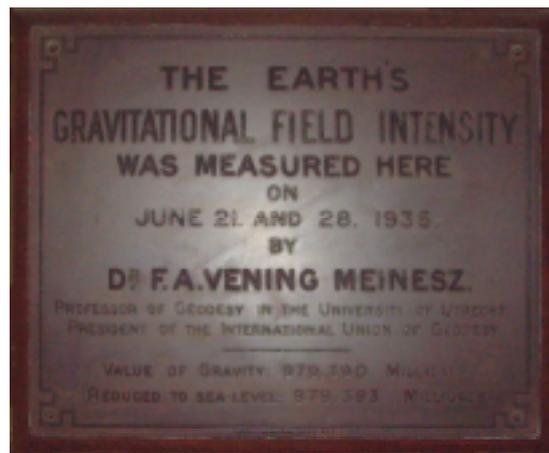


History of the Department of Physics at UWA

Issue No. 11: “The Earth’s Gravitational Field – An Interlude”

Written by John L. Robins

Just inside the entrance to the Physics component of the Physics and Chemistry building opened in 1935, which is the part now occupied by Geology, there is a brass plaque mounted on the wall. This plaque commemorates a visit to the University by Dr. F.A. Vening Meinesz who made an accurate measurement of the acceleration due to gravity within the newly completed Physics building. This event forms part of the fabric of our Department’s history even though no Physics staff members were directly involved in the measurements.



The plaque, shown above, reads as follows:

**THE EARTH'S
GRAVITATIONAL FIELD INTENSITY
WAS MEASURED HERE**

**ON
JUNE 21, AND 28, 1935**

**BY
Dr. F.A. VENING MEINESZ**

**PROFESSOR OF GEODESY IN THE UNIVERSITY OF UTRECHT
PRESIDENT OF THE INTERNATIONAL UNION OF GEODESY**

**VALUE OF GRAVITY: 979,390 MILLIGALS
(REDUCED TO SEA-LEVEL: 979,393 MILLIGALS)**

The story behind this visit is recorded in a poster which has been prepared by the Geology Department and is now displayed on the wall below the plaque. It is my pleasure to acknowledge this poster as the main source of the information and illustrations presented below on Vening Meinesz, his research and the submarine K.XVIII.

In 1935 Felix Andries Vening Meinesz (1887-1966) was Professor of Geodesy at the University of Utrecht, and President of the International Union of Geodesy.



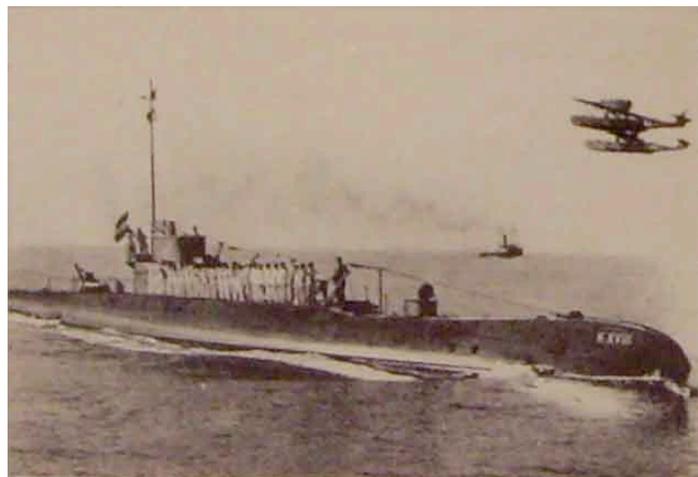
Dr. F.A. Vening Meinesz

Geodesy is the Science of the size and shape of the Earth, and of the precise location of points on its surface. It includes the determination of the Earth's gravitational field and the study of variations in the tides, polar movements and rotation. The Earth's shape can be inferred from its gravity field, and accurate and extensive gravity measurements allow greater understanding of the Earth's crust, including the mechanism of plate tectonics and the underlying causes of mountain building and other processes which shape our Earth.

The acceleration due to gravity (g) can be determined from the relationship between the length of a pendulum and its period of oscillation, but precise measurements need a stable environment. Vening Meinesz designed an apparatus able to measure g in submarines at sea with an accuracy of four parts in a million. To escape wave movements, the submarine descended to a depth of at least 100 feet (30.5 m) for each measurement.

From 1923 to 1937 Vening Meinesz travelled about 100,000 nautical miles by submarine. He accumulated an enormous amount of information about the Earth's gravity, and theorised about continental drift, mountain-building and convection currents within the Earth. The unifying concept of plate tectonics, however, was not developed by Earth scientists until after World War II.

Vening Meinesz arrived in Fremantle on June 20, 1935, from Holland in the new Dutch submarine K.XVIII. The vessel had travelled via Madeira, St. Vincent, Pernambuco, Rio de Janeiro, Montevideo, Mar de Plata (Argentina), Tristan da Cunha, Cape Town, Durban and Mauritius. It had a maximum surface speed of 18 knots and the cruise had already taken 7 months. The voyage was primarily to test the ship and her complement, and secondarily to allow Vening Meinesz to measure g . K.XVIII submerged twice a day for this purpose.



Submarine K.XVIII

K.XVIII was the first submarine to enter Fremantle harbour, and was an object of intense interest to the media and public. The crew were feted and entertained continuously, but Vening Meinesz was able to make a series of observations extending 190 km east of Perth. A major consequence was the appreciation of the immense thickness of sediments under the

Perth coastal plain. He also made two measurements of g within the newly constructed Physics building as recorded by the plaque described above.

K.XVIII left on July 2, after a twelve-day stay, for Surabaya in the Dutch East Indies, continuing its scientific programme. The photograph shown here was taken as K.XVIII arrived in Surabaya on July 11. The tall figure standing apart from the crew on the deck is Vening Meinesz. He was reported as being about two meters tall, so must have found confinement in a submarine more of a hardship than most. (Poster credits picture to <www.dutchsubmarines.com>)

It is interesting to note that the unit used on the plaque to express the acceleration due to gravity is the milligal. The Gal, which is short for Galileo Unit, is rarely used these days as a unit for acceleration but is defined as one centimeter per second squared. Thus one milligal is 10^{-5} meters per second squared and Vening Meinesz's measured value for the acceleration due to gravity within the Physics Department was 9.79390 meters per second squared.



Prof. A.D. Ross and Dr. F.A. Vening Meinesz
Onboard the Submarine K.XVIII

Apart from the plaque we have two other records of Vening Meinesz's visit. The first is a photograph that Lance Maschmedt has located and preserved. It shows Vening Meinesz together with Professor A.D. Ross and appears to have been taken inside the submarine. There is no record of the photographer or the specific occasion although it is understandable that Ross would have been invited to inspect the vessel and view the research equipment on-board.

We come across Vening Meinesz's name once again, during the official opening of the Physics and Chemistry building, which was held on 25 October 1935, four months after Vening

Meinesz had left Perth. Of course the building had been in use throughout the year. A report of the formal opening (see Issue 3) includes the following statement: “Before asking Mr. Drew to perform the opening ceremony, the Chancellor, Sir Walter James, read messages of greeting and congratulation from Dr. Fleming, of the Carnegie Institution of Washington [see the story of the Watheroo Magnetic Observatory in Issue 8], Sir David Rivett, chief executive officer of the Commonwealth Council for Scientific and Industrial Research [later to become CSIRO], and Dr. F.A. Vening Meinesz, the noted Dutch scientist, who recently visited this State in the submarine K18. ‘It was very good of them to think of us.’ he remarked.”

Epilogue

It would appear that after Vening Meinesz’s visit, no further measurements of the gravitational field were undertaken within the Department, except for those measurements made by hundreds of students in their 1st Year Laboratory classes, until about 1980. At that time Dr. Frank van Kann commenced a research project aimed at developing an airborne detector, capable of measuring anomalies in the earth’s gravitational field, using gravity gradiometry techniques. Such measurements are of vital importance to the mining industry. This time the air, rather than the ocean, is being used as the measurement platform.

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