The Swedish contribution to aids to navigation history

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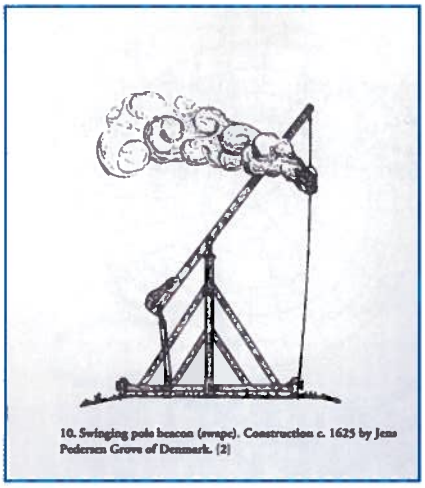
Certainly, Sweden has been greatly involved in the development of aids to navigation but one should bear in mind the parallel developments that have also taken place in other countries.



10. Swinging pole beacon (swape). Construction c. 1625 by Jens Pedersen Grove of Denmark. [2]

The first lighthouse was established in 1202 in what is now southern Sweden and it assisted Franciscan monks sailing to the ancient Denmark. At the time this beacon consisted of a wood burning fire on a small hill. The fire was only lit when a ship was expected within sight and at other times it was in darkness.

During the 1500s the aids to navigation providers used beeswax candles and tallow candles in simple lanterns.

A century later, as the wood burning fire rapidly consumed fuel the light source was a stone crucible with wood charcoal. Eventually iron fire pots were employed on top of a stone tower or in a raised iron basket (cresset). It is considered that the two swinging pole beacons (the swape) the Danes built on the island of Nidingen in 1629 was the first twin beacon, that is to say an erection that enabled a character to be achieved.

In the 1700s and 1800s Swedes showed great ambition with innovation and advances in aids to navigation technology. They normally provided coal fires and in the late 1700s used wick lamps burning fish oil as well as tallow candles. A form of glass lantern was provided although intensity was low.

Metal reflectors

Often the aids to navigation providers combined techniques showing wick or candle lights in clear weather and coal in bad. To increase brightness of the lights they commenced experiments with metal reflectors. Johan Daniel Braun used on the lighthouse at Örskär in 1687 five large parabolic metal reflectors with six oil lamps each and it is claimed that this was the first lighthouse in the world where illuminating power had been reinforced by some kind of additional apparatus. However it was found that the light was spread because the multiple lamps were out of focus and the reflectors were darkened by smoke.

The revolving beam

The next revolutionary step was to use clockwork to make reflectors and lights rotate and to provide flashes. Without doubt this set a whole new standard in aids to navigation techniques and was realised by Jonas Norberg who came up with the idea of arranging parabolic reflectors on a stand which was rotated by means of clockwork. It now became possible to obtain periods of alternate light and darkness which could be used to advantage and thereby provide characteristic flashes. At Carlsten on the west coast of Sweden the first revolving beam lighthouse in the world was commissioned in 1781.

Fire oven

Thereafter the experts of the day chose to use coal which provided a stronger light compared to that of the wick lamps. Unfortunately, there was a downside in that the flame was unprotected and efficiency was reduced significantly in heavy rain or high wind. In 1791 Anders Polheimer created a "fire oven" which was an improvement on the open coal lighthouse for he enclosed the fire in a pot and led the air in channels each with an entrance in a different direction under the pot. These channels delivered a natural draft or used the wind to force more air to the fire. In turn this resulted in a significant increase in brightness. However, there was also an increase in coal consumption but this was reduced by Polheimer who enclosed the fire in a glass lantern which in turn protected the fire from wind and weather.

The suggestion of automation

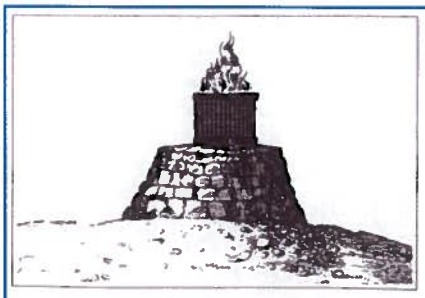
Sweden has a long coastline with numerous waterways and, consequently, required a large number of lights. It was necessary to obtain a safe and complete lighthouse system including new leading lights with recognisable light characters at the least possible cost. With this in mind the Swedish Lighthouse Department gave an undertaking to obtain reliable, automatic light systems which could be left without inspection for a considerable period. This commenced a chain of unique developments which in the end improved maritime safety all over the world.

Further innovation

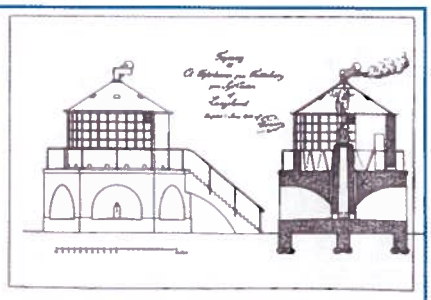
John Höjer designed in 1870 a single large lighthouse reflector driven by clockwork and which rotates rapidly around its focus, creating very short flash periods.

Lighthouses with different characters

Pilot Director C G von Otter discovered another way to achieve light characters in 1878 with a device having vertical blinds and turned by clockwork. This design was such that the lighthouse could show different characters in different sectors in order to prevent grounding while at the same time, for example, the fairway would get a fixed light. Von Otter had served in the Royal Navy and been introduced to the then new system of Morse signalling and he had an idea that lighthouses could transmit their name, in abbreviated form by this me-



11. Open coal fire at Kullen, Sweden 1791. Sketch by Anders Polheimer.



12. Enclosed coal fire with draught system from below at Falkebjerg, Denmark 1804. [2]

thod but the time was not right for this proposal and he won no credit in Sweden until foreign professionals gave him recognition when he was in England and continuing with his inventions.

A further advance was that of G V Lyths with the "*intermittent sleeve*" which was lowered at intervals down and around the flame to provide a form of character.

Coloured flashes

In order to prevent confusion between light from a beacon and light from domestic properties in the Swedish archipelago beacons were provided with coloured light and character. In 1882 aids to navigation engineer L F Lindberg constructed an apparatus which consisted of shielding plates (filters) of red or green glass arranged so that a flashing light, or alternately coloured and white light, was created when it was made to rotate around a lamp by means of the hot air rising from the lamp.

These early developments were mainly for approach lights. Scandinavian countries lacked all fairway beacons until 1880 and it would have been very costly for these to have been developed widely in Swedish waters.

Unattended lights

One of the first lamps burning "gasified oil" was developed by Nyberg and Lyth in Sweden in 1881. This worked by vapourising colza oil and burning it without a mantle as it would be with a Bunsen burner. This could operate unattended over a number of days. However, it was found that this type of burner was not efficient in producing a good light output. In 1889 a similar lamp was developed for burning kerosene.

At the end of the 1800s lamps with wicks were still used yet needed careful handling to avoid smoked glass and mirrors. At the same time Sven Carlsson designed the Lux lantern that burned pressurised kerosene in a mantle impregnated with salt. This gave a strong white light and was installed in a number of lighthouses.

G V Lyth also constructed in 1890 a kerosene lantern for operation on a buoy and here the oil reservoir and air pipes were designed to operate in a swell.

Buoy with flashing lights

To avoid confusion between buoys a Commander Ramsten designed a buoy with riveted oblique wings on the buoy body providing a twisting motion when the buoy was subject to heaving motion on station. Its lantern had clear and red glass inserts that delivered an alternating white and red light.

Small gas plant for buoys

One of the earliest acetylene gas buoys was developed in 1902 by Commander R von Myhlenfels. Around its body was four or five cylindrical containers each open at the top and in which a gasholder, open at the bottom, was kept floating by the gas pressure. The gas was produced by calcium carbide reacting with water at the bottom of the gas holders.

Gustav Dalén

Somewhat later the acetylene gas production was industrialised and gave Gustav Dalén ideas for different types of equipment that went on to revolutionise the aids to navigation operations in all countries. There was the gas flasher, the AGA light with an open flame and the Dalén light that was a more complicated structure burning gas in a mantle to provide a brighter light. Then there was the mantle changer and, not least, the sun valve which turned off the light during daylight. Gustav Dalén received the Nobel Prize in 1912 for his services to navigation.

Sound signals

As a warning in fog some form of sound signal must have been used in antiquity but the earliest reliable drawings of a proper fog signal is that of Nidingen in the Kattegat. Here a wooden tower was erected in 1766 with a large fog bell covered by a roof. Its clapper was attached to a rope from the ground and in fog four strokes were sounded every half hour. This fog signal station is claimed to be the world's first.

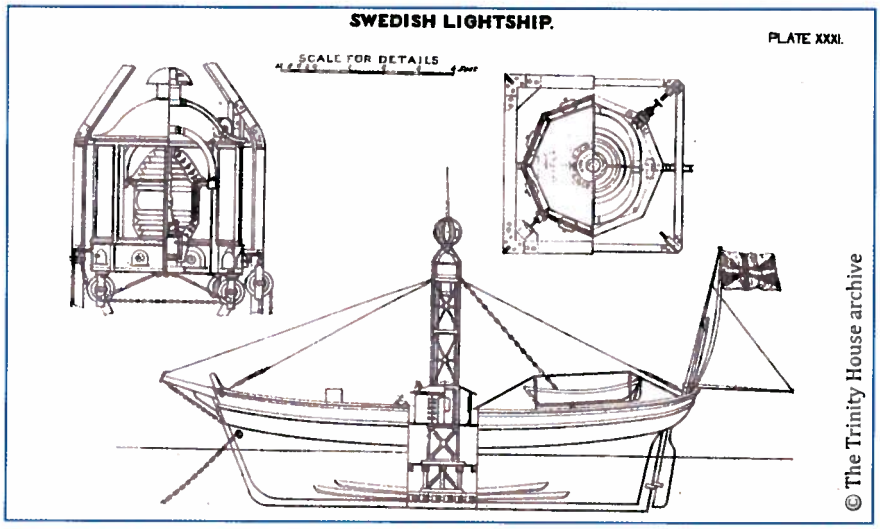
Engineering to produce sounds more recently resulted in the Swedish invention of the Typhon and the Super Typhon by H Rydberg of 1921. The Typhon gave unmatched sound with good efficiency produced by a series of extremely short 'beeps' from membranes (a diaphragm) driven by steam or compressed air.

Caisson lighthouses

Robert Gellerstad of the Swedish Lighthouse Board designed the telescopic tower which could be built ashore, floated like a ship on a caisson which is then sunk, fixed and filled with ballast on the seabed. The prefabricated tower is then jacked up hydraulically to assume its full height. The first tower using this method was constructed in 1958. Constructed with a few narrow slots in the concrete tower providing openings for the light made it possible to construct a helicopter landing pad on top of the structure. Within a short time 24 telescopic towers were erected in the Baltic in water depths of up to 18 metres. These replaced all remaining Swedish lightships. The same method of construction was adopted at Kish Bank in Dublin Bay on Ireland's east coast.

Slot sector light

For the caisson lighthouse the slot sector light was invented by the aids to navigation engineer Bengt Holm. It consisted of several sealed beam lamps, arranged in an array of 2 x 96 units. Such lamps are



connected in several separate groups, switched on in sequence, thus providing a stable power load and a character like that of a rotating light. With a slot sector light it is possible to create very distinct boundaries and sectors if the lamps are placed some distance from the slot, for example six metres.

Racon

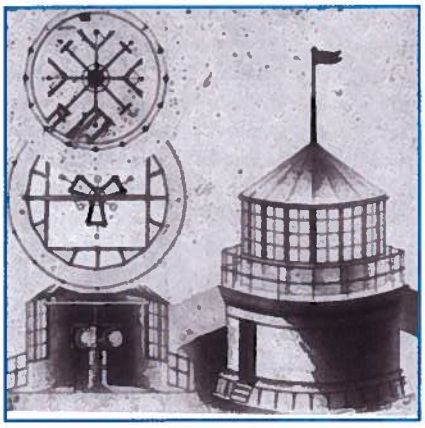
In 1978 the Ericsson company developed a new type of radar beacon (racon) which worked on both the 3cm and 10cm radar band. It responded in the same frequency as the received signal and provided an image on the radar display in the form of a Morse character.

AIS

1983 saw the pilot Benny Pettersson sketching out an idea for a ship's transponder. The "*SPEX*" transponder was only a laboratory test device but its intention was to give the name, position, speed and other interesting parameters for incoming ships. Transponder development continued and in 1990 the new ideas were presented to Bo Tryggö at the Swedish Maritime Administration (SMA). The new transponder system, AVMS, was tested on the ferries as it was realised that it, together with an accurate position sensor, would be an excellent tool to help the navigator. Håkan Lans systems with the synchronisation of time slots were used together with GPS information to create today's AIS systems.

DGPS

Bo Tryggö and Rolf Bäckström at the Finnish Maritime Administration were aware of the importance of accurate positioning. They found that internationally there were different solutions for sending correction data for the GPS system. A test was carried out to send correcting data via long wave radio beacons from the lighthouses at Almagrundet in Sweden and Porkkala, in Finland. Ferries between Sweden and Finland were the test sites for evaluation of the system and this, coupled with tests in the United States, served as the basis for an international standard. ■



La contribution suédoise à l'histoire des aides à la navigation
Cet article concerne le premier phare créé en 1202 sur la route menant à l'ancien Danemark, fournissant une aide visuelle grâce à l'allumage d'un feu de bois quand un navire était attendu, était en vue et pour d'autres raisons quand il y avait de l'obscurité. L'article a été rédigé par un expert de l'Administration Maritime Suédoise qui retrace le développement d'une grande ambition nourrie d'innovations et de progrès dans les aides à la navigation, depuis le 16ème siècle jusqu'à aujourd'hui. Il y a eu de la cire d'abeille et des bougies de suif dans de simples lanternes. Les réflecteurs nécessaires ont été développés au 17ème siècle. Par la suite, au 18ème siècle, sont venus les feux tournants et les foyers fermés. Puis sont apparus les mécanismes à horloge permettant de créer le rythme du feu, l'introduction de la couleur pour les feux à secteurs, l'utilisation des huiles végétales, des mèches, des dispositifs à gaz. Bien entendu, il est fait mention du grand scientifique et titulaire du prix Nobel 1912 Gustav Dalén, ainsi que de ses successeurs qui ont perfectionné les signaux sonores, ont créé les lentilles à échelons, introduits les balises radar, expérimenté l'AIS et fait la démonstration du DGPS. ◆

La contribución sueca a la historia de las ayudas a la navegación
El artículo informa desde el primer faro establecido en lo que entonces era la antigua Dinamarca en 1202 y proporcionaba una baliza que llevaba un fuego de madera ardiendo que se encendía cuando se esperaba un buque, cuando estaba a la vista, y en otros momentos había oscuridad. El artículo, escrito por un experto de la Administración Marítima Sueca, traza el desarrollo muy ambicioso con innovación y los avances en ayudas a la navegación desde el siglo 16 hasta el presente. Había cera de abejas y velas de sebo en faroles sencillos. El necesario reflector fue desarrollado en el siglo 17. Luego vino el haz giratorio y el fuego encerrado en un recipiente en el siglo 18. Más tarde siguieron el mecanismo de relojería para proporcionar un carácter a la luz, la introducción del color para las luces de sector, la introducción de aceites vegetales, las mechas, las plantas de gas. Por supuesto, se menciona al gran científico y ganador del Premio Nobel de 1912 Gustav Dalén, junto con sus sucesores que mejoraron las señales sonoras, crearon las estructuras caisson, introdujeron la baliza de radar, experimentaron con AIS y nos mostraron el DGPS. ◆

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