

IN MEMORIAM F.A. VENING MEINESZ

Wednesday August 10, 1966 was the last day in the 79-years long and very well-spent life of Professor Dr. F.A. Vening Meinesz. That day the world lost one of the greatest earth scientists that it had ever known and this journal one of its most esteemed Editorial Board members.

Felix Andries Vening Meinesz was born on July 30, 1887 in Scheveningen, a sea-side town in the western Netherlands. His father, Sjoerd Vening Meinesz, was at that time burgomaster of Rotterdam, but in 1891 he became burgomaster of Amsterdam and it was in the latter town that young Felix grew to manhood. At the age of seventeen, he matriculated as a student of civil engineering in the Technical University, Delft, where he graduated in 1910 with the degree of engineer. Professor Heuvelink, of the department of geodesy of the Technical University, then invited him to spend two years of post-graduate study in the determination of the force of gravity at some pendulum stations in The Netherlands. This work formed part of the activities of the Netherlands Geodetic Commission. He received his doctorate in 1915 (cum laude), but this was not at all the end of his programme of gravity observations.

Initially, Vening Meinesz worked on land. His beginning was a bit difficult, for he found himself plagued by the waves of the North Sea, which beat against the dunes that protect the lowlands of Holland. No matter how stable he tried to make the fundaments of his pendulums, the microseisms gave rise to spurious disturbances. He succeeded in overcoming the problem, however, in a very simple fashion, characteristic of the genius worker, viz. by swinging *two* pendulums in opposite phase at every station in his Netherlands network.

In 1923, he tried to move his field of activity to the sea. The first attempts to carry out gravity measurements at sea were made aboard the surface ship "Paleleh", but these did not lead to results. Upon the suggestion of a friend, Van Iterson, he began to think of the possibility to work aboard a submarine. To this end he sought and obtained the assistance of the Royal Netherlands Navy. Aboard their submarines he could swing his pendulums on a reasonably stable platform - one submerged in the relatively calm waters below the ocean waves. He thus presented himself, in all the majesty of his towering height of close on two meters, at the submarine quay of the naval base at Den Helder, causing the commander of the allotted submarine to remark drily: "This won't survive a trial trip of 24 hours".

But Vening Meinesz did survive it. And although he had to live all his waking and working hours aboard doubled-up like a half-shut knife and although his domed skull made direct contact with a great many parts of the ship, he went on surviving it for years.

His first major trip, in 1923, with the submarine K2, brought him and his penbulums from Den Helder, via the Suez Canal, to Tandjung Priok in the then Netherlands East Indies. It was mainly a large-scale trial. In 1925, he made a cruise with the K11 to Alexandria. Next came a very fruitful cruise with the K13, in the years 1926-1927, from Den Helder via the

Panama Canal to Surabaya, with a programme aimed at obtaining a general gravimetric picture of the equatorial Pacific Ocean. Detailed work was done in recording profiles of the deep-sea trenches off Guam, Yap, the Philippines and no less than four profiles of the Java trench. In 1929–1930 the observations were continued, again aboard the K13, carrying out a survey of all the seas off the East Indies. Finally, he made a cruise with the K18, in the years 1934–1935, down the east coast of South America, across the southern Atlantic Ocean, via Tristan da Cunha to the west coast of Africa, round the Cape, up to the east coast of Africa via Durban and Mauritius, and so across the southern Indian Ocean via Australia to Surabaya.

In 1937 he made two trips. First, aboard the O16 from Den Helder to Washington and back to Lisbon. Next, aboard the O12 to Curaçao, in the West Indies. In 1938, he worked aboard the O13 in the Channel. In addition to all these researches carried out aboard Netherlands submarines, Vening Meinesz made also two cruises with U.S. submarines and one with a Italian submarine.

The gravity data which Vening Meinesz collected in the Indonesian area revealed the occurrence of large divergences from isostatic equilibrium. Along a narrow belt there exists a great deficiency of gravity. This belt follows all along west of Sumatra, and south of Java, Timor and the Outer Banda Arc and is continued northwards between Celebes and Halmahera in the direction of the Philippines. An offshoot appears to follow the eastern arms of Celebes. The positive anomalies are either arranged in belts following the negative strip on both sides, or they form separate broader fields. Vening Meinesz also found that earthquakes with normal focus depths are crowded together along the narrow strip with negative anomalies of



**AT THE TIME OF THE
K2 AND K13 EXPEDITIONS ...**



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gravity, while those with a deep focus are restricted to the Asiatic side. The volcanoes were noted to lie in a row at some distance from the negative anomalies on the concave side of the arc.

Observations like these led to his famous theory about the major deformations to which the earth's crust is subjected and their effects: horizontal compression leading to downbuckling of the sial crust in geosynclinal areas to form a deep root in the heavier substratum of sima, thus causing belts of strong negative anomalies; disappearance of horizontal compression leading to mountain ranges in continental areas and to low ridges taking the place of trenches in oceanic areas; horizontal tension, or at least stress release, leading to the formation of graben and horsts; wrench faulting, in many cases accompanied by overriding that leads to asymmetrical gravity disturbances.

Gravity profiles across the continental margins led him to assume a fairly abrupt thinning of the sial layer under the oceans. In addition to this, gravity investigations of oceanic volcanic islands showed that these heavy masses are not compensated by light roots. Instead, the gravity field denotes regional compensation of these islands. This means that the earth's crust is slightly and elastically depressed over a wide area, because of the weight imposed on the crust by the volcanic cones, but that the crust does not react plastically.

To explain the negative anomalies which he had found in the Indonesian area, Vening Meinesz found that the existence of convection currents in the substratum is the only hypothesis that can account for the phenomenon. These convection currents may be supposed to be brought about by the earth's cooling at the surface. They are likely to make only a half turn and in this

PROFESSOR VENING MEINESZ ON EXCURSION



way to bring the cooled upper mantle layer down. These currents cause orogeny. Long periods of rest separate the current periods.

The previous considerations lead to his hypothesis about the earth's history. During an early phase, when the mantle of the earth was not yet crystalline, sialic shields were pushed together, whereas in the more recent part of the history of the earth compression leads to linear features, such as geosynclines. This latter phenomenon can perhaps be explained by the mantle having crystallized. In a still earlier part of the history of our planet, starting with a homogeneous earth of high temperature, a central current may have led to differentiation, resulting in a heavy core, surrounded by the earth's mantle, and at the surface the formation of an urcontinent. Later mantle currents drew this urcontinent apart, thus leading to the development of the present continents, which may, however, have become more or less deformed during mantle-current periods that have occurred since then. These currents must also have caused relative movements of the continents, and such relative movements are likely to still take place during the present orogenic period.

Vening Meinesz was also struck by certain regularities and preferred directions in terrestrial morphology. He offered an explanation based upon the assumption that early in the history of the earth a displacement of the axis of rotation caused stresses in the crust. These stresses led to rupture and breaking up of the crust in a system of more or less diamond-shaped blocks. Later, volcanic and orogenic forces would tend to avail themselves of these ancient zones of weakness. Thus, the pattern was rejuvenated. Vening Meinesz pointed out that several major topographic features fit the assumed pattern of ancient Precambrian cracks in the crust very well (e.g., the ridges in the north Pacific and Atlantic Oceans, the structure of the Canadian Shield, the boundaries of continental blocks).

The results of the scientific studies of Vening Meinesz are laid down in a large number of publications. Among these, major works are the four volumes of *Gravity Expeditions at Sea* and the two volumes of *Pendulum Observations at Sea*. All of these were published by the Netherlands Geodetic Commission. Further, there are two textbooks. The first, written jointly with W.A. Heiskanen, *The Earth and its Gravity Field* was published in 1958 by McGraw-Hill, New York. The other book *The Earth's Crust and Mantle* appeared in 1964 from Elsevier, Amsterdam.

From the beginning of the journal until his death, Vening Meinesz was a member of the Editorial Board of *Tectonophysics*.

Vening Meinesz was Professor of Geodesy, Cartography and Geophysics at the State University, Utrecht (1927–1957) and Professor of Physical Geodesy at the Technical University, Delft (1938–1957). From 1945 to 1951 he was also President Director of the Royal Netherlands Meteorological Institute, De Bilt, and from 1951 onward President of the Board of Governors of that Institute.

In the years 1933–1945, Vening Meinesz was President of the International Association of Geodesy and in the period 1948–1951 he served as President of the International Union of Geodesy and Geophysics.

The recognition which Vening Meinesz met nationally and internationally appears clearly from the number and nature of the memberships, honorary doctorates and prizes and medals awarded to him.

Vening Meinesz was member of the Royal Netherlands Academy of

Sciences (since 1927) and foreign member of the Royal Society (London), the National Academy of Sciences (Washington), and of the Academies of Science of Paris, Rome, Göttingen, Helsinki, Oslo and Coimbra. He was also a member of several other learned societies.

The degree of doctor honoris causa was awarded to Vening Meinesz by the University of Liège (1947), the Technical University of Helsinki (1949), the Free University of Brussels (1949), the University of Strasbourg (1950) and the Columbia University in the City of New York (1955).

In 1962, he received the Vetlesen Prize.

Among the many medals bestowed on Vening Meinesz, were the "Plancius Medal" of the Royal Netherlands Geographical Society (1930), the "Howard N. Potts Medal" of the Franklin Institute in Philadelphia (1936), the "Penrose Medal" of the Geological Society of America (1945), the "William Bowie Medal" of the American Geophysical Union (1947), the "Alexander Agassiz Medal" of the National Academy of Sciences of the U.S.A. (1947), the "Waterschoot van der Gracht Medal" of the Royal Netherlands Geological and Mining Society (1951), the "Leopold von Buch Medal" of the German Geological Society (1959) and the "Wollaston Medal" of the Geological Society of London (1962).

Vening Meinesz was a very gifted and pleasant teacher, who always took much delight in noticing that his lectures had stimulated students to read more about the subjects he was teaching than they were required to do in preparation for their examinations. A meeting with him was always instructive, even on the very rare occasions when I did not hear him speak in the most friendly terms, namely when driving his car and giving his opinion about other drivers on the road.

Until retirement, Vening Meinesz always took pleasure in joining field excursions. Besides all that I learned from him, I will also remember him for the pride with which he always carried a cheap box camera around, pleased that the only thing he had to do was to push a button. Hardly anyone, how well equipped with photographic materials, could beat him in the quality of the photographs! This characterized him. Although many complex instruments had no secrets for him in construction and handling, he loved simplicity, and knew how to have this bear good fruits. It reflected plainly his great personality.

During the burial ceremony, the coffin of Vening Meinesz was hidden under a purple cover with on it only one wreath, from Queen Juliana of The Netherlands and her husband, Prince Bernhard.

A.A. Manten (Utrecht)