

# THE ROLE OF SPRINGS IN THE HISTORY OF SWEDEN

## Källornas roll under historiens gång i Sverige

by GERT KNUTSSON, Professor emeritus, Brännkyrkagatan 96, 11726 Stockholm  
e-mail: gertknut@comhem.se



### Abstract

Springs have always been used for water supply. The first settlements from the Stone Age were often located close to springs as well as many farms and crofts later on in the forests and highlands. Several of the growing towns and villages from the Middle Ages were supplied by water from springs. Spring cults were related to the assumedly mysterious strength of the water from special springs during certain days of the year, when the water had a healing effect on the body. Many of these springs were called offering springs during heathen times and holy springs during Christian times. In modern times mineral springs were recognized to have health effects and many spas were established at such springs. Some of the spas also started to tap the spring water and to sell bottled water, which is still very popular. Today springs are used for environmental control due to the fact that the water in a spring gives an integrated, condensed representation of the environment in its catchment and thereby the changes of the water chemistry due to, e.g. acidification or pollution. Some springs have also given inspiration to artists, authors and composers to create paintings, novels and songs.

*Key words* – Water supply, spring cult, mineral springs, spas, environmental control

### Sammanfattning

Källor har nyttjats för vattenförsörjning i alla tider. Den första fasta bebyggelsen under stenåldern lokaliserades nära källor, där det fanns ständig tillgång på gott vatten, liksom längre fram gårdar och torp i skogsbygder och fjälltrakter. Åtskilliga av de växande städerna och tätorterna under medeltiden hade källor som vattentäkter. Källkult utvecklades vid vissa källor, som ansågs ha vatten med magiska krafter särskilda dagar, när vattnet hade en läkande effekt på kroppen. Många av dessa källor kallades offerkällor under heden tid och heliga källor under kristen tid. Senare framkom att källvatten med viss kemisk sammansättning, s.k. mineralkällor, var hälsobringande, vilket gjorde att hälsobrunnar anlades vid en del av dessa källor. Vattnet tappades också upp på flaska och såldes vida omkring, vilket fått ny popularitet. Källor används nu mer och mer för miljöövervakning, eftersom vattnet i källan ger en integrerad, koncentrerad information om tillståndet i tillrinningsområdet för källan och eventuella förändringar genom t.ex. föroreningar och ingrepp. Källor har också gett inspiration till författare, konstnärer och tonsättare, som skapat dikter, romaner, tavlor och sånger med källmotiv.

### Introduction

Springs have been used for many purposes during history, but today the knowledge about springs and their use is poor among most people in spite of the importance of springs for e.g. water supply, environment control and as cultural heritage. Therefore there is a need to give some information to enhance the interest for springs among for example geologists, hydrologists and people interested in local history and folklore. Those who want to learn more about springs are recommended to study the text-book “Källor i Sverige” (Springs in Sweden) (Källakademien, 2012).

### Hydrogeology

Hydrogeology in Sweden is characterized by many types of aquifers and great differences in groundwater recharge. Fracture aquifers in crystalline hard rocks are the most common type with, in general, low fracture porosity and low hydraulic conductivity contrary to that in fracture and fault zones. Porous aquifers are found in glaciofluvial deposits such as eskers and deltas with high conductivity in contrast to the most common loose deposit, the till or moraine, which is hard packed by the land ice. Fractured and porous aquifers in consolidated limestone and sandstone have high well yields in relatively young formations



Fig. 1 *What is a spring? The spring at Vråkär, Hallandsåsen is a typical spring, where groundwater flows out on the land surface. It is a spring in a till (moraine) deposit with low discharge, which is the most common type of spring in Sweden. It is used for water supply of a cottage (photo G. Knutsson 2005).*

in southern Sweden but medium or low yields in older strata. Karst aquifers have limited extension but there are some very well developed zones on the islands of Gotland and Öland as well as in the mountain range of the Caledonides. The overall climate is humid, cold-temperate with moderate precipitation (500–1000 mm/year). The recharge figures vary; in eastern Sweden from 280 mm/year in sandy soil to only 20 mm/year in mixed crystalline rocks with 10 m thick overburden of compact sandy till. A detailed description of the hydrogeology is given by Knutsson in Knutsson and Morfeldt (2002).

## Springs

A spring is a site where groundwater flows out on the land surface in a natural way (Fig. 1), sometimes under pressure above the surface as an artesian spring.

There are different types of springs due to the geology and topography. The most common type of spring in Sweden is a spring in a till deposit. Such springs have low discharge (0.1–3 l/s, Knutsson, 1971), which is also typical for springs in hard rocks as granite and gneiss. Springs with high discharge (10–200 l/s) are found in glaciofluvial deposits (Fig. 2) but also in sandstone and limestone. The latter rock is karstified in certain areas with discharge of up to 1000 l/s (Fig. 3, Källakademin, 2012). Springs have been studied in Sweden since the days of Nordic mythology e.g. the springs of Mimer and Woden, during the journeys of Linné, by inventories of the Geological Survey of Sweden (SGU) and the Academy of Springs (Källakademin, founded in 1986), which also has produced a text-book about springs in Sweden (Källakademin, 2012).



Fig. 2. *The spring at Brändskog, Härjedalen has high discharge as the water is flowing out from a big aquifer in an esker. This type of spring has been, and still is, used for water supply of towns and cities, e.g. Kalmar, where three springs from the Nybro esker still are in use for the water supply; one of them since 1910 (photo A. Damberg 2010).*

Fig. 3. Springs with the highest discharge are found in karstic rocks (limestone). The photo shows the Bjurälven spring in NW Jämtland, where a small river flows out from a cave system (photo G. Knutsson 2004).



## Water supply

Springs have been used for water supply since time immemorial due to the stable quantity and the good quality of the water in most springs. It is well documented that the first settlements during the Stone Age in the county of Västergötland were located close to springs (Schnell, 1966), as were the ancient forts from the later Iron Age on the island of Öland. Later on many farms and crofts in the forests and highlands were established near springs; some of them were also used as cold storage for milk and food, which still is a method used by Laplanders in the North. Meeting places such as churches, court houses and market places were often situated near springs with high capacity and good quality of drinking water, e.g. the springs at Frostbrunnsdalen in Stora Tuna in Dalecarlia and Luddö spring in Värnamo in Småland (Eriksson, 2013).

Inhabitants in the growing towns and villages of the Middle Ages such as Skara, Uppsala and Visby got their drinking water from springs. Even in modern times several cities such as Gothenburg, Kalmar, Lidköping and Nyköping were supplied by water from springs. The good quality of the springwater was valued, especially during periods of epidemic diseases. In Lidköping for example, none of the inhabitants, who drank the water from the Råda spring, were infected by the cholera epidemic at the end of the 19th century. Earlier, before the use of electricity and steam for pumping, water supply experts also looked for springs located high up in the terrain with free flow down to the users. Such a spring was found outside Gothenburg, the Kallebäck spring (Fig. 4), from which a 4.8 km long pipeline in wood was constructed leading to the centre of the city in 1787 (Bjur, 1988). This springwater was also used for brewing beer. But when a new naval harbour was founded in

Fig. 4. The Kallebäck spring outside Gothenburg has high discharge from the aquifer of a terminal deposit. A pipeline in wood was constructed leading down to the centre of the city in 1787 (photo G. Knutsson 2012).



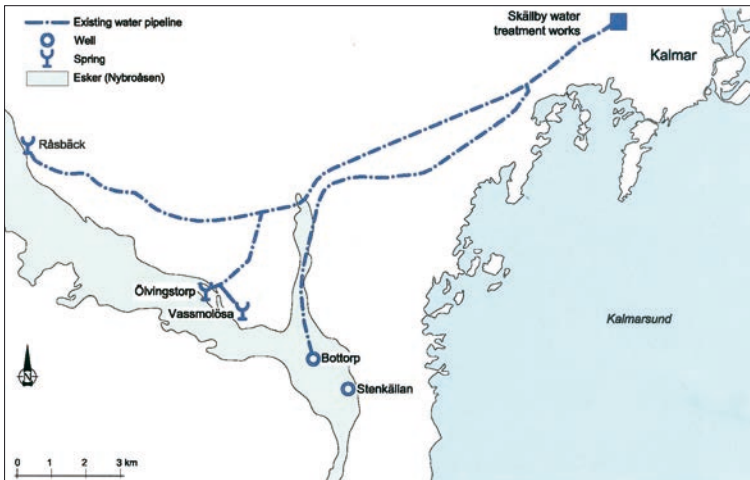


Fig. 5. The water supply system of Kalmar with springs and wells on the Nybro esker (map prepared by Kylefors, 2014).

Karlskrona in the archipelago of Blekinge in 1790, drinking water had to be transported by boat from the large Lyckeby spring on the mainland. The water supply in Kalmar had been problematic with bad quality and low capacity since the 16th century. During new geological mapping three springs with high discharge and very good quality of water were found on the northeastern slope of the Nybro esker, which meant that water from some of them had free flow down to the city. The Råsbäck spring with a discharge of around 25 l/s (Hörberg, 1997) was first utilized in 1910 with a 21 km long pipeline to the city. Later on the other two springs were developed. However, the population as well as the water consumption per capita increased very much after the Second World War, so in 1953 an ordinary well had to be constructed to receive more groundwater from the esker and later on several wells with artificial recharge. The springs are still used (Fig. 5).

The water supply of some small towns and villages, e.g. Bollnäs, Mörbylånga and Älvdalen is mainly based on springs even today. Free flow of water from the springs to the users is still practiced in some villages and many scattered settlements in the countryside, e.g. in the provinces of Härjedalen and Småland. Springs are also used as reserve supply and/or as water supply for fire prevention in many places.

### Spring cults

Spring cults were related to the idea of the mysterious strength of the water from some springs thought to have a healing effect on the body during certain days of the year: Midsummer Night in heathen times and the night before Trinity Sunday in Christian times. But only special springs had such strength: those with runoff to the north and/or with special colour or taste. The oldest

finding of such a spring cult is from Alvastra in Östergötland where a 5000 year old pile-work is located in a spring-fed fen. Many of these springs were offering springs where people offered coins or other things to obtain good health by drinking the spring water or by bathing or washing clothes in the spring. 6000 coins from the 14th century to modern times were found in the springs called Barnabrunnarna north of the city of Växjö in southern Sweden (Fig. 6). In Christian times this type of spring was christened as holy springs and was named after Apostles or holy men e.g. St. Erik's spring in Uppsala and St. Sigfrid's spring in Växjö. In modern times the spring traditions have been transformed to more or less folk festivals, for example at the Ugglevik spring in Stockholm. Some local historical societies of today try to preserve these springs and the old traditions around them either as music festivals or as pilgrim walks along a track with many holy springs, for example the track of St. Olof from the province of Medelpad on the Baltic Sea to the Cathedral at Nidaros (Trondheim) on the Atlantic Ocean.

### Water therapy and mineral water

Already in Ancient Greece spring water with certain chemical composition was recognized to have health effects and in the Middle Ages many spas were established also in Central Europe. Such mineral springs were also found in Sweden and the first spa was opened in Medevi 1678. The development of spas was very fast and more than 300 spas were operating all around Sweden in 1770 (Källakademin, 2012). Most of them were local "health springs" or regional spas and they had to close during the 19th century. However, the famous "national" spas had many guests even during this period:

Fig. 6. Barnabrunnarna north of Växjö in Småland is an offering spring, where 6000 coins from the 14th century to modern times have been found. People offered to get good health by drinking the spring water, bathing and washing clothes in the spring (photo G. Knutsson 2005).



Loka had 500 guests, Ramlösa 1000 and Ronneby 2000 guests per season (Hult, 2007). Several “national” spas, e.g. Loka, Medevi, Ramlösa and Sättra are still in operation (Fig. 7) and some of them have also started to tap the spring water and to sell bottled water with great success, even to other countries. The use of bottled water has increased rapidly during the last few years and in 2009 the annual consumption was 12 l per inhabitant in Sweden (Källakademien, 2012). A study of 33 bottled waters on the Swedish market (several of them imported) showed a large variation of mineral concentrations in the waters; some were very soft, others were very hard with very high concentrations of calcium and magnesium and elevated concentrations of some heavy metals (Rosborg, 2009).

## Environmental history and control

The conditions in and around a spring give an integrated, condensed representation of the biological, chemical and physical processes in its catchment and indicate thereby the changes in the environment at one single site.

The conditions and changes in the past are documented in minerogenic sediments of some springs, e.g. siderite and travertine or in organic deposits as peat downstream the spring. Changes in the climate, e.g. higher precipitation and temperature with more intense weathering and leakage have resulted in increased sedimentation of bog iron ore in acid environments or of travertine in basic environments. Fossils are very well preserved in travertine. The postglacial changes in cli-

Fig. 7. The Medevi Spa north of Motala was established 1678 at a mineral spring, which was found by Urban Hiärne, a medical and chemical doctor. About 300 spas and “health springs” all around Sweden were established at the end of the 18th century, but most of them had to close during the next century. Few of them are still running, e.g. Loka, Medevi and Ramlösa, where the spring water is bottled and sold in great numbers (photo G. Knutsson 2011).



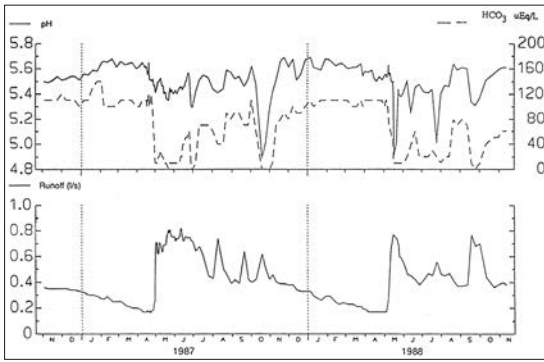


Fig.8. Runoff (below) and the fluctuations of pH and alkalinity ( $HCO_3^-$ ) (above) in spring no 2, Djursvallen, Lofsdalen (Knutsson, 1992).

mate and development of the vegetation were discovered in the travertine of springs in southernmost Sweden before the pollen analysis was introduced. Some archaeological objects have been preserved in “spring peat”, for example the pile-work in wood at Alvastra – see above.

Present changes in the catchment of a spring can be detected directly by regular analysis of the water chemistry and measurements of the runoff from the spring. Otherwise such information has to be gathered from many different sites in the ground and water of the catchment. Furthermore, springs are very suitable for these types of studies, as good water samples can easily be taken without causing disturbance by pumping as when taking samples in tubes or wells. The runoff measurements are also very convenient to do. Quantitative impact in the form of drainage or pumping somewhere in the catchment will result in lower runoff from the spring or lowering of the hydraulic pressure; even removal of the outlet of the spring. Qualitative impact on the environment such as pollution at one spot or diffuse

pollution of the whole area will be recorded in the chemistry of the spring water and in the changes of biota. SGU started such observations in some springs already in the 1960s and later on regional as well as local authorities began to use springs to detect changes in the environment, e.g. in the county of Stockholm and the municipality of Upplands Väsby.

Acidification of soil and groundwater due to acid precipitation was documented from 1960 to 1980 by time series of pH, alkalinity and sulphate in springs in SW and W Sweden as were so called acid surges in small springs, which damaged the biota (Fig. 8, Knutsson et al., 1995). Pollution from agriculture (above all nitrate) or from roads and traffic (for example chloride from de-icing salt) are now detected in many springs (Fig. 9).

## Motifs for artists and inspiration for authors and composers

The spring itself with fresh, purling water and the environment around it with beautiful flowers, often orchids, (Fig. 10) has inspired several artists to create paintings as well as many composers to set music to poems about springs. The oldest painting with a spring as part of the motif is the painting on the ceiling in the Dädesjö church in Småland from the 13th century. In more recent times Gustaf Skoglund is known as an artist with some very beautiful “spring motifs” from southern Sweden as is Ingegerd Möller from northern Sweden (Fig. 11).

The fresh water, which flows up from the underground, and all folklore and legends related to springs have fascinated authors and inspired them to write novels and poems. Such a spring in Alguetsboda, Småland, called “The Spring of the Brides” inspired Vilhelm Moberg (the

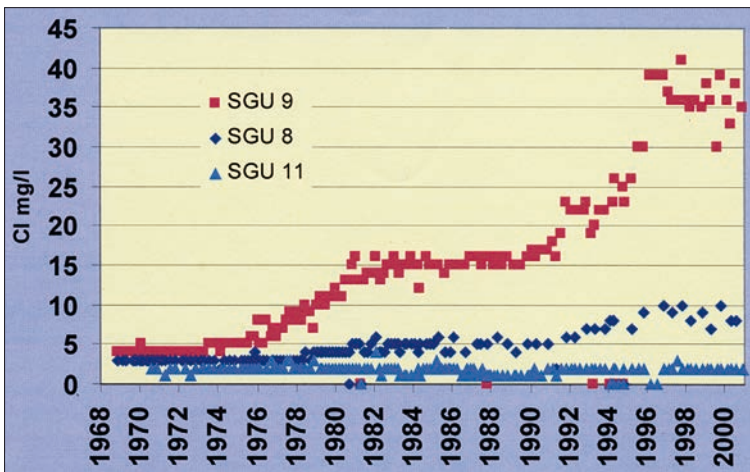


Fig. 9. Today several springs are used for environmental control both on a national and a local level. The Geological Survey of Sweden (SGU) has been studying some springs since the 1960s. The figure shows graphs from three springs at Tärnsjö, NW Uppland situated on and around an esker with a highway and a local road on the top. The graphs show that the springs have received different salt pollution from de-icing of the roads due to their location on the esker. Spring no 11 is located in a local aquifer and is not polluted (Källakademien, 2012).

author of “The Emigrants”) to write a novel in 1946 with the same name and a composer, Lars Åke Franke-Blom, to create music for a ballet, which was shown on Swedish television (SVT) in 1983 with great success (Fig. 12). And recently a film about springs called “The eye of the ground” has been produced for SVT by Kurt Skoog.



Fig. 10. The spring itself and the environment around it with beautiful flowers has inspired several artists, authors, composers and film directors to create paintings, novels and films with spring motifs. The photo shows an orchid in a spring fed fen (photo G. Knutsson 2009).



Fig. 12. The photo shows the bride at “The Spring of the Brides”, a ballet showed in SVT 1983. The ballet was based on the novel with the same name written by Vilhelm Moberg, who was inspired of the legends around a spring (photo S. Tornehed 1983).

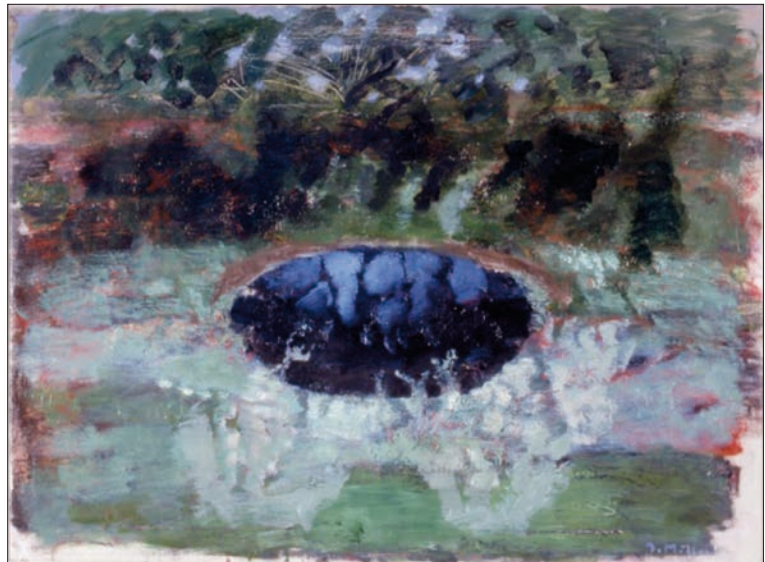


Fig. 11. The photo shows a painting by Ingegerd Möller called “The eye of the ground”, 1992.

## Protection and conservation of springs

The multiple use and importance of springs throughout history means that some springs are protected by law as cultural or natural objects of great value, e.g. springs with certain old traditions, such as St. Olof's spring at Kinnekulle where the first king of Sweden was christened, or springs with sensitive flora or a special shape, for example a cupola of peat. Sometimes a combination of constant flowing water with a special chemical composition and temperature produce a so-called "key biotope" with a certain type of flora, which has to be protected. Some of these springs are of great interest for tourism, see Johannisson and Gustavsson (2010), some others are used as checkpoints in orienteering or for water supply along walking tracks. All these types of springs have to be protected and looked after to remain undisturbed by drainage, forestry or pollution. Heavy storms in southern Sweden in recent years have damaged some sensitive springs (Knutsson, 2012).

## Conclusions

It has been shown that springs have been – and still are – used for many purposes above all for water supply. Today the interest for springs is focused either on environmental control or as attractive objects for tourism. Many springs with their distinct location are also popular as checkpoints for orienteering and so called geocaching.

## References

- Bjur, H. (1988) Vattenbyggnadskonst i Göteborg under 200 år, Hans Bjur och Göteborgs VA-verk, Göteborg.
- Eriksson, A. (2013) Kallkällornas betydelse för vattenförsörjningen i Sverige, Grundvattendagarna 2013 Lund 16–17 oktober, Rapporter och meddelanden 135, 26–27, SGU, Uppsala.
- Hult, A. (2007) »Dricka brunn» Om gamla tiders SPA, Atremi, Mjölby.
- Hörberg, I. (1997) Vårt välsignade vatten, Kalmar Vatten och Renhållning AB, Kalmar.
- Johannisson, N., Gustavsson, H. (2010) Vila vid denna källa... Utflyktsmål i Emmaboda kommun, pp. 44–45, Emmaboda kommun.
- Knutsson, G. (1971) Studies of ground-water flow in till soils, GFF Vol. 93, pp. 1–22.
- Knutsson, G. (1992) Studies of some acid springs in till, Lofsdalen, Sweden. In: Nordisk Hydrologisk Program NHP Report, Nr 30, 366–375, Oslo.
- Knutsson, G. (2012) Förändringar av källor – främst i skogslandskapet, Geologiskt Forum Nr 75 Sept 2012, pp. 21–26.
- Knutsson, G., Bergström, S., Danielsson, L.-G., Jacks, G., Lundin, L., Maxe, L., Sandén, P., Sverdrup, H., & Warfvinge, P. (1995) Acidification of groundwater in forested till areas. In: Effects of acid deposition and tropospheric ozone on forest ecosystems in Sweden. Ecological bulletins 44. Eds. Staaf, H. & Tyler, G. Copenhagen 271–300.
- Knutsson, G., Morfeldt, C.-O. (2002) Grundvatten – teori och tillämpning, Svensk Byggtjänst, Stockholm, pp. 19–132.
- Källakademien (2012) Källor i Sverige, Sivart Förlag, Stockholm.
- Rosborg, I. (2009) Health aspects of minerals in drinking water. Drinking Water – Sources, Sanitation and Safeguarding, Swedish Research Council Formas, pp. 35–45.
- Schnell, J.-B. (1966) Vatten och fornyfynd. Bebyggelsehistoriska studier på Västergötlands kambrosilurområde. www.kallakademien.se/mer om källor/litteratur.