Taming tempests through telegraphy and media appearances: Science communication and the construction of a Swedish storm warning system before the Great War

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Summary

The aim of this paper is to explore relations between science and the public. Specifically, Swedish meteorology around 1900 and the rôle of media relations in the construction of a storm warning system will be discussed. It is argued that science-public interaction can be a factor in the process of establishing priorities in science.

Contents

1. Introduction

In this paper, various communicative practices are discussed, with early twentieth-century Swedish science in general and, more specifically, cosmical physics and meteorology as the setting. The focus is on how science develops in interaction with the public, the subject is the construction of a storm warning system in Sweden, and the rôle of communication in the construction and stabilization of that system. In the following, we will look at how one part of the Stockholm cosmical physicists' work – meteorology – was made into a public commodity, in the form of storm warnings. We will look at how interactions between the meteorologists and the public helped shape the Swedish system for stormwarnings. The meteorologist Nils Ekholm and some of his fellow scientists in the group of cosmical physics in Stockholm were often present (and presented) in the media, media appearances were an integral part of their scientific identities.

This paper approaches the science of meteorology from two directions. One is Ekholm and his colleagues and the various scientific networks and institutional milieux they moved in. The other is the influence of the Stockholm press and other parts of the public. The paper discuss the shaping of the priorities of meteorology as the outcome of interaction both within the scientific and the media/public world. Audiences in Stockholm and other parts of Sweden were, it is argued, not passive but active in the process that led to the establishment both of a centralized stormwarning system on a national scale as well as the further stabilization of Ekholm's position within the establishment. Sources include popular science texts, public speeches, scientists interfacing with the public through boundary organizations, even publically staged experiments where citizens were enrolled as experimenters.

A growing literature suggests that interaction with audiences outside of academe or the state are important in shaping science and technology. Knowledge about and interest in a particular scientific programme among various subsets of the public can bring resources to scientists. Mass media can have implications for the course of scientific development. The co-construction of users and producers of technologies and the importance of grasping the dialog between science and the public when charting the development of science are themes underscored in parts of history of science and technology, science and technology studies, and related fields.[1] As Thomas

[1] Stephen Hilgartner, 'The Dominant View of Popularization: Conceptual Problems, Political Uses,' *Social Studies of Science* 20 (1990), Bruce V. Lewenstein, 'Cold Fusion and Hot History,' *Osiris*

F. Gieryn has observed, mass media and its audiences can sometimes enter as players in the research process, to the extent that media texts and their readers and authors in a sense become equivalents to the 'gentlemen witnesses' of the seventeenth century. Journalists become 'vital allies' to the scientist and press conferences can sometimes become sites of science.[2] Such communicative practices can be one way of making parts of the scientific enterprise more in tune with the wishes and demands of society at large, it can be an area of evaluation, contributing a mechanism for social testing of new technologies or scientific systems.[3] Therefore, analyzing the boundary organizations that facilitate such communications and the sources they produce, such as press releases, are sometimes important for understanding what goes on in the history of science.

Nils Ekholm, Svante Arrhenius, the media and cosmical physics

One hundred years ago, there was, as Sven Widmalm has argued, not a single style of communication with external audiences in Swedish science.[4] Media presence varied across the map of Swedish science. One style of communication was found in a group at the well established universities in Uppsala and Lund. They already had significant status and resources. The Uppsala physicists discussed by Widmalm, the spectroscopists Thalén and the Ångströms, belong here; generally sceptical of the attempts to gain access to the media, they had opponents in an emerging cadre of new men of science. Exemplified by such names as the chemist and physicist (and Nobel laureate) Svante Arrhenius, the polar explorer Adolf Nordenskiöld and the

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7 (1992), Nelly Oudshoorn, 'On Masculinities, Technologies, and Pain: The Testing of Male Contraceptives in the Clinic and the Media,' *Science, Technology, and Human Values* 24 (1999), Nelly Oudshoorn and Trevor J. Pinch, *How Users Matter: The Co-Construction of Users and Technologies* (Cambridge, Mass.: MIT Press, 2003), Peter Weingart, 'Science and the Media,' *Research Policy* 27 (1998).

[2] Thomas F. Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (Chicago: University of Chicago Press, 1999) chapter 4, quote: 200.

[3] Oudshoorn, 'On Masculinities, Technologies, and Pain: The Testing of Male Contraceptives in the Clinic and the Media.'

[4] Sven Widmalm, *Det öppna laboratoriet: Uppsalafysiken och dess nätverk 1853-1910* (Stockholm: 2001) chapter six.

mathematician Gösta Mittag-Leffler, this group often entered a public stage where they attacked scientific opponents, distributed credit in the form of awards, and furthered their causes by publically aligning with the interests prevalent in Swedish society. In this culture of official celebration and visibility, the individual genius was put in focus; innovations and the importance of science for industrial development was emphasised, rather than science for its own sake. These scientists thrived in the media. Several of them had their academic home at the newly founded Stockholm Högskola (university college). Founded in 1878, it did not have the traditions connected with universities in Uppsala (founded in 1477) or Lund (1666).

At the universities, latin had long been a compulsory subject and the graduates had to study seven subjects according to the rules laid down in 1870. Scientists at the universities were for the most part critical of this state of affairs and they had better things coming; in the 1891 university statutes, compulsory latin study was dropped and the number of subjects in the bachelor degree was lowered to five, these could now also be more freely chosen. Research was somewhat upgraded in status at the universities around the turn of the century, but the universities did not seem to want to part with their traditional identity of education of civil servants and teachers, an identity in which science played only a part alongside the humanities. The Stockholm university college, on the other hand, initially placed research and science at the centre. The first professors there were all scientists rather than humanists. A country that went through a rapid process of industrialization in the second half of the nineteenth century, Sweden had a number of critics that claimed that the classical universities were not in tune with time. Scientists at the Stockholm university college and in other placed in the decades around 1900 – industry laboratories, research institutes outside of the universities, various state offices and other sites of scientific activities – had other ways of connecting with society. Without the status that came with the professorial chair at an old and well established university, the Stockholm scientists utilised other ways to gain support, one being public recognition. They worked actively to create stages or arenas there they could publicize their activities. Celebrations of science such as the Nobel prize, first awarded in 1901, were recurrent spectacles that drew the attention of the media and the public and made it possible for the scientific enterprise to enter the public view and imagination. To accomplish this, they sought out the media with targeted efforts. Several studies have brought forth evidence of the many and heterogeneous milieux where Swedish scientists were active in

the decades around 1900. Meteorology is a further example of the phenomen that many links held together the research enterprise with groups 'external' to science.[5]

The meteorologist Nils Ekholm was, together with Vilhelm Bjerknes and Svante Arrhenius, a leading figure of the Stockholm Physics Society.[6] This was a group comfortable with media exposure and openness, whereas the physicists at the well-established physics department at Uppsala university looked with scorn upon the Stockholm physicists' way of dealing with the Stockholm newspapers.[7] Whether it was the introduction and presentation of discoveries and inventions such as X-rays and radium, drumming up publicity around their own work, or antagonistic scheming against their enemies in Swedish or Nordic Academia, the Stockholm physicists often sought out publicity. Controversies were sometimes aired publically at the society's meetings, which soon appeared in the press. The science presented was not always mature knowledge explained and 'translated' for public consumption; the Stockholm scientists often lifted new developments straight from the research front that hadn't yet entered the consensus of the scientific establishment, but were rather science in the making, put out for public dissemination, inspection, and discussion.[8]

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[5] Gunnar Eriksson, *Kartläggarna: naturvetenskapens tillväxt och tillämpningar i det industriella genombrottets Sverige 1870-1914* (Umeå: Umeå universitetsbibliotek, 1978), Thomas Kaiserfeld, *Vetenskap och karriär: Svenska fysiker som lektorer, akademiker och industriforskare under 1900-talets första hälft* (Lund: 1997), Anna Tunlid, *Ärftlighetsforskningens gränser: Individer och institutioner i framväxten av svensk genetik* (Lund: Avdelningen för idé- och lärdomshistoria, 2004). The many cases of extramural activities in the history of Swedish science could in this period could make the country a case along the lines of Pestre, in the critique of notions of such connections being of recent date. Dominique Pestre, 'The Production of Knowledge between Academies and Markets: A Historical Reading of the Book *The New Production of Knowledge*,' *Science, Technology, and Society* 5 (2000).

[6] Elisabeth Crawford, *Arrhenius: From Ionic Theory to the Greenhouse Effect* (Canton, MA: Science History Publications, 1996), Robert Marc Friedman, *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology*, 2 ed. (Ithaca: Cornell University Press, 1993), Axel Wallén, 'Nils Gustaf Ekholm,' *KVA Årsbok* 23 (1925), Anders Ångström, 'Ekholm, Nils Gustaf,' *Svenskt biografiskt lexikon* (1949).

[7] Widmalm, *Det öppna laboratoriet: Uppsalafysiken och dess nätverk 1853-1910* 282.

[8] One instructive example was when Ekholm, at a meeting with the physics society on 11 March 1899, criticized Kristian Birkeland's theories on auroræ and sunspots, a field where Ekholm had

The press articles about the talks held by Ekholm, Arrhenius, Bjerknes and others at the Physical Society meetings are of such length and consistency that it is probable that the journalists worked from press reports that were reported more or less verbatim. The society was a kind of boundary organization that aimed at facilitating the communication within the scientific world as well as matching together the scientists and the general newspaper-reading public which, needless to say, included groups vital for the Stockholm physicists' work: politicians, industrialists.[9]

Several of the Stockholm physicists were active in a synthetic tradition that was something of a continuation of the Humboldtian science of the nineteenth century.[10] Often called cosmical physics, the field studied natural phenomena on large spatial scales and was a meeting of astronomy with meteorology and other geosciences.[11] The *Encyclopædia Britannica* defined it as 'a term broadly applied to the totality of those branches of science which treat of cosmical phenomena and their explanation by the laws of physics. It includes terrestrial magnetism, the

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published several works together with Svante Arrhenius and therefore had an interest in creating opinion against Birkeland's work. The open meeting of the Physics society and the newspaper coverage for the meeting was used as arenas of public scientific debate. It was also a space where it was possible to say things in another rhetorical tone than in the scientific literature, like calling Birkeland's theories outright 'fantastic fiction'. 'Solfläckarna och norrskenen,' *Aftonbladet*, 15 March 1899.

[9] For more on boundary organizations, see David H. Guston, 'Boundary Organizations in Environmental Policy and Science: An Introduction,' *Science, Technology, and Human Values* 26 (2001), David H. Guston, 'Stabilizing the Boundary Between US Politics and Science: The Role of the Office of Technology Transfer as a Boundary Organization,' *Social Studies of Science* 29 (1999).

[10] Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (Kent: Dawson, 1978) chapter three.

[11] The scientists doing cosmical physics had synthetical ambitions, pertaining to a conceptual unity, but that had not yet been institutionalized in departments, chairs, a process that happened in the 20th century with the creation of institutional structures, sources of funding and patronage that supported a subset of what had been cosmical physics: the earth sciences. Ronald E. Doel, 'The Earth Sciences and Geophysics,' in *Companion to Science in the Twentieth Century*, ed. John Krige and Dominique Pestre (London, New York: Routledge, 2003).

tides, meteorology as related to cosmical causes, the aurora, meteoric phenomena, and the physical constitution of the heavenly bodies generally. It differs from astrophysics only in dealing principially with phenomena in their wider aspects, and as the products of physical causes, while astrophysics is more concerned with the minute details of observation.'[12] Svante Arrhenius worked on cosmic phenomena of broad range, such as the question of the origin of life on Earth and the ultimate fate of the cosmos. He even argued that physiological phenomena, such as menstruation and epileptic seizures, varied in tune with cosmical processes and speculated that the positions of the Moon and Sun influenced the Earth's atmospheric electrical field, which in turn influenced the human nervous system. Besides such work, Arrhenius also worked on attempts at institutionalizing the field by publishing a textbook on cosmical physics, aimed at academic audiences.[13] Together with Ekholm, Arrhenius published several studies of cosmical physics on the influence of the Moon on weather, thunderstorms, air electricity, and the aurora borealis, where the statistics of these phenomena where analyzed. They found correlations; both the Moon and the Sun could possibly influence geophysical phenomena. Arrhenius also put Man in these grand schemes: are humans under the influence of cosmic variations? Datasets consisting of tens of thousands of recorded times of births, times of menstruation, and the onset of epileptic seizures showed period of one tropical month and one close to 26 days. Arrhenius speculated that variations in the atmospheric electricity could influence the human nervous system. He also devised theoretical mechanisms that explained the dynamics of the solar corona, the tails of comets, the riddle of the nebulæ, and the ultimate fate of the cosmos: exchange of matter between stars and nebulæ would, Arrhenius argued, keep the heat death in check. The universe, thus, was eternal. Synthesizing his ideas in a series of lectures at the Stockholm university college and in his textbook *Lehrbuch der kosmischen Physik*, Arrhenius became a proponent of a synthetical type of cosmical physics.[14]

The difference between the synthetical ambitions of the cosmical physicists and the astrophysicists working on 'minute details of observation' noted by the *Encyclopædia Britannica* was

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[12] 'Cosmic,' in *The Encyclopædia Britannica* (New York: The Encyclopædia Britannica Company, 1910).

[13] Svante Arrhenius, *Lehrbuch der kosmichen Physik*, 2 vols. (Leipzig: Hirzel, 1903).

[14] Crawford, *Arrhenius: From Ionic Theory to the Greenhouse Effect*, Gustav Holmberg, *Reaching for the Stars: Studies in the History of Swedish Stellar and Nebular Astronomy, 1860-1940* (Lund: History of science and ideas department, Lund university, 1999) 171-81.

real enough. Astrophysics and physics aimed at precision measurements had a strong position at the Lund and Uppsala departments of physics and astronomy, also when these scientists worked on subjects within science relating to geophysics, such as geomagnetism, where several they did precise observation in cosmical physics, rather than the larger synthesizing style of cosmical physics pursued by Arrhenius and others. At Uppsala, Thalén and the Ångströms worked on mapping and measuring the solar spectrum and perfecting the measurement of solar radiation. Nils Dunér worked, both at Lund and Uppsala observatories, on observational astrophysics such as the classification of stellar spectra and spectroscopical measurements of redshift in the solar spectrum due to the Sun's rotation.[15]

Cosmical physics lent itself more to engagement with the media and popularisations compared to the more precision measurement kind of physics. In this way, Swedish cosmical physics mirrors the situation in Britain, where Balfour Stewart, Norman Lockyer and others brought similar perspectives to the media market.[16] This is evident in the media appearances of the Stockholm group of cosmical physics. It also became evident when Svante Arrhenius published *Världarnas utveckling* in 1906. It was a popularization of Arrhenius' scientific work in the field of cosmical physics and became a success in the Swedish book market; it appeared in eight editions, the last published in two volume in 1929 and 1929 (then, after Arrhenius' death, expanded by Knut Lundmark). It was translated into English, German, French, Finnish, Russian, and Italian.[17] It drew up a vast panorama of cosmic connections, beginning with catastrophic geological processes – which, following the 1906 San Francisco earth quake was a newsworthy topic –, then moving on to discussions of how the Earth is connected with the solar phenomena, before reaching out to the ultimate questions of the stability of the cosmos, where Arrhenius solved the problems with entropy that otherwise seemed to put limits to the possibilities of an eternal universe. As if this was not enough, the question of the origin of life was also explained, where

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[15] Holmberg, *Reaching for the Stars: Studies in the History of Swedish Stellar and Nebular Astronomy, 1860-1940*, Widmalm, *Det öppna laboratoriet: Uppsalafysiken och dess nätverk 1853-1910*.

[16] Graeme Gooday, 'Sunspots, Weather, and the Unseen Universe: Balfour Stewart's Anti-Materialist Representations of "Energy" in British Periodicals,' in *Science Serialized: Representations of the Sciences in Nineteenth-Century Periodicals*, ed. Geoffrey Cantor and Sally Shuttleworth (Cambridge, Mass.: The MIT Press, 2004).

[17] Olov Amelin, 'Physics as Ideology: Svante Arrhenius as a Writer of Popular Science,' in *Center on the Periphery: Historical Aspects of 20th-Century Swedish Physics*, ed. Svante Lindqvist (1993).

Arrhenius famously argued that life had not begun on Earth but had arrived here as bacteria floating through space, sailing on cosmic radiation pressure. It was a book of daring speculation draped in scientific clothing.[18]

Fields such as geomagnetism, meteorology, and studies of the aurora borealis could, besides the support from the academic system, also count on strong financial and symbolic support from the extensive programme of Swedish polar expeditions, in which the geosciences were vital parts. This was a highly visible activity placed in the spotlight of the media, and Nils Ekholm knew this: he had witnessed the power of the printing press first-hand when he, one of the three participants in the Swedish expedition by balloon to the North pole led by S.A. Andrée, left the expedition before lift-off because he felt the proper safety precautions had not been taken, an act (in the words of Ekholm's biographer) 'for which he had to bear much criticism especially in the sensationalist daily press, but one for which he, as the results showed, had very good reasons'. The expedition's three men, with a stand-in replacing Ekholm, vanished in the Arctic wilderness; the remnants of them was found in 1930 along with photographs, that were later developed, and diaries detailing their perils.[19] Prior to Andrée's expdition, Ekholm had been leader of the Swedish meteorological expedition to Spitsbergen during the international polar year 1882-1883. Swedish polar expeditions were large-scale enterprises where Swedish technology and science were placed in the centre of media attention, often with nationalistic overtones. Many of the scientists active in polar research presented their work in a national rhetoric, and got access to financial and symbolic resources from *nouveau-riche* industrialists and the Swedish royal court. In the words of historian of science Sverker Sörlin, '[p]olar science thus became a powerful manifestation of the progressiveness of the northern nation.' Long series of geophysical observations and collections of natural history specimens took on an identity of national achievements.[20] By taking part in polar explorations with its many connections with public

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[18] Svante Arrhenius, *Världarnas utveckling* (Stockholm: Geber, 1906).

[19] Urban Wråkberg, *The Centennial of S.A. Andrée's North Pole Expedition: Proceedings of a Conference on S.A. Andrée and the Agenda for Social Science Research of the Polar Regions* (Stockholm: Center for history of science, The Royal Swedish Academy of Sciences, 1999), Ångström, 'Ekholm, Nils Gustaf.'

[20] Sverker Sörlin, 'The Burial of an Era: The Home-Coming of Andrée as a National Event,' in *The Centennial of S.A. Andrée's North Pole Expedition: Proceedings of a Conference on S.A. Andrée and the*

interest and the public presentation of scientific achievements draped in symbolism of national pride, Ekholm experienced a kind of media training.

3. The media and the storm of 1902

When the Swedish parliament allotted funds for a central meteorological bureau in 1872, one of the tasks set for the organization was issuing weather forecasts and, with extreme weather on the horizon, storm warnings. A handful of ships saved annually because of stormwarnings would surely compensate the costs of running the bureau, it was argued in parliament.[21] Such national economic arguments surfaced several times in the rhetoric around the central meteorological bureau.

Thirty years later, in 1902, a system for the production and distribution of storm warnings had not yet been implemented in Sweden. In that year, Robert Rubenson, director of the bureau, died and Ekholm, an employee at the Bureau since 1890, was one of the candidates for the post as director. He had external allies that presented arguments in the public about his suitability for the post: Ekholm was described by the daily paper *Dagens Nyheter* as 'a man with initiative and energy […] the most agile and active of the Bureau's staff'. The article also mentioned that the Bureau had not followed the bylaws by failing to issue storm warnings.[22] Despite the good press, Ekholm did not win the appointment process, and Hugo Hamberg was appointed as the new director.

Ekholm continued to work on his career improvement as well as the development of a system for storm warnings (these two co-evolved), and we will in the following look more closely at the interconnections between Ekholm, the storm warning system, the media, and various groups in Swedish society. He was critical of the Bureau's lack of storm warnings, and took this criticism out in the open. Ekholm represented another kind of meteorology than Hamberg's, and the atmosphere at the bureau seems to have been partly antagonistic at times. Looking back on this

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Agenda for Social Science Research of the Polar Regions, ed. Urban Wråkberg (Stockholm: Center for history of science, The Royal Swedish Academy of Sciences, 1999).

[21] *Riksdagens protokoll vid lagtima riksmötet år 1872. Andra kammaren*, vol. 2 (Stockholm: 1872) bilaga no 7.

[22] 'Meteorologiska byråns framtid,' *Dagens Nyheter*, 7 november 1902.

situation more than a decade later, Ekholm claimed that 'almost all of my proposals for better methos were vetoed by Rubenson and H.E. Hamberg'.[23] What kind of meteorology was to be performed at the Bureau, was it the climatological studies of Hamber, or the more dynamic meteorology of Ekholm? That question might have been settled or at least stabilised for a period of time by the powers that appointed the director. The director could have influence on the kind of meteorology pursued at the Bureau via the more or less daily running of the Bureau's activities. The state, through its various instances and organizations, could influence the course of the Bureau's activities through regulations. These rather traditional policy actors and policy processes were in place, were active, were vital, but they did not wholly determine the outcome. Comparisons and priorities between various kinds of meteorology were sometimes settled in the open spaces of media, facilitated by boundary organizations such as the Physical society. Through media and communicative practices, Ekholm and others built up momentum for the kind of science Ekholm thought played a too minor rôle at the Bureau, even after he and the type of meteorology he represented had lost the appointment process in 1902. In what follows, we will examine the workings of such heterogeneous policy making, with comparison with other European countries.

Severe storms are forceful phenomena that like a flash shines the light on various societal structures and phenomena. The severity of at big storm can bring meteorology into connection with political and ideological fractures in a society; they can influence the political situation – witness the amount of political debate following the Katrina disaster in 2005 – or, at least, lead to new situations for meteorology. In such instances the media are of course of central importance and meteorologists' handling of such storms and their media dramaturgy are thus important. They become forceful reasons for evaluating the science of meteorology and the practice of storm warnings; they can become vehicles for pushing the implementation of storm warnings faster through the policy system. One example of this was the severe storm in late October 1859 what was so disastrous to Great Britain. It reshuffled meteorological science and changed the position of meteorology in British culture and society.[24] Another event occurred in December 1902 when, immediately following Hamberg's appointment as director of the Bureau, a severe

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[23] Letter from Nils Ekholm to Svante Arrhenius, 27 February 1916. Folder E01:1, Nils Ekholm collection, Center for History of Science, The Royal Academy of Sciences, Stockholm.

[24] Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago & London: The University of Chicago Press, 2005).

storm swept the coastal areas of southern Sweden. People were killed, telegraph communications with the outside world were disrupted, railroad tracks were torn loose and thrown up in the air; humans and the emblematic high technologies of the newly industrialized Sweden were presented in the media as vulnerable to the disruptive energies of the storm.[25] In less than two weeks time, Ekholm organized a public meeting at the Royal Academy of Sciences in Stockholm where he argued for the construction of a system for storm warnings in Sweden. The audience contained, besides the newly appointed bureau director Hamberg, highranking naval officers and officials in the maritime sector and members of cabinet. Ekholm used a nationalistic rhetoric and discussed the severe weather conditions that had struck the nation and how a storm warning system could minimize such damages in the future – he claimed that financing a storm warning system would be a good investment for the Swedish state.[26]

A month later, Ekholm addressed the Physics society with a slightly different rhetoric. He discussed recent attempts at understanding the causes of storms, the technicalities of storm predictions, and the advanced technological methods of reaching high altitudes with meteorological instruments. The audience – consisting of those present as well as the readers of the newspapers' accounts – got the impression that Ekholm and his colleagues were working with modern methods and instruments to understand the factors behind the development of storms.[27] Because of its connection with technologies such as self-recording instruments for *in situ* measurements at high altitudes, aeronautics, and telegraphy, Ekholm's way of doing meteorology had an air of modernity, of speed, of new science-based technologies that permitted long-range control and communication. On the theoretical side of things, similar claims to modernity were evident in the Stockholm Physics society. In the Stockholm group there was Vilhelm Bjerknes, who in these years already had begun his work that later on would lead to new approaches to analysing the weather.[28] In the press, the work of Bjerknes and others was presented as ways to a 'rational method' for weather predictions; the reporting showed Bjerknes

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[25] 'Orkanen och dess härjningar,' *Svenska Dagbladet*, 29 december 1902, 'Orkanen på västkusten,' *Svenska Dagbladet*, 28 december 1902.

[26] 'Stormarna och den moderna meteorologien. Inrättande af stormvarningar å Sveriges kuster,' *Svenska Dagbladet*, 9 january 1903.

[27] 'Sammankomster. Fysiska sällskapet,' *Dagens Nyheter*, 16 february 1903.

[28] Friedman, *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology.*

as the theoretician and discussed Bjerknes' new graphical methods used in calculating forecasts.[29] For the initiated, this dynamical meteorology was wuite different from the one pursued by Hamberg, whose speciality was the influence of peat bogs and forests on the Swedish climate. Ekholm had a keen interest in the technical side of this way of doing meteorology, such as aeronautics and telegraphy. When the Swedish aeronautical society was founded in 1900, he became its first chairman. He wrote about wireless telegraphy and its prospects for the distribution of weather observations - quite another thing than peat bogs.[30] The difference betweem Ekholm's more applied and dynamic kind of meteorology, and the more long-term climatology of, for example, Hamberg, was sometimes made explicit in Ekholm's public presentation of meteorology. In a speech held at the Physical society in the spring of 1904, he criticized the way meteorology was pursued in Sweden when he claimed that the interest in dynamic meteorology 'had been waning among the official leaders of meteorology'.[31]

Systems for forecasting and storm warnings, often built upon technologies such as telegraphy, were constructed in several European countries from mid-nineteenth century and onwards. After a number of mistakes in the business of making and issuing storm warnings and predictions had occurred, several countries saw a more cautious approach to public warnings. Later on, interest grew again. Katharine Anderson has shown in a detailed analysis of meteorology in Victorian England that the strength of the popular interest meant much to the policy process surround meteorology; popular expectations and interests in the weather became one of the factors driving the conjunctures of meteorology.[32] The Stockholm debates about dynamic meteorology vs. climatology and Ekholm's practice of 'going public' as a way of building alliances that gave support to meteorology had parallel cases in several other European countries. If anything, Sweden was a latecomer to the field of storm warnings, the Netherlands having begun issuing storm warnings in 1860, France in 1863, the Norddeutsche Seewarte in Hamburg in 1868, and

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[29] 'Rationell metod för väderleksförutsägelser,' *Stockholms Dagblad*, 26 October 1903, 'Rationell metod för väderleksförutsägelser,' *Dagens Nyheter*, 26 October 1903, 'Vid fysiska sällskapets sammankomst,' *Aftonbladet*, 26 October 1903.

[30] See for example Nils Ekholm, 'Om telegrafering utan tråd', folder F01:5, Ekholm collection, Center for History of Science, The Royal Academy of Sciences, Stockholm.

[31] 'Om stormar,' *Stockholms Dagblad*, 14 May 1904.

[32] Anderson, *Predicting the Weather: Victorians and the Science of Meteorology*.

Russia in 1874.[33] That Sweden lagged after and that the country needed an ambitious programme of meteorological reformation was a rhetoric sometimes used by Ekholm, for example in a speech he held in the physics society in 1903.[34] Similar arguments had been heard before, when the physicist and member of parliament Erik Edlund in 1872 argued for the creation of a central bureau of meteorology.[35]

4. Developing the storm warning system through communication

Ekholm was successful in his attempts to build up support through media work; a system for the prognostication of storms and the distribution of storm warnings in Sweden was financed and implemented. In September 1905, the system began distributing storm warnings to 27 stations along the southern and western coasts of Sweden. If an approaching storm was predicted, the Central bureau sent out a telegram that was posted on official bulletin boards at the stations along the predicted track of the storm. Some stations were also equipped with semaphore signals, so that ships out at sea could see if a storm warning was issued.[36]

The fishing and shipping communities, the users of the storm warnings, publically identified themselves as supporters of the project, both before it had been implemented and after. These sectors were, from Ekholm's perspective, vital allies that gave him both symbolic and financial support. A Scandinavian fishing conference in 1904 had discussed the lack of a system of storm warnings in Sweden and issued a public statement that argued that the process to build such a system ought to be speeded up.[37] In 1906 and 1907 he applied for and got external funding from the Swedish Merchant and Seafaring Foundation 'for making scientific investigations of the storms in the western and southern part of Sweden to improve the precision of the storm warnings', at a time when such research was not sufficiently financed by the Central Meteorological Bureau 'whose resources where being used for other tasks'. External allies was an

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[33] Compare the Swedish case with ten other countries presented in Ibid. table 2.1.

[34] 'Stormarna och den moderna meteorologien. Inrättande af stormvarningar å Sveriges kuster.'

[35] *Riksdagens protokoll vid lagtima riksmötet år 1872. Andra kammaren*, vol 2, 542 ff.

[36] Nils Ekholm, 'Om lufttryckets ändringar och därmed sammanhängande företeelser,' *Ymer* (1908).

[37] 'Fiskerikonferensen i Marstrand,' *Göteborgs Handels- och Sjöfartstidning*, 18 July 1904.

important factor in the development of meteorological research activities at one of the leading institutes of meteorology in Sweden.[38]

That the users were satisfied with the system once it had been created was an important part of the future of the system, and as Ekholm worked to maintain and improve the technical and scientific parts of the system, he also focused on the social and publicity parts of the system; the publicity works of Ekholm did not end once the system had been implemented. Ekholm and the storm warning system is a clear example of communication being an integral part of a technoscientific project. Ekholm spent quite some time to collect, systematize and publish the user's opinioins about the system. These publications were aimed at a readership that could influence the future of the system. He published letters and reports from fishermen, giving the users' opinions of the system. All users were not of course equal: in the reports users from important sectors of the economy such as shipping were highlighted. Such publications went a bit towards increasing trust in the system among politicians and state officials.[39] The positive evaluations from the users were arguments for defending the storm warning system. Ekholm wrote about how 'the storm warnings had become so popular among the coastal population [on the west coast], that the fishermen and seamen in the eastern and northern parts of Sweden began asking for such a benefit."[40]

Storms could give publicity and provide traction for the plans of constructing a storm warning system, but they also held the potential of destabilizing meteorological systems. One example of this was when a strong storm hit Marstrand on the west coast of Sweden in July 1907, killing 14 people travelling by boat on a leisure trip, an accident that could be seen as a threat to the Swedish storm warning system. Ekholm claimed that the system had, in fact, worked: the storm had been correctly predicted, a storm warning had been duly issued, and, according to Ekholm, no fishermen were killed because they heeded the issued warning. The problem was rather

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[38] Nils Ekholm, 'Det svenska stormvarningsväsendet', Nils Ekholm collection, Center for History of Science, The Royal Academy of Sciences, Stockholm.

[39] Ekholm, 'Om lufttryckets ändringar och därmed sammanhängande företeelser.', Nils Ekholm, *Stormvarningarna i Sverige: En liten historik* (Stockholm: 1910), Nils Ekholm, *Stormvarningarna på Sveriges västra och östra kust 1905-1910: Omdömen och iakttagelser* (Stockholm: 1911).

[40] Nils Ekholm, 'Det svenska stormvarningsväsendet', Nils Ekholm collection, Center for History of Science, The Royal Swedish Academy of Sciences, Stockholm.

members of the general public who did not listen to the warning before going out to sea; in the papers, it was made clear that the 14 people killed were not professional seafarers.[41]

Ekholm was successful in establishing a public image of the system's reliability. Initially, the system did not, for financial reasons, exist on the east coast, but an expansion in that direction was of interest to both Ekholm and the users. Organizations in the shipping and fishing industries pushed for an expansion of the system, and asked the government for funding for such an expansion. In 1913, parliament decided to fund such an expansion, after a debate where nationalistic and economic arguments had been aired. Prior to the decision in parliament, several reports of experts from organizations such as The Royal Swedish Academy of Sciences, and the Board of agriculture (a governmental organization that among other things worked on fishing industry) had been positive.[42] Before such an expansion could be implemented, though, the Great War broke out, which put a temporary stop to the international dissemination of meteorological data, with the consequence that the storm warning system ground to a halt. Expansion of the Swedish storm warning system had to wait until after the war.

The parliament's decision in 1913 to fund further expansion of the stormwarning system marks the end to Ekholm's activities to implement a Swedish storm warning system. He had been instrumental in getting the system going in the first instance, and had been successful in building up trust for the system, so that official Sweden decided to continue building up the system. In the same year, Ekholm was appointed professor and director of the meteorological Bureau of Sweden. Public communication had been one of the tools used by him to further his own career as well as the kind of meteorology he represented. His professional position when this process began had been rather weak; during the 1890's, he was assistant (*e.o. amanuens*) at a bureau that did not work on storm warnings. Public communication and interaction with actors outside of science and meteorology had been useful for Ekholm's career. The system of storm warnings was a heterogeneous system consisting of weather observations from various parts of the world,

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[41] Ekholm, 'Om lufttryckets ändringar och därmed sammanhängande företeelser,' 388f, Ekholm, *Stormvarningarna på Sveriges västra och östra kust 1905-1910: Omdömen och iakttagelser*, 'En ohygglig ovädersnatt,' *Göteborgs-Posten*, 19 July 1907 1907, 'Olycksnatten i Marstrand,' *Göteborgs Handels- och Sjöfartstidning*, 19 July 1907.

[42] 'Kungl. Maj:ts nådiga proposition nr 236,' *Bihang till riksdagens protokoll 1913 1 saml* (Stockholm, 1913).

computing assistants, fishermen and their organizations, telegraph systems, weather observations and forecasts transmitted via telegraphy, aeronautics, politicians, professional meteorologists, graphs, forecasts &c. Media work and science communication played a part in keeping this heterogeneous system together and going.

Besides newspaper texts and public addresses, one could also view the storm warning system itself as a kind of communication. The semaphore signals and the storm warning telegrams posted on the dozens of stations around the coast transmitted a message of technoscientific nationalism. The shipping and fishing industries, so vital to the country, were supported and protected from the unpredictable and violent Nature by a science and technology that emanated from the nation's capital, by a system that defended the nation's borders against incoming storms.

5. A scientific experiment run by a newspaper

One does not need to know the minutiæ of meteorological science to evaluate a forecast or a stormwarning. The utility of the science behind forecasts is more readily apparent to the public than some other kinds of science. The public can therefore be said to perform a kind of continuous evaluation that is not possible in more esoteric sciences. Ekholm could use the stories from the users in the coastal areas as a resource; the reporting back to the centre of calculation in Stockholm became a source of support for the system of stormwarnings. By utilizing the power of the press, this activity gained reach, scientifically as well as socially. The users and audiences, the citizens and the sectors of the economy that lived by the sea, had the potential to both provide and withdraw support for the system. These users were vital allies for Ekholm and the system.

Another way in which the public sphere became important for the development of meteorology became evident in 1913, when Ekholm's methods of predicting the weather were challenged by Gustaf Strömberg, assistant astronomer at the Stockholm astronomical observatory. Strömberg's rival method for predicting the weather used lunar theory; the Moon influences the weather, and this could be used for calculating future temperatures, Strömberg argued, while Ekholm was sceptical. Ekholm had, as we have seen, earlier on worked with Arrhenius on the possible connections between geophysical phenomena and the Moon, but that was in the 1890's, and the

results were not utilized later in the daily practice of issuing forecasts and storm warnings. Instead of correlations with the lunar position, weather forecasting used telegraphic networks for the communication, collection, and analysis of meteorological observations on a global scale. Lunar theories had attracted much interest during the nineteenth century, but was something of a backwater in professional meteorology when the controversy around Strömberg surfaced in 1913.[43] It was therefore rather logical that the dispute was played out in the open, rather than through the regular peer review in the academic system. But Strömberg's challenge to the forecasting pursued at the Central Meteorological Bureau got publicity. To the public, Strömberg's predictions could seem to be good science, they came from an astronomer and thus had the insignia of scientific precision inscribed in them.

During the autumn of 1913, the Stockholm daily paper *Dagens Nyheter* published Strömberg's predictions of the temperature along with observations of the temperature. The articles were presented as a way of letting the readers evaluate the claims of Strömberg. 'Today, those readers of *Dagens Nyheter* who are interested in the weather begin checking the reliability of the amanuensis Strömberg's method of predicting the weather.'[44] During the autumn months, the newspaper published a large number of columns under the heading 'Strömberg och verkligheten' (Strömberg and reality) which contained graphs and meteorological data, comparing Strömberg's predictions with the actual weather. The newspaper described its activity as 'the experiment run by *Dagens Nyheter*'.[45] The use of the term 'experiment' is significant; that was how the testing of Strömberg's and Ekholm's methods was perceived and presented in the media, the media was aware of the interactiveness and the mediated role of the support mechanisms for the meteorological project and of its own part in this. The tone in the articles was not polemical but in a sense scientific; *Dagens Nyheter* presented the meteorological data in a 'scientific' manner, using numerical data and diagrams throughout.

Witnessing science being produced has long been a part of scientific factmaking. Science has built up methods of getting scientists to work and witness what they are doing, either through actual

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[43] See for example Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* 46ff.

[44] 'Strömberg och verkligheten,' *Dagens Nyheter*, 27 October 1913.

[45] 'Strömberg och verkligheten,' *Dagens Nyheter*, 2 December 1913

or virtual witnessing.[46] This witnessing activity need not only be about what is going on in the collaborative milieux of labs and the core sets of the scientific fields that meet in conferences and at workshops or in committees. Also, the collective activity that involves scientific communication with groups of people 'external' to science is sometimes part of the factmaking activities of science. This can take different proportions and mean more or less, be a more or less direct engagement between science and audiences, depending on circumstances such as what kind of science we are looking at, what political and cultural groups surround it. Esoteric Big Science-projects costing billions of dollars might not have much collaboration with 'outsiders' when it comes to actual participation, whereas fields such as astronomy and even more so botany and zoology have had many pro-am collaborations. The public here is not a passive bystander, a recipient of popular science being amused by the spectacle of science, but rather someone that takes part in the activity of science.

In the case of meteorology and the dispute between Strömberg and Ekholm, reputable meteorological scientists might not have been very interested in entering into a direct confrontation with the lunar methods of Strömberg. Lunar theories were more or less discredited in serious meteorology by then. But for others than professional meteorologists, the challenge from Strömberg's methodology was real enough. He even managed to get create alternative institutionalization, described by *Dagens Nyheter* as 'Strömberg's weather bureau'; complete with several computing assistants and calculating machinery, it sure looked like science to the public.[47] It could be seen as a viable alternative, as trustworthy as the work of the Central Bureau of Meteorology. With Ekholm's policy success having been built for some time on public appearances, and the trust in Ekholm's meteorology and his institution might corrode or be disturbed by an activity such as Strömberg's, it was in a sense logical that the 'testing' of Strömberg's rival theory should be undertaken in full view of the public – *by* the public –, orchestrated by a daily and with citizens as experimentalists. Ekholm had built a substantial part of the momentum in the policy development on publicity, where media appearances, public science and mediated collaboration with actors in the fishing and shipping sectors were sources for public support. He wouldn't want to loose that. And *Dagens Nyheter* had their own economical motives; public interest in the predictions was high, the newspaper noted, and therefore it

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[46] Steven Shapin, *A Social History of Truth: Civility and Science in Seventeeth-Century England* (Chicago & London: The University of Chicago Press, 1994).

[47] 'Strömbergs väderleksbyrå,' *Dagens Nyheter*, 19 October 1913.

decided to buy predictions for November and December 1913 and evaluate these in a running series.[48]

Strömberg also could gain support – he was not a meaningless opponent for Ekholm and his activities. His predictions were of interest for publishers, and he closed several deals that made it possible for him to take temporary leave from the Stockholm observatory to concentrate on meteorology. He also raised money from investors. Such progress in getting funding was duly reported in the media, along with Strömberg's plans for the future. And, *Dagens Nyheter* noted, '[j]ust as impossible for a non-professional to criticise or defend Mr Strömberg's method, just as easy is it for the most uneducated to confirm the amazing correlation between the curve he has calculated for this year and the observed temperature. […] Mr Strömberg's reputation as an authority on the weather has got further support', the paper continued and gave several indications of the precision of the forecasts. 'If the correlation will continue the year out in such high degree, Mr Strömberg's authority will be able to endure several blows before it is seriously hurt.'[49] The newspaper viewed the reputation of the astronomer about to become meteorologist Strömberg as someone worth investigating.

The weather did not cooperate; *Dagens Nyheter*'s 'experiment' showed that Strömberg's method did not give sufficiently good predictions, that much was evident in the rather balanced reporting, complete with graphs, during the autumn and winter of 1913. Strömberg's work in meteorology was now finished; with the public trust in his ideas about his lunar methods eroded, the market for his computations and forecasts disappeared, and he returned to astronomy. After a short stint at the Lund observatory in southern Sweden, he headed west and worked at the Mount Wilson observatory.

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In Ekholm's collection of papers at the Center for the History of Science, there is a scrapbook cointaining Ekholm's press cuttings. These contain many things to do with cosmical physics and meteorology in the media, not least the happenings surrounding Strömberg's attempts during 1913 to establish a rival forecasting service. The collection of cuttings are useful for the historian,

[48] Ibid.

[49] 'Amanuensen Strömberg överger astronomien,' *Dagens Nyheter*, 24 September 1913.

since they make the material accessible and easy to find, but the scrapbooks are interesting in their own right as artefacts, as material proof of the interest Ekholm had of following the stories being told about meteorology and related fields in the media. Just as the public viewed and evaluated the forecasts emanating from Strömberg's own rival 'bureau', Ekholm at the Central Bureau observed and evaluated the appearances of Strömberg in the media. The media mattered to Ekholm.

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[50] Gustav Holmberg, 'Nils Ekholm, stormvarningarna och allmänheten,' in *Den mediala vetenskapen*, ed. Anders Ekström (Nora: Nya Doxa, 2004).

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