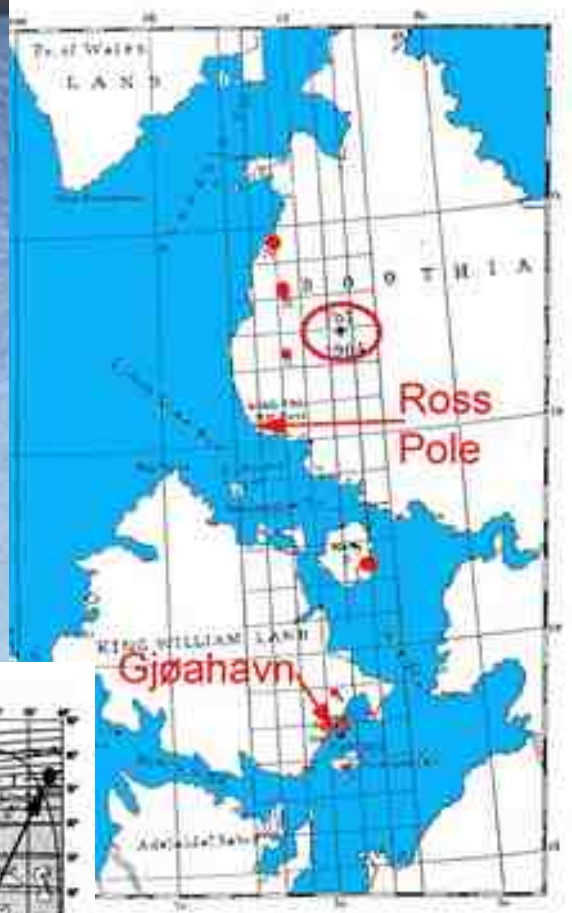
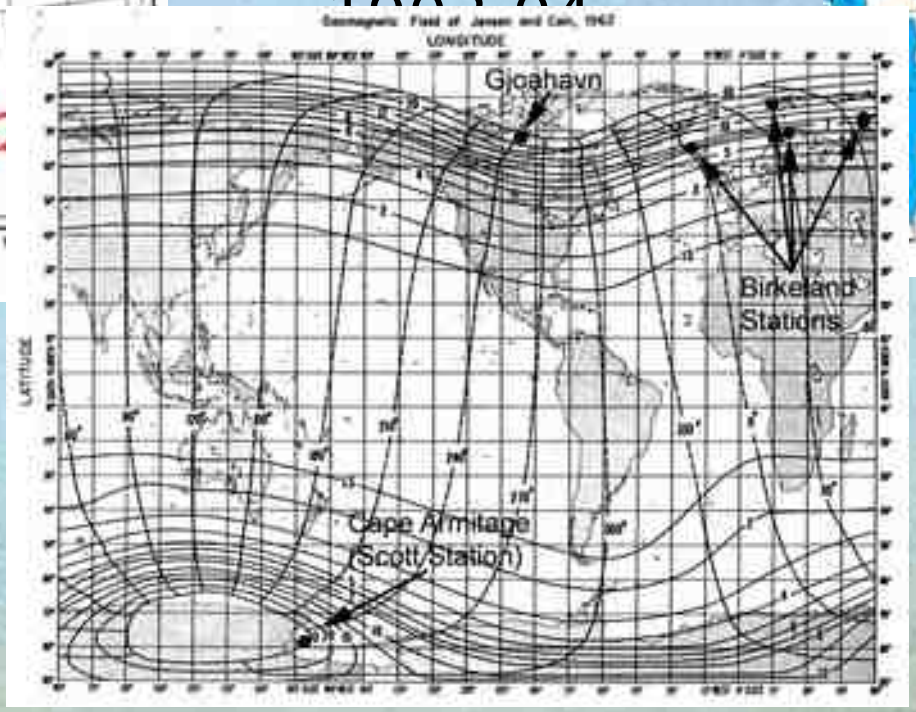
Simultaneous Geomagnetic and Auroral Observations in the Northern (GH) and Southern Polar Cap(CA) During the Year 1902-04

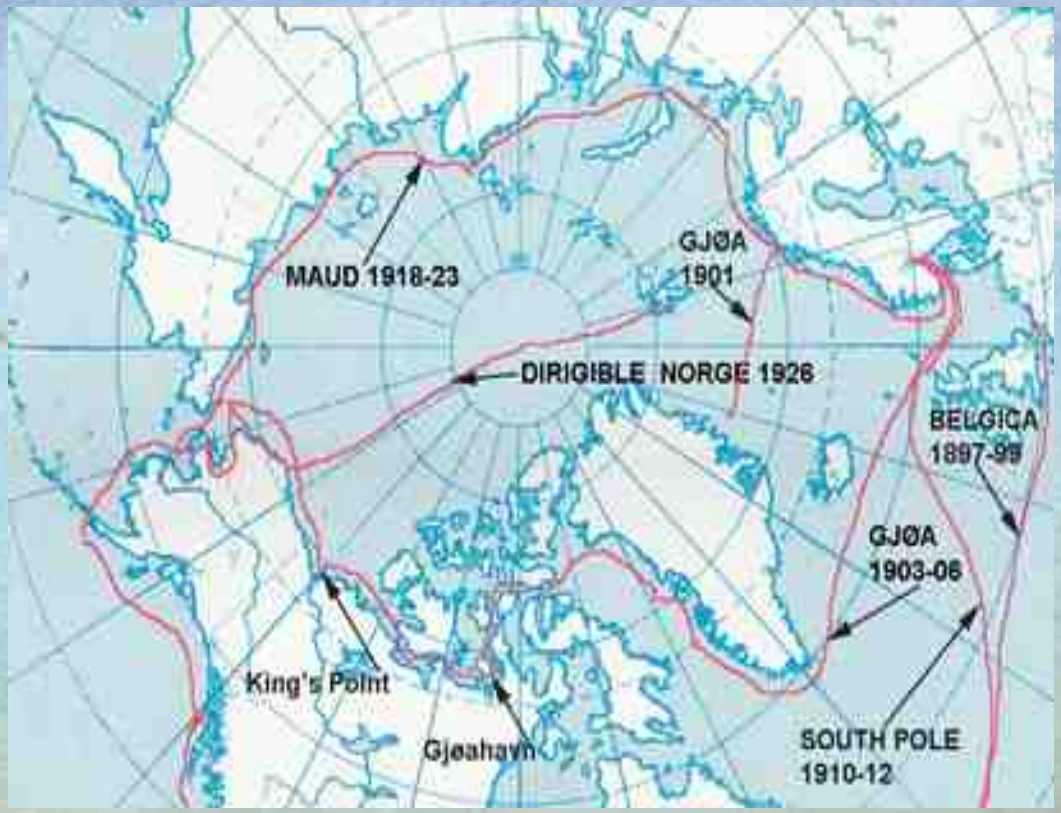




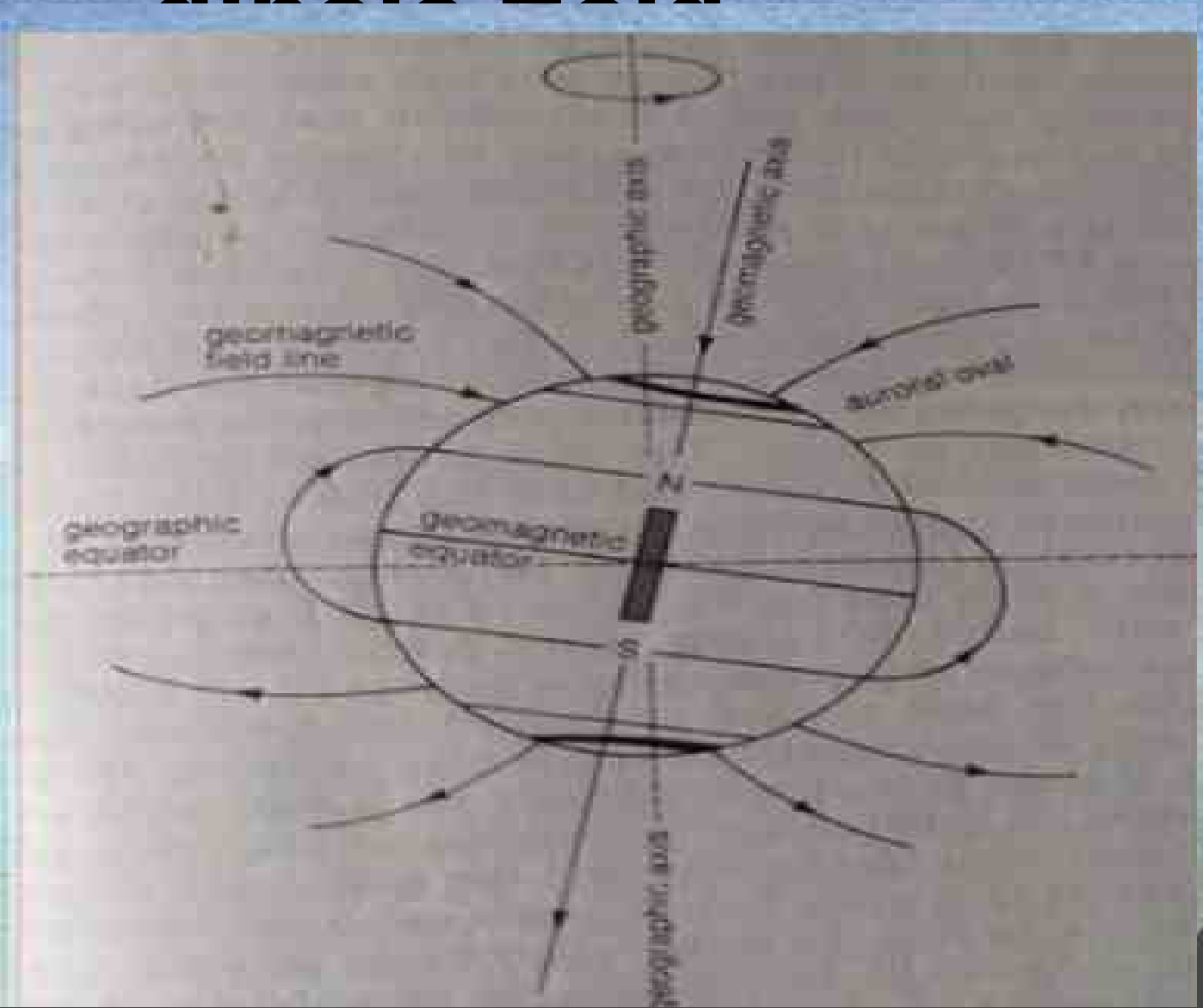
Brief biographies:

R. Amundsen's polar Expositions in the north and south – first Beldiga, last MAUD. Here consentrate on the Gjøa Exp. (1903-06).

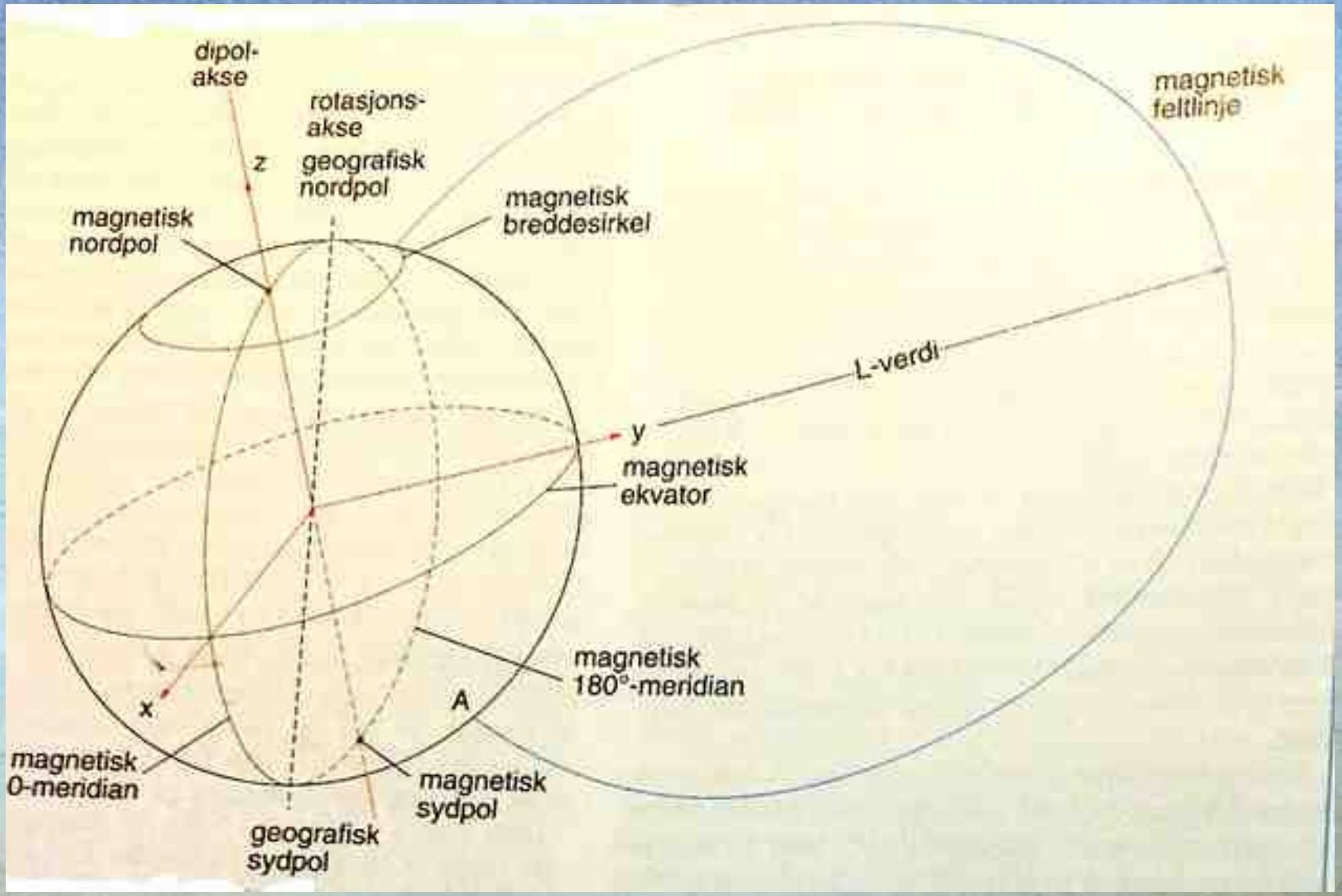
Scott only carried out 2 exp – Discovert + Soth Pole



The Earth's magnetic dipole field



Magnetic coordinates and magnetic time



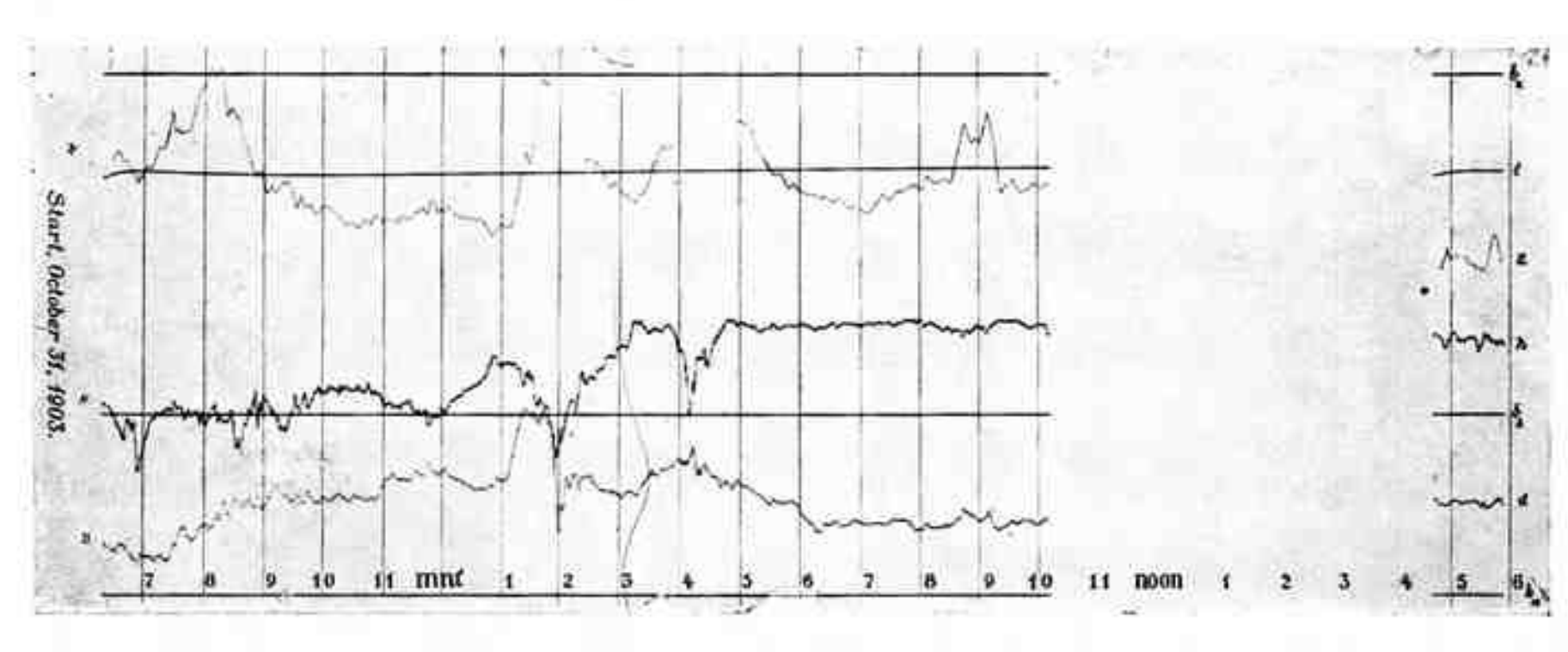
Gjøahavn & “Villa Magnet”

The housing for the continuous magnetic measurements at Gjøahavn (GH) – 3/10 1903 to June 1905, was made from shipping cases using non-magnetic nails. It was dark and nearly air tight. The kerosene lamp was smoky and used up oxygen.

Coordinates and magnetic values for all Gjøahavn Stations; Mag. Latitude ~ 89 degrees N.

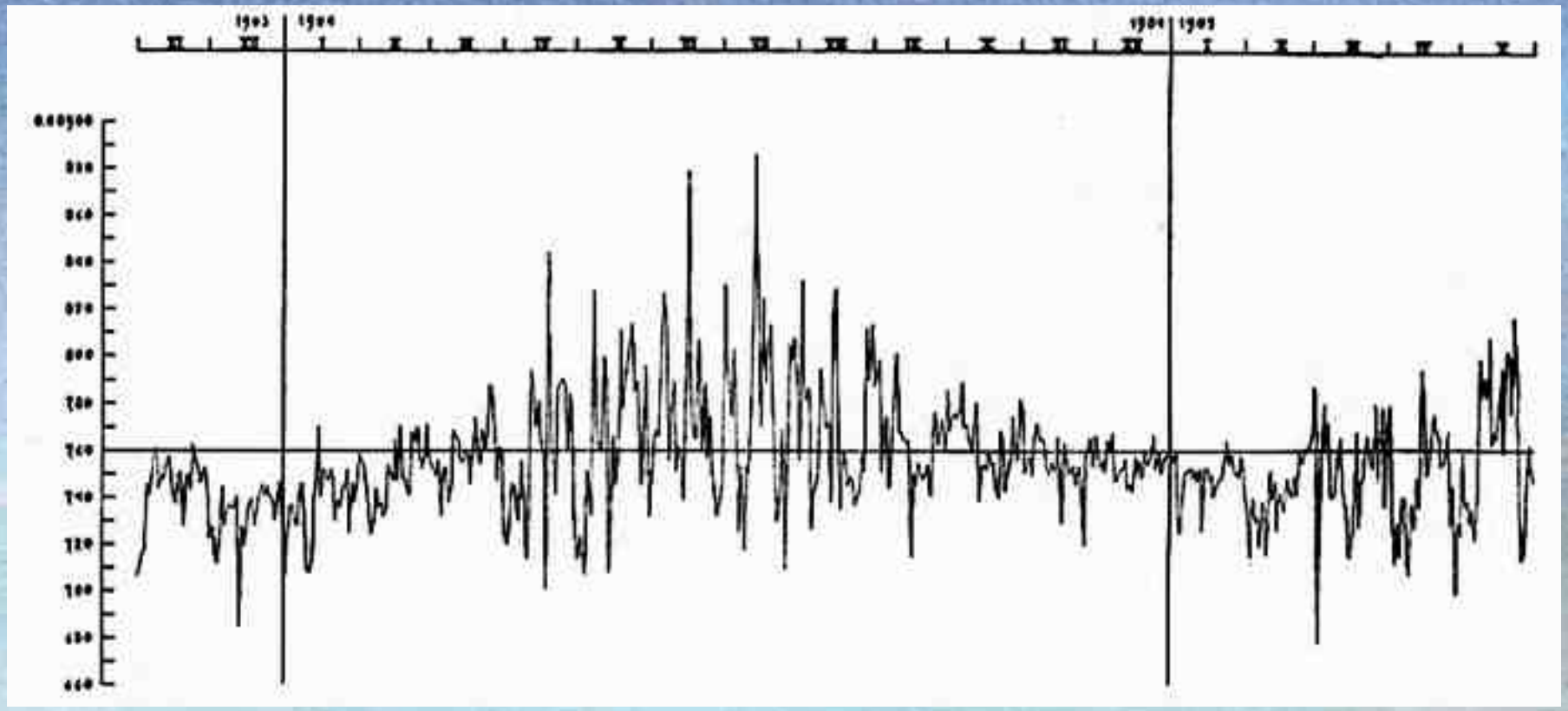
Station	ϕ		λ		D		H	I		d
	°	′	°	′	°	′	γ	°	′	*km*
Beechey Island	74	43N	91	54W	128	28W	1550*	88	20.0	480
Gjöahavn	68	37N	95	53W	7	24W	761	89	17.4	206
1.....	68	27N	95	49W	44	00E	755	89	15.0	229
2.....	68	28N	96	18W	2	50E	900	..	....	224
3.....	68	42N	95	31W	35	15E	645	..	....	203
4.....	68	48N	95	56W	4	10W	655	..	....	190
I.....	69	24N	95	22W	35	30W	410	89	36.0	130
II.....	70	25N	96	18W	45	40E	395	89	34.0	16
III.....	70	42N	96	15W	120	00E	140*	89	52.0	23
IV.....	70	56N	96	21W	101	30W	285	89	38.0	45

Magnetic Effects



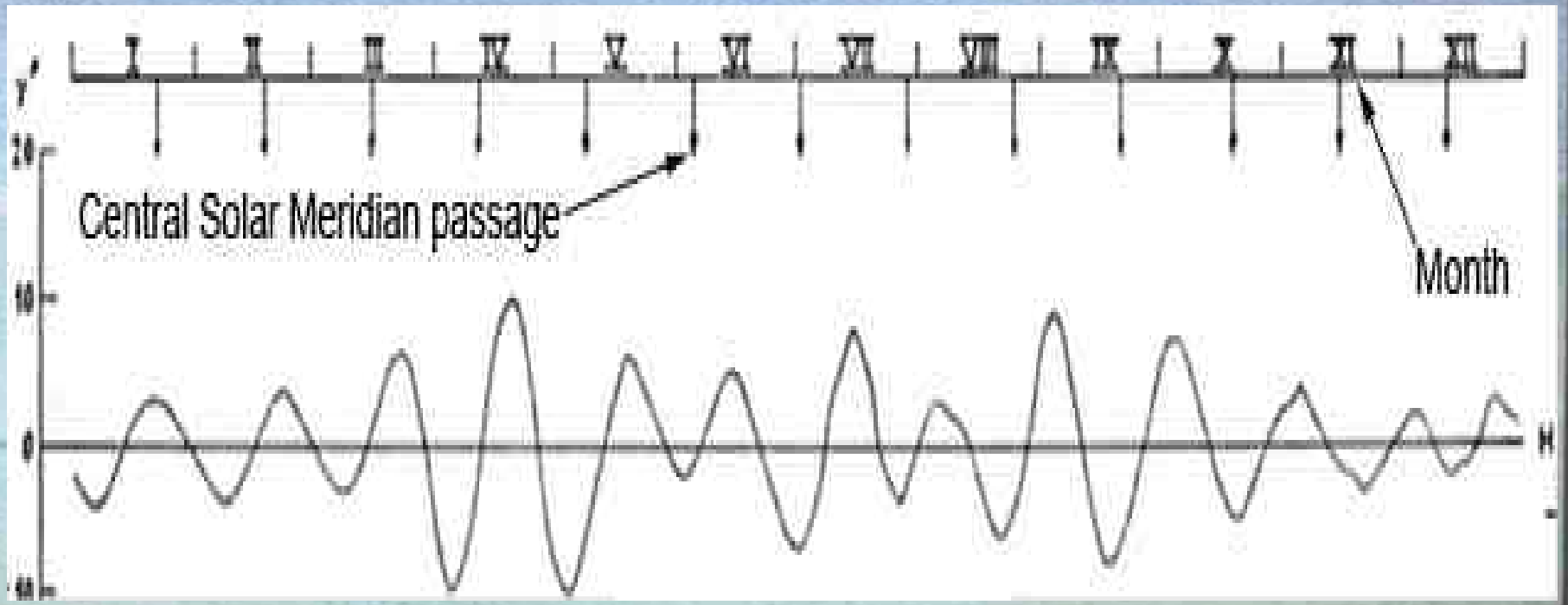
The first day magnetic recordings at GH - October 31, 1903, showed large, wild fluctuations due to ionospheric currents. Largest storm in that century: 100 yrs later: Halloween storm - similar.

Daily & Seasonal Variation



The daily & seasonal variations in the H component; greater in summer than in winter because of the increased sunlight creating large conductivity in the upper atmosphere. Vertical axis = mag. intensity. Hor. ax. = months.

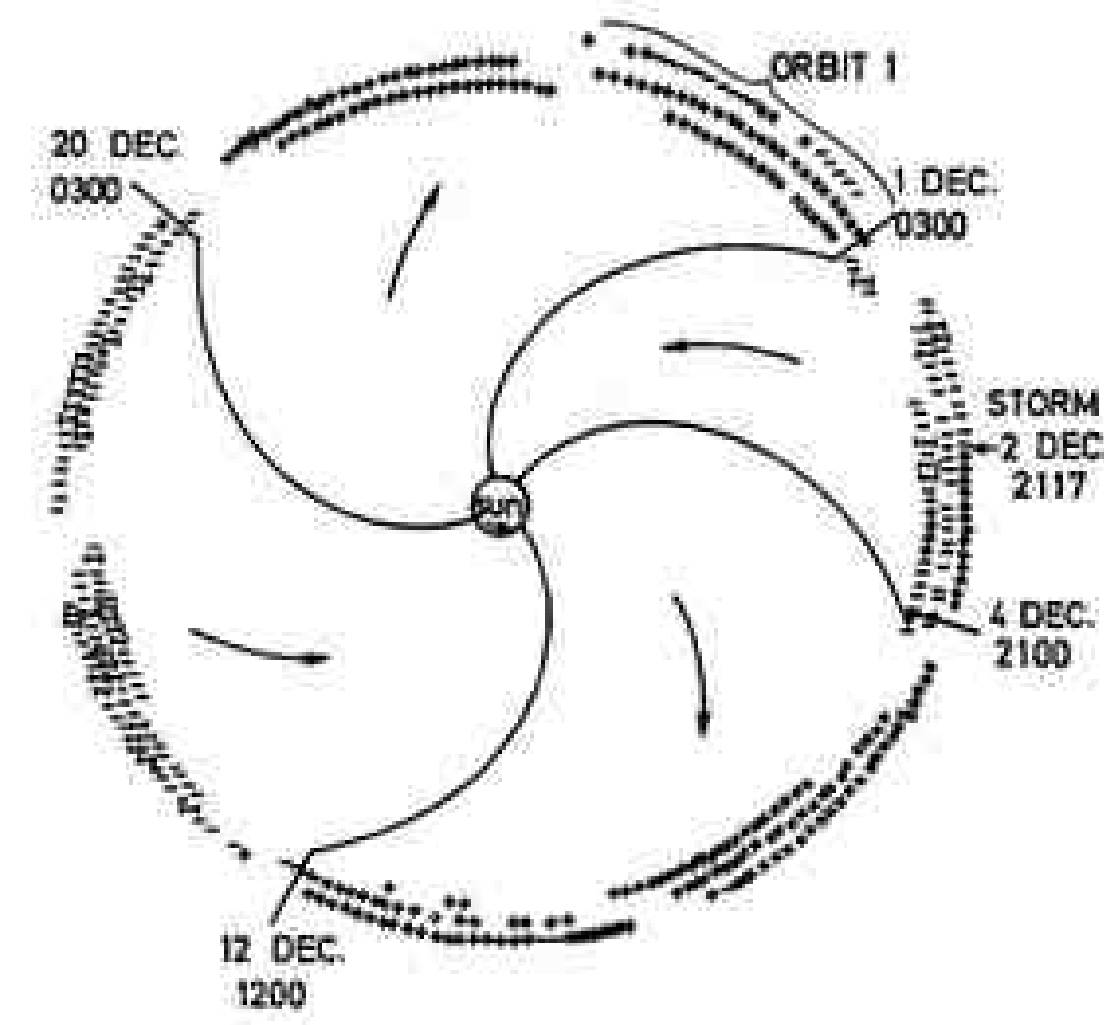
An28-day wave-period is observed every month in the magnetic records, most marked in summer months.



The Space Age:
The Solar Wind & Sectorstrutures

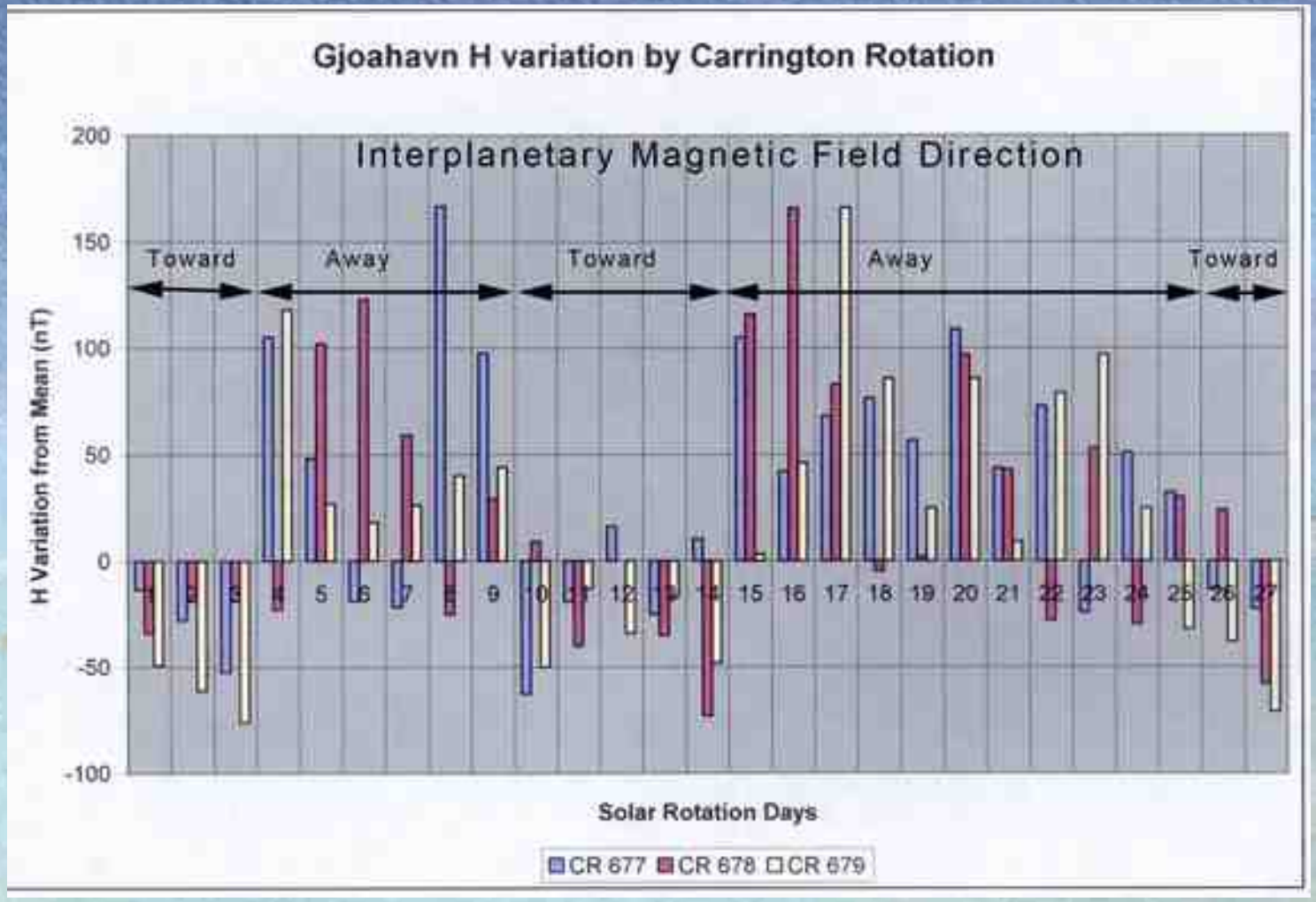
Electrons and protons from the Sun – called The Solar Wind, carried with them the solar magnetic field.

The interplanetary magnetic field changed polarity four times every solar rotation due to wavy structure in the solar magnetic field. Discovered in 1965.



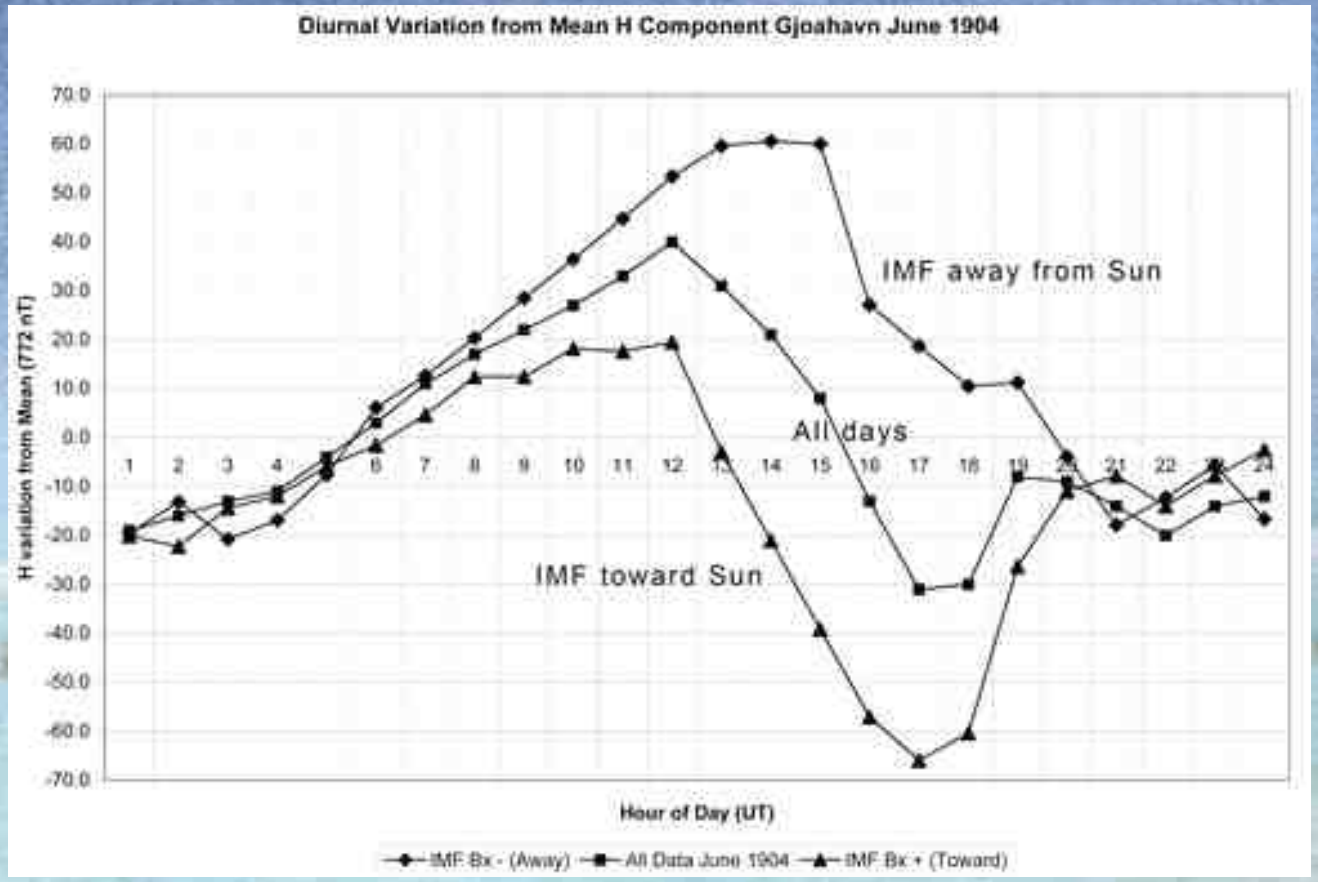

Structures in IMF at Gjøahavn for June 1904. Magnetic field changed little during last 120 yrs.

IMF changes for 3 solar rotations



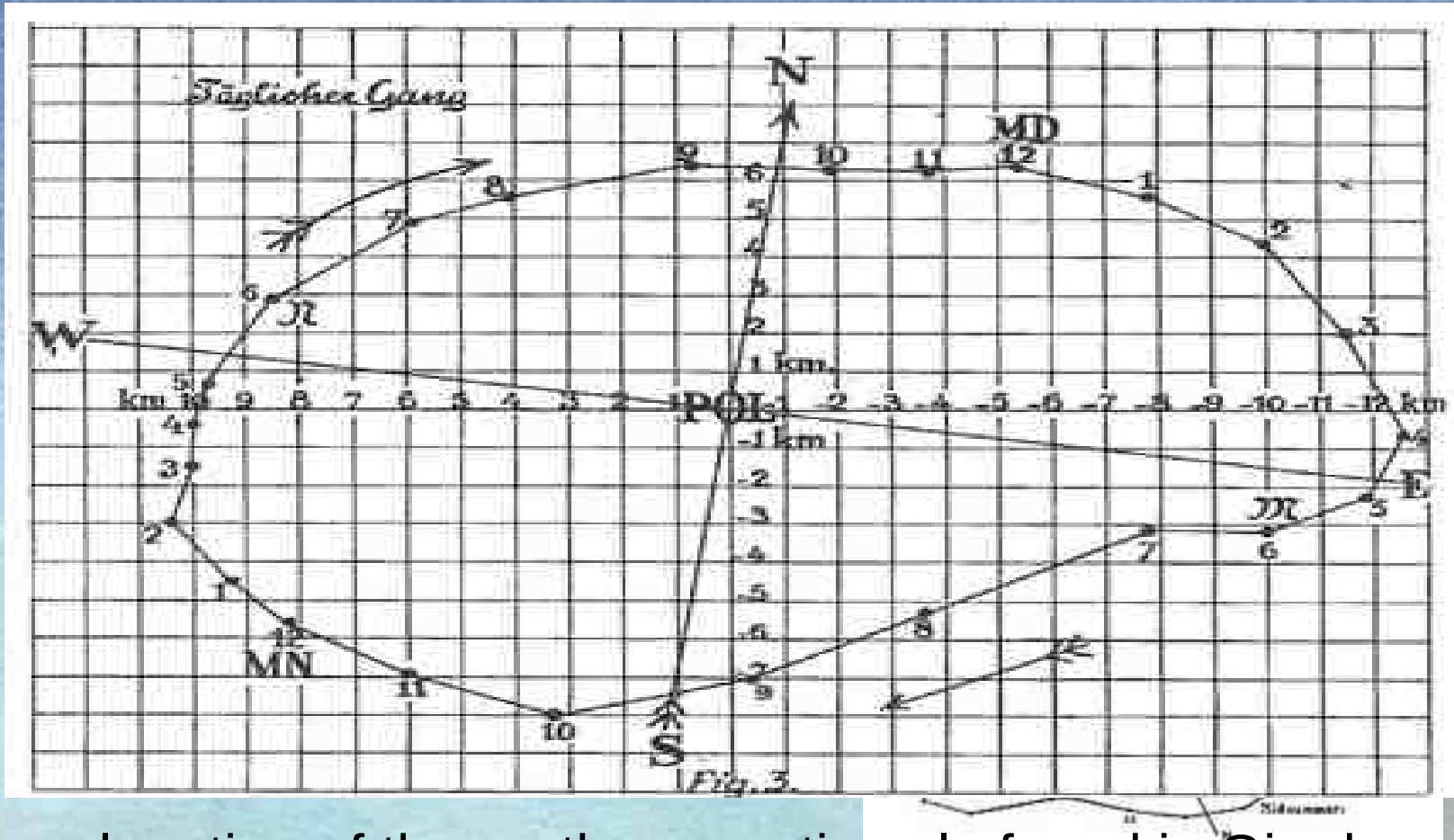
Solar Wind Magnetic Field Direction inferred from Gjøahavn mag. data for May, June, July 1904. Three 28-day solar rotations superposed: 4 sector crossings.

Polar Current Direction in Daily Variation



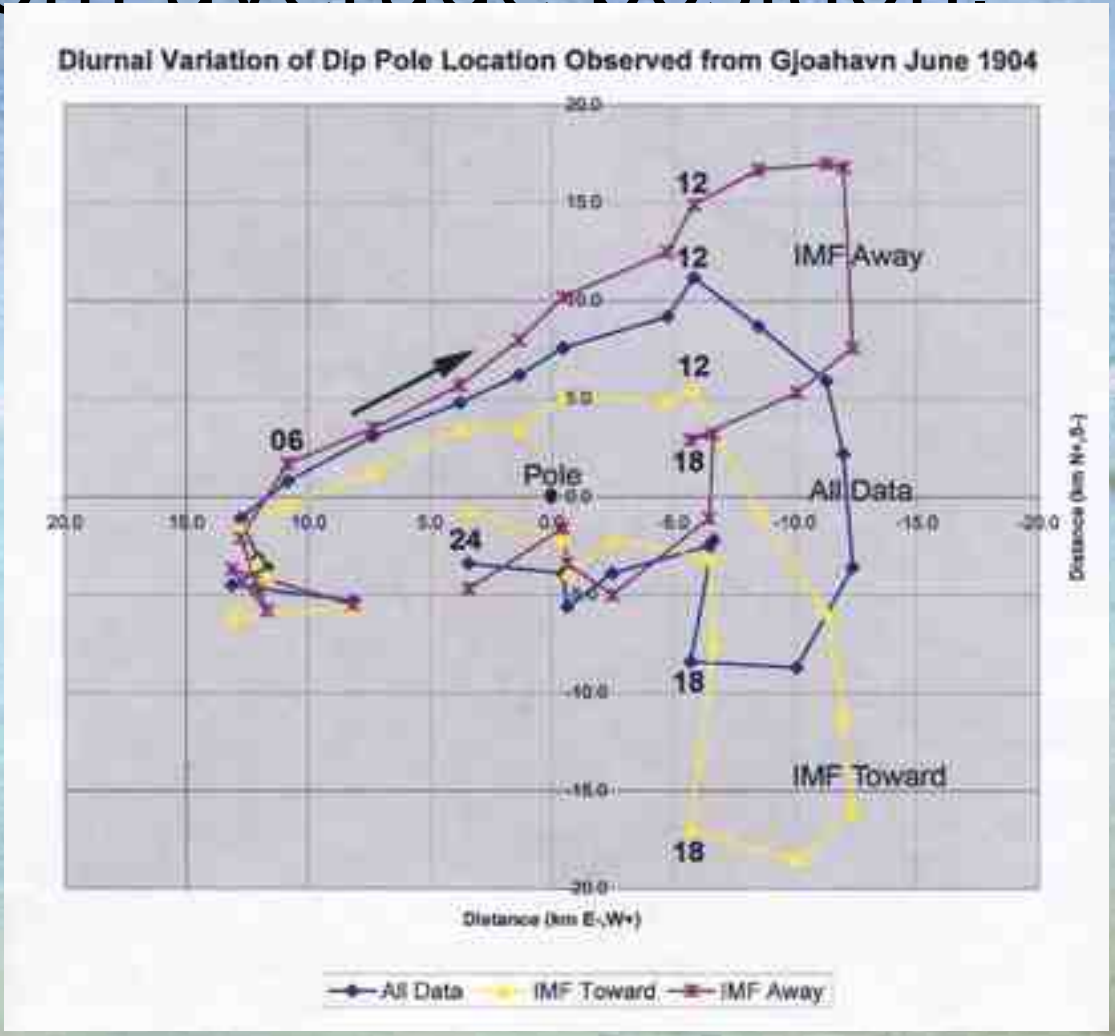
The effect of the change in direction of the solar magnetic field is thus to add or subtract from the value of the horizontal magnetic component during 09-19 UT

Result from GH data 1903 – 05.

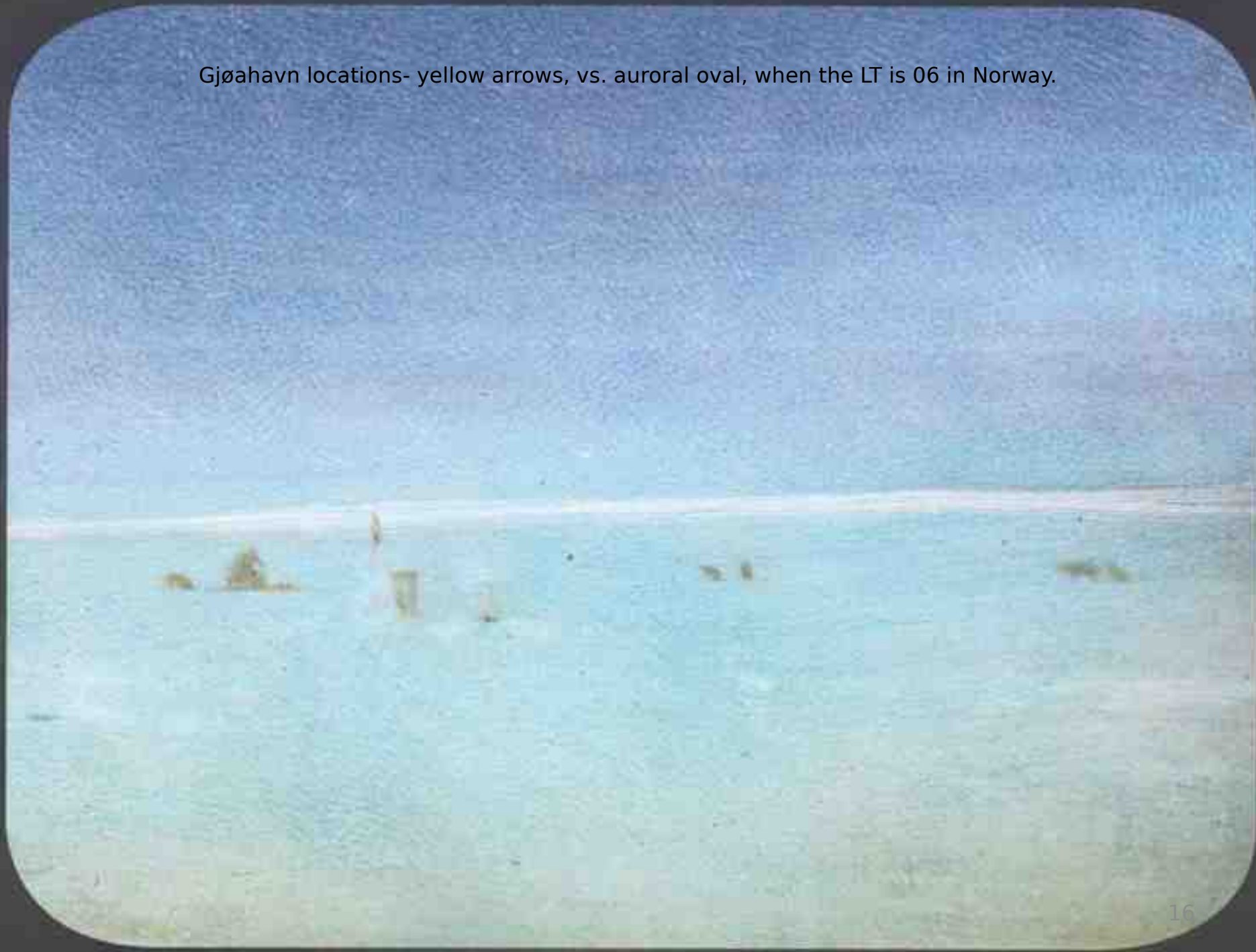


The diurnal motion of the north magnetic pole found in Gjøahavn data. Amundsen: The magnetic pole don't have a fixed, permanent location. "Our journey was not a great success".

Daily rotations of the north magnetic pole in June 1904 due to IMF. Location between 10-30 km from average position.



Gjøahavn locations- yellow arrows, vs. auroral oval, when the LT is 06 in Norway.

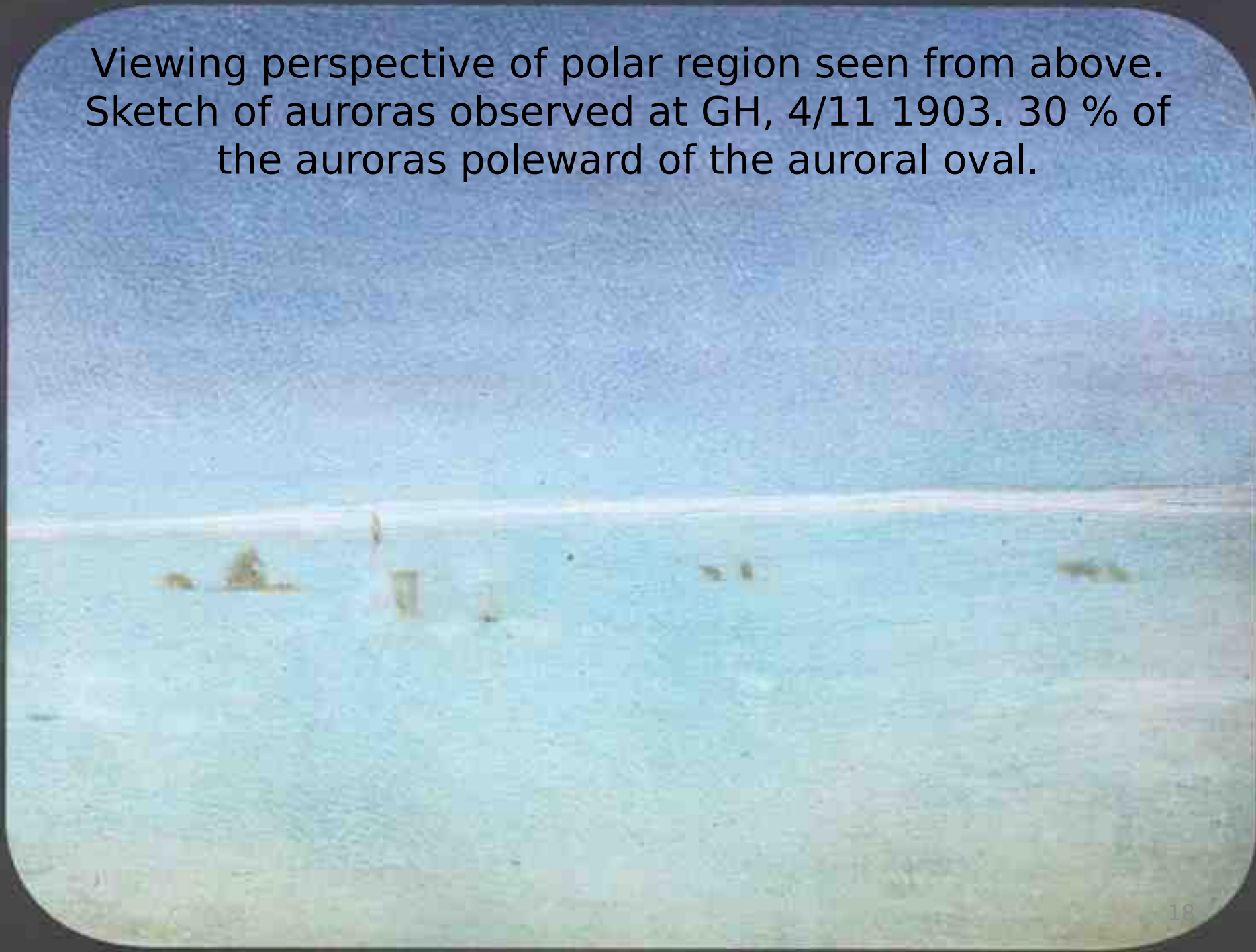


One page of the auroral logbook for GH. No foto or drawings

Observations of Aurora Borealis.

Year	Days	Hours	Aurora Borealis.
			Streamers from SE to south.
			Dense, magnificent bands from SE to south.
			Faint streamers and bands, frequently and briskly changing.
			Faint streamers, E—SW.
			Faint streamers and bands, NE, SW, low to south.
			Faint horizontal strips at the south horizon.
			Faint streamer in the south.
			Faint strips E to W ca. 20° above the horizon. Thick mass of clouds at the base.
			Very faint streamers from the horizon, ca. 40° towards the south.
			Cloudlike arcs to E and W, ca. 20° above the south horizon, ca. 10° above the W-horizon.
			Aurora in E and SW, 20° above the horizon with dark clouds underneath, a single streamer 60° towards the south.
			Bright strips NE — N, at the highest 30° above the horizon.
			When going from skio, we saw a luminous beam above our lodge, and believed that this was an illusion, but reaching the top of the hill we saw the light to be an aurora in the E. It had the shape of a large fan on the ice between us and the horizon. Gradually the streamer lengthened along the ice as far as to the W. Then flickering streamers appeared to stretch towards the south. At 9h 15m p.m. growing too hindered further observation.
			Faint aurora in W, vague in form.
			Very faint aurora in W.
			Wildly spreading aurora, but still faint, with its centre at the W-horizon, from there sending streamers towards the south. In the northern sky a faint aurora of vague form. Only in it the sky was clear.
			Strong belt from the E low towards SW, altitude ca. 30°.
			Faint strips from E to W horizon.
			Faint aurora as streamers from the E and SW low towards the south, ca. 45° high.
			Strong flaming rising beam from the SW low, through the south to the E horizon.
			Faint streamers in E.
			Faint, bright streamers from the E low towards the south, ca. 30° high.
			Aurora as a faintly flickering haze in the NW horizon.
			Arch E—W to NW ca. 15° high.
			Very strong aurora as streamers SW-NE through south.
			Still strong streamers, but on the south several longer and smaller ones in lively motion.
			Very faint, hardly visible portion in the south.
			Ridge NW-WNW. Some faint and frequently shifting points at south.
			Bands through south all around the horizon.
			Very strong band E-WNW ca. 30° above the horizon. From SW a streamer to south, fading away towards the south, where it wholly disappeared.
			Faint streamer from E to south, where it entirely went out.
			Strong rising band from N low to south, frequently changing to flickering streamers that rapidly died away.
1904	January		At low E-W. On the SW a faint streamer to the south.
			Strong flickering streamers NE-WNW, stretching from the low to south, there forming a garland (horizontal).
			Bands and rising streamers at the ice, ESE-NW

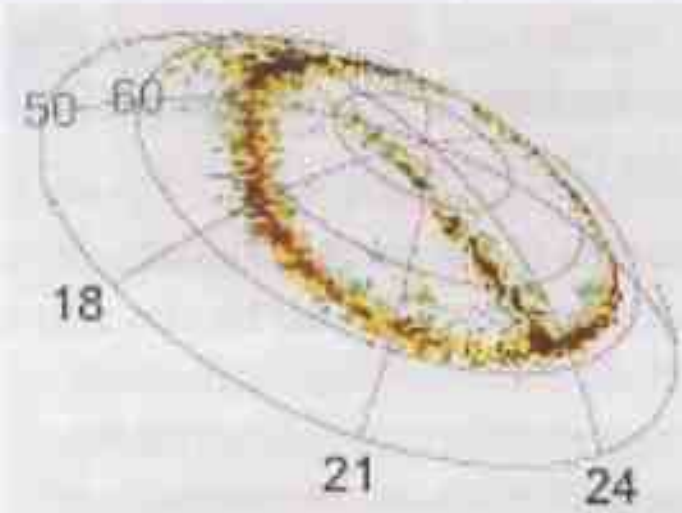
Viewing perspective of polar region seen from above. Sketch of auroras observed at GH, 4/11 1903. 30 % of the auroras poleward of the auroral oval.



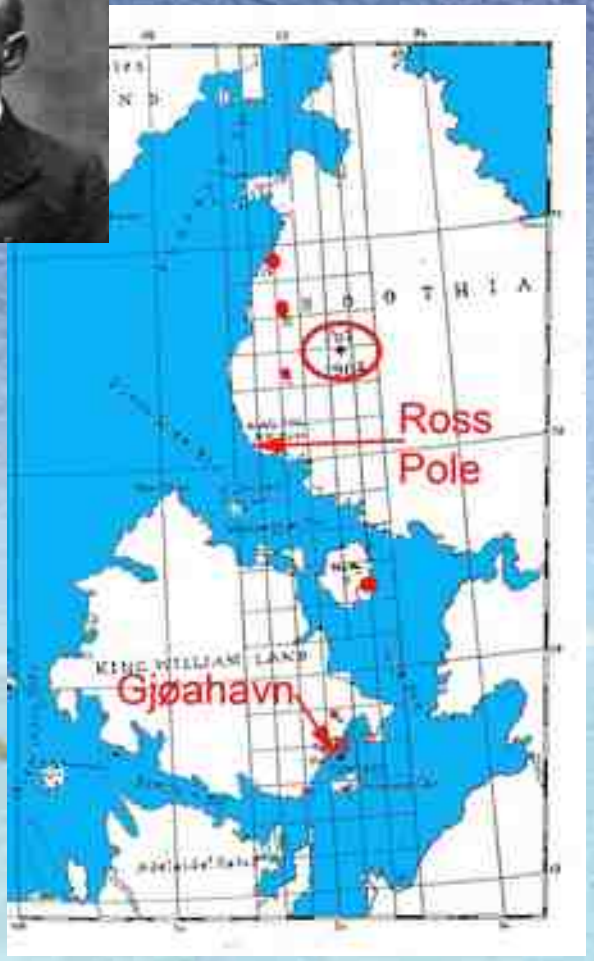
Polar arcs- Theta auroras,

Sun-aligned arc in north & south.

Nature's owen clock.



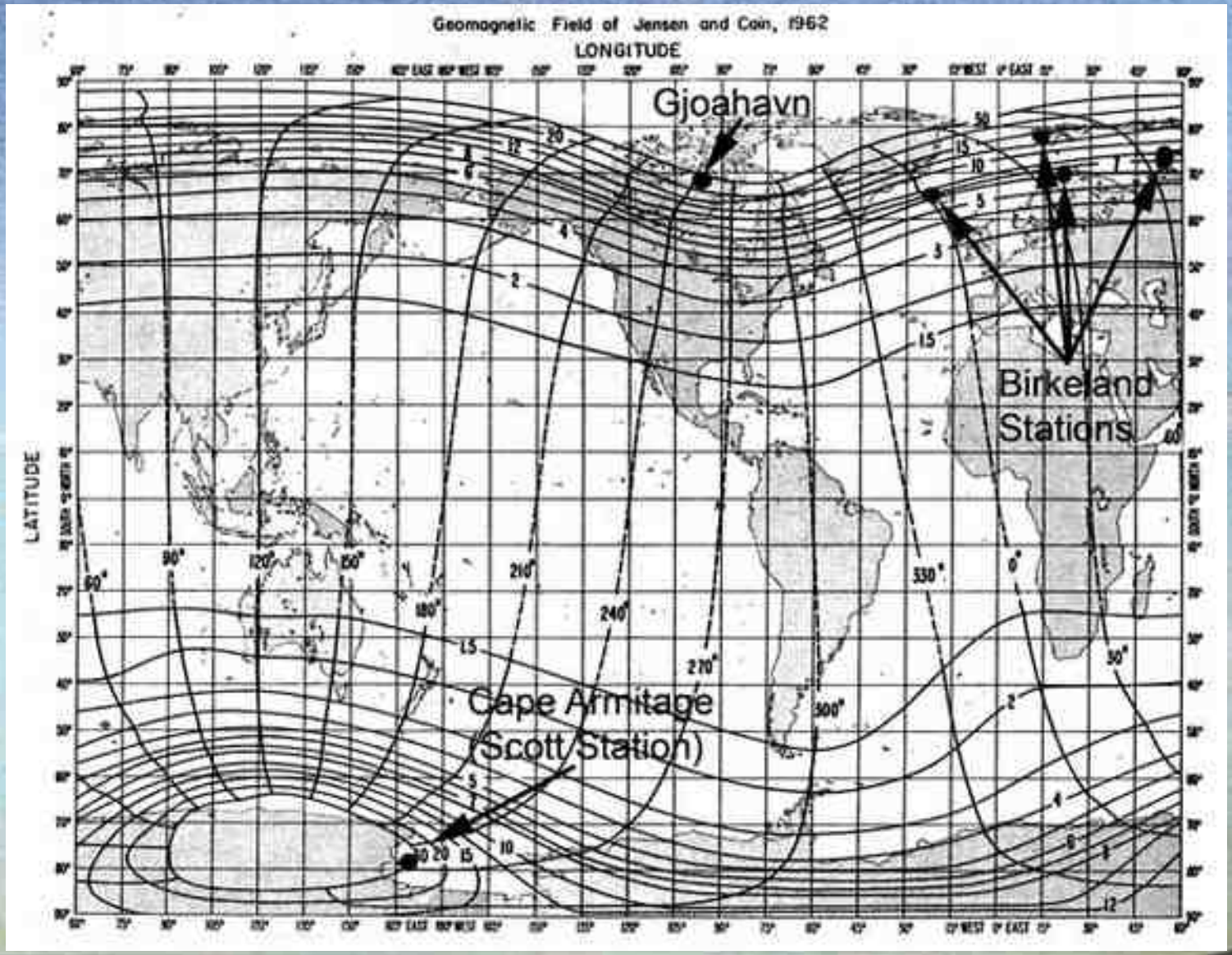
Amundsen -- Scott



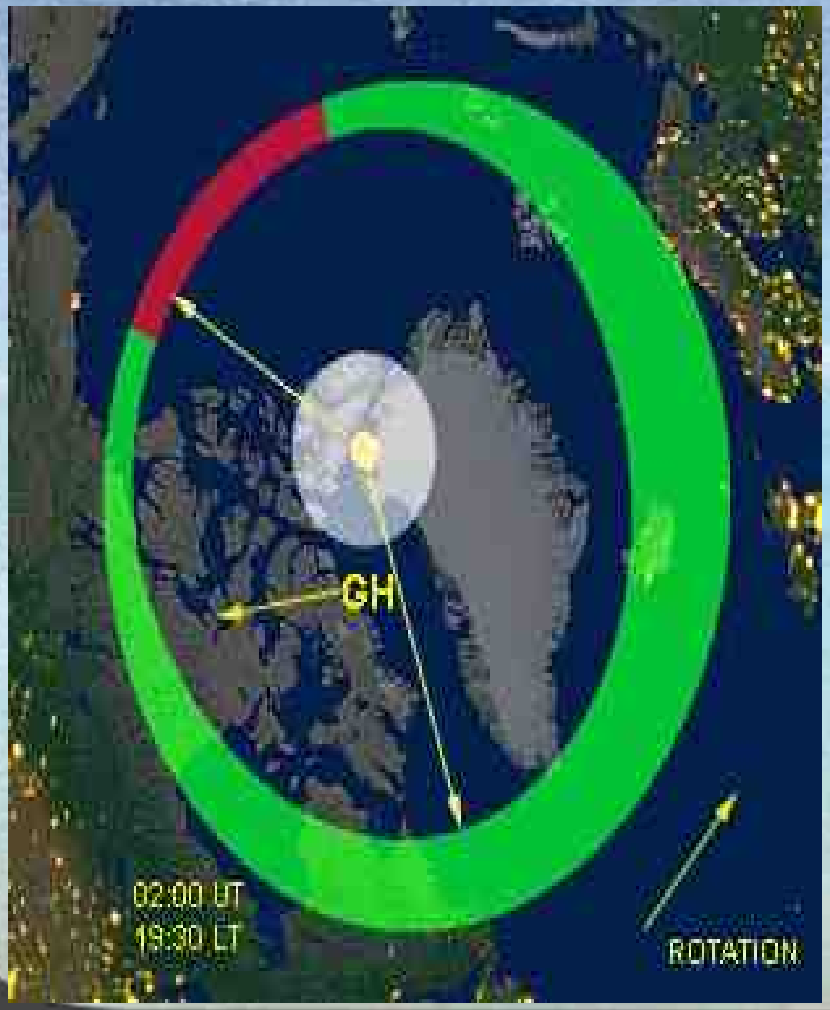
Amundsen's Gjøa (1872-1928) & R. Scott's (1868-1912) Discovery Exp. – at McMurdo, were tied to the same magnetic field line.

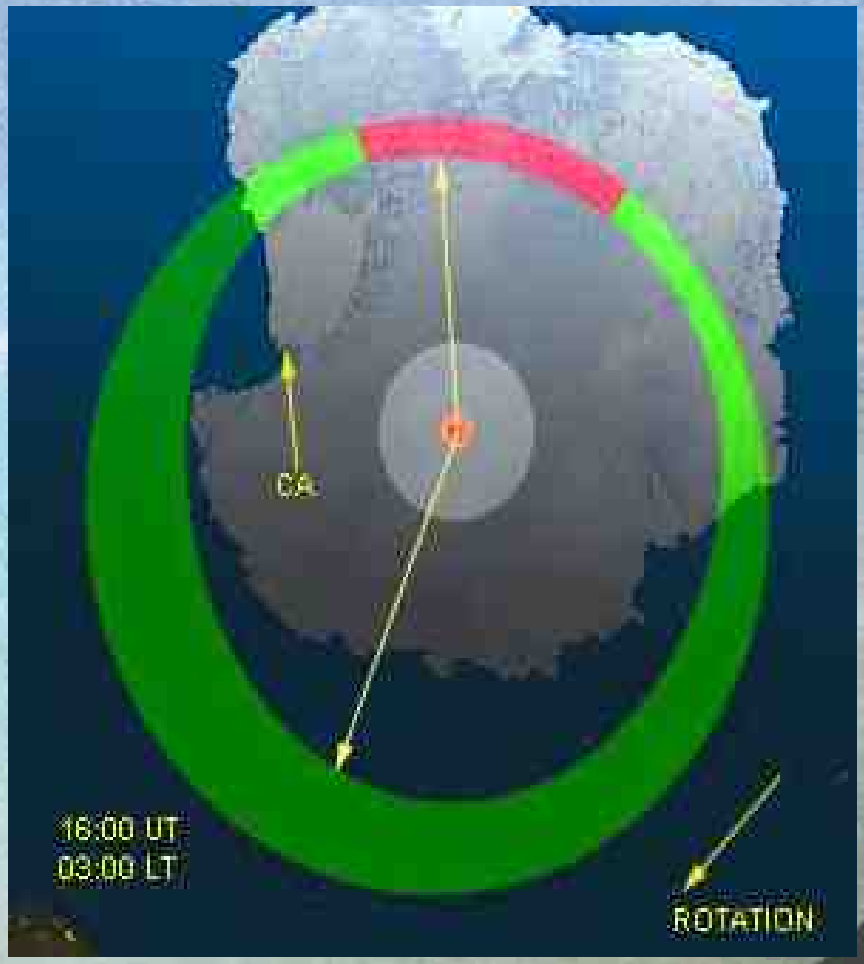
Their interaction to the Earth's magnetic poles.

Polar Expeditions between 1901-1905

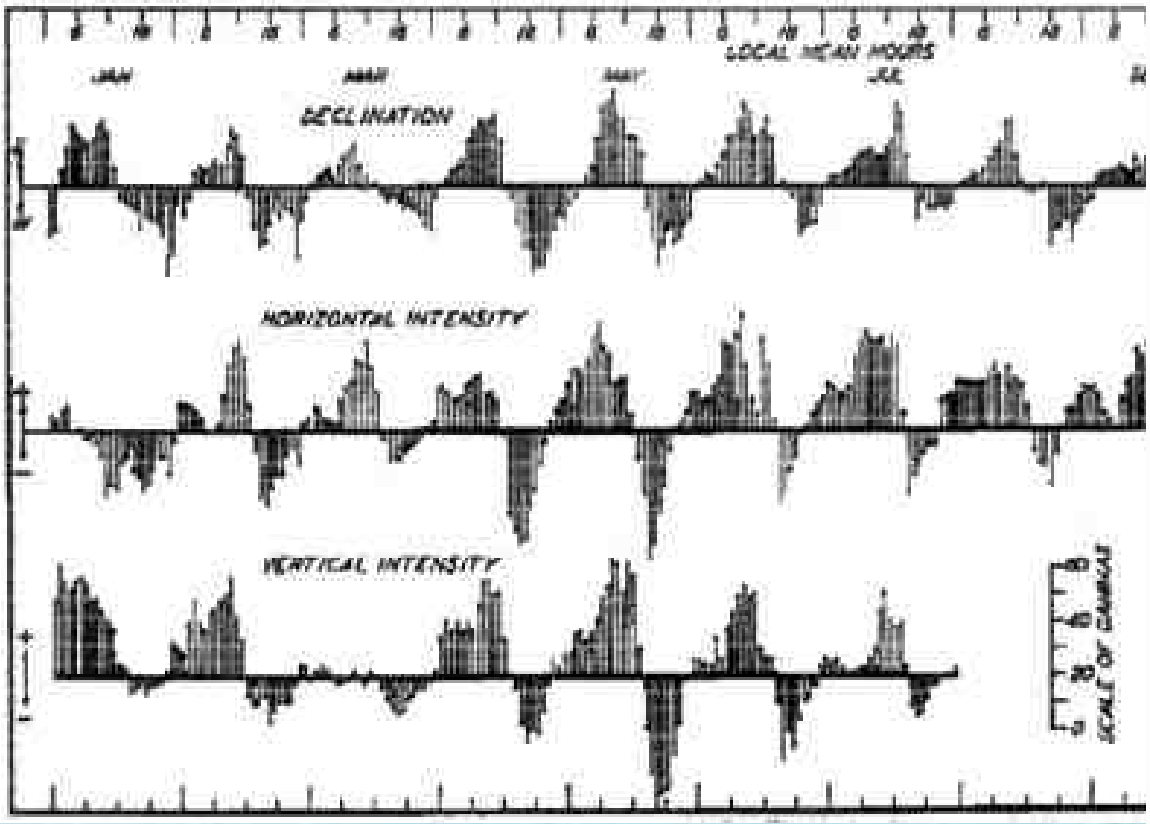


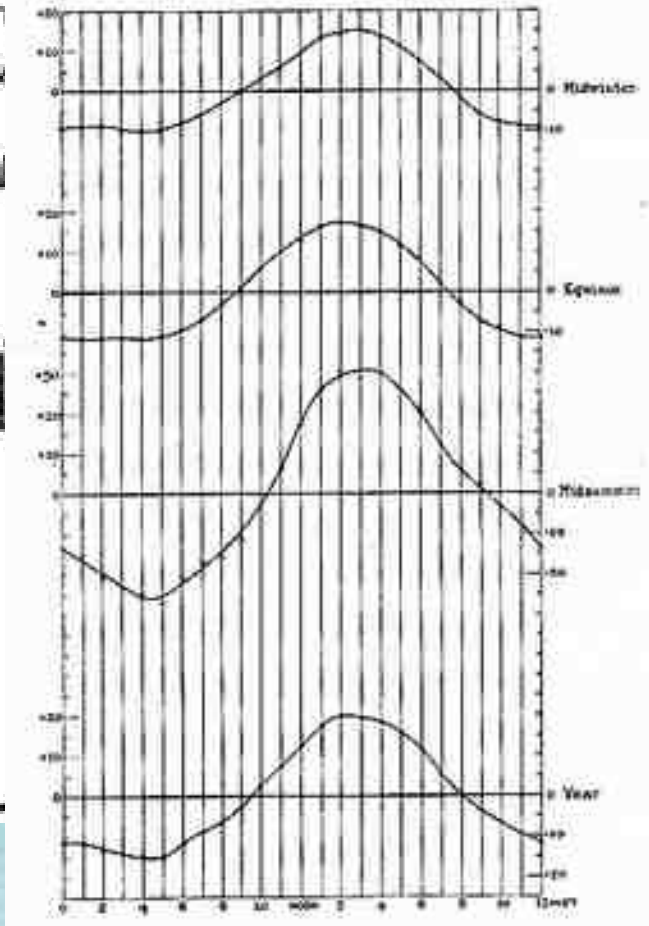
The location of the auroral oval in N at LT 1930 & S at LT 03. Notice direction of rotation.





Amundsen(left) -- Scott





Diurnal & yearly variations of the H component found (Chree,1909) in the Scott's data: similar to that found in the Gjøahavn data (in all 3 components).

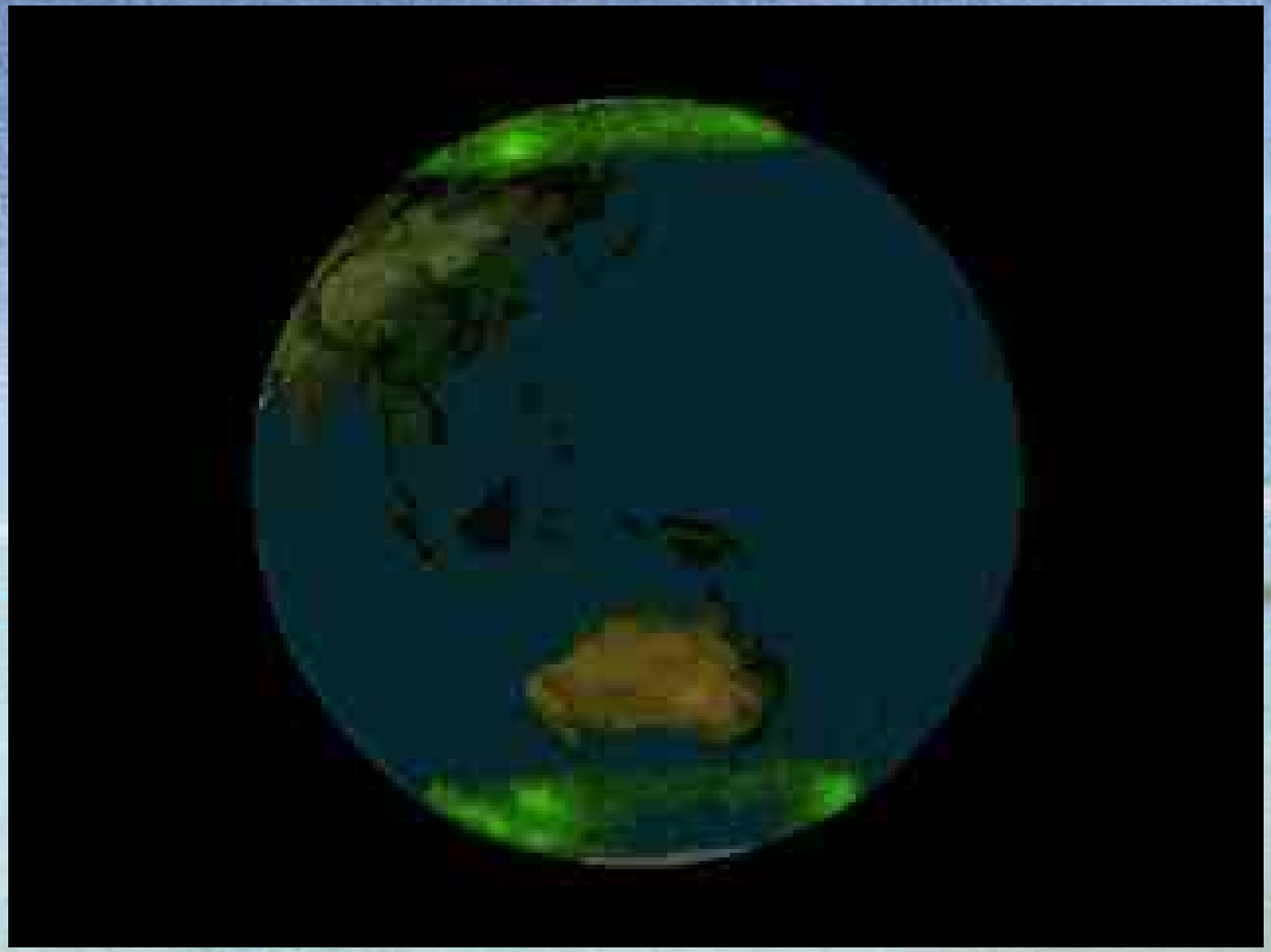
Drawing of Aurora observed at CA

e station Cape Armitage may be 15 to 60 min east of Gjøahavn in magnetic time.

A list of UT and Local Solar Times of Magnetic Midnight & Noon, Average Time of Solar Noon & Magnetic Midnight (MdNt) for Gjøahavn and Cape Armitage. The time for Substorm Poleward Expansion (SS) is also included..

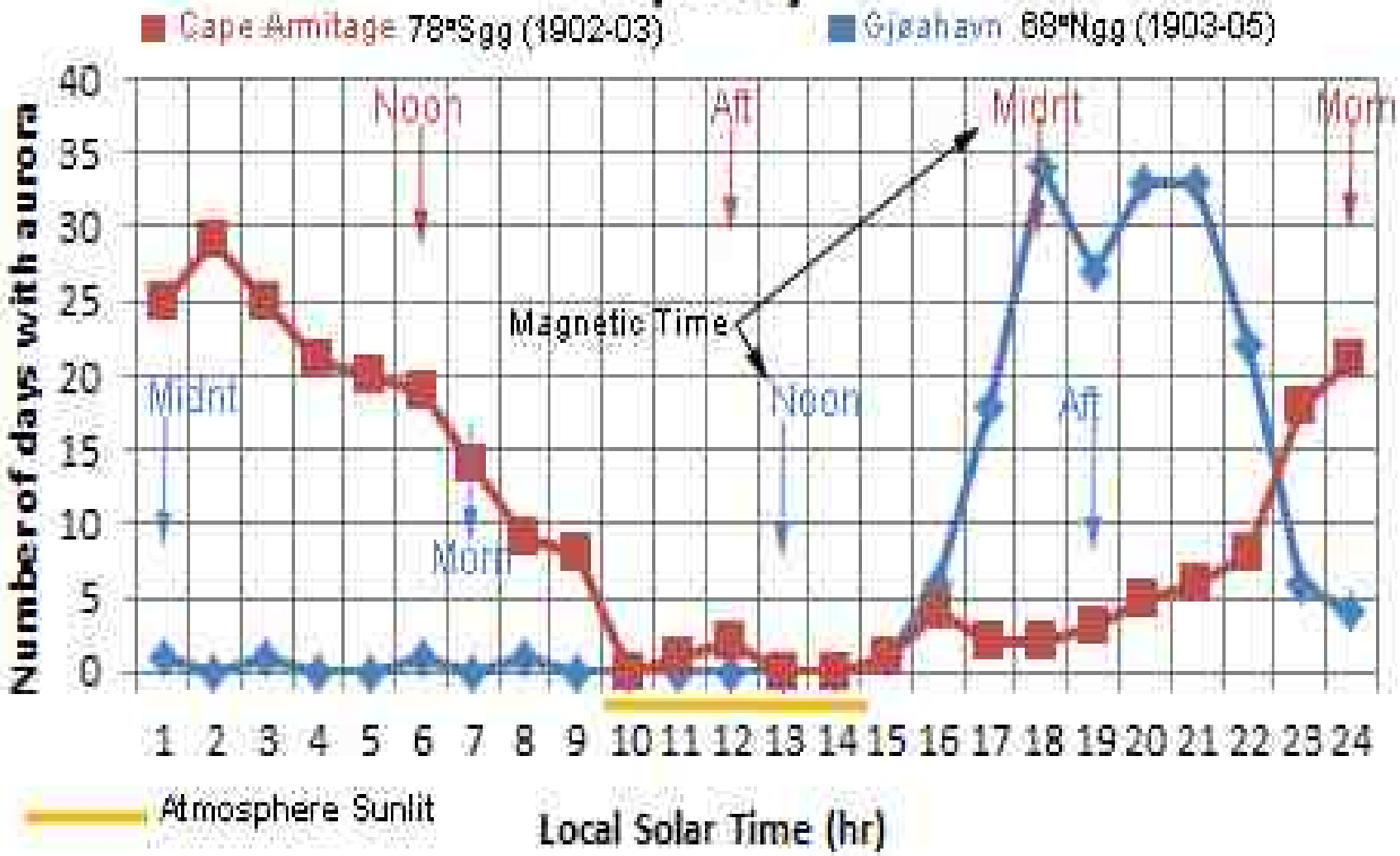
Station	Time	Mag.Noon	Mag.MdNt	SS Onset	SolarNoon	SolarMdNt
Gjøahavn	UT	19:30	07:30	06:00	18:24	06:24
	Local Solar	13:00	01:00	23:30	12:00	00:00
Cape Armitage	UT	19:00*	07:00*	05:30	23:06	11:06
	Local Solar	08:00	22:00	18:30	12:00	00:00

Conjugate Aurora

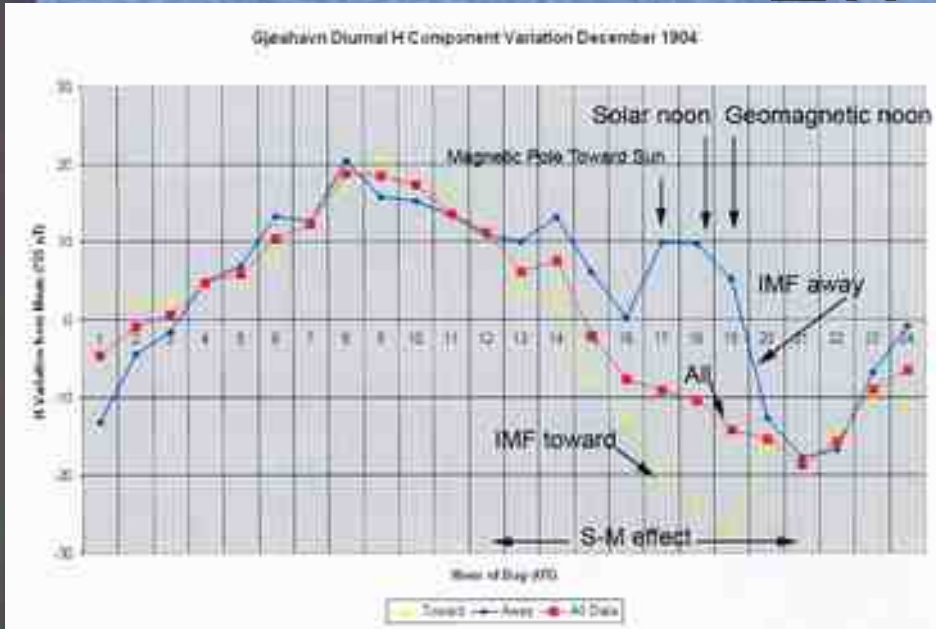


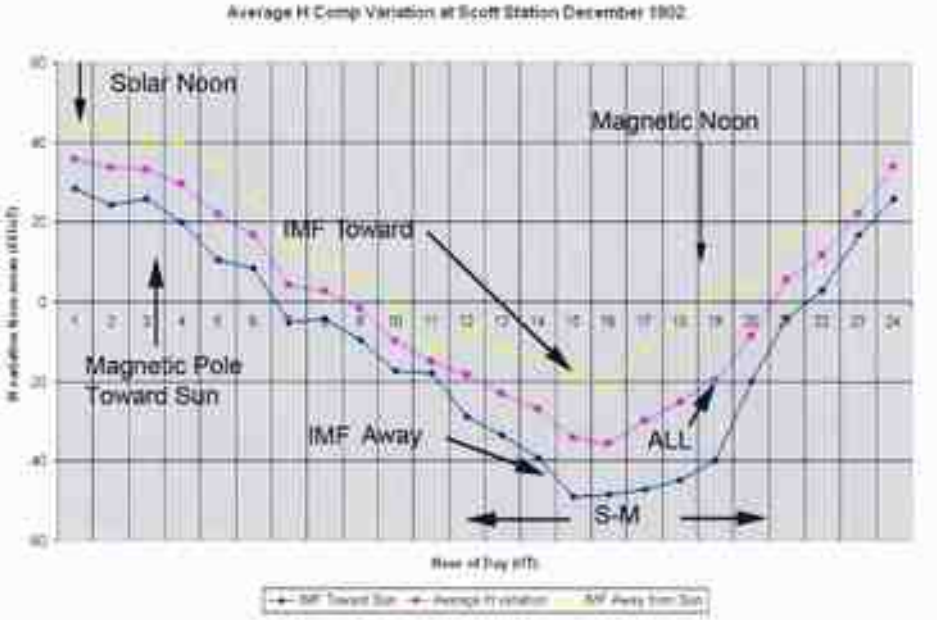
The aurora borealis (north) is conjugate to the aurora australis (south).

Average Diurnal Visual Auroral Observation Frequency



Amundsen-Scott Solar Wind Effects





The S-M Effect occurs at the same magnetic time at magnetically conjugate stations. Thus, the S-M effect is a magnetospheric effect. NB: The diurnal variations at CA peaks 6 hours earlier than GH and is thus a solar or a Universal Time effect.

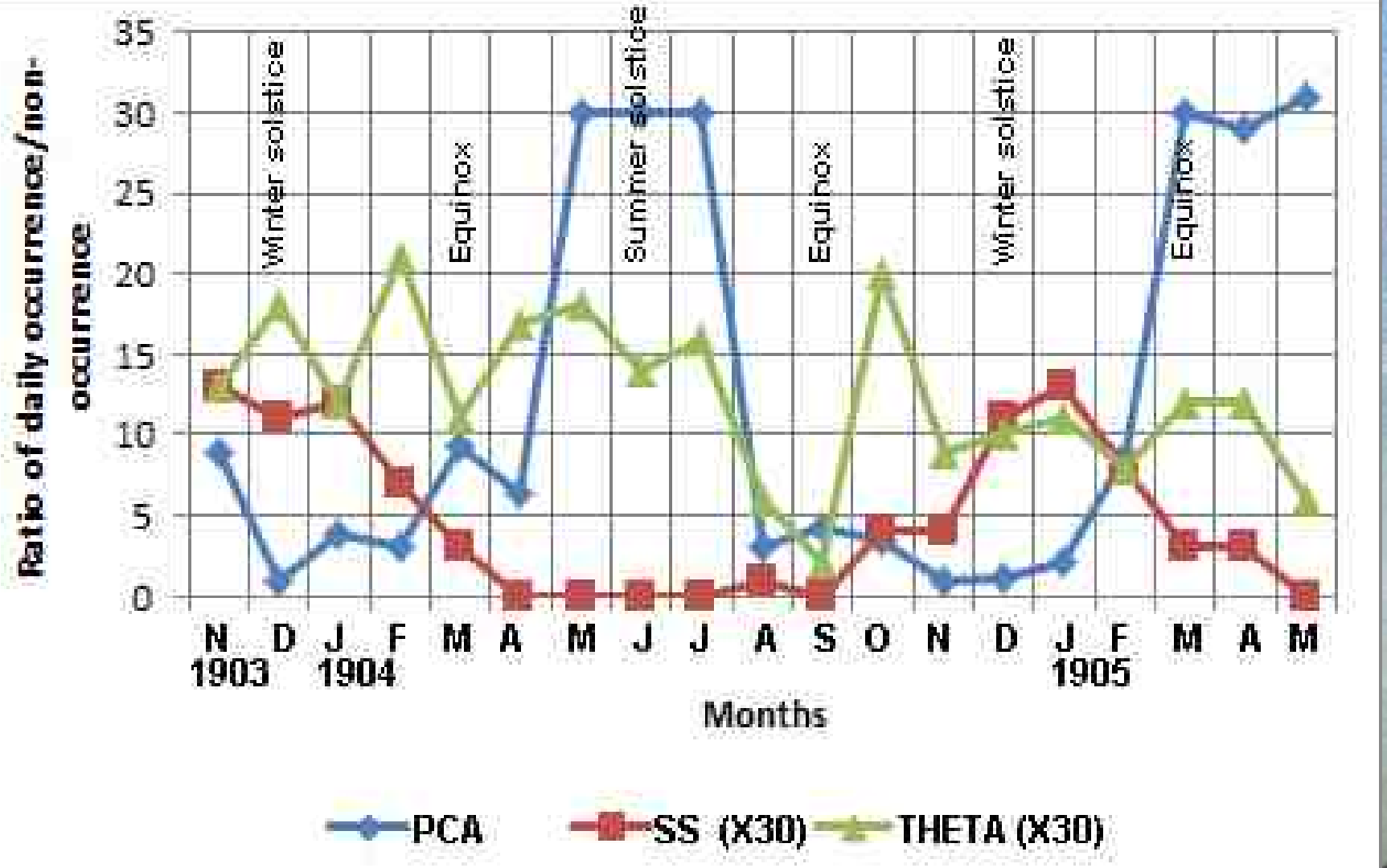
Conclusions

- 1. The mag. poles don't have a fixed, permanent location.
- 2. A regular, 28 day wave in the field observed.
- 3. The marked IMF effect was observed at both stations at same MT.
- 4. The IMF & magnetic sector structures burried in the ground data.
- 5. The IMF is a geomagnetic effect, regular daily variations due to solar e-m radiation.
- 6. Polar cap auroras have a complex relation to mag disturbances – polar rain.
- 7. The solar wind effects on magnetic field & auroras similar to what we observe to day.
- * Historic data important to study temporal & spatial variations.

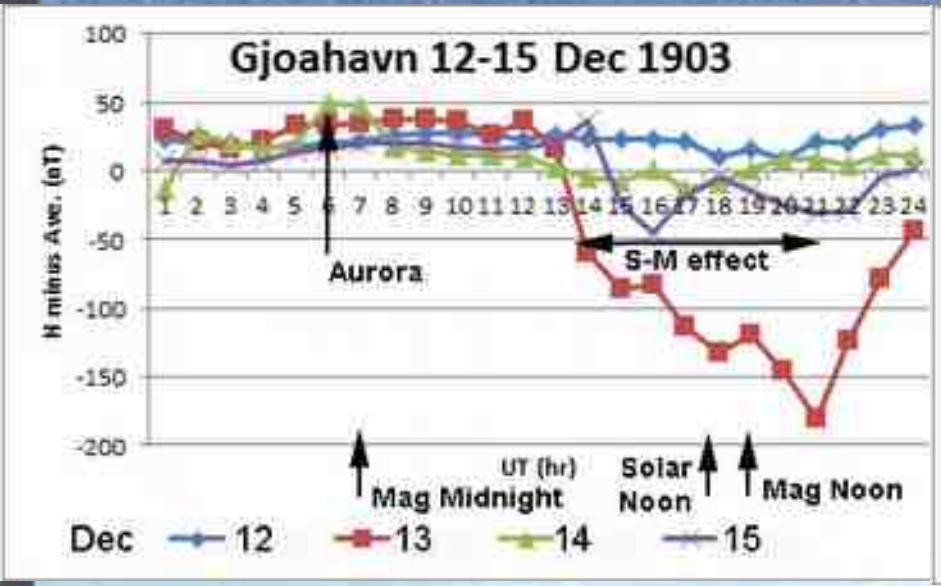
Sources for auroral- & magntic disturbances

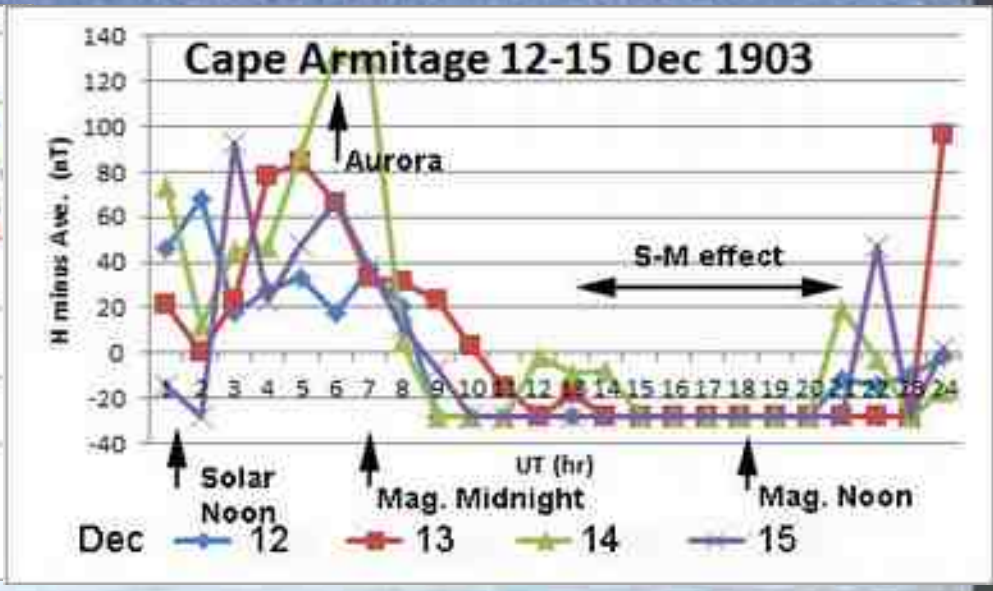
- Up to now: The solar wind – both electrons and protons are the sources.
- Alternatives:
- 1. UV & X solar radiations; solar control; Then the results best explained in LT & a geog. coord. system.
- 2. geomag. control; Solar wind; Then the results best explained with MT in a magn. coord. system
- Both plasma precipitation & intense e-m radiation produce large currents whih are sources for ionospheric disturbamces.

Daily occurrence of diffent of auroral forms



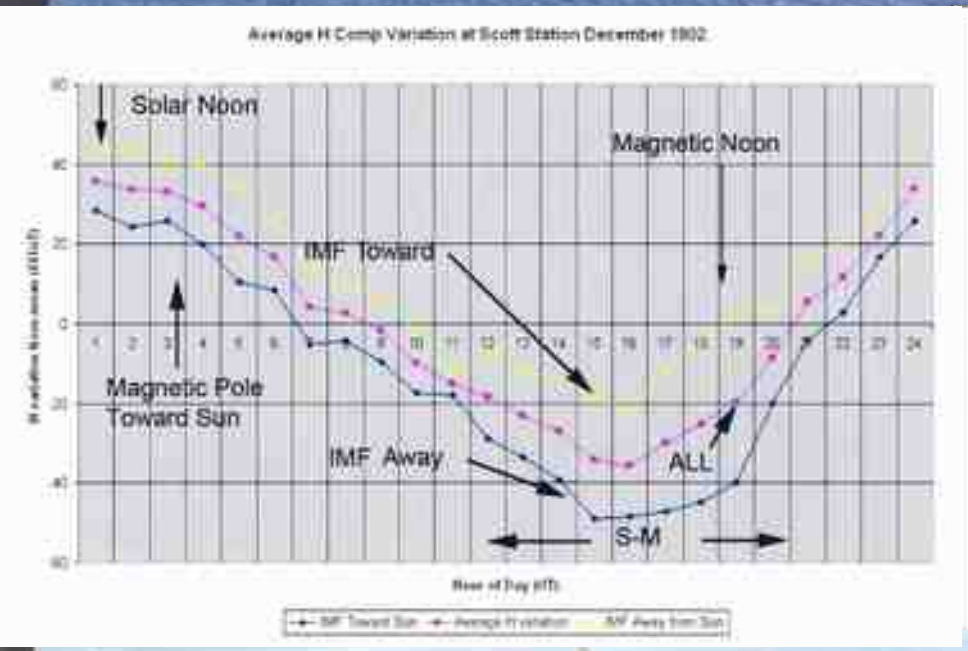
Amundsen-Scott Simultaneous Obs.

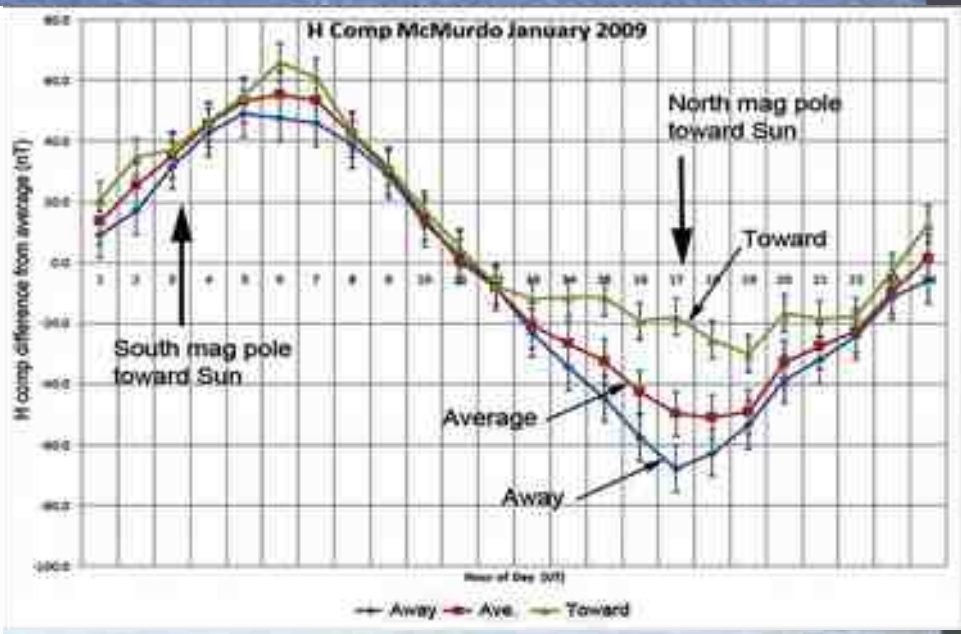




In 1903, simultaneous observations from both stations. The S-M effect is seen to occur as usual 12-21 UT in the north, but in the south it occurred when the trace went off scale. Thus, the only simultaneous magnetospheric effect seen simultaneously from both stations was the aurora on Dec 14th.

CA data: Solar Wind Effects





In this comparison of data from Scott Station, the S-M effect is still obvious, but the main diurnal variation has shifted, a change in the effective location of the pole over the intervening 100 years.