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Current References 2004-1

**Pioneers in Modern Meteorology and Climatology :  
Vilhelm and Jacob Bjerknes**

**A Selected Bibliography**



*Vilhelm Bjerknes: Oljemaleri malt av Rolf Groven, 1983, eies av Geofysisk institutt*

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National Environmental Satellite, Data, and Information Service  
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## **Preface**

This bibliography has been compiled for the presentation on Vilhelm and Jacob Bjerknes' works in the NOAA Central Library Network's collections given by Doria Grimes at the 2004 Annual AMS/ASLI Conference on January 16, 2004, in Seattle, Washington. The bibliography contains printed publications and online Internet resources by and on Bjerknes. The entries are arranged alphabetically by title. This publication is available online for downloading in Microsoft Word, HTML and in PDF formats at:

[http://docs.lib.noaa.gov/rescue/Bibliographies/Bjerknes/Bjerknes\\_July\\_2004.pdf](http://docs.lib.noaa.gov/rescue/Bibliographies/Bjerknes/Bjerknes_July_2004.pdf)

[http://docs.lib.noaa.gov/rescue/Bibliographies/Bjerknes/Bjerknes\\_July\\_2004.doc](http://docs.lib.noaa.gov/rescue/Bibliographies/Bjerknes/Bjerknes_July_2004.doc)

[http://docs.lib.noaa.gov/rescue/Bibliographies/Bjerknes/Bjerknes\\_July\\_2004.htm](http://docs.lib.noaa.gov/rescue/Bibliographies/Bjerknes/Bjerknes_July_2004.htm)

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## Vilhelm Bjerknes (1862-1951)



Photo courtesy of European Geophysical Society at:  
<http://www.copernicus.org/EGU/egs/bjerknes.htm>

A Norwegian scientist who was one of the founders of modern meteorology and scientific weather forecasting, he was born in Oslo, Norway. His father, Carl Anton Bjerknes, was professor of mathematics at Christiania (now Oslo) University, and Vilhelm helped him with some of his experiments in hydrodynamics before leaving to spend 1890 and 1891 in Germany working as an assistant to and collaborator with the physicist Heinrich Hertz. He then spent two years as a lecturer at the School of Engineering (Högskola) in Stockholm and in 1895 was appointed professor of applied mechanics and mathematical physics at the University of Stockholm. In 1897, he developed a synthesis of hydrodynamics and thermodynamics that allowed him to propose a system for forecasting weather scientifically. In 1904, he published a scientific paper outlining a method of numerical forecasting. The Carnegie Institution supported this work, allowing Bjerknes to employ a long series of "Carnegie assistants" who joined the "schools" he founded at Leipzig and Bergen.

Bjerknes returned to Norway in 1907 as a professor at Kristiania (the spelling had been changed) University and, in 1910 and 1911, he and three of his assistants (the Swedish meteorologist Johan W. Sandström and the Norwegians Olaf D. Devik and T. Hesselberg) published *Dynamic Meteorology and Hydrography*. This book described their research to date and proposed many new techniques for weather forecasting as well as suggesting improvements to existing ones. In 1912, he was appointed professor of geophysics at the University of Leipzig. While there he founded the Leipzig Geophysical Institute.

In 1917, during World War I, Bjerknes returned to Norway to found the Bergen

Geophysical Institute as part of the Bergen museum. It is now part of the University of Bergen. He joined the staff of the University of Oslo in 1926 and remained there until his retirement in 1932.

It was while he was at the Bergen Institute that Bjerknes did his most important work. During World War I, he and his colleagues established a network of weather stations throughout Norway. These reported observations and measurements to Bergen, where they were assembled to produce general pictures of weather conditions at particular times over a wide area. Studying these pictures led Bjerknes and other members of the Bergen School to conclude that there exist air masses that differ from each other and that these masses are separated by distinct boundaries. Likening the masses to opposing armies, they called the boundaries between them fronts and developed a frontal theory to account for their development and disappearance and the weather associated with them.

The Bergen frontal theory also explained the way cyclones form over the Atlantic. Bjerknes described this work in 1921 in a book that became a classic: *On the Dynamics of the Circular Vortex with Applications to the Atmosphere and to Atmospheric Vortex and Wave Motion*. This formed the basis for the modern theory and practice of meteorology.

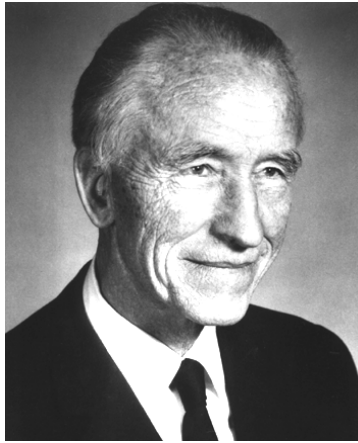
Vilhelm Bjerknes was an inspired and popular teacher who attracted talented workers and made sure they received full recognition for their work. He died in Oslo on April 9, 1951.

(Allaby, Michael. *Bjerknes, Vilhelm Frimann Koren*." Encyclopedia of Weather and Climate. New York: Facts On File, Inc., 2002. Science Online. <http://www.factsonfile.com>)



Vilhelm Bjerknes, 1862 - 1951 (Drawing by Hailey King)

## Jacob Aall Bonnevie Bjerknnes ( 1897-1975)



(Photo courtesy of Eugene M. Rasmussen, University of Maryland)

The son of Vilhelm Frimann Koren Bjerknnes, Jacob Aall Bonnevie Bjerknnes was born in Stockholm and, during World War I, helped his father organize the network of weather stations that supplied the data they used to develop their theories of air masses and polar fronts. Jacob also discovered that depressions originate as waves on fronts. In 1939, he moved to the United States and in 1940 became professor of meteorology at the University of California, Los Angeles. He became a U.S. citizen in 1946. After World War II, Bjerknnes conducted extensive studies of the upper atmosphere and jet stream; in 1952 he was among the first to use for this purpose photographs taken by high-altitude research rockets. Bjerknnes also studied the climatic consequences of the interaction of the ocean and atmosphere in the tropical Pacific and in 1969 was the first to propose what became known as the Bjerknnes hypothesis. This holds that ENSO arises from changes in sea-surface temperature, leading to changes in wind strength and direction, leading to changes in the ocean circulation, leading to further changes in sea-surface temperature. Bjerknnes died in Los Angeles, in 1975.

(Allaby, Michael. "Bjerknnes, Jacob A. B." Encyclopedia of Weather and Climate. New York: Facts On File, Inc., 2002. Science Online. <http://www.factsonfile.com>)

**List of selected publications by Vilhelm Bjerknes held in the  
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Backa Erik Eriksson -- A new era in teaching synoptic meteorology / by Tor Bergeron --  
On the determination of variable mean values / by V. Walfrid Ekman --  
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Europa in der Zeit 17.-19. Oktober 1935 / von Alf Nyberg und Erik Palmén --  
Solstraaling og Epidemier / af Helge Petersen -- Vindströmmar och tröghetsströmmar / av  
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## **Internet resources on Vilhelm Bjerknes (1862-1951)**

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"Universitetet i Bergen har mottatt den gledelige melding at Bjerknessenteret for klimaforskning har fått status som senter for fremragende forskning. Denne status gir en finansiering som bør gi klimaforskning i Bergen et løft mot ypperste internasjonale nivå, skriver Sigbjørn Grønås, professor i meteorologi, Geofysisk institutt, UiB"  
<http://www.bt.no/meninger/kronikk/article92098>

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Grimes, Doria. *Bjerknes – like father – like son.* Abstract of the Power Point presentation given at: International Commission on History of Meteorology (ICHM) Conference, Polling, Germany, July 2004.

[http://www.meteohistory.org/2004polling\\_preprints/docs/abstracts/grimes1\\_abstract.pdf](http://www.meteohistory.org/2004polling_preprints/docs/abstracts/grimes1_abstract.pdf)

*Bjerknes Centenary 2004: Climate Change in High Latitudes. Open Science Conference, September 1-3, 2004, Bergen, Norway.*

<http://www.bjerknes.uib.no/conference2004/>

“The conference will commemorate the centenary of Vilhelm Bjerknes’ pioneer publication of 1904: *The problem of weather forecasting as a problem in mechanics and physics*, Met. Zeits. Wien 21: 1-7. This scientific article paved the way for modern meteorology and practical weather forecasting, as well as leading to modern climate research.”

*Bjerknes, Vilhelm Friman Koren*, Encyclopedia Britannica Online

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Related links:

<http://www.mlahanas.de/Stamps/Data/Mathematician/pages/Bjerknes1.htm>

<http://www.freestampcatalogue.com/database/landcat.php3?jaar=1962&code=NO>

[http://www-gap.dcs.st-and.ac.uk/~history/PictDisplay/Bjerknes\\_Vilhelm.html](http://www-gap.dcs.st-and.ac.uk/~history/PictDisplay/Bjerknes_Vilhelm.html)



*On the shoulders of giants. Vilhelm Bjerknes (1862-1951).* NASA, Earth Observatory  
<http://earthobservatory.nasa.gov/Library/Giants/Bjerknes/bjerknes.html>

*Mathematics and meteorology*  
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*Contiuing the saga*  
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This medal has been established in 1995 by the Section on Oceans and Atmosphere (OA) in recognition of scientific achievements of Vilhelm Bjerknes. It is reserved for distinguished research in atmospheric sciences.

Grønås, Sigbjørn. *Vilhelm Bjerknes og loven om værvarsling*. Published online. In: *P2-akademiet*. Foredrag ved Sigbjørn Grønås 29. og 31. januar. Publisert 27.01.2004 11:59  
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**Carl Bjerknæs (1825-1903)**  
**Father of Vilhelm and grandfather of Jacob**  
(Photo courtesy of JOC/EFR, November 2002)

For more information on Carl Bjerknæs visit:  
[http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Bjerknæs\\_Carl.html](http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Bjerknæs_Carl.html)

**List of selected publications by Jacob Bjerknæs held in the  
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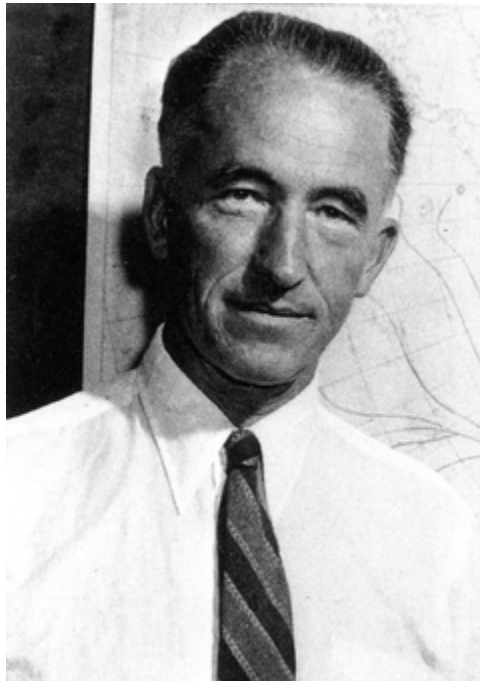
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