikket*, Berge composed 17 different elements, of which approximately half consisted of recordings of Jan Erik Vold’s readings. Some of these readings were reproduced without any processing, while others were layered with different effects, also with elements played in reverse. Berge clearly composed with Vold’s texts, and in that sense flirted with the text/sound-tradition that was so important in Sweden at the time.

Several of the musical elements in *Blikket* appear fairly straightforward, while others are clearly very structured in ways that suggest that they have been made in the Dutch studio during Berge’s stay there in 1969, perhaps as preparation for the assembly of the soundtrack. With the available tape technology at the time, composing for 83 minutes duration was a daunting task, no doubt. According to Finborud, playback happened through 20 loudspeakers, and because no speakers can be seen in the few photos of the original installation, it is reasonable to assume that they were hanging from the ceiling grid that was installed in the studio primarily for mounting spotlights, well above the heads of the audience.

In sum, *Blikket* was an intense work that enveloped the audiences in sound and light. Berge describes the work as minimalist, in the sense that variation within a small material was controlled by a set of principles. From this perspective, *Blikket* can also be described as a type of generative art or system art. Two of Vold’s poems in the installation, *Blikket* and *Kulturuke* are good examples of this type of system poetry, or concrete poetry.

## 4 Engineering, technical components and control

The engineering team consisted of staff from The Norwegian Defence Research Establishment (FFI), where Irma Salo Jæger’s husband Tyco Jæger was directing the electronics department. Three engineers were put on the project: Halvor Heier, Birger Kommedal and Harald Schiøtz.

Technically, *Blikket* was a difficult installation, and the engineers have explained that it was not an easy task mechanically to get the cubes and paddle wheels to rotate with only fans to drive them. The gyro forces would contribute to making the rotations uneven, and it is unlikely that the kinetic aspects worked fully as they were intended to do.

The lights were turned on and off automatically according to a pre-programmed pattern, and by custom made relays that reacted to specific sound frequencies. Each relay reacted to only one frequency, and according to Finborud, all frequencies were recorded onto one magnetic tape, which then in effect controlled the entire light sequence. Spotlights were mounted on the floor and above the cubes, and were turned on and off in synchronicity. In order to get a sharp light and a defined cone of projection, light bulbs from slide projectors were used.

The laser drawings on the wall were made by a beam pointed towards a mirror, and the mirror was mounted on a rubber membrane which was fastened to a loudspeaker cone. The laser beam was reflected to a second mirror that could be adjusted to create the optimal laser image on the wall when the rubber membrane vibrated.

In his program notes for the installation, Berge wrote that one could hear the sound coming first from one side, and then the other, and also that sound was experienced as moving around the listener. This

suggests that the tape was recorded in at least stereo. So it is logical to believe that the installation featured at least three track playback - stereo plus the control signal for the lights.

The installation was running at set times, and the engineers remember clearly that no extra control over sound and light was necessary during performance. This means that the fans and tapes performed the installation automatically. For a more detailed description of the installation as it appeared in 1970 please refer to [Skylstad and Habbestad \(1992\)](#), and [Finborud \(2012\)](#), and for more information about Sigurd Berge, see [Rudi \(2019\)](#).

## 5 Source materials, processes, restoration and reconstruction

Preserving and maintaining artworks poses sets of challenges regarding accuracy and authenticity. Textual information must often be interpreted, physical artifacts might be missing or in bad shape, and recorded sound might be of such low quality that presentation for today's audiences could possibly embarrass both the work and the artist. In his book *Playing with history* [Butt and John \(2002\)](#) (where he writes mostly about acoustic music), music historian John Butt discusses the balance between deadly accuracy and historical flavour. His thoughts are equally valid also regarding technology-based music, and are mirrored by Miriam Akkerman in her article on historically informed performance practice (HIP) in early mixed music. [Akkermann \(2018\)](#) She writes: "How can or should this composition be played? How to deal with the old (outdated) technology? Reconstructing, updating, substituting, simulating or emulating? How to interpret the score and what about the author's intention?"

These concerns were also at the base regarding the restoration and reconstruction of *Blikket*. There were few primary sources of text and sound, and there was a clear lack of consistency on several details between the few written descriptions and the material facts that could be derived from the sounding material. Also, source material came to light over a period of more than a year, and this made it necessary to constantly reconsider the conclusions reached about how *Blikket* had been put together.

The primary written sources were: The program booklet from HOK, sketches for the light sequences from Salo Jæger's archive, and two pages where Sigurd Berge describes the sounding pieces/elements that *Blikket* was built around. In addition, a handful of photos from the installation as it appeared in 1970. Two valuable secondary sources were [Finborud \(2012\)](#) and [Rajka \(1991\)](#). Although much of her description of the installation was faulty, she provided good information on Salo Jæger's life, context and works, and especially on how Salo Jæger's kinetic art was received by critics and audiences.

### 5.1 Process

The first contact with the National Museum about the installation was in January 2018. At the time, the museum had one 1/4 inch tape where audio apparently had been recorded in both directions of the tape. The tape was difficult to understand, and an attempt at interpretation at a commercial studio had failed to bring clarity. The signal on the tape was in mono, and in very poor condition. However following a new digitisation of the tape, it became clear that the order of the elements corresponded with Berge's list in the program booklet from HOK. Because material was recorded in both directions of the tape, it was easy to assume that the tape had been played forward and then automatically reversed. However, that type of functionality was not commonly found in tape machines in 1970, and to my knowledge there is no record of HOK having a machine with that feature. The tape was not likely to be a mastertape.

In order to try to find a better starting point for the restoration, I contacted Berge's children, asking if they had more written or recorded material. Fortunately, his son Åmund had preserved all tapes from Berge's archive, and I visited and borrowed all tapes that contained electronic material. Many of the recordings were related to *Blikket* as sketches and versions, but there were no *identical* copies of the tape already received. I also contacted the National library, and they shared digitised copies of all electronic material they had from Berge, but they did not have copies of *Blikket*. A CD print of *Blikket* excerpts from a 2010 CD<sup>2</sup> was incomplete and not of much help either. It seemed that tapes with better quality sound did not exist, and consequently, it was decided to restore and reconstruct the installation sound based on the first tape we received. A restoration was made, and the artist, two of the original engineers plus representatives from the museum saw and listened to the reconstruction of sound and light in a studio, and the version was accepted in May 2018.

In June 2018, two tapes with electronic control signals were sent over from the museum, and digitised. The digitisation confirmed that one of the tapes contained only five different frequencies, and that they

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<sup>2</sup>Sigurd Berge - Early Electronic Works, Prisma Records – PRISMA CD708

sounded according to specific patterns. This was clearly the missing tape with the control signals that Finborud had described. The patterns on the tape however did not correspond with the light score in the program book, and it was decided to stay with the simulation that was based on the program book until clarification could be found.

During July 2018, I visited Berge's archive of books, scores, notes and other handwritten material at his family farm at Vinstra in Gudbrandsdalen, but no additional tapes were found there. However, much interesting background material was found, on his work in Holland and his compositional thoughts. This greatly helped the understanding of his musical development.

During October 19-26, a technical test of sound, light and the kinetic elements was performed at a rented theatre space in Oslo, and it was largely unsuccessful; the sound was bad, the lights were wrong, and the kinetics were unstable, to say the least. Clearly, the logic of the performance needed to be revisited for a more robust reconstruction.

In January 2019, Berge's son contacted me. He had found another box of tapes, and among them two master tapes for the installation, with all elements in the right order, and of much better quality than on the first tape received. The music was also recorded as a stereo files. It was decided to look away from all work that had been done on restoring sound from the first tape, and instead reconstruct from the newly arrived master tapes, plus the tape with the control signals received in June 2018. The restoration of the audio signal and the construction of a new performance file was completed in the early spring 2019.

At this point, the timeline for the entire project had shifted significantly, due to delayed completion of the new museum building, and that full access to the space necessary for building both the sculptural parts of the installation as well as the sound was also delayed. We were however able to come in and see the room during the building process, and also received architects' drawings that allowed us plan for loudspeaker type, number and placement.

In 2020, The Covid epidemic hit, and resulted in further delays in finishing the installation. The kinetic elements were mounted in 2021, together with the loudspeakers on the walls. The installation and tuning of the sound was started during a few days in late fall and winter 2021, and completed in April 2022, during which time we had a close dialogue with the museum staff about the lighting specifications, additional technical equipment in the room, and the programming of control system for motors, sound and light.

## 5.2 Kinetics

In her book, Suzanne Rajka [Rajka \(1991\)](#) describes Salo Jæger's sculptures in an exhibition at Kunstnernes Hus in 1965. Salo Jæger presented four sculptures *Skulptur I: Mobile*, *Skulptur II: Skovleform*, *Skulptur III: Konstruksjon (med to skovleformer)* and *Skulptur IV: Konstruksjon (med fem skovleformer)*. In all sculptures, she used aluminium frame cubes with plexiglass mounted in different ways, and the sculptures were lit so that the plexiglass reflected constantly changing patterns of light and colour onto the walls. Two of the sculptures (III and IV) were also set in motion by electric fans. It seems clear that Salo Jæger reused this idea for *Blikket*.

At the onset of the project, only one cube had been preserved, and the additional four were built by the museum staff as identical copies. After the test installation in October 2018, it was decided to rotate the cubes by electric motors in order to increase stability, and instead of hanging the cubes in fishing tackle, they were now hanging in slim steel rods that were mounted to the motors. This part of the installation was built by the museum staff. In order to not overload the motors at start and stop times, a ramping procedure was implemented, for slower start/stop of the rotation.

Fan noise was a pressing issue. Five fans were needed for the installation, and they were to be mounted on the base close to the cubes. The museum staff experienced huge difficulties in finding fans with a large enough airflow to rotate the padwheels, while at the same time not generating more noise than could be accepted regarding the audio part of the installation. Many fans were tested by the museum staff, a decision was landed, and a fan type was chosen. The mounting directly onto the base of the installation however generated a lot of noise from acoustic resonances in the base, and in addition the structural noise from the fan chassis was significant. After fitting rubber gaskets for isolating the chassis from the base, and the motor from the chassis, the sound level was brought down significantly, and this became the solution. (See Fig. 5)

## 5.3 Sound

Restoring and reconstructing sound is a challenging task. It is important that the sound retains its original character, but this must be balanced against the expectations of today's listeners (and hopefully also some



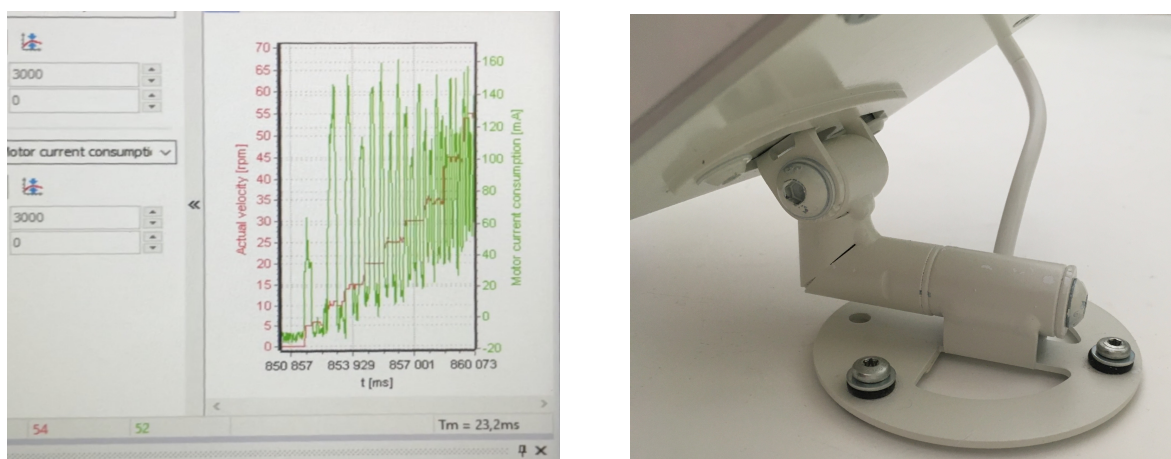


Figure 5: Ramping of the motors turning the cubes, fan mount showing the rubber gaskets.

future listeners as well). It is also important that reconstruction is accurate and in keeping with the artist's intention and skill, and that the result comes close to the emergent qualities the sound had when first performed. Also, depending on the available source material, it is not always easy to determine which principles and systems the composers have used, and how consequent they have been in implementing them. Balancing these concerns means that the reconstruction to a degree must also be balanced with the aesthetical, perhaps also artistic inclinations of the person reconstructing the work. These types of issues are discussed in *Historically Informed Performance Practice*, as described in [Akkermann \(2018\)](#).

The starting point for reconstructing the sound in *Blikket* was not the best; the tape from the National Museum was a stereo tape, however with the two tracks being recorded in different directions - in effect a mono file after digitisation and reordering of the elements. The reordering was made from the program booklet from 1970, and seen as a whole, the material could be sufficient for reconstructing a performance file. Following the unsuccessful search for *Blikket* tapes at Berge's son, it seemed that there were no other options, and it was decided to make a new performance file from the available material. The signal quality was too low to be used as it was, and cleaning was needed. The cleaning process was quite time-consuming because the different elements on the tape had different noise profiles, and that the mastering process of the more complex elements had resulted in something similar to a patchwork quilt of rapidly changing noise profiles. The recordings of Jan Erik Vold's readings had been made at several locations and times, probably also on different equipment, so the cleaning of those recordings became a puzzle of different filterings, which resulted in quite uneven quality even after the cleaning had been done.

Balancing cleaning and preservation of content is always difficult, particularly when the material is in bad condition. Generally one can say that some of the original content disappears in the cleaning process. On the original tape, some of the sound had also been "rubbed off" to other parts of the tape while being stored on a spool, and could sound like a faint echo that came before or after the main signal, depending on the direction of the recording. Particularly in regions with soft sound, these echoes were noticeable, and they are close to impossible to erase, since they blend with the noise profiles and the material one wants to keep. The cleaning process took approximately three weeks to complete.

The easiest alternative would have been to use the sound files as they were, but they were in such bad shape that it was decided to use the cleaned material despite its non-optimal nature. This decision was cleared with Salo Jæger, Halvor Heier and the museum curator.

In the program booklet, Berge had emphasised the timeline and total duration (83 minutes) of the performance, and he had described how the sound could come from different directions, and envelop and circle the listener. Given the emphasis the artists had put on permutation principles and the use of the number five in their conceptual description, it seemed logical to think that the time axis, duration and movement were absolutely crucial to the integrity of the work as the artists must have seen it, and it was decided to reconstruct these aspects as accurately as possible. But how?

The recorded sound on the tape was approximately 1:30 longer than the prescribed 83 minutes, and the different subsections could be both longer or shorter than what the program booklet described. To some extent, inaccuracies could have been caused by tape machines that did not all run at the exact same speed, but a difference of one and a half minutes can not be explained that way. During the reconstruction, a decision needed to be made on whether this inaccuracy should be kept, or if we should

edit the silences in order to make the timeline exactly 83 minutes. After deliberation, it was decided to keep the inaccuracy, because the effect of cutting out one and a half minutes of silences would have significantly changed the dramaturgical development of the sound. The expression of the composer and poet could easily have become quite disturbed.

The discrepancy between the “program” and the tape suggested that the written description was actually more of an approximate intention than a final version, and we found support for that point of view in the fact the the timeline was described with a resolution of 10 seconds, which is rare in music and recordings. We have not found written sources that discuss this problem, and there were no other sound files that we could use for verification.

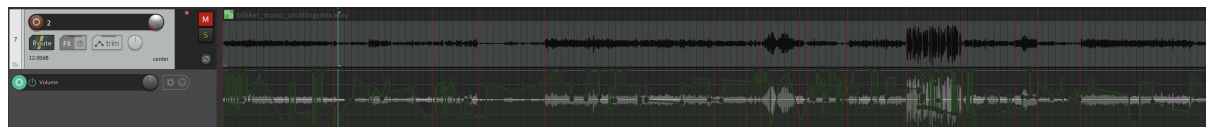


Figure 6: Screenshot of one track from the first reconstruction for ten loudspeakers. Note that the green graph indicate changes in sound level.

In the program booklet, Berge writes that the sound “wanders in the room,” that it “is thrown from loudspeaker to loudspeaker in several layers,” and that it comes from different directions, alternately. These formulations, in combination with the fact that we had not found the original master tape or any indications of the technology used for the performance, made it reasonable to believe that a type of distribution of sound other than simple playback was required. The first reconstruction was playing the same mono file from ten different tracks, however by changing the amplitudes an effect of sounds moving in the space was created. Music is a robust signal, and this was not particularly difficult for the purely musical elements, however the recorded text required a more careful approach. The choice was to create quite slow movements, and to move mostly between the semantic blocks, so that for example whole sentences emerged from the same place, while the next sentence would come from a slightly new location. This work was done manually, by employing breakpoint curves (Fig. 6). The breakpoint curves were different for each track and each track was routed to only one loudspeaker.

In the HOK studio where the installation was first mounted, one of the engineers remembered that the speakers had most likely been mounted on the wall, or hung against the wall from the ceiling grid. No loudspeakers can be seen in the few surviving pictures from the installation, but a secondary source states that 20 speakers were used. For the exhibition space at the National Museum, twenty speakers would be unnecessarily many, and a preliminary decision was made to cut the number in half, creating a distribution for ten speakers. This would somewhat reduce the possibilities for nuanced variation in the playback, but no precise description of the panning patterns had been found, indicating that this type of precision had been important to Berge. The technology in 1970 did not include any methods for very precise location of sound, and ten loudspeakers seemed like an adequate number.

A simulation was made within these restrictions. However as discussed above, in January 2019 a mastertape came to light, and the whole idea had to be redrawn. Firstly, the new tape was of much better quality, so the same type of minute cleaning was not required; we could work with broader strokes. There were sections that were of poor quality, and fortunately we were able to find elements on other tapes to change those out. The new mastertape was in stereo, rendering the carefully constructed sound distribution model useless. Distributing stereo as enveloping sound in a room must be made differently than in mono in order to maintain the composer’s intentions.

The discovery of the new master tape, in combination with architectural drawings of the space, made it necessary to revisit the number of loudspeakers. In order to create even movement of sound in a space, the speakers can not be too far apart. That will create dips in the sound level when moving the sound, and the sound would appear to come first from one speaker and then the next. A new calculation was made, and it was found that 14 speakers would be a more adequate number for providing a good coverage for filling the room and providing an immersive effect. The 14 speakers should be mounted with equal distances, also across corners. This type of exactness is crucial, and although no record exist on how this was done at HOK in 1970, we know from music history that spatiality and sound distribution was at the forefront of composers’ attention, and expect that they paid attention to the issues of loudspeaker placement.

In order to keep the stereo effect that Berge had developed in his mix of the master tape, it was decided to divide the room into four and have the top left and bottom right corners receive one channel, and

the top right and bottom left corners receive the other one, in effect dividing the room in four sections. With this distribution, visitors in any location in the room would hear the stereo effects that Berge had composed. This solution also realised Berge’s ideas about how sound “wandered in the room,” “was thrown from loudspeaker to loudspeaker in several layers,” and that it came from different directions.

## 5.4 Light

In the program booklet, the duration of the performance is listed as 80 minutes plus 3 minutes for the laser part. 80 minutes divided on 320 permutations gives a time interval of exactly 15 seconds for each light change, and it is not unreasonable to expect that the idea of the duration of the sound and music had been adapted to this pattern, although there were only 310 changes in the lighting score in the program booklet. It should also be mentioned that the score in the program book had errors in the track assignment in the mirrored second part. With these types of discrepancies in the source material, it is unclear exactly how the installation was constructed, and it became clear that our judgement was necessary also for the construction of the light sequence.

The first version of the light sequence was made according to the program book, and adapted to the duration of the sound file. The result can be seen in Fig. 7, and note that there are relatively few changes in the course of the 83 minute duration. After seeing the pattern while listening to the sound track in May 2018, one of the engineers remembered clearly that this pattern had not been used in 1970, but that something else had been used. However, we had no indication of what that was until the control tapes were sent over in June 2018. There were two tapes, one containing five sine tones that were turned on and off rapidly, and the second one with sine tones and a human voice counting. Emails with engineer Heier where he described how the control tape had been created, confirmed that we had indeed received the original control tape. The duration was however only 40 minutes, half of the performance duration, and it was decided to flip it and make it run backwards for the second half. This seems like a hazardous decision, but the result was in keeping with the mirroring principle underlined in the program booklet and evident in the lighting score. (Fig. 8) The higher change rate gave striking results, from an artistic point of view much more interesting, fortifying our belief in the decision.

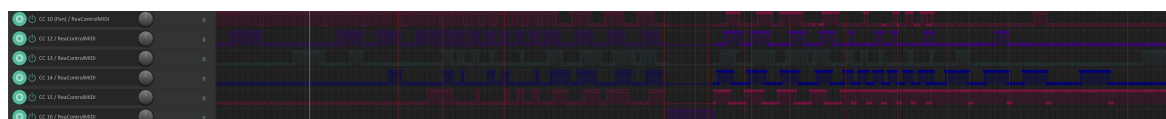


Figure 7: Screenshot of the light sequence from the program book.

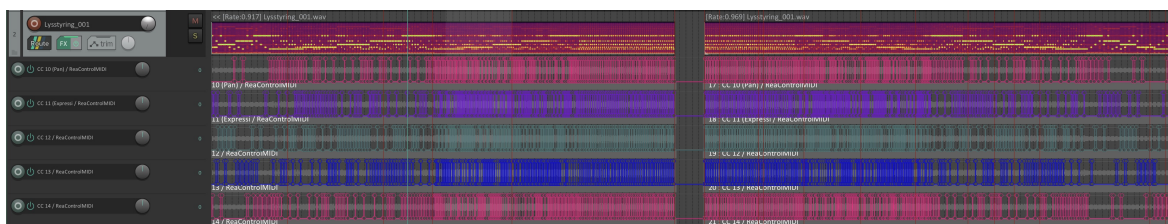


Figure 8: Screenshot of the light sequence from the control tape.

In the press release for *Blikket*, Berge writes that “...the tape with text and music has been linked to Irma Salo Jæger’s light sculpture by using a computer,” but he does not write exactly what was programmed. Berge (1970a) However, because the programming was joining the visual and audible parts, it is reasonable to assume that it was the pattern in the light control that had been programmed, and that the permutations had been algorithmically generated. There is no trace of computer sound in the music, and the sine tones were clearly recorded manually, being turned on and off in pace with the counting voice heard on one of the control tapes. This leaves the calculation of the control track as the only realistic option for use of computation. And we know that FFI at the time were investigating the usefulness of computers in art Espelien (1974).

In 1970, the lights were turned on and off by relays, activated from a magnetic tape. The solution in the reconstruction was to represent the changes as MIDI data, and control the light via the much used DMX protocol. The light was then controlled from the same performance file as the audio, and a small translator from MIDI to DMX was built by Thom Johansen for the purpose.



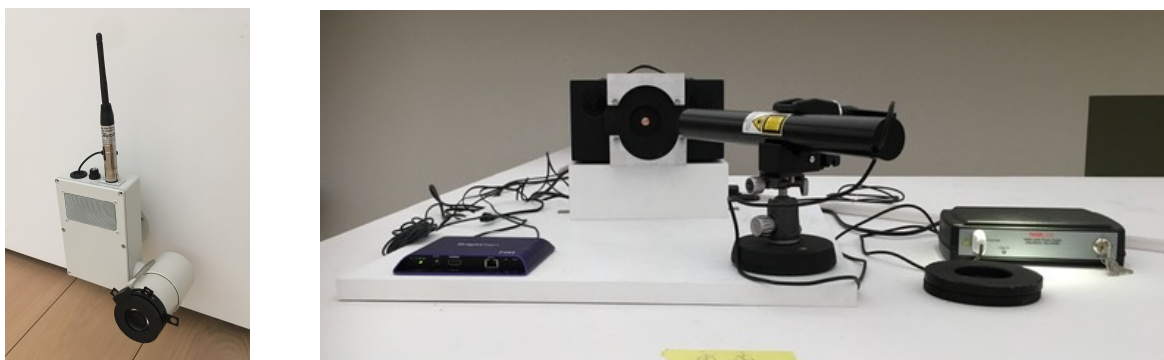


Figure 9: Wall-mounted spotlight, laser setup

Originally, bulbs from slide projectors were used, today an obsolete technology. The installation now is lit by LED spotlights, however the rise- and fall time of LED lights are quicker than the lights used originally, and in order to bring the lighting in line with the original expression, the controller card in each spotlight was modified in order to have the light intensity rise over a time that was close to the rise time used in 1970. Equally, and perhaps more important, was that an on/off clicking sound from the spotlights were also removed in the modification. The light quality (cold/warm) was also taken into consideration.

Mounting the lights was done so that the spots from above were hung from the ceiling in the exhibition space, while the spots at floor level were mounted on the walls in the space. (Fig. 9) This means that the visitors will be standing between the light and the installation. This could be of concern, however testing has so far showed that this is not a huge problem. Each spot is masked to light only one section of the installation, giving clarity to the light sequence. There is however no written description on exactly how this was done in 1970, although we know from photos that the floor-mounted spots were placed immediately in front of each section, in effect concentrating the light so that it did not bleed across sections.

Each section was lit from above and below, but there is no record on whether the top and bottom spots were turned on and off in a vertical sync. After testing, it was decided to shift the top light one section to the right, so that the bottom light for one section and the top light for the next section were synchronised. This was found to give a better distribution of light in the performance, especially in the beginning and end of the sequence, when the light changes are relatively infrequent.

In 1970, the middle section of three minutes was filled with the composition *Bazaine*, named after the painter who is also represented in HOK's collection. All spotlights were turned off, and the fond wall in HOK's studio was filled with a laser drawing generated from the music. The rendering process was simple; a rubber membrane was glued to the front of a speaker cone, and a mirror was glued to the membrane. A laser was pointed towards the mirror on an angle, and when sound was played through the speaker, the membrane and the mirror would vibrate so that the laser beam would make a drawing on the wall. The reflective layer on the mirror was on the *front* of the glass, to eliminate diffraction by the glass. There is no written record of the size of the laser image at HOK (and consequently how sharp the laser drawing was), but the intensity of the laser beam has been documented, and the same strength has been used in the reconstruction. For the installation at the National Museum, two lasers are used to project two images on a wall, with several meters separating them. The museum room is not as deep as the studio at HOK, so the images are smaller, and perhaps also higher up on the wall so the beam can not reach the eyes of visitors. (Fig. 9) These decisions have been made by museum staff in communication with Salo Jæger.

In the program booklet, Berge writes that the laser light draws *Bazaine* and *Han ser på henne*, but this does not add up to the given laser light duration of 3 minutes. From the program booklet, the duration of these two parts is 3:50; close to a minute longer than 3 minutes. And *Bazaine* alone did not last longer than 2:30, so once more, because of discrepancies in the primary sources, an artistic decision needed to be made. The decision was to use the laser light only during *Bazaine*, because the intensity of sound and light matched and was augmented as a separate section, as described in the program booklet.

## 5.5 Equipment and control interface

In 1970, the installation was running at a regular schedule from April 17 to May 4. The playback controlled both the sound and light sequences, but there is no accurate information on exactly how this control was done, although it is clear that light and sound must have been synchronised. Given that the control tape we received was a separate tape, makes it unlikely to assume that HOK had a three-track (or more) machine at their disposal.

In the version we have recreated for the National Museum, sound and light control is included in a file that is executed in the *Reaper* digital audio workstation. The software runs on a Raspberry Pi mini computer the size of two-three credit cards placed side by side. This is a robust solution with no moving parts, and the sound signal is routed to the speakers through an external sound card. The computer and sound card is placed in a small wall-mounted cabinet in the exhibition space, together with an interface for the spotlights and an internet switch.

A custom controller (Fig. 10) has been programmed for the installation, allowing direct playback of each of the elements in the installation. The controller interfaces with the Raspberry Pi, and includes a test sequence for light and sound, staggered start/stop for the mechanical part of the installation, and extra functions for turning light and sound on/off. The control also interfaces with the Crestron general control system in the museum.

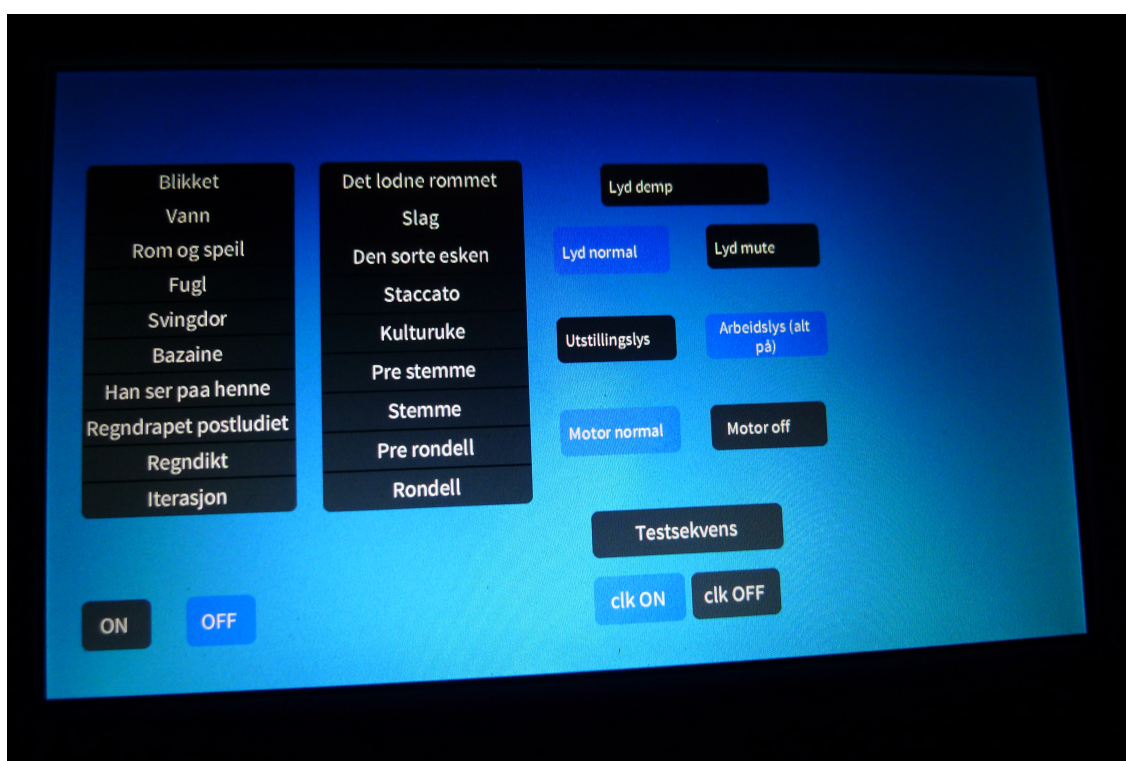


Figure 10: The installation controller with all available functions.

## 5.6 Sound adjustments to the museum space

Every space has an acoustic character which reduces some frequency areas and amplify others. The shape of the room can also add echoes where the sound is reflected back and forth between walls. In the original version of *Blikket* this was not the case, due to the shape of HOK's studio, where no walls are parallel. However, the space in the new National Museum has the shape of a rectangular box, and some echoes in certain frequency areas were detected. There were also acoustic challenges from the fan noise and general room resonances.

The most efficient method for dealing with noise and unwanted sound in specific frequency areas is filtering. Modern digital filters are both static and dynamic (changing with the audio content), and a combination of several filters was applied. In addition, the amplitude in some sections was lifted, while in other sections it was reduced. These can be radical changes to audio files such as music, possibly

destroying the content completely. We have used filtering sparingly, and in *Blikket*, the main focus has been on reducing frequencies that would stand out due to room resonances, and on increasing signal clarity for Vold’s readings to appear clear and consistent in the space.

For some sections of the master tape, careful re-balancing has also been made, in order to emphasise the flow of the installation rather than risk that certain elements stand out too much. All this was done by ear in the museum space. It is important to be aware that our sound treatment has been *site specific*, and that the sound treatment must be done again for installation in a different space. In order to give an impression of the complexity of the filtering processes, an illustration is provided. (Fig. 11) The horizontal line shows the frequency range from low to high, and the wavy lines show how filters either amplify or reduce frequency areas. The sharp yellow downward peak, for example, reduced a very specific frequency and just a little more around it, while the yellow upward bulge amplifies a wider frequency range.



Figure 11: A screenshot showing a filtering process in a commercially available software.

## 6 Summary, conclusions

The restoration and reconstruction process of *Blikket* started from a few primary sources available from HOK and Salo Jæger’s archives, and two secondary sources [Finborud \(2012\)](#) and [Rajka \(1991\)](#). There were inconsistencies in the written documentation, and few details on how the installation was performed and technically set up were available. This necessitated a careful evaluation of different solutions, making choices that would align optimally with what the artists actually did in 1970. This required us to also draw on the types of contextual information described in [Rudi \(2019\)](#). The sound material from the first tape that seemed to be the only basis for all audio restoration was not very good, and required enormous amounts of work to become something close to presentable.

All this necessitated a continual search for both written and sounding material, both primary and secondary sources, and Berge’s archives were searched for additional tapes and written notes. Berge’s family was very helpful, and it is doubtful if the end result would have been very satisfying if additional material had not been found. The willingness to revisit and reconsider the decisions already made in the reconstruction process was of huge importance.

All of Berge’s tapes have been digitised and carefully scrutinised, since the marking on tape boxes are not always correct when compared with the audio file content. We have become very familiar with the scope and development of Berge’s electronic work, and many pieces not previously published have come to light. This has given impetus to an idea of producing a double CD, where one CD will contain *Blikket* in its entirety, while the other will present a mix of published and unpublished works from his catalogue.



## 7 Acknowledgements

The reconstruction of *Blikket* was initiated by the National Museum, for a more complete inclusion in their collection. Additional credits goes to the University of Huddersfield, where much of the research and writing has taken place, financed by a Leverhulme grant.

In the throes of the reconstruction processes, my previous NOTAM colleagues Cato Langnes and Thom Johansen has most generously poured their competence into the project, as has the museum curatorial, administrative and technical staff. This reconstruction project has been a collaborative project, and would have been very difficult had it not been possible to draw on the good will and memory of the original technical team, and Irma Salo Jæger, one of the artists that have made all this possible.

Berge's family has contributed essential sounding material, as has the National Library, and for the preparation of this manuscript, great thanks go to Jina Chang for critical reading and supplementary information.

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