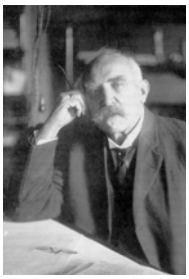
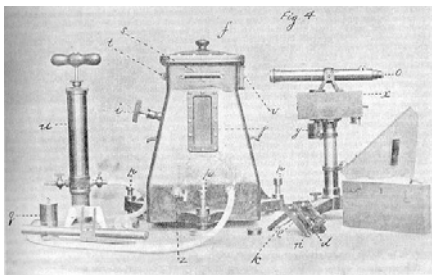
Gravimetry and the Geodetic Survey

The three "pillars" of Geodesy include: the shape of the Earth, the Earth's orientation, and the **Earth's gravity field**. Gravity measurements provide knowledge about the Canadian landmass, can help identify potential oil- and mineral-bearing geological formations, even help define Canada's continental margins in the sovereignty issue over the North Pole. Gravity also helps geodesits improve national surveying standards and enables the computation of the **Geoid** which relates GPS heights to mean-sea-level.

Gravimetry's Canadian Beginnings

Otto J. Klotz *(left)* was the first to use the original Mendenhall pendulum gravimeter *(right)* in Canada in 1902. He acquired his first readings in Ottawa and later Montreal and Toronto to demonstrate the utility of gravimetry to the Dominion Observatory.





The first regular gravity survey was conducted in 1914-15 and consisted of 18 points. As Canadian activities in gravimetry flourished, a National Gravity Program was created to map the gravity field over all of Canada's lands and offshore.

Following the Mendenhall pendulum came the torsion balance, the relative gravimeter and finally the Absolute Gravimeter (AG) that directly determines acceleration due to gravity by precisely measuring the time and distance travelled by a free-falling optical mass in a vacuum chamber.

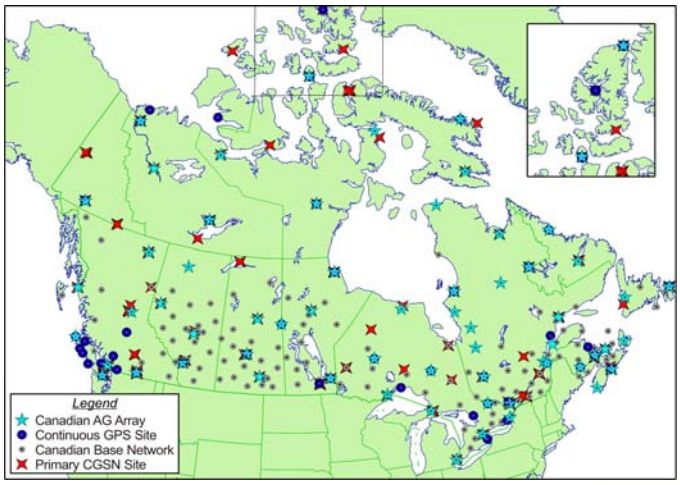
Right: the FG5 absolute gravimeter

Gravimetry within the Geodetic Survey

Gravity operations were moved within NRCan from the Geological Survey of Canada (GSC) to the Geodetic Survey Division (GSD) in 1995. In addition to maintaining the Canadian Spatial Reference System (CSRS), GSD has been responsible for maintaining the **Canadian Gravity Standardization Net** (CGSN) which provides datum control for gravity observations across Canada.

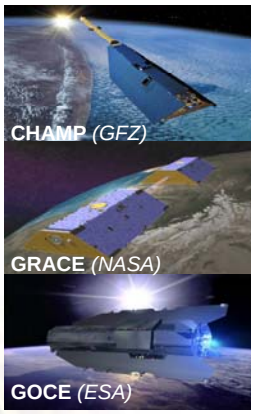
CGSN Modernization & the National Absolute Gravity Array

To help better define the vertical component of the CSRS, efforts are now underway to create an array of **Absolute Gravity** (AG) observation sites co-located with GPS reference sites across Canada. It will support scientific studies, including (with NRCan partners) earthquake zone deformation, sea-level rise, hydrological mass monitoring and post-glacial rebound. The new **Canadian Absolute Gravity Array** will replace the primary control points of the CGSN.



Measuring the Earth's Gravity Field from Space

The study of the Earth's gravity field is being further advanced by three revolutionary satellite gravity missions over this decade: CHAMP *(CHAllenging Minisatellite Payload)*, GRACE *(Gravity Recovery And Climate Experiment)* and GOCE *(Gravity field and steady-state Ocean Circulation Explorer)* gravity mission satellites.



Satellite gravimetry can measure groundwater mass variations as well as water system dynamics within the Great Lakes Basin. Its potential is yet to be fully explored.

GSD has been actively involved in the evaluation of **satellite-derived gravity models** since 2001, and the upcoming satellite gravity missions will be used to develop a more accurate **Canadian Geoid model** which will be the basis for Canada's **new height system**.