

'East of noise'

Eivind Groven

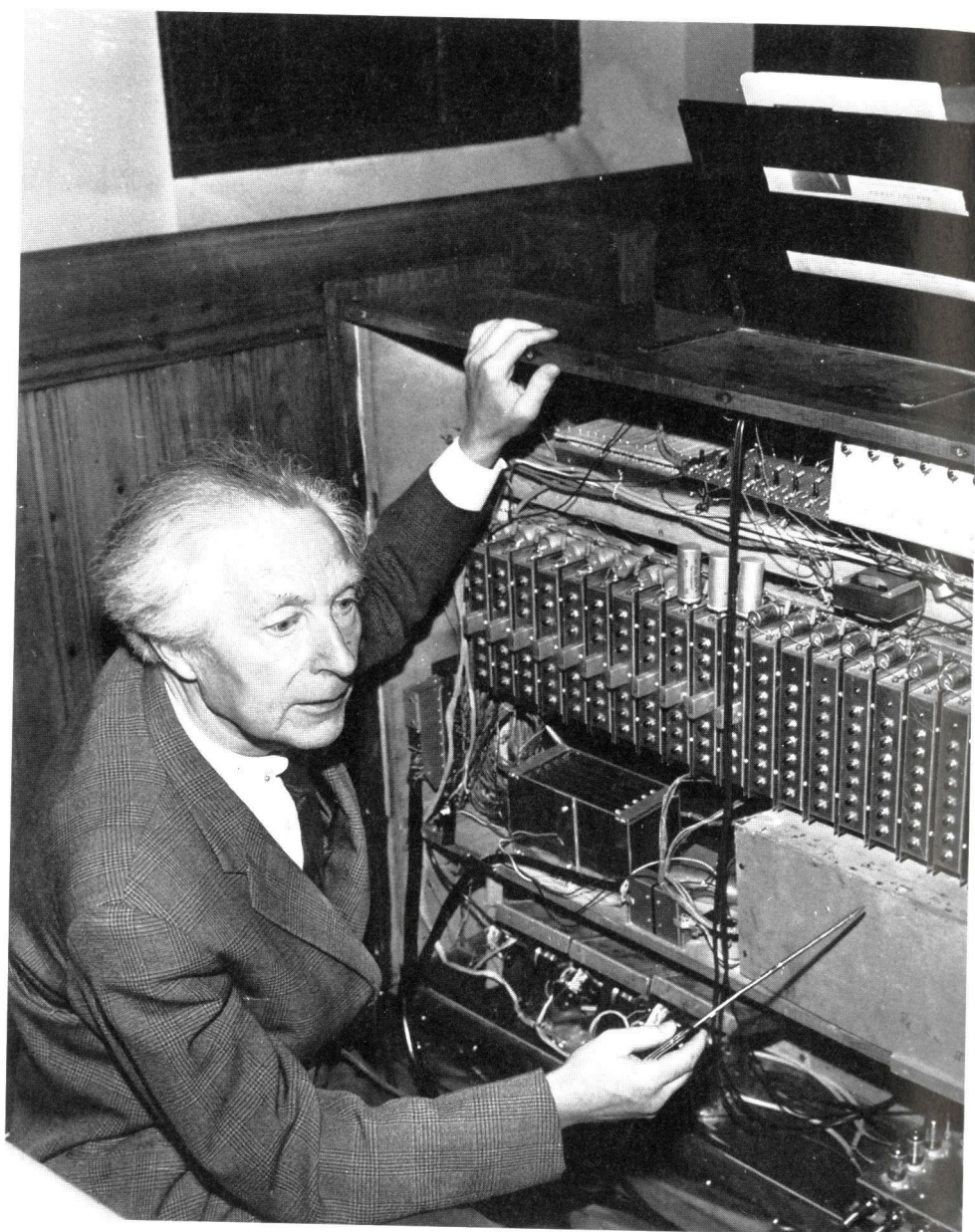
Composer, ethnomusicologist, researcher



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akademika
publishing



Eivind Groven behind the electronic organ (probably the first one in Norway), completed in 1965. The instrument utilized a 43-tone scale and a newly-built just intonation automat. Photographer: Unknown, undated. Private.

JØRAN RUDI

Eivind Groven and technological innovation

Introduction

There is an overall cohesion in Eivind Groven's life and work that links his aesthetic experience and theoretical understanding to his practical interest in research and creative work, and these different aspects of his life are intertwined in a rich network of connections. For Groven, the final proof of the validity of his theories was in the sounding results: one could *hear* in the findings whether the theory was correct. Understanding Groven's approach to technological innovation involves considering how this amalgam of theory and practical investigation functioned in a social perspective, represented in an approach taken by, for example, Edwin T. Layton: 'The divisions between science and technology are not between the abstract functions of knowing and doing. Rather they are social.'¹ Layton points to the arena, rather than to the type of work. Groven's thorough and extensive work in elaborating theoretical and practical aspects of just intonation and the just intonation automat shows that he transcended demarcations between research, dissemination, and development in a strong and convincing manner.

The issue raised by the Pythagorean comma and how various intonation systems are related to it is described in detail in other chapters in this volume, as are Groven's compositional and musical activities. For this reason, this chapter focuses on how Groven's use of the new technology contributed to the realization of the values he considered were the foundation for art and culture, and for the construction of a modern Norway. The chapter also contains a description of the technological extensions of the just intonation automat since Groven's time, mainly

the contributions made by David Code and the Norwegian Center for Technology in Music and the Arts (NOTAM) from 2001 onward.

In this chapter, technology is understood as physical objects and activities or processes. The inclusion of activities is common within technology studies, as discussed by, for example, Wiebe E. Bijker et al.² Technology is also discussed as a competence; users' knowledge about how something should be done is considered an integrated part of the technology. Discussing technology as both objects and activities makes it easier to understand its social preconditions and results, and acknowledge that technology is developed in a social context and at the same time shapes it. When considering the totality of Groven's work, these aspects and perspectives can all prove useful in explaining his research and work as a developer, and his efforts as a proponent of folk music – especially when looking at the results of his efforts.

Groven's background and the natural scale

Eivind Groven was born into a farming family with long roots in the county of Telemark, Norway. In interviews, he always emphasized this background and it was in this environment that folk music became part of his life from an early age. Groven came from this culture and worked with different aspects of it throughout his life as music collector and disseminator, as composer, and as researcher and developer. He was comfortable with this identity, which was evident throughout his entire mature life as a composer. Folk music shines through in all of his works.

He started to play music at an early age, and when he came across a zither in 1913, he became aware of the principles of just intonation while tuning the instrument. A zither consists of a resonant body and normally between 30 and 40 strings that are stretched horizontally across it and tuned in chords. Some of the strings should have the same tuning, but with just intonation, these pitches did not always come out equal, and this frustrated Groven.³ His frustration led him to realize the principles of just intonation for the first time. Although he understood that the compromises in equal temperament made it possible to play music in all keys without retuning, he experienced them as so negative that he later likened the difference to looking through a clean or dirty windowpane.⁴

The basis for Groven's work is the natural scale as heard from the willow flute, among other instruments. He believed that nature has convincingly established the principles of tonality and that 'it is obvious that the [natural scale] heard from wooden lurs, willow flutes, or other wind instruments without fingering holes has dictated the feeling of tonality for thousands of years.'⁵ In the text *Naturskalaen* (*The Natural Scale* / *The overtone scale*) from 1927, Groven expands on this conviction, writing that 'the natural scale has been, and is the basis for living music [and] what is found in nature follows the general principles of beauty, as it corresponds with the human inclination.'⁶ In his book *Temperering og renstemning* from 1948, Groven developed his reasoning further, and through analysis he finds how intervals in other scales are derived from the natural scale, which then forms the basis for all "normal" art music.⁷ Groven considered just intonation as qualitatively better and more correct than equal temperament, and his strong insistence can be traced back to his folk music background and the tonalities he experienced. Thus, just intonation becomes a link to both natural phenomena and his personal experience, often alluded to when discussing in texts and interviews the willow flute and the tuning problems he experienced with the zither. Just intonation ties into something original and genuine that Groven felt had been lost in equal temperament and the common acceptance of this tuning system: 'When a person, regardless of how musical he is, never gets to hear these intervals while growing up, and thus never gets to unlock the latent ability for interpretation of these intervals, which might be demanding, he goes astray and becomes helpless when hearing them in the folk music.'⁸ Based on this conviction, Groven systematically engaged himself in the possibilities afforded by the new technologies in his time through a range of professional activities.

Broadcasting and dissemination

In 1931 Groven took a position with the private radio enterprise *Kringkastingsselskapet* (Norwegian Broadcasting Company) and was responsible for folk music programmes. At that time, broadcasting was in the process of becoming an industry of national concern, entailing a shift from the more regionally oriented broadcast perspectives that had dominated private radio companies since radio transmissions started in 1923.

The Norwegian Broadcasting Corporation (NRK) was established in 1933, at a time when electricity was not yet available in all parts of the country, the telephone was still uncommon and expensive, most roads were unpaved and rough, and there was no mass media connecting the country. The electrical industry was a new, promising industry on the rise, and broadcasting, as the most advanced media technology, was taking on new tasks. Radio broadcasting increasingly assumed responsibility for gathering and expressing culture from around the country rather than disseminating urban culture as far as the wattage of transmitters allowed, mostly through entertainment programmes. Norway was to become aware of its unique identity and culture, and it was therefore important that the *entire* country could be heard through the material gathered and transmitted. Importantly, of all music played on the radio at that time, less than 25% was of Norwegian origin. Radio was given the cultural and clearly political task of nation building. Accordingly, radio programmes became important arenas for cultural struggles. Similar developments were also taking place in Germany and England, where national broadcasting corporations were established around the same time.

Historian Hans Fredrik Dahl suggests that radio is a technical invention, while broadcasting is a social invention.⁹ Broadcast engineering was quite a challenge in Norway, due to its length and physical geography characterized by mountains and valleys, which made it difficult to transmit signals and for listeners to receive them. The differences between the many rural and urban cultures in Norway posed further challenges in terms of the social aspects of the technology. When Groven was hired by the private radio enterprise, it was to bring folk music into the programmes. Until then, folk music had not been prioritized, and when Groven established the radio programme *Folkemusikkhalvtimen* (The half hour of folk music), in 1931, it was thus a clear signal that those times were past. The programme is still broadcast today, which has earned it the distinction of being one of the longest-running radio programmes in the world.

Broadcasting was tasked with conveying information and educational programmes, and innovation was considered central to the industrial and cultural development of the country. Work with radio material was considered of great importance, evidenced in the formation of 'listeners'

associations' to influence programmes through criticism and debate. Engagement in the folk music programme was enormous, and Groven fulfilled his tasks by bringing fiddlers from around the country into the studio for direct transmissions. Real-time broadcasting of this type was risky, since there were large differences in how well-prepared the fiddlers were and how well they understood studio work and microphone technique. Some listeners found it difficult to accept that Groven used broadcasts of folk music in their original form rather than using arrangements and selections that had hitherto been the norm. The asymmetrical rhythms and just intervals sounded alien to urban listeners, and the above quote above from *Naturskalaen* is probably representative of common reactions. Groven broadcasted living traditions from around the country, and this was difficult for urban populations to accept because it was a clear break with existing broadcasting traditions, the premises of which had been established in the cities. Groven's work also included educational aspects, such as lectures, which augmented his programming of the music.

Groven's work for radio was part of the construction of modern Norway, and this cultural struggle resulted in greater recognition of Norwegian folk music.¹⁰ Broadcasting technology fostered increased cultural understanding, making it possible for artistic expressions with previously small exposure to gain respect, visibility, and significance. Folk music would probably not have been able to achieve such wide attention without the use of the new technology. Thus, broadcasting had democratizing aspects, in much the same way Internet is considered as having today.

Recording and acoustics

Groven expanded his work when the opportunity to record on film was introduced in NRK in 1936. Through the acquisition of an optical recorder, it became possible to record on film, develop the film, and edit material by cutting and splicing the film. Time accurate editing was not possible because splicing tape had not yet been invented – one needed to overlap and glue the ends of the celluloid together, rendering in-time edits impossible. Only real-time transmissions were possible until the purchase of recording technology, but now radio programmes could be

produced prior to broadcasting them. This was a major advancement from lacquer disc recording that had been the only available recording technology in the two years prior to the use of the optical recorder. Editing became even easier following the introduction of magnetic tape during World War II.

Several sources point to Groven as a main proponent for acquiring recording technology, and using this technology Groven was able to begin his work of collecting folk music. He travelled around Norway, made recordings for the collection, and edited radio programmes. In addition, he notated folk music and wrote arrangements for conventional orchestral instruments. He notated between 150 and 155 *slåtter* (folk dances) from Telemark alone.¹¹ The radically improved opportunities to collect and disseminate music fitted very well with Groven's desire to make just intonation known and accessible to the public, and it can be said that he 'played Norway together as a country' with his music and new technology.¹² His work would not have been nearly as effective without the technology, either in terms of the collection or the dissemination. Thus, Groven contributed significantly to the national project of broadcasting and his efforts were important for realizing the value of radio. The popularity of his programmes, evident in letters from his listeners, suggests that the success of broadcasting depended on listeners' recognition of a cultural heritage that they could call their own, and his broadcasts thus contributed to the legitimization of NRK's perspective of educating and building future Norway. Technological innovation is often used to solve existing problems, and it was the new media reality that created the opportunities for folk music to wield influence beyond its local boundaries.

Groven's work with music broadcasts and recording at NRK made him aware of the significance of acoustics in experiencing music. The 'dry' radio studio was a new invention that would simultaneously give engineers control over the sound and protect the programmes from unwanted external noise. However, with the disappearance of the natural acoustics and reverb of the rooms, the music changed character and lost its bluster. Groven successfully argued that the new radio building (at the time the most ambitious in Scandinavia, and completed during World War II) should include a studio with acoustics specifically tailored for folk music. He found his acoustic ideal in Hovistova, an old farmhouse

built from logs using traditional notching technique, and located at the Folk Museum (Norsk folkemuseum) in Oslo. Groven had noted the acoustic signature of the timber walls during an earlier direct broadcast, and found that it had given the music the type of acoustic warmth that it needed but without blurring the fiddlers' articulations. The reverb time and spectral balance at the NRK studio was adjusted by mounting absorbing materials behind perforated wooden panels in what was to be called 'Studio 17', jokingly also called *fenalåret* (a type of cured lamb's leg). Thus, NRK had built a studio specifically dedicated to folk music, which points to the emphasis placed on this genre and the respect for Groven's competence and initiative. Further in 1937, Groven won NRK competitions for radio signature tunes and intermission signals, which also indicates the level of public interest in folk music aesthetics and what it represented. Studio 17 still exists, although the walls have been painted in recent years, changing the original acoustic signature.

Instrument and system-building

Groven's practical and theoretical research focused, with few exceptions, on methods for making just intonation accessible in the performance of music. In order to 'cancel the distance between human emotion and the material expression', Groven developed technologically advanced instruments by implementing the results from his theoretical work,¹³ described in his book *Temperering og renstemning*.¹⁴

As early as 1929, Groven received a stipend from Anders Backer-Grøndahl to build a piano for just intonation. The idea was for a pianist to be able to tune the piano using 88 long levers that would be moved by electric motors, with the tuning controlled from an extra manual that the musician could use while playing. The measurements that served as the basis for calibrating the motors were made with technical assistance from Jon Christian Skeie, at the Department of Physics, University of Oslo. There were several reasons why the instrument did not become a success: tuning and retuning it took too long, and the instrument became unstable and did not hold pitches well. There were also electrical problems.¹⁵ Physicists were often supportive of Groven's ideas, and lauded both his tenacity and combination of skills, all of which were necessary for the extensive development work that he had chosen to undertake.

Especially Professor Johan Holtsmark from the Norwegian Institute of Technology in Trondheim (now Norwegian University of Science and Technology) was a strong source of support. In 1930, Olav Ryssdal wrote that Groven possessed a rare combination of ideas and skills, and showed extraordinary energy in the pursuit of the tasks he had set for himself.¹⁶

The tuning system was a 36-tone/octave system that Groven later described in detail in his book *Temperering og renstemning*. Following his first attempt and making a piano, Groven started to look at organ instruments with set pitches. By using organs, he could just choose key and thus avoid the problems of retuning altogether, and his first thought was that this should be done with a separate control manual. Groven's position at NRK had given him a basis for developing just intoned instruments, and in 1936 he received a small grant for building a harmonium with just intonation. This reed instrument was finished in 1936, and was used in several broadcasts.¹⁷

When Groven travelled to Germany in 1936 he became aware that he was not the only developer that had come across the idea of using a separate register manual, and his written travel report¹⁸ shows that he became familiar with parallel initiatives for tuning as well as different methods for frequency measurement, all of which were important in his development of instruments with just intonation. Tuning system examples include the Puhlmann system that made use of mechanical methods for changing keys, albeit too slow for practical use in musical instruments,¹⁹ and the Eitz harmonium, with 53 keys/octave²⁰ that rendered the instrument quite difficult to use in performances, even with a three-manual setup.²¹ Groven's report shows clearly that although the principles of just intonation were known and accepted, a practical system for operation had not yet been developed. His interest in methods for frequency measurement had underpinnings in his transcriptions, in a description of folk music studies he wrote that in the 1930s he started to use a Morse code receiver for transcribing rhythm, by tapping in time with the music and measuring the distance between the dots made on the receiver tape.²²

In 1939, Groven came upon the idea for the just intonation automat, which by exploiting the time interval from when a key is struck until air starts flowing into the organ pipes could allow for an adaptive tuning based on octaves, fifths, and major thirds. The selection process was

executed with the use of relays – electrically controlled switches that should open and close for the different organ pipes, depending on what was played. In this way, chords could be tuned according to previously played chords in the same performance, and would not be the result of a preset ‘registration’. The system turned out to be very complex, with more than 300 relays of different types that were engaged and disengaged by the key combinations in the performances.²³ In *Renstemningsautomaten* Groven explained that the relay speed was approximately 4 ms faster than the onset of the tone from when the key was pressed down, and this would necessitate a quite precise playing style because the selection of correct organ pipes would depend on two or more keys being pressed. This is somewhat similar to the first electric MIDI guitars from the 1980s, when the smallest error in picking technique or fingering on the fretboard would give huge errors in tone selection. The entire technical process of the development of Groven’s automat has been described in detail in David Code’s chapter titled ‘Groven *ex machina*: The evolving technology of tuning’, in this book.

Following several years spent soldering, the automat was finally ready in 1947, and the pipe organ was installed in Trinity Church in Oslo in 1954.²⁴ The organ was later installed in Fagerborg Church for a period, and in 1971 it was moved to Eivind Groven’s Organ House, which had been constructed on Groven’s property at Ekeberg with financial support from NRK. Groven’s solution for a practical interface for just intonation is unique, and the solution was re-engineered in conjunction with the construction of an electronic organ with 33 timbres, completed in 1965. This organ had a new type of automat in which the relays were replaced by transistors, but the logic was the same as in the original automat.²⁵ The reconstructed automat was a user-friendly and efficient solution to the problems of adaptive just intonation. However, the construction of the new automat necessitated some changes, since Groven had chosen to employ a 43-tone scale instead of the 36-tone scale he had used until then. In the 1970s, Groven adapted a Sonata electronic organ to just intonation, and when that organ was connected to the transistor automat he went back to the 36-tone system.

It is characteristic of Groven that he harnessed new technology to promote just intonation. In the 1960s, electronic organs with built-in rhythm sections started to make their way into Norwegian households,

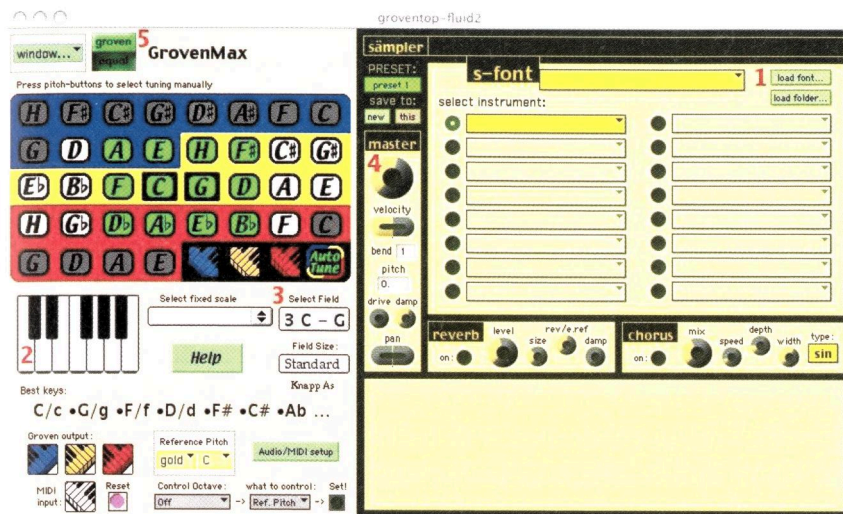
and these organs were the first instruments to give non-specialists the experience of electronically generated timbres and rhythms. Apart from this work, there is no evidence that Groven showed any interest in the qualitatively new methods for sound generation and processing that the advances in music technology presented.

Extensions of Groven's work

Groven's work was realized using analogue technology, but the new possibilities available through digital technology were explored in two computer simulations of aspects of his automat.²⁶ A real-time program that adjusted pitches toward just intonation through the use of MIDI pitchbend was another approach, in a program that added and subtracted the necessary cents of the (half)tone steps in order to arrive at Groven's specifications.²⁷ These programs were made available to the public.

In 2001, musicologist David Code reprogrammed Groven's just intonation logic as a Max-object, and made it available as a stand-alone program.²⁸ The program dynamically selected correct pitch values during performance, and sent the information out on three MIDI channels, each connected to separate Yamaha pianos. The pianos were tuned as the organ pipes, with 36 tones per octave, and performances could thus be given with just intonation. The first concert performed with 'The Groven Piano' took place in 2001 at The Norwegian Academy of Music, with assistance from various sources, including NOTAM and Eivind Groven's Institute for Just Intonation. David Code has described this system in several academic publications.²⁹

The next step along the road to modernization was to establish digital software control of the organ in the Eivind Groven's Organ House, and since the automat was already programmed in Max with the same division of the octave as in Groven's original system, all that was needed was to replace Raad's transistor automat from 1965 with Code's digital automat. The transistor automat was substituted with a desktop computer and a custom-built interface that contained three MIDI cards that would activate the relays when receiving MIDI note messages. This interface communicated with the computer through a USB (Universal Serial Bus). Each of the three MIDI cards translates from MIDI note message to 16V current, and the current opens and closes the relays, controlling



The Groven Max-object with the sampler section to the right.

the airflow to the organ pipes. The relays from Groven's original system were retained, and with these additions Code's digitized automat could be used with the organ.³⁰ The playing manual was replaced with a MIDI keyboard from Kurtzweil.

The changes to the electronic control of the organ were for the most part modernizations of existing technology, replacing obsolete components with hardware solutions made possible through technological developments. However, a clear extension of the system was made when portability was added in 2004. Dag Henning Kalvøy and Henrik Sundt from NOTAM, in collaboration with David Code, extended the digital automat initially made for the organ, so that after it had selected a note an objective pitch in Hertz would be calculated. This pitch would then be sent to a sampler where the sound would be played. Norbert Schnell at IRCAM (Institut de Recherche et Coordination Acoustique/Musique) contributed with customization of the software sampler *Fluidsynth*,³¹ which is free software that uses soundfonts. Soundfonts are developed through sample-based synthesis and can be described as something between recorded and synthetic sound. This type of sound representation is well suited for the microtonal manipulation that the Groven automat requires.

The sound types that are included in the free download are piano, English organ, and a soft synthetic pad. The sampler is open in the sense that users can download and use other soundfonts in addition to those included in the system from NOTAM's side. These changes to the system allow anyone to use Groven's automat anywhere, independently from the organ and the Organ House, given that they have a computer and a MIDI keyboard. The sampler, the sound fonts and the Max-object is freely available from the NOTAM website, called 'Portable Pure Tuning'.³²

Summary

Groven's work in connection with radio and broadcasting was his first encounter with cutting-edge technology and he realized broadcasting's potential for Norway's national identity by giving folk music a new platform. When recording equipment was introduced, Groven embarked on his large-scale work of collecting recorded music, in addition to the notation collection he had made. His collection of music raised the quality of the radio broadcasts, and served as the basis for what were to become large-scale archival efforts. With his programme *Folkemusikk-halvtimen*, Groven created an opportunity for folk music to transgress its boundaries for experience and appreciation, and establish folk music's significance in national cultural heritage. By allowing fiddlers to perform live on air, Groven directed attention to the origins of the music, which was supplemented by his lectures and other educational initiatives. At the same time, using original material emphasized the significance of local culture and physical site for musical origins; the local origins of folk music became part of the construction of a national identity, disseminated by NRK throughout the country.³³ Groven's approach and work at NRK was not without controversy, as the urban population made their criticisms clear in newspapers and other media.

When Groven worked on his just intonation piano, he envisioned an industrial production of the instrument and took out patents on his retuning mechanism in the USA, England, Germany, and France.³⁴ However, this solution was unsuccessful. In newspaper articles there is evidence that Groven also later entertained the idea of mass production of his instruments. For example, he described the relay automat as a prototype ready for production,³⁵ and described his electronic organ in

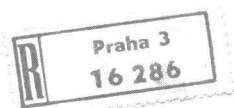
a similar way.³⁶ In 1958, the newspaper *Morgenposten* mentioned that the electronic organ had been patented widely – in Sweden, Denmark, England, Belgium, and Germany.³⁷ Groven's automat represented a highly innovative use of current telephone technology, and the transfer to transistors that was concurrent with the development of the electronic organ suggests that Groven was open to incorporating new generations of music technology. In the journal *Forskningsnytt* 1957, he praised the ease with which just intonation could be achieved with electronic means, while at the same time he expressed reserve against technologically-based new timbres such as those produced by the Hammond organ. His interest in the new technology was clearly focused on its usefulness in extending just intonation.³⁸

Groven's underlying project was the promotion of folk music and just intonation, which he believed was a nature-given aesthetic tonal preference. There is no evidence that Groven developed any interest in the new types of composition techniques that the development of electronics allowed for, and he explicitly distanced himself from much of contemporary music, which he described as both a 'disease' and 'complete craziness'.³⁹ Naturally, this resulted in strained relationships with some of proponents of modernism in Norway, most prominently Pauline Hall. However, composer Klaus Egge described Groven as a natural lyricist. When bringing formal structures from folk music and elements of overtone series into art music, he attached himself to a type of musical modernism that was reaching back to original roots in search of the way forward. Groven can thus be said to have placed himself also in an experimental tradition,⁴⁰ and this might have been one of the reasons why composer Arne Nordheim, in a radio programme broadcast in 1978, characterized Groven as an 'avant-gardist in his time'.⁴¹ However, Groven strongly rejected any human sense of tone and timbre that did not correspond with the natural scale, and philosophically this rather situated humanity outside nature, since man-made tuning systems were thought of as aberrations.⁴² This is an interesting paradox. On the one hand, Groven represented democratization and inclusion with his use of new broadcasting technology, and on the other hand, he represented cultural conservatism by rejecting the musical expressions most clearly emerging from the same industrial and media reality. Thus, Groven bridged an interesting and challenging contradiction.

178.



Herr
Eivind Groven, Komponist
Rødtveit's weg 2.
Simonsbräaten
Oslo



Norwegen

Praha, 14. V. 57.

Sehr geehrter
Lieber Herr Kollege Groven,

Ihr theoretisches Buch mit
tschechischer Übersetzung
hat mich sehr erfreut.
Ich habe über Ihre Orgel,
Ihr Tonsystem und Ihre
Forschung in der Volks-
musik in einem Vor-
trag in unserem Korn-
ponistenverbande berich-
tet und in der Musik-
zeitschrift des Verban-
des anged. In dem ver-

öffentlichem Verzeich-
nis der norwegischen
Musik auf Magneto-
phon Bändern habe ich
auch Ihre 1. u. 2. Sym-
phonie angegeben.

Herr Bjarne Kortsen,
der mich zu Ihnen ge-
bracht hat, ist nun in
Praga beim Frühjahrs-
musikfest. Wir beide
senden Ihnen beste
Grüsse und Erinnerun-
gen.

Jeg takker Dem hjertligst
for Deres bok som er meget
verdiful og er med de
hjertligste hilsener

Pod vilamizt.
Praha - Rusle

Alois Hába

Letter, 14 May 1957, from the Czech composer Alois Hába, commenting Groven's work with the pure-tuned organ. Owner: Eivind Groven's Institute for Just Intonation.

Groven's ambition of replacing tempered tuning was daring and there came a point in time when technical developments in the electrical industry made it possible for him to realize this ambition. Despite the resistance he experienced, Groven seems to have believed that musicians and the general public would support just intonation when made aware of it and when it was possible to use it on a broader scale. Momentum for just intonation peaked with the installation of the organ in the Trinity Church in 1954, and through subsequent recordings made with the organ. Public attention was greatest when the Nobel Peace Prize Laureate Albert Schweitzer played the organ and the event was described quite extensively in the press. The public was becoming acquainted with just intonation and the organ was in use in Trinity Church for several years before it was moved to Fagerborg Church. However, it proved difficult to gain public acceptance for the idea that just intonation was the only correct tuning system and that the natural scale was superior to other scales. Moreover, there was a lack of support for this idea from the modernist music scene, which was not particularly interested in microtonality, as expressed during the Darmstadt summer courses, among other events, from 1946 and onwards.

The organ was moved to the Organ House at Ekeberg in 1971, where it remained virtually unchanged until David Code's digitization of the automat in 2001. The system in the Organ House has since been modernized and a portable automat for electronic instruments has been developed and is freely available as a download from NOTAM's pages. The Internet is currently the most important medium for dissemination, and time will show how much the just intonation automat will come into use with the opportunities afforded by this new development. If we direct our attention once more to the social aspects of technology, it is through the conscious creation of a practice that technology and its value is realized, and this is currently the most important challenge for the just intonation automat and its proponents.

To be of consequence, ideas and technologies must be supported and included in social practices. New technological developments typically challenge existing boundaries and inspire innovation, and at the same time contribute to the formation of new social groups of users. One question related to understanding Groven's significance is thus whether his work with technology created a new consciousness, and to

what extent his work as a researcher and developer has been and will continue to be taken up in the social, cultural fabric. From this perspective, Groven's work at NRK undoubtedly yielded the most important impact on public acceptance of just intonation and folk music to date. The radio programme he created is still broadcast, more than 80 years after it was established. Interestingly, while Groven believed it better to concentrate on national cultural heritage, today's global means of dissemination brings his contributions to just intonation, to the awareness of local musical origins and to Norway's cultural heritage, way beyond the country's national borders. At the same time, folk music is flourishing once again on the national cultural scene.⁴³



Eivind Groven (playing Bach?) at the pure-tuned pipe organ in Trinity Church (Trefoldighetskirken) in Oslo, 1953. The organ is now housed in Eivind Groven's Organ House at Ekeberg in Oslo (Eivind Groven's Institute for Just Intonation). Photographer: Unknown. Private. Source: Billedsentralen.



The electronic pure-tuned organ in the living room, Nedre Nordjordet, Ekeberg in Oslo. Photographer: Per Michaelsen, 1969, Private.