PIONEERS AND MILESTONES OF INDONESIAN GEOLOGY

3-PALEONTOLOGISTS AND OTHER SPECIALISTS

J.T. VAN GORSEL

ITB Press

Pioneers and Milestones of Indonesian Geology (~1820-1960s)

3 - The Specialists
(Paleontology, Petrography, Geochemistry, Geophysics, Geomorphology, Archeology)

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CONTENTS - Volume 3

Cover Chapter IX: Middle Jurassic (Lower Callovian) ammonite Macrocephalites keeuwensis from Mamapiri, along the coast of Cenderawasih Bay in the Birds Head, West Papua (Boehm, 1913).

IX. MACROPALEONTOLOGY

The science of *Paleontology* (the science of fossils) had many more practitioners in the late 1800s- early 1900s than it does today. At that time, studies of fossils delivered many exciting new discoveries on ancient life forms and delivered insight in biostratigraphic successions, evolution, mass extinction events, etc. The succession of life on Earth, as demonstrated by the fossil record, challenged long-held religious dogmas of creation and the origin of life. Fossils also taught us much about paleoclimates, timing of orogenies, etc.

Parts of Eastern Indonesia proved to be quite rich in Late Paleozoic and Mesozoic fossils. Many of these were known from other parts of the Tethys orogenic belt, like the Himalayas and the European Alps, many others were new to science (especially Timor and the Sula Islands).

Today's wisdom regarding paleontology is that most of the ancient life forms are fairly well described and understood. Although the general public shows great interest in visiting paleontological museum collections, job opportunities in paleontology in academia are rather limited and very few macropaleontological experts are left in the world today. For practical applications, micropaleontology has proven to be more convenient than macropaleontology, so this is now the more dominant tool for biostratigraphic, paleoenvironmental and paleoclimate studies.

IX.1. The 'Golden Age' of Macropaleontology (~1880-1940)

Fossils collected by academic geographic- geologic expeditions to Netherlands Indies in the early 1900s (especially Timor) spawned a series of spectacular paleontological studies, mainly by German paleontologists. However, with the exception of German professor Karl Martin in Leiden, there was virtually no paleontological expertise in the Netherlands at that time. Most of the macrofossils collected in the Netherlands Indies were therefore sent for study to experts in Germany and Austria. For microfossils (foraminifera, radiolaria) there was more expertise in France and Britain at that time.

This period may therefore be called 'the golden age of paleontology', as most of this macropaleontological-taxonomic expertise of the early 1900s no longer exists (not only in Europe and Asia, but worldwide). Most of the important paleontological studies on Indonesian macrofossils are therefore 90-140 years old.

The offspring of German Professor Karl von Zittel (1839-1904)

Many of the German and Austrian paleontologists that did pioneering studies on fossils from the Netherlands Indies were trained in the *'Von Zittel* School' at the University of Munich, Bavaria, Germany. Karl Alfred Zittel (*Karl Alfred Ritter von Zittel* after 1885; Fig. IX.1) was Professor at the University of Munich from 1866 until his death in 1904, and was arguably the most influential paleontologist of all time. He was long-time Chief Editor of the influential journal *Palaeontographica* and authored several classic textbooks like the voluminous *Handbuch der Palaeontologie* (in translated editions as *Textbook of Palaeontology)* (1895; multiple editions until 1935) and *Geschichte der Geologie und Palaeontologie bis Ende des 19 Jahrhunderts* 1899; in translation *History of Geology*).

Among the well-known paleontologists that were trained at Von Zittel's department at the University of Munich and that worked on collections from the Indonesian region are *August Rothpletz*, *Gustav Steinmann* (1877), *George J. Hinde* (1881), *Otto Jaekel* (1886), *Ernst Stolley* (1891), *Ferdinand Broili* (1898), *Johannes Wanner* (1901), *Karl Deninger* (1902); *Curt A. Haniel*, *Georg Boehm* and *Lothar Krumbeck*.

The 'Munich University school' also included paleobotanist Prof. *K. Goebel*, who supervised Dutch paleobotanist *W.J. Jongmans* in 1907. Later, as a student of Von Zittel's successor Prof. *F. Broili,* the University of Munich also contributed to the training of the prominent vertebrate paleontologist in the Indonesian region, *Ralph von Koenigswald*, in 1928.

German paleontologists that died during Army duty, WW I and WW II

The two World Wars in Europe (both started by Germany) inflicted heavy tolls on Germany's paleontological heritage. During World War II, many of the German institutes with famous geological-paleontological museums and collections were destroyed or heavily damaged due to Allied bombings in 1944-1945 (Munich, Bonn, Berlin, Breslau, Dresden, etc.). During the First War (1914-1918) the lives and careers of several promising German paleontologists were cut short, when they were conscripted in the German Army and died in military battles:

- *Curt A. Haniel* in 1914 in Laon, France, at age 30;
- *Richard J. Schubert* in Gorlitz, West Galicia, in May 1915 at age 39;
- *Karl Deninger* in Italy in 1917;
- *Fritz Frech* in Aleppo in 9/1917;
- *Friedrich Vogel* near Soissons, France, in 1915, at age 54 (former assistant of K. Martin in Leiden).

Some 'firsts' in Pretertiary paleontology of Indonesia

The first Pretertiary fossils from the Indonesian region were identified in the 1860s-1870s:

1. first (Late) Paleozoic fossils in Indonesia by H.E. Beyrich (1865, Berlin), describing 'Carboniferous' (should be Permian) fossils from Timor collected by German Dr. C. Schneider;
2. first Late Paleozoic fossils from Sumatra by R. Verbeek (1875), Brady (1875), Geinitz (1876) and Ferdinand von Roemer (1880), reporting Permian fusulinid foraminifera, brachiopods, etc. from West Sumatra collected by Verbeek
3. first Cretaceous fossils in Kalimantan in 1878 (Von Fritsch *Patellina/Orbitolina*), followed by Cretaceous bivalves from Kalimantan by H.B. Geinitz (1883) and K. Martin (1888, 1889).
4. first Triassic and Jurassic faunas in Indonesia, from Timor and Roti, identified by A. Rothpletz (Munich, 1891), collected by Wichmann; followed by a brief report of Lower Jurassic ammonites and Upper Jurassic belemnite fossils from Roti Island near Timor, collected by Dr. C. Schneider from Surabaya and sent to C.F. von Roehmer in Breslau University, Germany (Gurich, 1893).

Key early monographs on paleontology of Netherlands Indies

A significant series of paleontological monographs and papers on Indonesian macrofossils was published in Germany and in the Netherlands Indies, mainly on Permian and Mesozoic of Sumatra (from Verbeek) and of Timor and East Indonesia.

Recurring authors of early paleontology publications include (in rough chronological order):

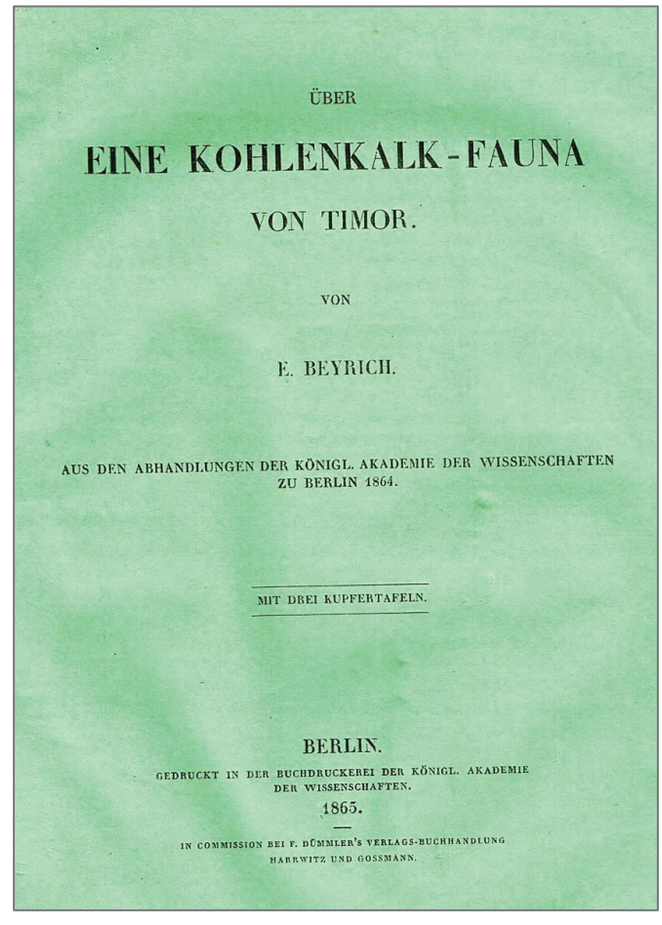
O. Boettger	1875-1883; Tertiary molluscs, Sumatra, Kalimantan;
H.B. Geinitz	1876-1878, West Sumatra Permian fusulinids, 1883 Cretaceous Kalimantan;
C.F. Roemer	1880, Sumatra Carboniferous-Permian fusulinids, brachiopods, etc.;
A. Rothpletz	1891-1892; Permian-Jurassic Timor-Roti;
K. von Fritsch	1877-1882; Borneo Tertiary forams and corals, Cretaceous *Orbitolina*, Sumatra Tertiary;
G.J. Hinde	1897-1917; Mesozoic radiolaria from Belitung, Central Kalimantan, Sulawesi;
P.G. Krause	1899-1911; Jurassic-Cretaceous Kalimantan; also with K. Martin, F. Vogel;
G. Fliegel	1901; Permian fossils of Sumatra;
G. Boehm	1901-1912; Mesozoic of Moluccas Islands; partly material collected by Verbeek in 1899;
J. Wanner	1907-1951; Permian ammonites, blastoids and crinoids of Timor, Mesozoic Moluccas;
H. Gerth	1909-1965; Tertiary corals, echinoids, larger foraminifera Java; Permian corals, sponges Timor; Jurassic ammonites New Guinea, etc.;
C.A. Haniel	1915; Permian ammonoids Timor, Leti,
E. Jaworski	1915-1933; Triassic brachiopods of Ambon, Upper Triassic molluscs of Misool, Early-Middle Jurassic ammonites
R. Schubert	1910-1915; Neogene foraminifera Sulawesi, New Guinea, Permian fusulinids Timor, Leti;
L. Krumbeck	1911-1934; Triassic-Jurassic brachiopods, molluscs Buru, Seram, Misool, Timor, Sumatra;
W. Soergel	1913-1915; Middle Jurassic from Misool;
O. Welter	1914-1923: Triassic ammonites Timor, Seram;
F. Broili	1915-1922, Permian brachiopods of Timor, Roti;
E. Von Bulow	1915; Triassic belemnoids, orthoceres Timor;
P. Vinassa de Regny	1915; Triassic algae, sponges Timor, 1925 Jurassic calcareous algae Sumatra;
C. Diener	1923; Middle-Upper Triassic ammonites, Timor;
E. Koker	1924; Permian corals of Timor;
J. von Pia	1924; Triassic calcareous algae Seram-Buru, 1937 Permian algae Sumatra;
G. von Arthaber	1926, 1928; Triassic ammonoids, Timor;

89. H. Ernst BEYRICH (Berlin 1815-1896)

H.E. (Ernst) Beyrich was a well-known German paleontologist from Berlin, and the first to identify and describe Late Paleozoic fossils from Timor in 1862.

Heinrich Ernst Beyrich was born in Berlin on 31 August 1815. He attended the *Gymnasium* in Berlin from 1827-1831, and at age 16 started studies at the University of Berlin. In 1834 he moved to the University of Bonn, to study paleontology and geology under Professor August Goldfuss. He returned to Berlin in 1836 and finished with a doctorate in 1837 at age 22, with a thesis on Devonian goniatites of the Rhenish Schiefergebirge.

Beyrich became *Privatdozent* (lecturer/tutor) at the University of Berlin in 1841 and Extraordinary Professor in 1846. He was Assistant at the Mineralogical Museum in Berlin in 1848 and Curator of the Berlin Paleontological Collection after 1857. At the same time, he was lecturer at the *Konigliche-geologische Landesanstalt und Bergakademie* of Berlin, and after 1865 became Full Professor. From 1873, he became the first Director of the Mineralogical Museum, while also being Technical Director of the *Preussischen Geologischen Landesanstalt* (Geological Survey of Prussia) in Berlin.



ÜBER

EINE KOHLENKALK-FAUNA

VON TIMOR.

VON

E. BEYRICH.

AUS DEN ABHANDLUNGEN DER KÖNIGL. AKADEMIE DER WISSENSCHAFTEN ZU BERLIN 1864.

MIT DREI KUPFERTAFELN.

BERLIN.

GEDRUCKT IN DER BUCHDRUCKEREI DER KÖNIGL. AKADEMIE DER WISSENSCHAFTEN.

1865.

IN COMMISSION BEI F. DÜMMLER'S VERLAGS-BUCHHANDLUNG HARRWITZ UND GOSSMANN.

Fig. IX.3. Portrait of H.E. Beyrich, probably around 1885.
Fig. IX.4. The first description of Late Paleozoic fossils from Timor (Beyrich, 1865) 'Kohlenkalk' was a NW European term for Carboniferous limestone.

In 1854 Beyrich introduced the now commonly used stage name *Oligocene*, the time period between about 34 and 23 Ma. This period is often poorly represented in the geological record of cratonic areas and shallow basins worldwide, due to major eustatic sea level lowstand(s). It represents the transitional period between the Eocene with its warm 'hothouse' climates, high eustatic sea levels and with few modern species, and the Miocene, which is more like the present-day 'icehouse' climates with frequent glacio-eustatic cycles.

Late Paleozoic fossils from Timor, 1865

Beyrich's main significance for the Netherlands Indies was as the author of the first publication on Late Paleozoic fossils from Timor (brachiopods, corals, crinoids), in 1862 and 1865 (Fig. IX.5). These were collected in the Kupang area, West Timor, by Surabaya-based German physician Dr. C. Schneider and were sent to Berlin in 1862 for identification.

Beyrich's 1865 paper was the first on the geology-paleontology of Timor since the report by naturalist Salomon Muller (1839-1844; fieldwork during the 1828 Triton Expedition), who interpreted the limestones around Kupang as Jurassic in age. The next paper on fossils from Timor was by Rothpletz (1892).

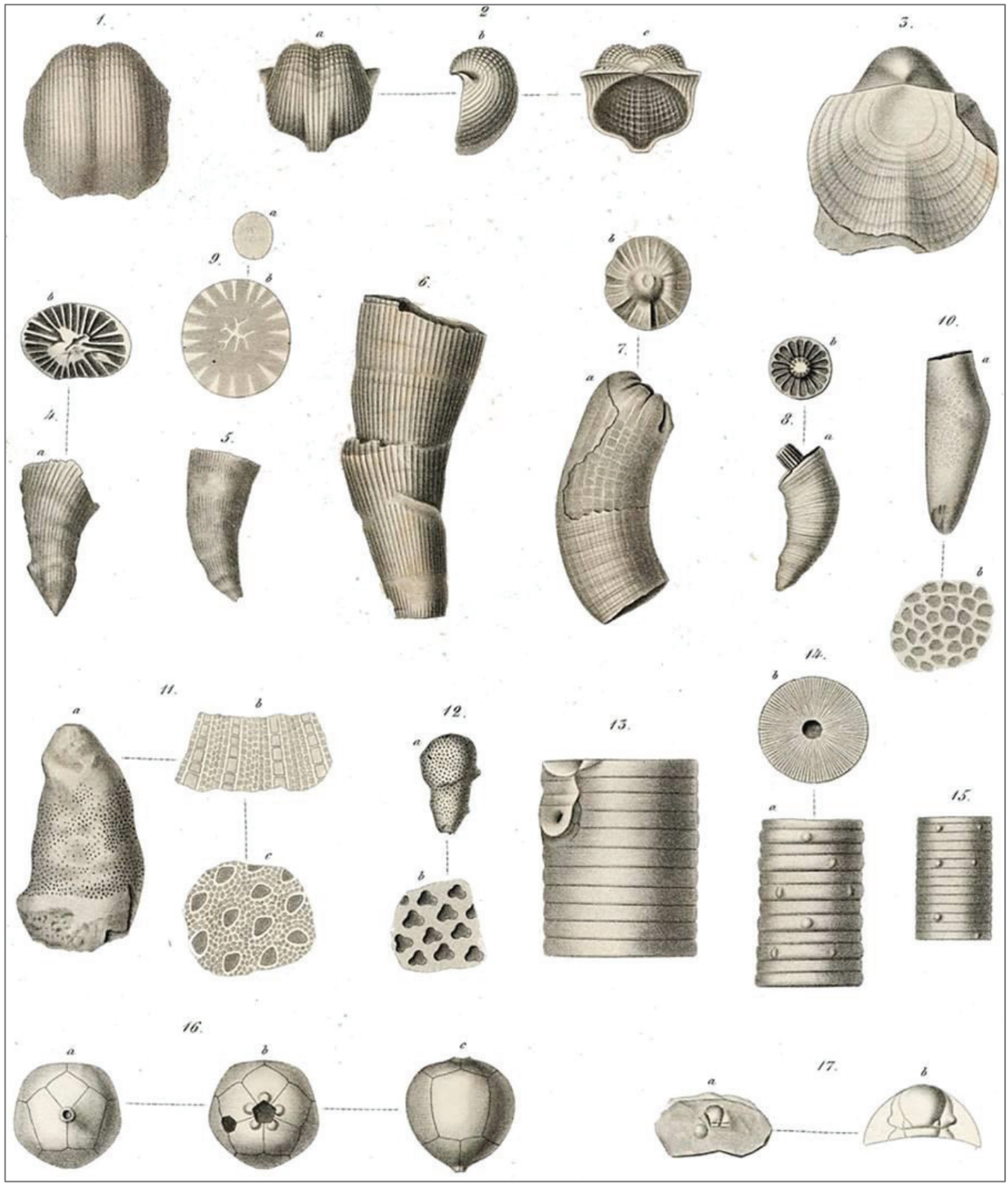


Fig. IX.5. The first Permian fossils reported from Indonesia (brachiopods, corals, crinoids and blastoid and a trilobite fragment from Timor; Beyrich ,1865).

90. Rogier D.M. VERBEEK (Paleontologist) (Doorn 1845- The Hague 1926)

Rogier Verbeek was not only known for his impressive volume of geological mapping work in the Netherlands Indies in the late 1800s, but he was also was responsible for a series of paleontological papers on previously unknown fossil faunas and floras that he collected from Sumatra, Borneo, Java and other areas. For more information on R.D.M. Verbeek-the-geologist see Volume 2, chapter VI/44).

Mining engineer R.D.M Verbeek wrote several paleontological papers, like the first records of Eocene larger foraminifera *Nummulites* in Indonesia (Sumatra, Central Java and SE Kalimantan; Verbeek, 1874; Fig. IX.9), and the first records of Carboniferous-Permian fusulinid foraminifera in West Sumatra. Other papers were by some of the top European paleontological experts of that time, who were mainly based in Germany and in London, and who had been enlisted by Verbeek to analyze fossils collected by him.

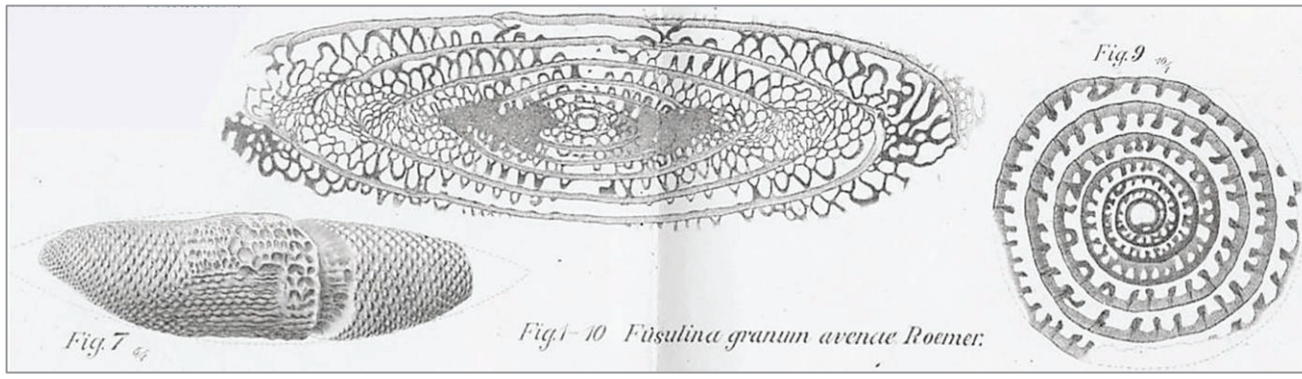
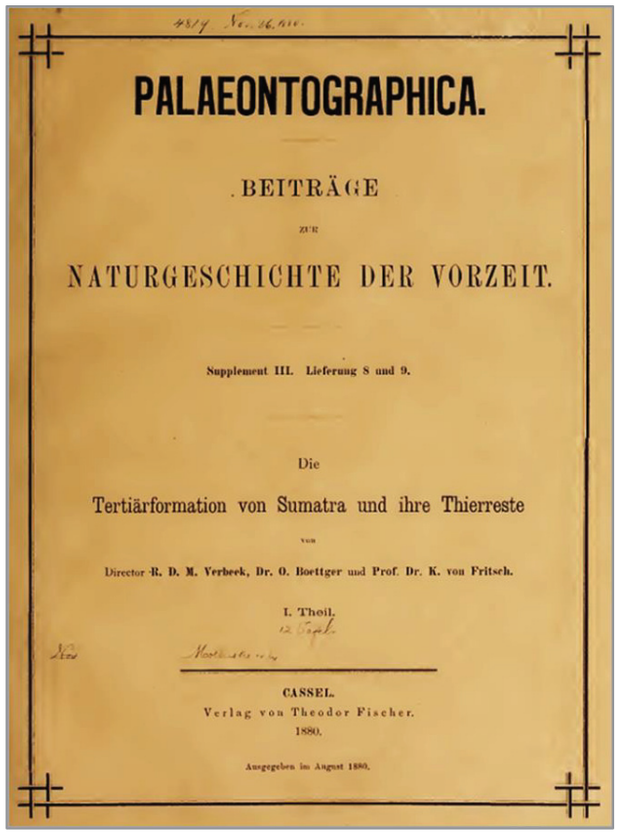


Fig. IX.7. Middle Permian Fusulina granum avenae, a larger foram initially described by Roemer(1880) from Verbeek's samples from the Padang Highlands of West Sumatra (Verbeek, 1896).


PALAEONTOGRAPHICA.

BEITRÄGE

ZUR

NATURGESCHICHTE DER VORZEIT.

Supplement III. Lieferung 8 und 9.

Die

Tertiärformation von Sumatra und ihre Thierreste

von

Director R. D. M. Verbeek, Dr. O. Boettger und Prof. Dr. K. von Fritsch.

I. Theil.

CASSEL.
Verlag von Theodor Fischer.
1880.

Ausgegeben im August 1880.

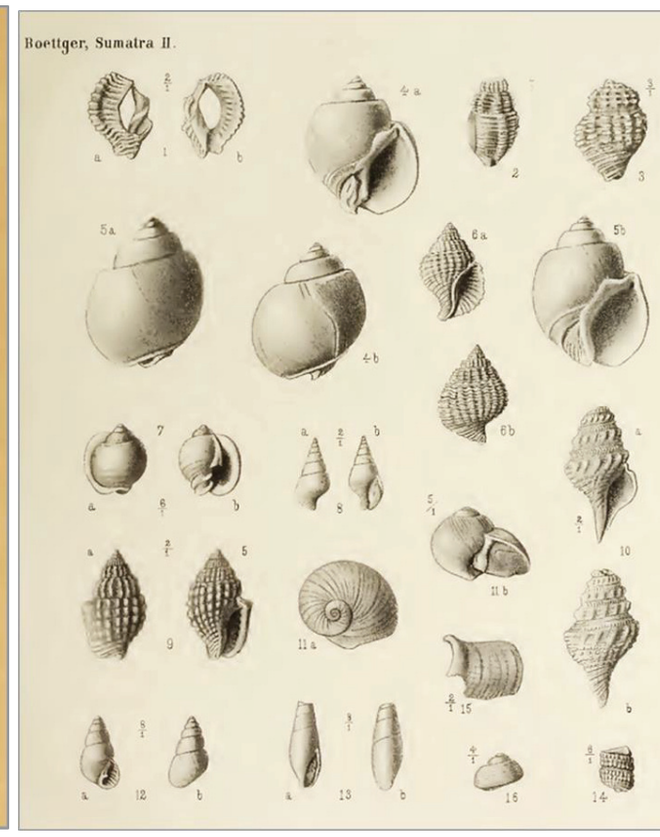


Fig. IX.8. The Verbeek (1880) volume on Tertiary fossils from West Sumatra, with an example of a plate showing gastropods from Middle Miocene Eburna Marls, Bengkulu area. by O. Boettger.

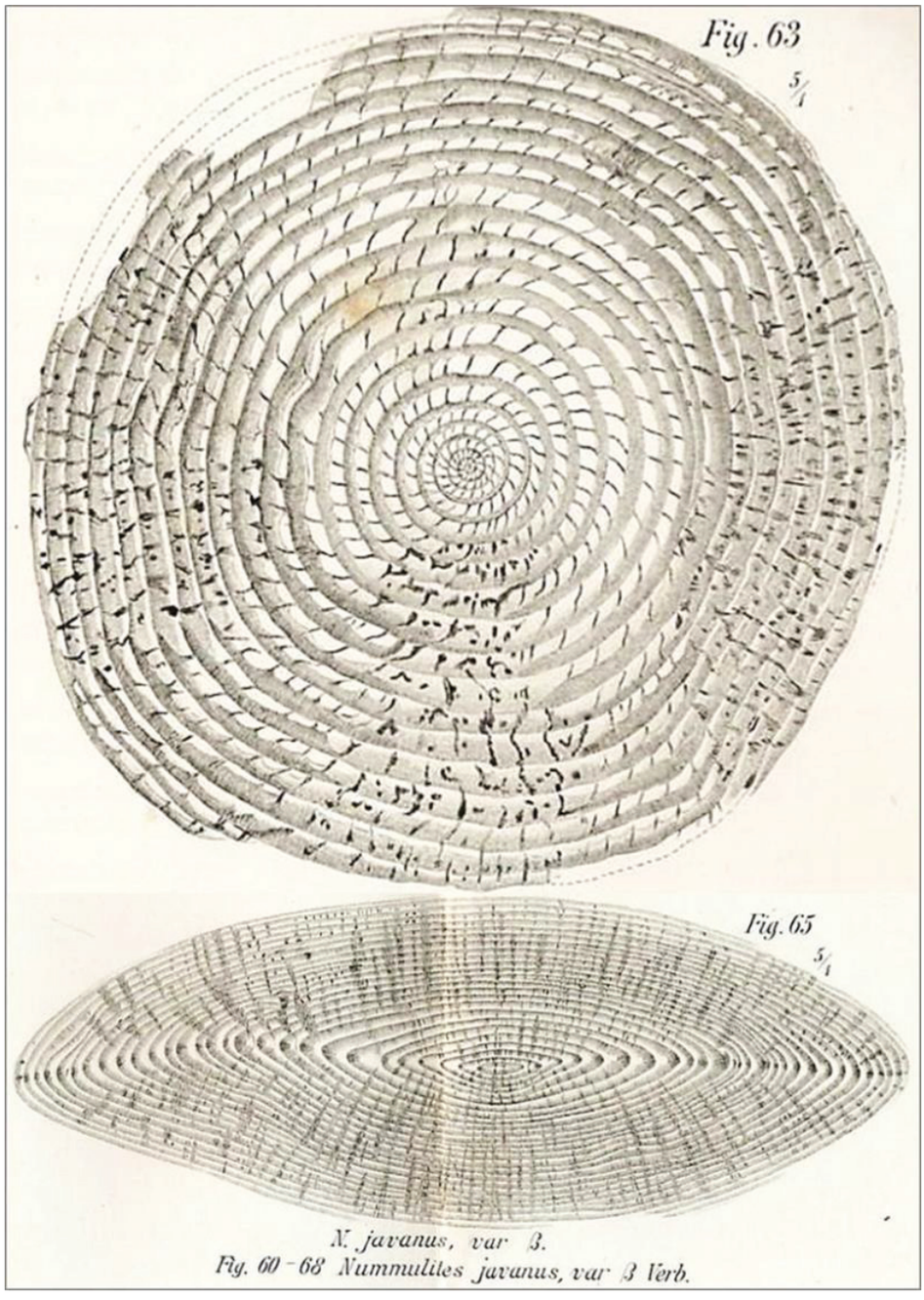


Fig. IX.9.
Large Middle Eocene Nummulites javanus from Nanggulan, Central Java (Verbeek, 1891, Verbeek and Fennema, 1896).

These specimens represent the large microspheric generation.

Fossil plants from the Eocene near the Ombilin coalfield were described by O. Heer (1874, 1879). Tertiary molluscs and foraminifera faunas from West Sumatra were described in two Palaeontographica volumes in 1880 and 1882, by O. Boettger, K. von Fritsch and H.B. Brady. Eocene lacustrine fish fossils from the same area were described by Rutimeyer (1874) and A. Gunther (1878) from the British Museum (Fig. IX.10).

Many of the fossils collected by Verbeek and his party in Java were described in various studies by K. Martin (1891, 1909, 1921; molluscs) and H. Gerth (1921; corals). Several new fossil genera and species were named after Verbeek, including:
- Prominent Permian fusulinid foraminifera *Fusulina verbeeki* (Geinitz, 1876) and *Verbeekina* (Von Staff, 1909);
- Larger foram *Lepidocyclina verbeeki* (Newton and Holland, 1899);
- Permian coral genus *Verbeekiella* from Timor (Penecke, 1908);
- Jurassic belemnite *Hibolites verbeeki* from the Sula Islands (Kruizinga, 1921);
- Cretaceous mollusc *Cytherea verbeeki* from Sulawesi (Dollfus, 1917);
- Phanerogam plant fossil *Spondiocarpus verbeeki* from the Pleistocene tin beds of Bangka (Warburg, 1897).

97. J. Karl L. MARTIN (Oldenburg 1851- Leiden 1942)

J.K.L. Martin spent most of his long career as the first Professor of Geology and Paleontology at the University of Leiden and as Director of the Geological-Mineralogical Museum of Leiden. He is known mainly for his paleontological studies of Tertiary molluscs and Pleistocene vertebrate fossils from Java, and was nicknamed 'The Linnaeus of the Javanese Tertiary'. Prof. Martin was also a renowned geologist who did pioneering geological fieldwork on islands of the Netherlands West Indies in 1884-1885 and in the Netherlands East Indies (Moluccas in the 1890s, Java in 1910).

Johann Karl Ludwig Martin (Karl) was born on 24 November 1851 in Jever near Oldenburg, Germany, where he grew up. From 1871 he studied geology and mineralogy in Munich and later in Leipzig. He obtained a doctorate in paleontology and zoology at the University of Gottingen in 1874, with a thesis on Triassic fossil fishes from Germany. After graduation, K. Martin remained for a few years at the Geological Museum of the University of Gottingen as Assistant and lecturer.

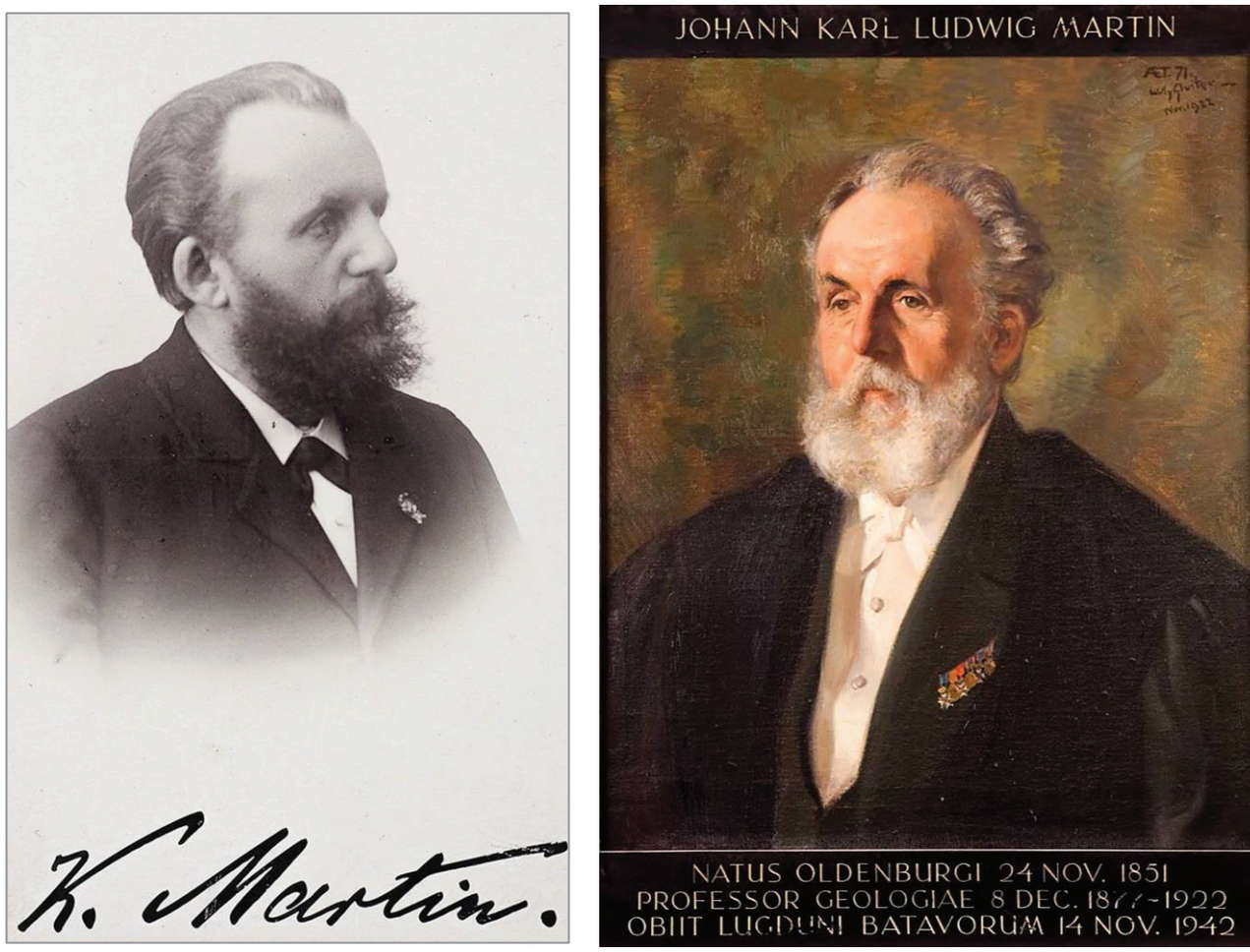


Fig. IX.32. Left: Karl Martin in 1902 (from Phaidra collection). Right: A painted portrait of Prof. J.K.L. Martin, probably close to retirement age in 1922 (from https://digitalcollections.universiteitleiden.nl/view/item/1582037).

Leiden University and Geological- Mineralogical Museum, 1877-1922

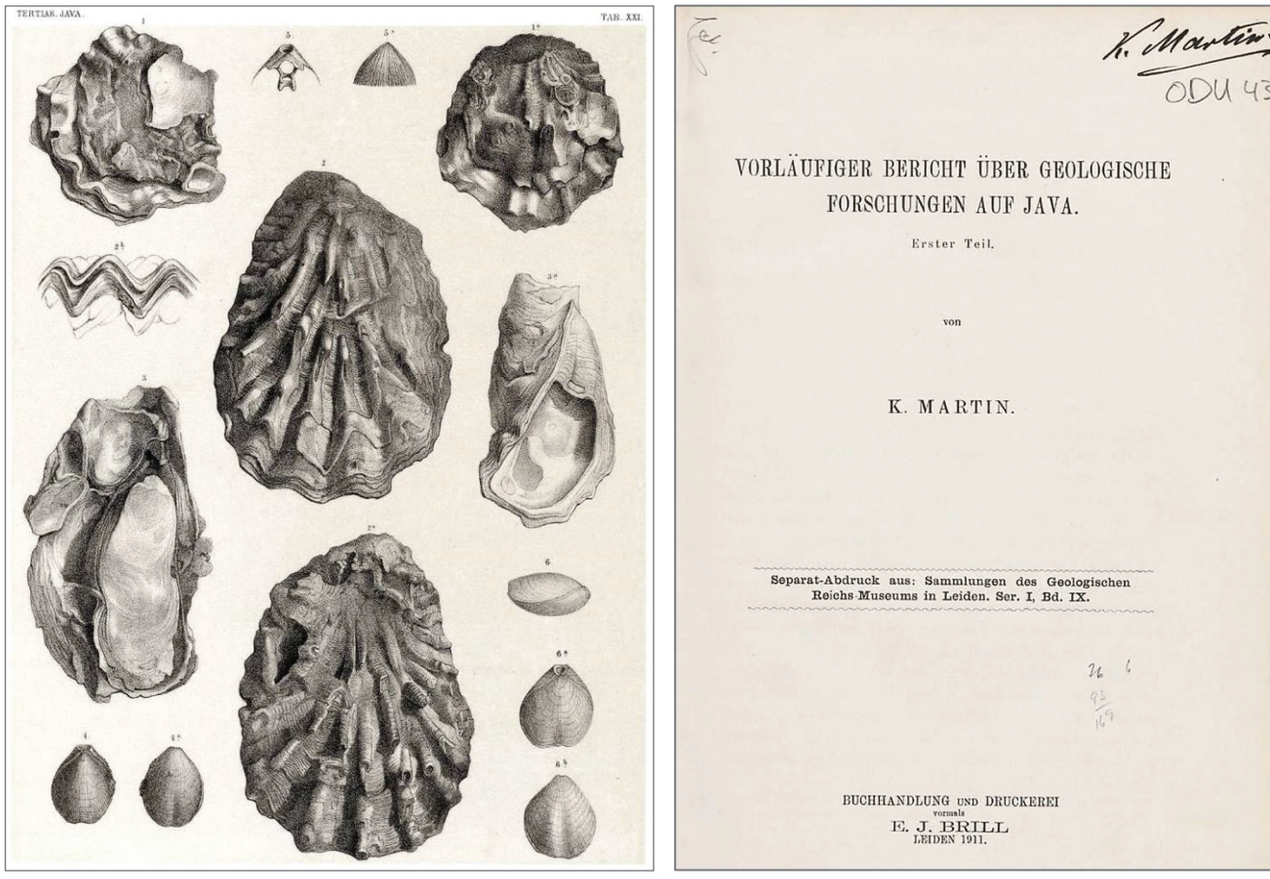
In October 1877, Karl Martin was appointed as the first Professor of Geology, Paleontology and Mineralogy at the University of Leiden, Netherlands, at the young age of 26. He would stay in this position for 44 years until the mandatory retirement age of 70 in 1922.

The numbers of geology students during Martin's years were very low, so the teaching load was relatively minor. During his 45 years in Leiden only five doctorate degrees in geology were awarded. Among his students were well-known geologists G.A.F. Molengraaff, I.M. van der Vlerk, L.U. de Sitter, J.H.F. Umbgrove and Ph.H. Kuenen. Another 'unofficial' student was Queen Wilhelmina, who owned a rock and mineral collection and received private instruction by Prof. Martin.

One year after his University of Leiden appointment K. Martin was also charged with supervising the geological and mineralogical collections that were housed in the *Rijks Geologisch-Mineralogisch Museum* (National Museum of Geology and Mineralogy). The collections were described as being 'in appalling conditions'. He held both jobs of Museum director and University Professor for over 40 years, until 1922.

Before embarking on a long career of studying fossils from the Netherlands Indies, Martin did a study of sedimentary rocks and fossils among the glacial erratics in Pleistocene deposits of the Netherlands and NW Germany (Martin, 1878).

For many years in the late 1800s- early 1900s Martin was the only investigator of fossils from the Netherlands Indies, and is commonly viewed as the *Father of the paleontology of the Netherlands Indies*. For much of this time he worked more or less as a lone researcher, with one Assistant.


TERTIAR. JAVA. TAB. XXI.

K. Martin.
ODU 43

VORLÄUFIGER BERICHT ÜBER GEOLOGISCHE FORSCHUNGEN AUF JAVA.

Erster Teil.

von

K. MARTIN.

Separat-Abdruck aus: Sammlungen des Geologischen Reichs-Museums in Leiden. Ser. I, Bd. IX.

BUCHHANDLUNG UND DRUCKEREI
vormals
E. J. BRILL
LEIDEN 1911.

Fig. IX.33. Left: A plate of Tertiary fossils from Java (Martin 1880, plate XXI), collected by Junghuhn. Right: Cover of a review of geological investigations of Java (Martin ,1911).

Martin uncovered several valuable collections in the museum, including those sent to Leiden by members of the *Natuurkundige Commissie van Nederlandsch Oost Indie* (Natural History Commission of the Netherlands Indies) between 1820 and 1850. Much of this material had not been studied or described before because most of these *Commissie* naturalists, who were expected to study their collections upon their return from the Netherlands Indies, had died there before returning. The *Commissie* samples were supplemented by new material collected in the mid- and late 1800s by F. Junghuhn, Raden Saleh and by mining engineers of the *Dienst Mijnwezen of the Netherlands East Indies* (Geological Survey) who sent fossils to Martin in Leiden for identifications (e.g., Fig. IX.34).

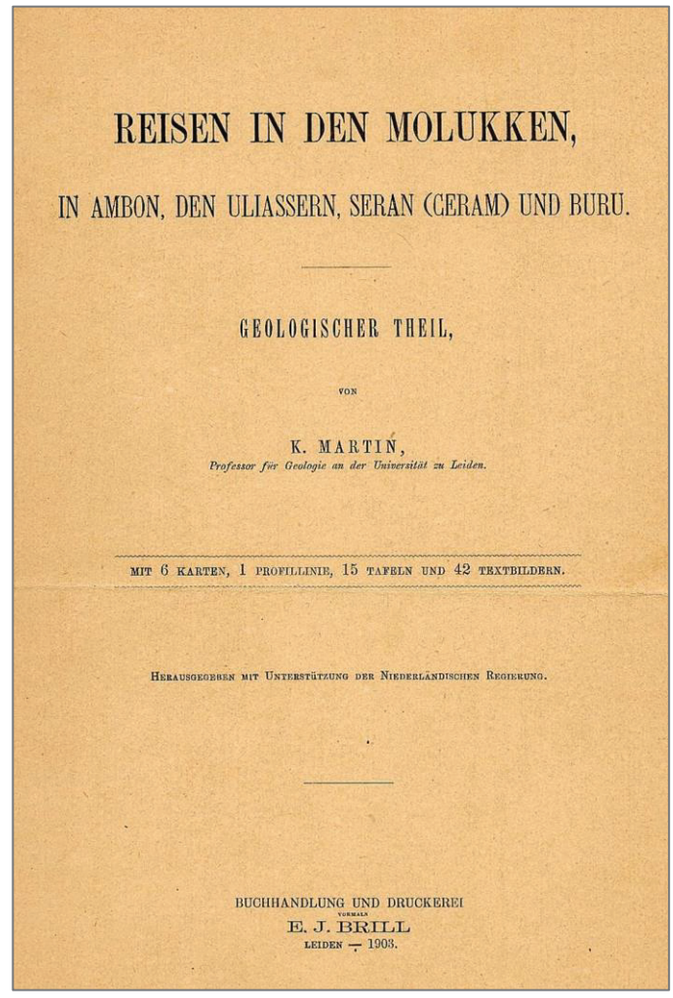
Martin's first major paleontologic work was on systematic descriptions of Tertiary fossils from Java collected by Junghuhn (Martin, 1879-1880). Large parts of the fossil collections from Java, collected by Verbeek and Fennema and other mining engineers, were identified and described by him and published in Martin (1891ab). Due to the large volumes of fossil and rock material to be described, Martin started a journal dedicated to publication of his research work in 1881: *Sammlungen des Geologischen Reichsmuseums in Leiden* (Collections of the National Geological Museum at Leiden). After Martin's retirement in 1922, the journal was renamed into the broader-scope geological journal *Leidsche Geologische Mededeelingen*.

Most of the fossil faunas from the Netherlands Indies studied by Martin are of Cenozoic age, but he also described Jurassic and Cretaceous fossil material from Kalimantan (Figures IX.35, IX.36).

Travels in the Moluccas, 1891-1892

Martin's expedition to the Moluccas islands in Eastern Indonesia from October 1891 until July 1892 took him to many places that at that time had never been surveyed before, including Seram, Buru, Ambon and other islands (Martin, 1903; Figures IX.38, IX.39). Subsequent workers like L.M.R. Rutten and P. Kuenen commented on the high accuracy of Martin's descriptions of the lithologic units and some of the fossils of these islands.

Martin's pioneering travels to Eastern Indonesia probably inspired later surveys to the area not long thereafter, by German explorers like G. Boehm (1901), K. Deninger (1906, 1912) and J. Wanner (1902, 1909, 1911), as well as Dutch geologists R. Verbeek (1900) and L. Rutten (1918-1920).



REISEN IN DEN MOLUKKEN,

IN AMBON, DEN ULIASSERN, SERAN (CERAM) UND BURU.

GEOLOGISCHER THEIL,

VON

K. MARTIN,

Professor für Geologie an der Universität zu Leiden.

MIT 6 KARTEN, 1 PROFILLINIE, 15 TAFELN UND 42 TEXTBILDERN.

HERAUSGEGEBEN MIT UNTERSTÜTZUNG DER NIEDERLÄNDISCHEN REGIERUNG.

BUCHHANDLUNG UND DRUCKEREI
VORMALS
E. J. BRILL
LEIDEN — 1903.

Fig. IX.37. K. Martin as field geologist in the Netherlands Indies in 1892 (from Escher, 1931).
Fig. IX.38. Title page of Martin (1903) 'Travels in the Moluccas in Ambon, Uliassers, Seram and Buru'.

Java fieldwork, 1910

A second trip to the Netherlands Indies was made by K. Martin in 1910, with his assistant and second wife H. Martin-Icke (Martin 1911-1914). The main purpose was to visit and sample the classic Tertiary fossil localities on Java and improve on the stratigraphic context of fossils collected by R.D.M. Verbeek and R. Fennema (1896), which had been described earlier by Martin (1899). Results of this trip were published by Martin (1911, 1912, 1914, 1916, 1917, etc.) in the *Sammlungen* of the Leiden Museum series.

103. Johannes WANNER (Scheidegg, Bavaria 1878-1959)

J. Wanner was a prominent German geologist/paleontologist who started his professional career as a field geologist with Royal Dutch/BPM in the Netherlands Indies in the early 1900s. Wanner's main claim to scientific fame was his role in discovering and describing the unique marine Permian and Triassic fossils from Timor and other parts of Eastern Indonesia. Marine Permian and Triassic faunas are generally rare in other parts of the world, but are unusually abundant and diverse in Timor.

Johannes (Johann or Hans) Wanner was born in April 1878 in Scheidegg, a small village in the Bavarian Alps near the border with Austria. He went to the village school in Scheidegg and grammar school in nearby Dillingen. Wanner studied geology in Munich, at the *Ludwig-Maximilians-Universitat* and at the *Technische Hochschule*, from 1897-1901. His doctoral thesis under the famous professor Karl von Zittel was on Upper Cretaceous faunas from Libya. He briefly was Assistant of Prof. Gustav Steinmann at the University of Bonn, before moving to the Netherlands Indies for the *Koninklijke* (Royal Dutch) in 1902.

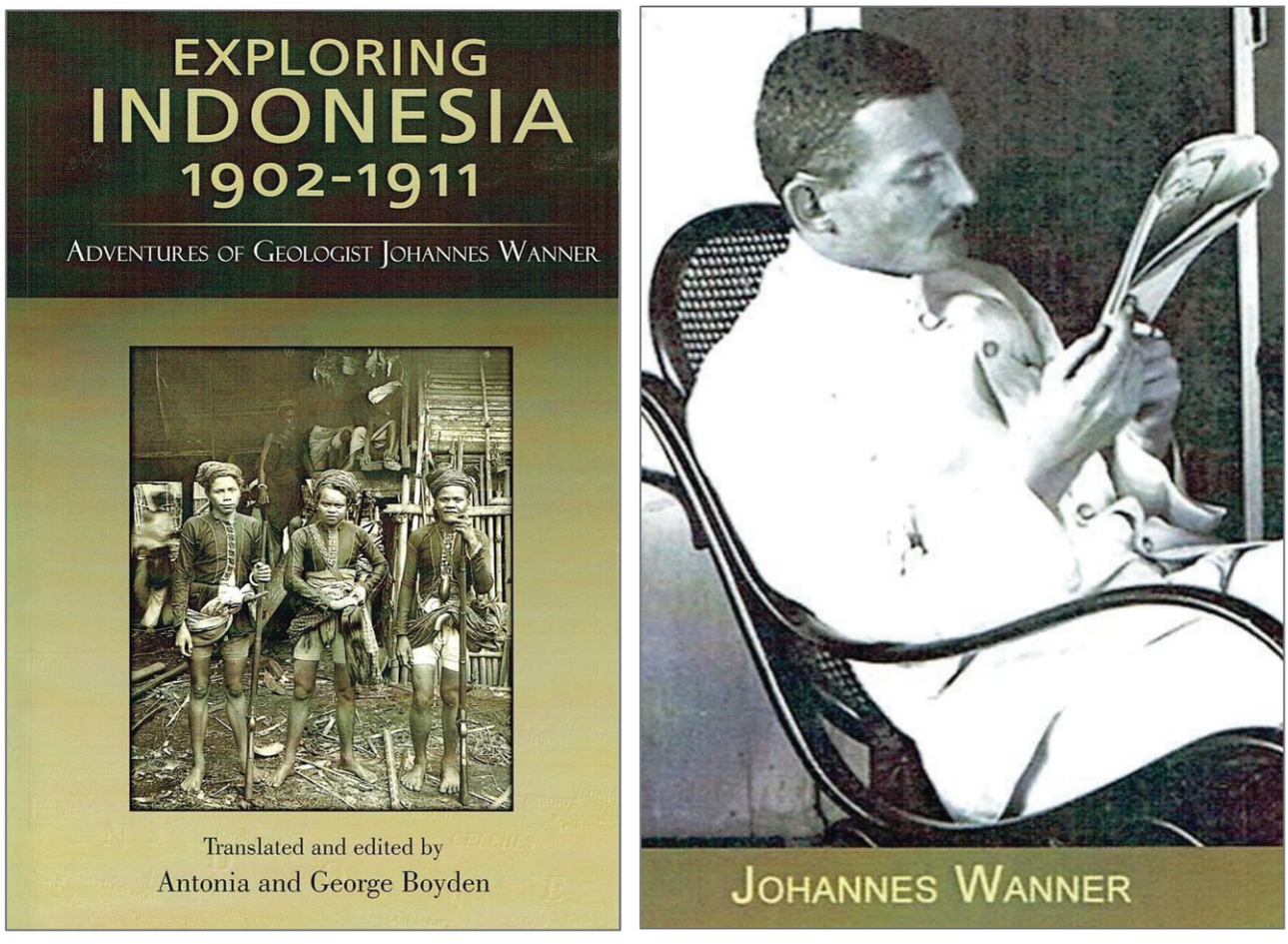


Fig. IX.62. Left: Book on J. Wanner's travels in Indonesia in the early 1900s. Right: Johannes Wanner in Pangkalan Brandan, North Sumatra, in 1903 (Boyden and Boyden, 2009).

Royal Dutch/BPM - I, 1902-1905

Between 1902 and 1911, Wanner traveled extensively across in Indonesia, both as a BPM geologist, but also on his own account when he was between contracts. Wanner did two stints working geological field surveys for the *Koninklijke Nederlandsche Petroleum Maatschappij* (KNPM = *Royal Dutch* Petroleum Company, before it merged with the *Shell Transport Co*. in 1907).

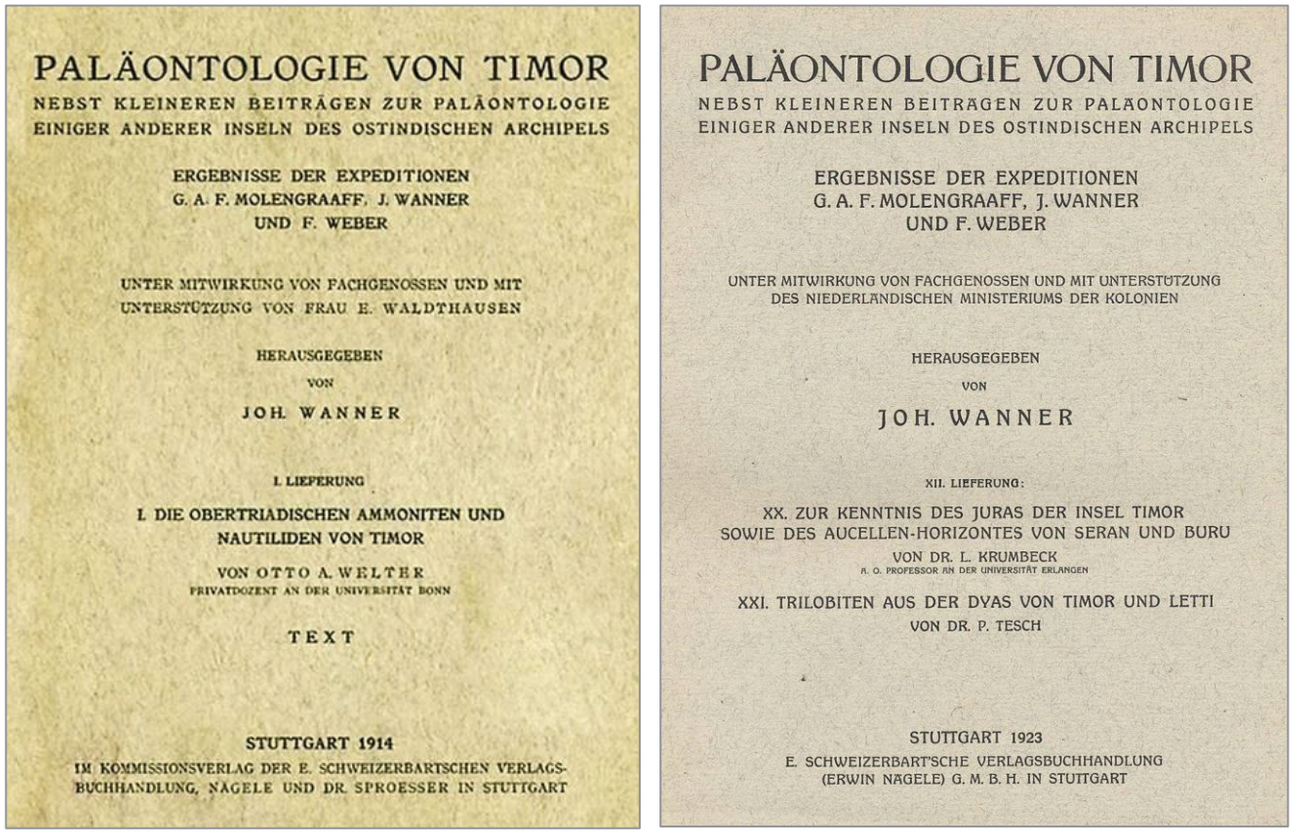
Seram, 1902

From 1902 Wanner worked on Seram (reporting on gas seeps in the Mehr and Nief Rivers), East Borneo and a second stint on Seram in 1904. Some of its results were published only much later due to BPM confidentiality issues, after Brouwer (1919) and Rutten (1920) had already published their observations in the region (Wanner and Knipscheer, 1951).

'Palaeontologie von Timor' monographs, 1914-1929

After his return to Germany in 1911 until his death in 1959, Wanner spent several decades coordinating the publication of numerous paleontological monographs on the Timor material. This included the 70 crates of fossils and rocks, which the Wanner Expedition had collected, but also the Timor fossils collected by the near-simultaneous Molengraaff-Brouwer Expedition and during the survey work of Swiss BPM geologist F. Weber.

The Timor faunas were documented in an impressive series of paleontological monographs by a group of (mostly German) paleontological specialists, coordinated by Wanner, and published in the 16-volume series *Palaeontologie von Timor* between 1914 and 1929. Wanner's own specialty was in Permian echinoderms (crinoids and blastoids) and ammonoids. Other contributors included Wanner's brother Cajetan Wanner (gastropods, bivalve molluscs), L. Krumbeck (Triassic and Jurassic molluscs and brachiopods), Otto A. Welter (Triassic ammonites), C.A. Haniel (Permian ammonites, H. Henrici (larger foraminifera) and others.



PALÄONTOLOGIE VON TIMOR

NEBST KLEINEREN BEITRÄGEN ZUR PALÄONTOLOGIE EINIGER ANDERER INSELN DES OSTINDISCHEN ARCHIPELS

ERGEBNISSE DER EXPEDITIONEN G. A. F. MOLENGRAAFF, J. WANNER UND F. WEBER

UNTER MITWIRKUNG VON FACHGENOSSEN UND MIT UNTERSTÜTZUNG VON FRAU E. WALDTHAUSEN

HERAUSGEGEBEN VON

JOH. WANNER

I. LIEFERUNG

I. DIE OBERTRIADISCHEN AMMONITEN UND NAUTILIDEN VON TIMOR

VON OTTO A. WELTER

PRIVATDOZENT AN DER UNIVERSITÄT BONN

TEXT

STUTTGART 1914

IM KOMMISSIONSVERLAG DER E. SCHWEIZERBARTSCHEN VERLAGS-BUCHHANDLUNG, NÄGELE UND DR. SPROESSER IN STUTTGART

PALÄONTOLOGIE VON TIMOR

NEBST KLEINEREN BEITRÄGEN ZUR PALÄONTOLOGIE EINIGER ANDERER INSELN DES OSTINDISCHEN ARCHIPELS

ERGEBNISSE DER EXPEDITIONEN G. A. F. MOLENGRAAFF, J. WANNER UND F. WEBER

UNTER MITWIRKUNG VON FACHGENOSSEN UND MIT UNTERSTÜTZUNG DES NIEDERLÄNDISCHEN MINISTERIUMS DER KOLONIEN

HERAUSGEGEBEN VON

JOH. WANNER

XII. LIEFERUNG:

XX. ZUR KENNTNIS DES JURAS DER INSEL TIMOR SOWIE DES AUCELLEN-HORIZONTES VON SERAN UND BURU

VON DR. L. KRUMBECK

A. O. PROFESSOR AN DER UNIVERSITÄT ERLANGEN

XXI. TRILOBITEN AUS DER DYAS VON TIMOR UND LETTI

VON DR. P. TESCH

STUTTGART 1923

E. SCHWEIZERBART'SCHE VERLAGSBUCHHANDLUNG (ERWIN NÄGELE) G. M. B. H. IN STUTTGART

Fig. IX.68. Volumes I (1914) and XX-XXI (1923) of the 'Paleontology of Timor' series, edited by J. Wanner.

This series is still the most important documentation of the extremely diverse Permian, Triassic and Jurassic macrofossils of Timor and other parts of Eastern Indonesia. Timor proved to contain the richest assemblages of marine Permian fossils in the world, and the Wanner-coordinated studies identified more than 1000 species (>one-third are crinoids and blastoids).

Crinoid and blastoid studies

Wanner's own studies focused on echinoderms, especially Permian blastoids and crinoids from Timor. In Wanner (1931) he listed 320 species of echinodermata (50 blastoids, 270 crinoids) from Timor, the richest Permian marine faunasin the world.

In 1931 Wanner wrote an extensive review of the stratigraphy and fossils of the Mesozoic in the Netherlands Indies in the *Feestbundel Karl Martin* (K. Martin Memorial Volume; Fig. IX.41).

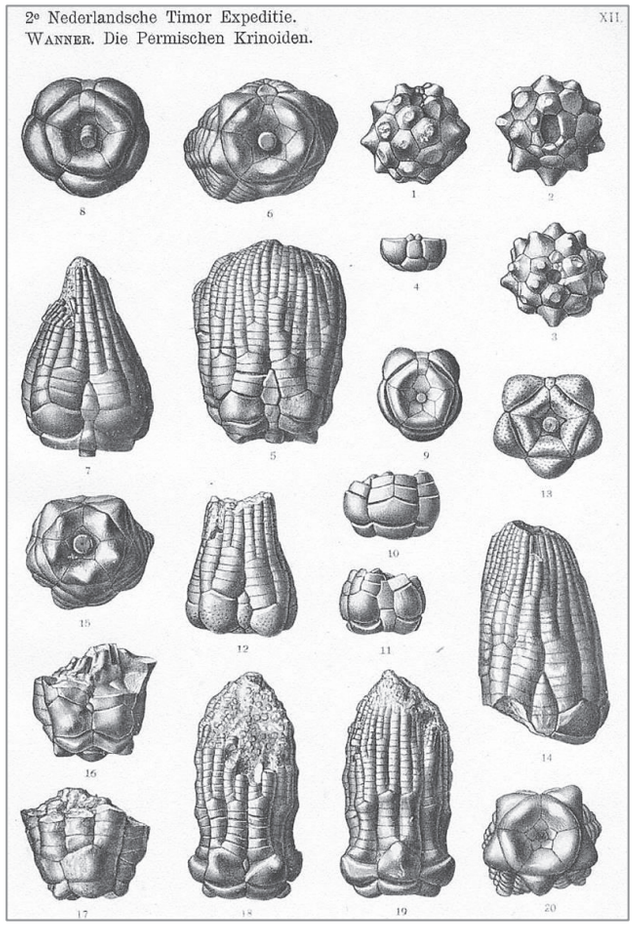


Fig. IX. 69. Most of Wanner's paleontological work was on crinoids (left ; Wanner, 1921) and blastoids (right, Wanner, 1922) from the Permian of Timor.

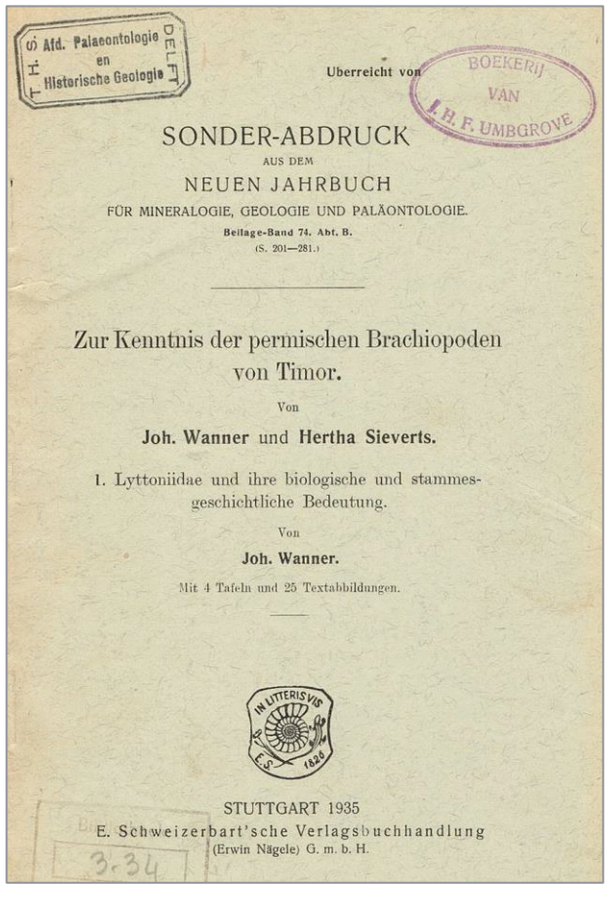


Fig. IX.70. Cover of the Wanner (1935) paper on Permian brachiopods from Timor.

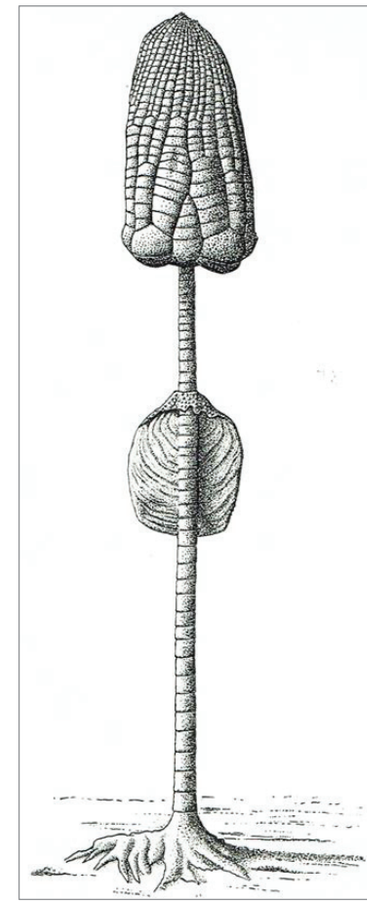
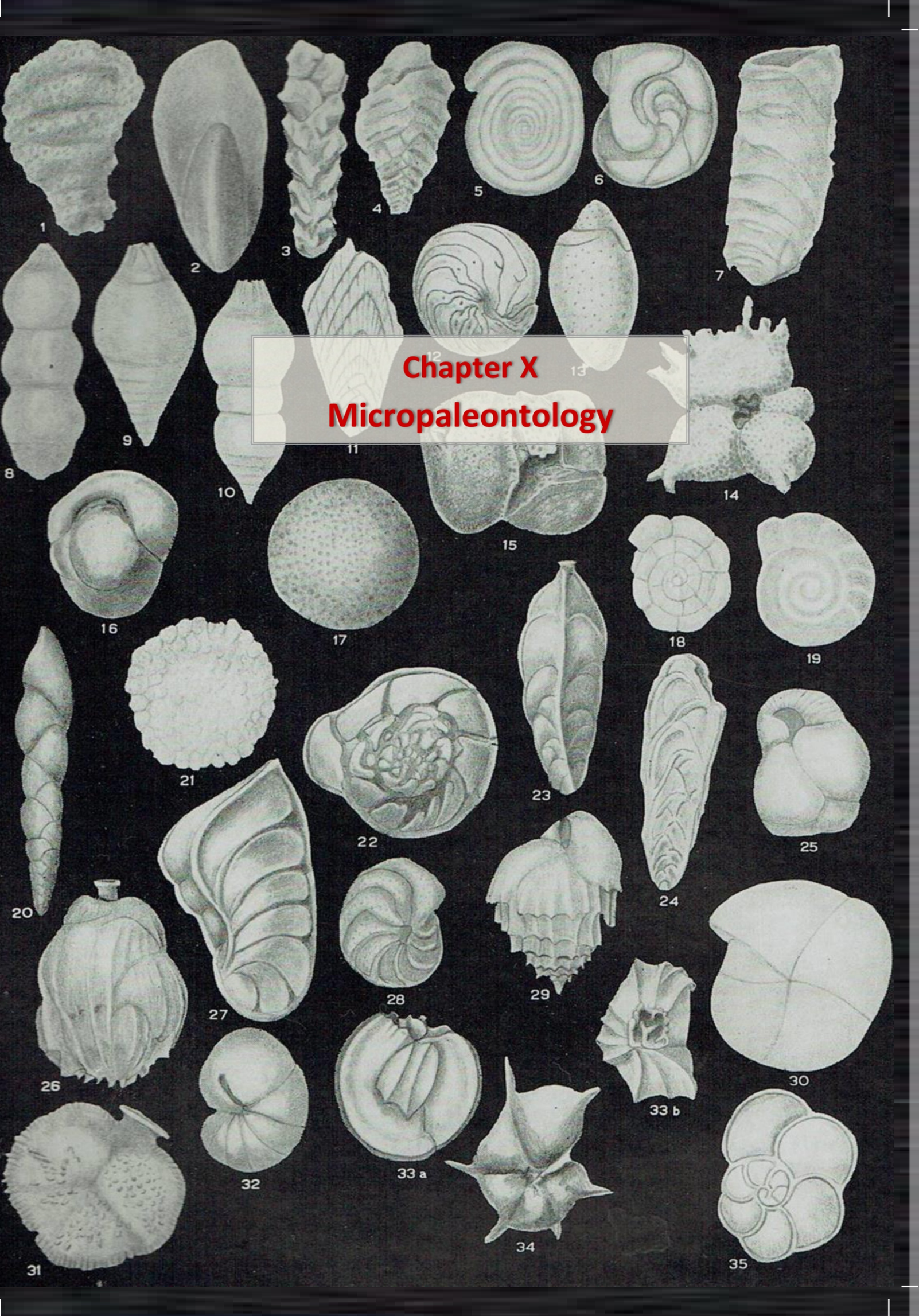


Fig. IX.71. Reconstruction of the Permian crinoid Parabursacrinus from Timor, with an attached brachiopod, Lyttonia catenata (Wanner and Sieverts, 1935).



Chapter X
Micropaleontology

Cover Chapter X: A selection of Recent smaller foraminifera from the Indo-Pacific region (from L. Boomgaart, in R.W. van Bemmelen, 1949, p. 88)

X. MICROPALEONTOLOGY

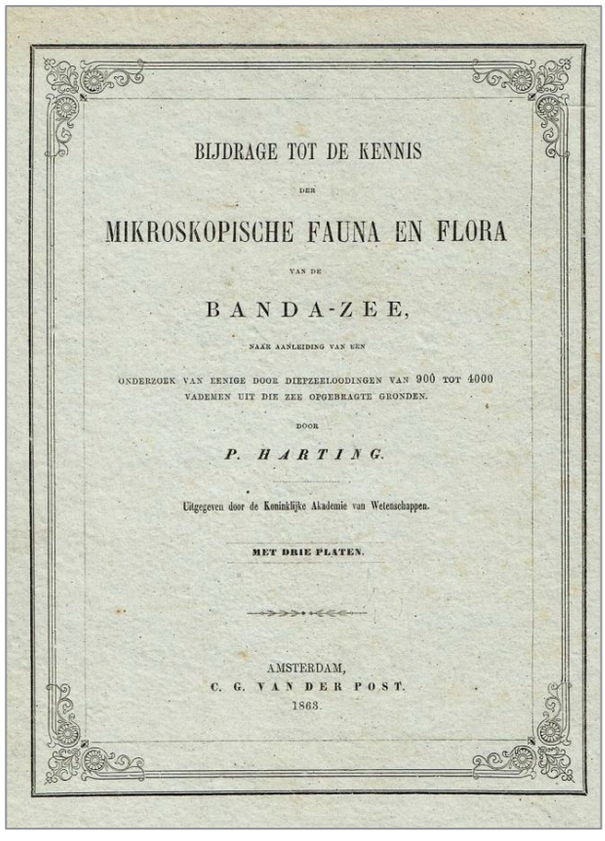
The golden age of micropaleontology started later than that of macrofossil paleontology. Some of the earliest classics on foraminifera in the SE Asia region date from the late 1800s. Larger foraminifera zonations were established in the 1920s-1930s, but most of the pioneering work on biostratigraphic zonations of other microfossil groups was done in the 1960s and 1970s. For a recent review see also *Introduction to Cenozoic microfossil biostratigraphy of Indonesia- SE Asia* (Van Gorsel, Lunt and Morley, 2014).

X.1. Early pioneers of micropaleontology in the Netherlands Indies

The majority of earliest well-known pioneers in micropaleontology in the late 1800s were 'hobbyists' with different day jobs. Among the 'hobby-foraminiferologists' that made significant early contributions to SE Asia were H.B. Brady (pharmacist) and F.W. Millett (civil engineer) in England, J.G. Egger (physician) in Germany, C. Schlumberger (marine engineer) in France and later also J. Hofker Sr. (biology teacher) in the Netherlands.

Alcide d'Orbigny (Professor of Paleontology of the Natural History Museum in Paris) and Christian Gottfried Ehrenberg (Berlin University) were some of the few pioneering academic professionals with strong micropaleontological interests in the 1800s.

Unlike macropaleontology, which unfortunately is virtually 'extinct' as a science today, micropaleontology is still thriving, although not as much as in the ~1960s and 1970s when oil companies started drilling in new offshore basins and when much new ocean floor material became available through the Deep Sea Drilling Project (DSDP, later ODP).



BIJDRAGE TOT DE KENNIS

DER

MIKROSKOPISCHE FAUNA EN FLORA

VAN DE

BANDA-ZEE,

NAAR AANLEIDING VAN EEN

ONDERZOEK VAN EENIGE DOOR DIEPZEELOODINGEN VAN 900 TOT 4000 VADEMEN UIT DIE ZEE OPGEBRAGTE GRONDEN.

DOOR

P. HARTING.

Uitgegeven door de Koninklijke Akademie van Wetenschappen.

MET DRIE PLATEN.

AMSTERDAM,
C. G. VAN DER POST.
1863.

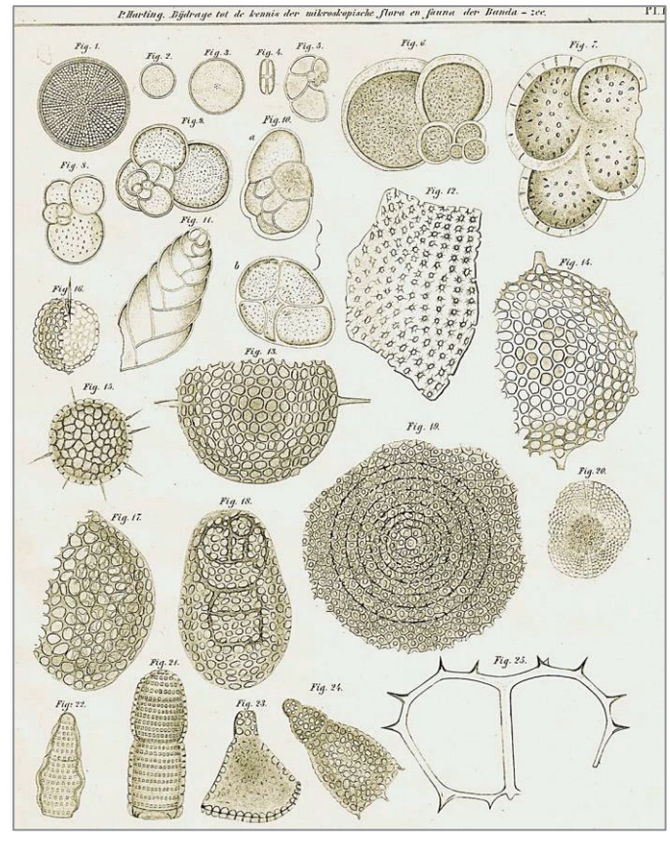


Fig. X.1. Cover of the Harting (1863) paper on Recent microscopic fauna and flora from seafloor sediments from the deep Banda Sea.

Fig. X.2. Plate I from Harting (1863), from a sample at 1200 fathoms (2200m), showing a diatom (Coskinodiscus, fig. 1) planktonic and benthic foraminifera (figs. 2-11) and radiolaria (16-24). The sample is also rich in sponge needles.

Micropaleontology in the Netherlands Indies

The very first paper on Recent microfaunas/floras from the Indonesian region, certainly of deep sea microfauna, may be the short paper by biologist/physician Prof. Pieter Harting from the University of Utrecht (1863; *Natuurkundige Verhandelingen der Koninklijke Akademie* in Amsterdam). This paper described foraminifera, radiolaria and diatoms from sediment samples from 990-4000 fathoms (~1800-7300m) in the northern Banda Sea, which were sticky clays on depth-sounding tool of a navy vessel in 1860.

One of the first branches of micropaleontology to be practiced routinely in the Netherlands Indies for biozonations in Tertiary basins was in larger foraminifera, which are still the primary tool for biostratigraphic zonation in shallow marine limestones. Early practitioners here were *K. Martin* in Leiden (publications in 1880-1912), *C. Schlumberger* (1894-1902) and *H. Douville* (1905-1924) in Paris, and *L.M.R. Rutten* (1911-1936) in Java and Utrecht. These were followed in the 1920s-1930s by *I.M. van der Vlerk*, *J.H.F. Umbgrove*, *H. Henrici* (1934, Timor larger foraminifera; student of J. Wanner), *Tan Sin Hok* (1927-1941), *S. Hanzawa* (Tokyo), *C.M.B. Caudri* (1934) and others.

Fig. X.3. The Paleontology laboratory of Dienst Mijnwezen, presumably in late 1920s. Standing in the corners are probably Dr. I.M. van der Vlerk (left) and Dr. J.H.F. Umbgrove (right). (photo Geological Museum, Bandung).

The first resident micropaleontologist in the Netherlands Indies was I.M. van der Vlerk, when he was stationed at the *Dienst van den Mijnbouw* (Geological Survey) in Bandung from 1922-1928 (see also below). He was succeeded by *J. Umbgrove* in 1926-1929 and by *Tan Sin Hok* in 1929-1945. These all tended to be specialists on larger foraminifera, which was the principal tool for dating rock formations in the Indonesian region during the 1920s-1950s.

There were no academic institutions in the Netherlands Indies with (micro-)paleontology staff during the Dutch colonial era, but oil companies BPM (Shell), NKPM (Stanvac) and NPPM (Caltex) all operated micropaleontological laboratories for subsurface correlations in Tertiary basins of Indonesia in the 1930s and later.

Today, most of the main universities in Indonesia (ITB, UGM, etc.) have micropaleontology specialists and teaching programs. Among the early leading Indonesian foraminifera micropaleontologists since the 1960s were H.M.S. Hartono, Harsono Pringgoprawiro and Darwin Kadar.

122. Louis M.R. RUTTEN (Paleontologist) Maastricht 1884- Utrecht 1946)

Prof. L.M.R. Rutten was not only one of the giants of the geology of the Indonesian archipelago, but was also a pioneering micropaleontologist of larger foraminifera. His life history and non-micropaleontological contributions are discussed in greater detail in Volume I, chapter III/22.

Rutten as a pioneering micropaleontologist, 1911-1926

Between 1911 and 1926 Rutten published >20 paleontological papers, mainly on Tertiary larger foraminifera from all across the Indonesian region. He was one of the first to recognize the importance of micropaleontology for biostratigraphic zonation and collected numerous samples of larger foraminifera in the region. His papers include descriptions of several new index species like *Miogypsina thecideaeformis, Miogypsina polymorpha, Flosculinella bontangensis, Alveolina wichmanni*, etc. Subsequent larger foraminifera experts for the Indonesian region, like I.M. van der Vlerk and Tan Sin Hok, could build on Rutten's pioneering foram work.

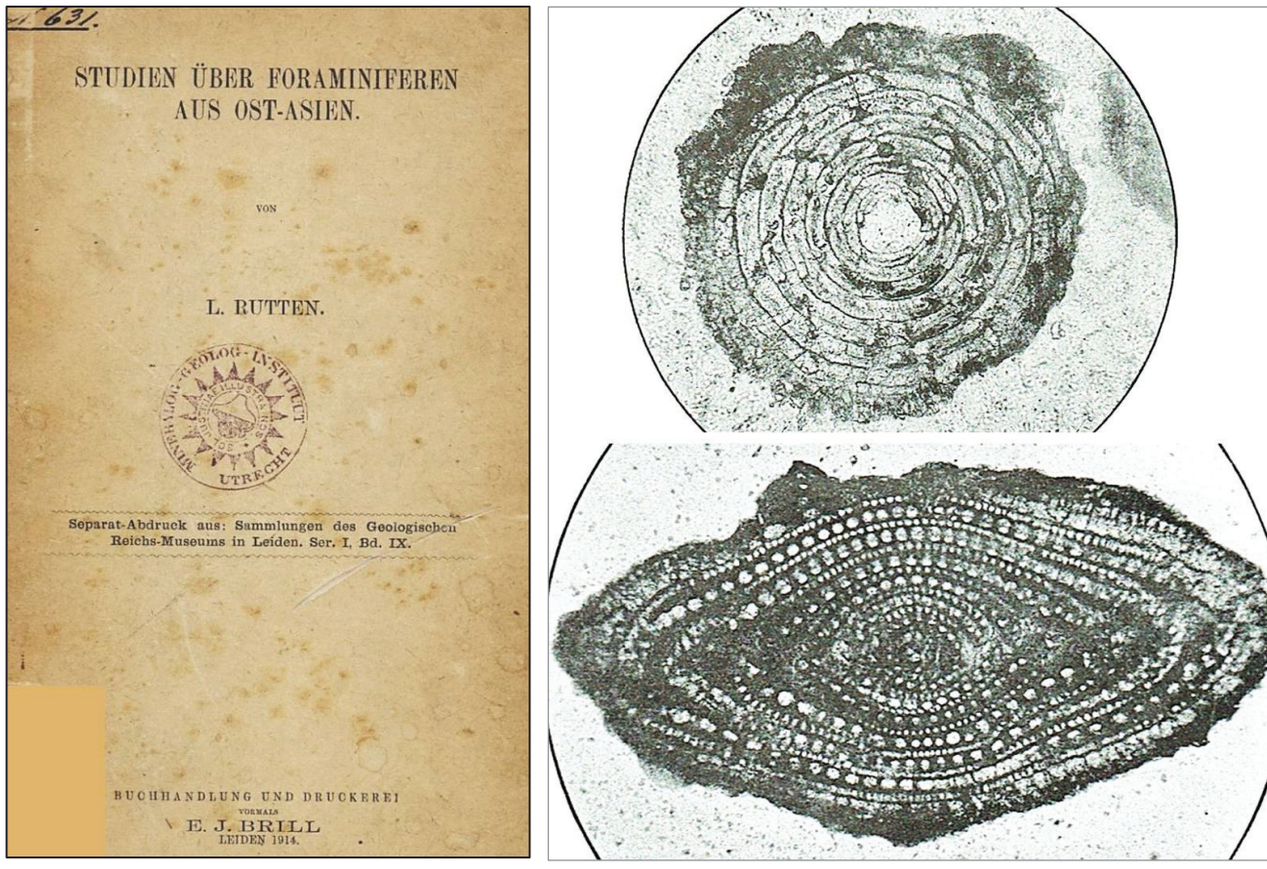


Fig. X.33. Left: Cover of one of Rutten's many papers on larger foraminifera: Right: A new alveolinid species: Alveolinella (Flosculinella) bontangensis from Middle Miocene marls West of Bontang, East Kalimantan (Rutten (1913). Top= axial section, bottom= longitudinal section.

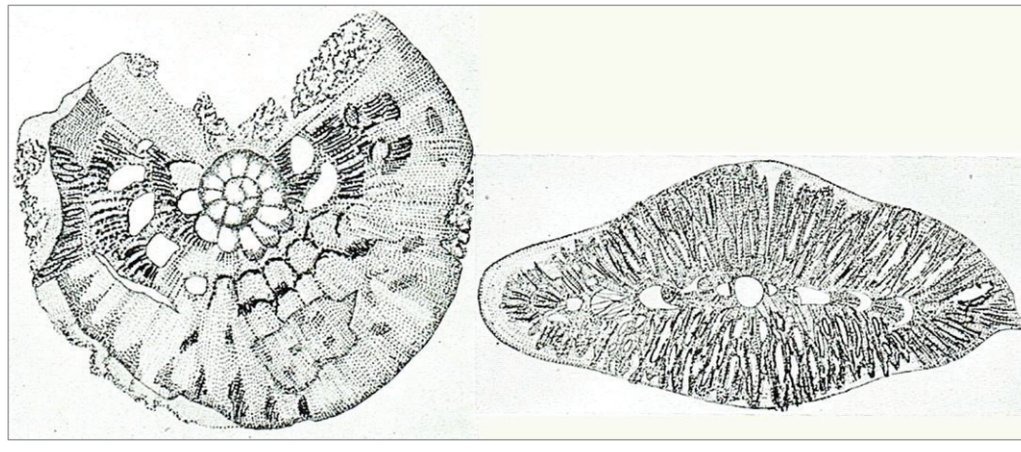


Fig. X.34. The first record of the Late Eocene larger foram index genus Pellatispira in Indonesia was from Sungei Apat in the Tidung Lands of NE Kalimantan by Rutten (1916).

123. Isaak M. VAN DER VLERK (Utrecht 1892 -Leiden 1974)

I.M. van der Vlerk was a Dutch micropaleontologist famous for pioneering studies on taxonomy, evolution and biozonations of Tertiary larger foraminifera of the Indonesian region. Together with J.H.F. Umbgrove, he paved the way for the well-known studies on evolutionary trends in Tertiary larger foraminifera by Tan Sin Hok in the 1930s at the Dienst van den Mijnbouw in Bandung, and later authorities in this field.

Isaak Martinus van der Vlerk was born in January 1892 in Utrecht, where he grew up. He studied geology in Groningen from 1914, leaving with an undergraduate degree in 1918. He continued his geology education in 1918-1920 at the University of Basel, Switzerland, where, under the guidance of Dr. August Tobler, he was first exposed to the method of dating Tertiary shallow marine limestones with the help of larger foraminifera.

Van der Vlerk finished with a doctorate in micropaleontology under Prof. Karl Martin at the University of Leiden, the Netherlands, in May 1922.His thesis was a study of Tertiary larger foraminifera (*Studien over Nummulinidae en Alveolinidae*) from samples collected on Sumbawa Island by J.J. Pannekoek van Rheden, stored in the collections the University and Museum of Basel He was the last doctoral candidate of Prof. K. Martin and would remain a scholar on larger foraminifera for the rest of his life.

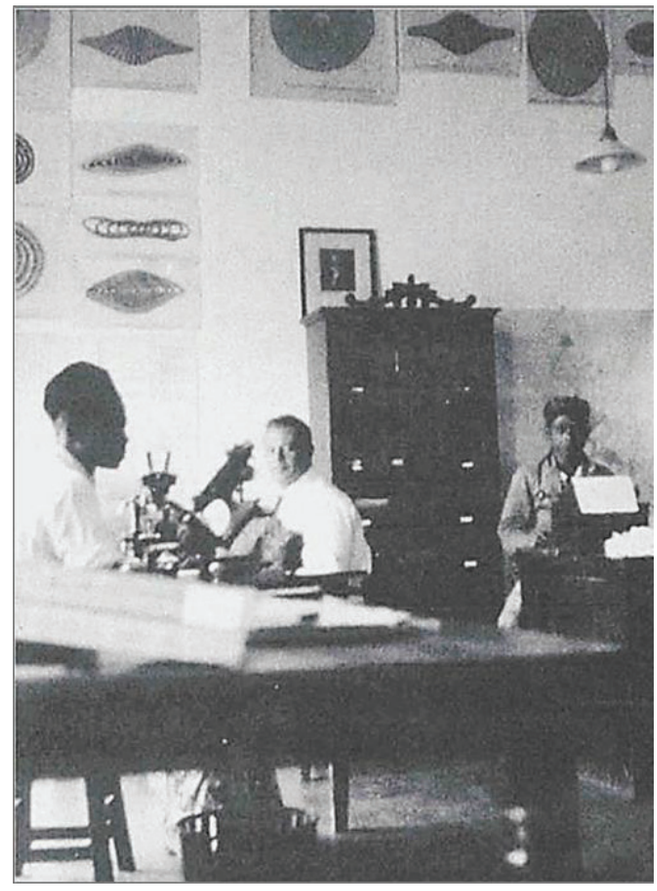
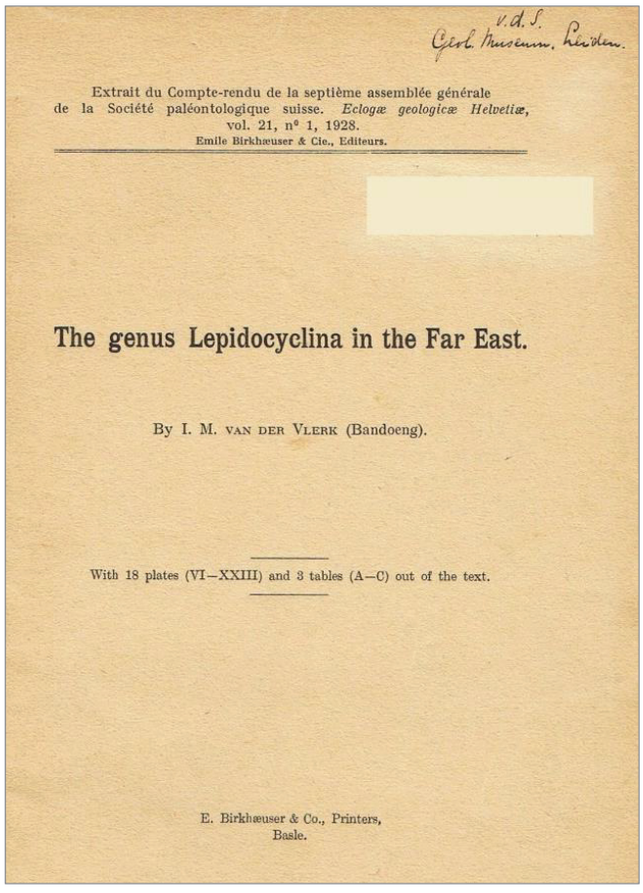


Fig. X.36. Portrait of I.M. van der Vlerk (in Von Koenigswald et al., 1963).
Fig. X.37. I.M. van der Vlerk in the Paleontological Laboratory of the Geological Museum in Bandung in the late 1920s (Winkler Prins, 2004).

Batavia and Bandung, 1922-1928

Right after graduation, Van der Vlerk moved to the Netherlands Indies to work at the *Dienst van den Mijnbouw* (Geological Survey) in 1922 and stayed for 6 years. He was the first micropaleontologist to reside in Indonesia (earlier studies on foraminifera were by academics in Europe). His lab was initially in Batavia and moved to Bandung in 1924.

Most of his work focused on larger foraminifera (Figs. X.38-X.43). At that time these were the most useful tool for biostratigraphic subdivision of the SE Asia Tertiary (Fig. X.44), but the main drawback was that they are found only in shallow marine carbonates, and often require oriented thin sections for species identification.



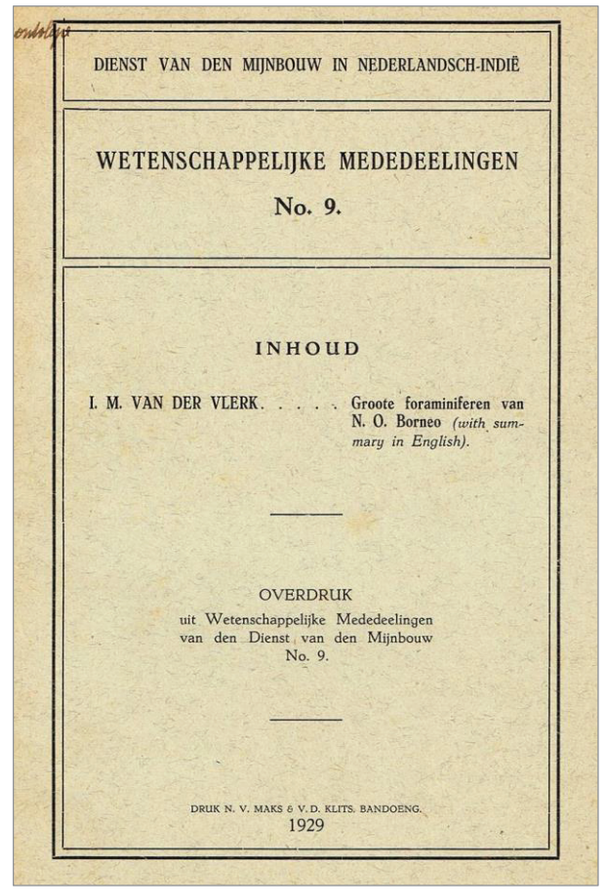
Extrait du Compte-rendu de la septième assemblée générale de la Société paléontologique suisse. *Eclogæ geologicæ Helvetiæ*, vol. 21, n° 1, 1928.
Emile Birkhæuser & Cie., Editeurs.

The genus Lepidocyclina in the Far East.

By I. M. VAN DER VLERK (Bandoeng).

With 18 plates (VI—XXIII) and 3 tables (A—C) out of the text.

E. Birkhæuser & Co., Printers,
Basle.



DIENST VAN DEN MIJNBOUW IN NEDERLANDSCH-INDIË

WETENSCHAPPELIJKE MEDEDEELINGEN

No. 9.

INHOUD

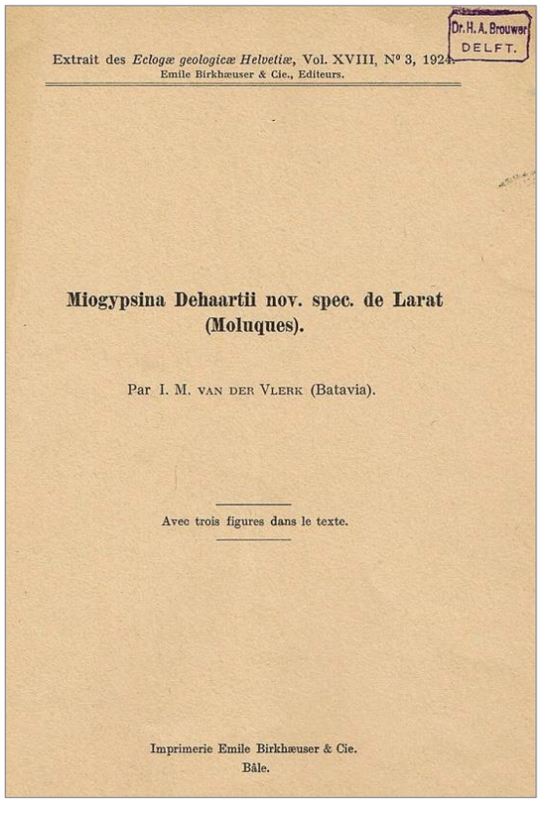
I. M. VAN DER VLERK. . . . . Groote foraminiferen van N. O. Borneo *(with summary in English).*

OVERDRUK
uit Wetenschappelijke Mededeelingen van den Dienst van den Mijnbouw
No. 9.

DRUK N. V. MAKS & V.D. KLITS. BANDOENG.
1929

Fig. X.38. Covers of two selected papers by Van der Vlerk, written in Bandung (1928, 1929).

During this time in Bandung, Van der Vlerk worked with J. Umbgrove and W. Leupold to develop a larger foraminifera zonation for SE Asia, which is still used today and is known as the *Letter Classification of the Netherlands Indies Tertiary* (Leupold and van der Vlerk 1932, Adams 1970).



Extrait des *Eclogæ geologicæ Helvetiæ*, Vol. XVIII, N° 3, 1924.
Emile Birkhæuser & Cie., Editeurs.

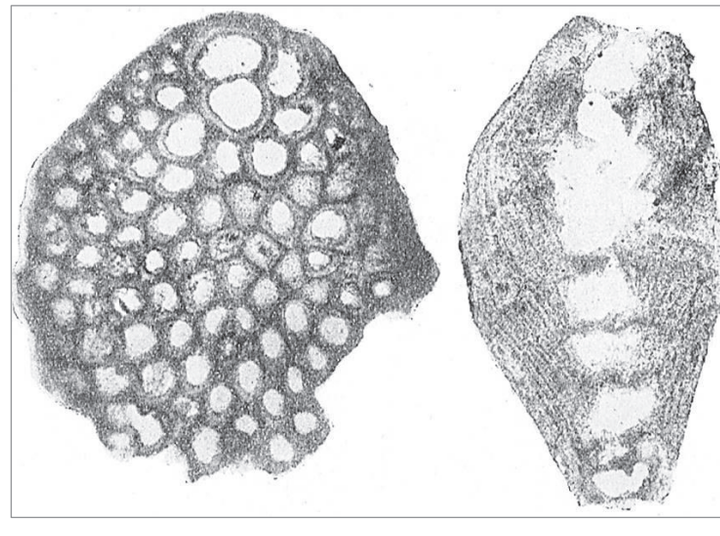
Miogypsina Dehaartii nov. spec. de Larat (Moluques).

Par I. M. VAN DER VLERK (Batavia).

Avec trois figures dans le texte.

Imprimerie Emile Birkhæuser & Cie.
Bâle.

Fig. X.39. Description of a new species Miogypsinoides dehaartii from Larat, characteristic for end-Oligocene. Below: Equarial and vertical thin sections of M. dehaartii (Van der Vlerk, 1924).



124. Jan HOFKER Sr. (Ymuiden 1898 -The Hague 1991)

Jan Hofker was another 'micropaleontologist-in-his-spare-time', who had a full-time career as a high school biology teacher, but still managed to publish >200 papers on Cretaceous- Recent foraminifera between 1921 and 1978. Among Hofker's main works are his four monographs on the Recent foraminifera from samples collected by the Siboga and Snellius Expeditions in Eastern Indonesia.

Jan Hofker was born on 15 June 1898 in Ymuiden (Velsen), the Netherlands, where his father worked for the Post-Telegraph service. He was the older brother of the well-known Dutch painter Willem Gerard (Wim) Hofker (1902-1981), who resided in Ubud, Bali, between June 1938 and December 1943 until he was interned by the Japanese in a camp in Sulawesi from 1943 until 1946.

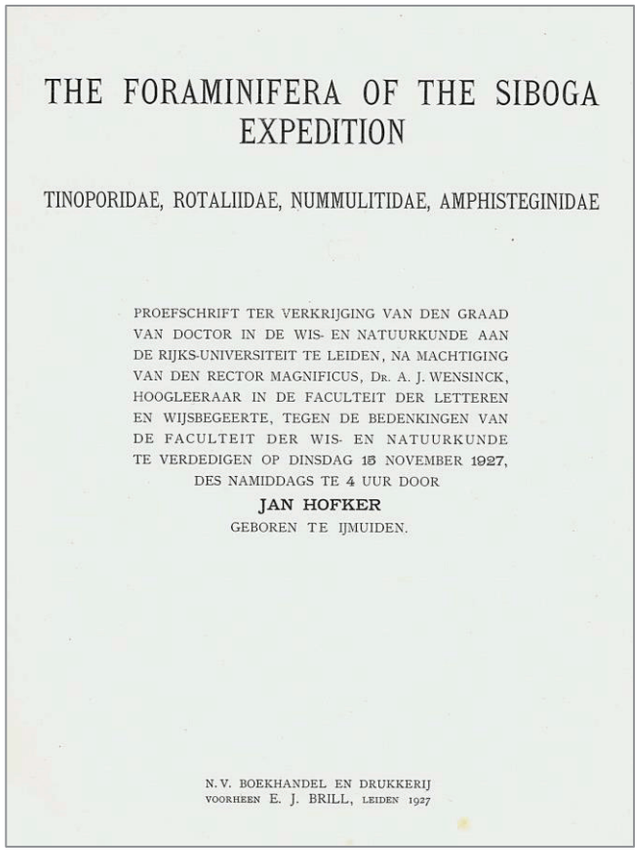
Hofker studied geology, botany and zoology at the University of Leiden, where he graduated in April 1922. He was one of the last students to attend lecture by the legendary Prof. Karl Martin. After graduation he started working as a high school biology teacher. He continued with a doctorate in Leiden on Foraminifera from the Siboga Expedition in 1927, under Prof. M. Weber.

A serious life-long hobby in foraminifera, 1922-1978

Hofker had a 40+ year career as high school biology teacher in The Hague, first at the *Gemeentelijk Lyceum*, later at the *Grotius Lyceum* (now Segbroek College) until his retirement in 1968. In his spare time he was an extremely dedicated 'hobby foraminiferologist'. Most of his over 200 papers were on Recent foraminifera from various parts of the world and on latest Cretaceous foraminifera from Limburg, the Netherlands. One of Hofker's first papers was on foraminifera from the *Zuiderzee* (now Ijsselmeer) in the Netherlands in 1922.

Foraminifera of the 1899-1900 Siboga Expedition (1927, 1930, 1951)

Hofker's first major opus was Volume I of the 3-volumes on the Recent foraminifera from seafloor samples collected by the *Siboga* Expedition in Eastern Indonesia (Hofker, 1927, 1930, 1951; Figures X.47-50), and which earned him a doctorate in Biology from the University of Leiden.



THE FORAMINIFERA OF THE SIBOGA EXPEDITION

TINOPORIDAE, ROTALIIDAE, NUMMULITIDAE, AMPHISTEGINIDAE

PROEFSCHRIFT TER VERKRIJGING VAN DEN GRAAD VAN DOCTOR IN DE WIS- EN NATUURKUNDE AAN DE RIJKS-UNIVERSITEIT TE LEIDEN, NA MACHTIGING VAN DEN RECTOR MAGNIFICUS, Dr. A. J. WENSINCK, HOOGLEERAAR IN DE FACULTEIT DER LETTEREN EN WIJSBEGEERTE, TEGEN DE BEDENKINGEN VAN DE FACULTEIT DER WIS- EN NATUURKUNDE TE VERDEDIGEN OP DINSDAG 13 NOVEMBER 1927, DES NAMIDDAGS TE 4 UUR DOOR

JAN HOFKER

GEBOREN TE IJMUIDEN.

N.V. BOEKHANDEL EN DRUKKERIJ
VOORHEEN E. J. BRILL, LEIDEN 1927

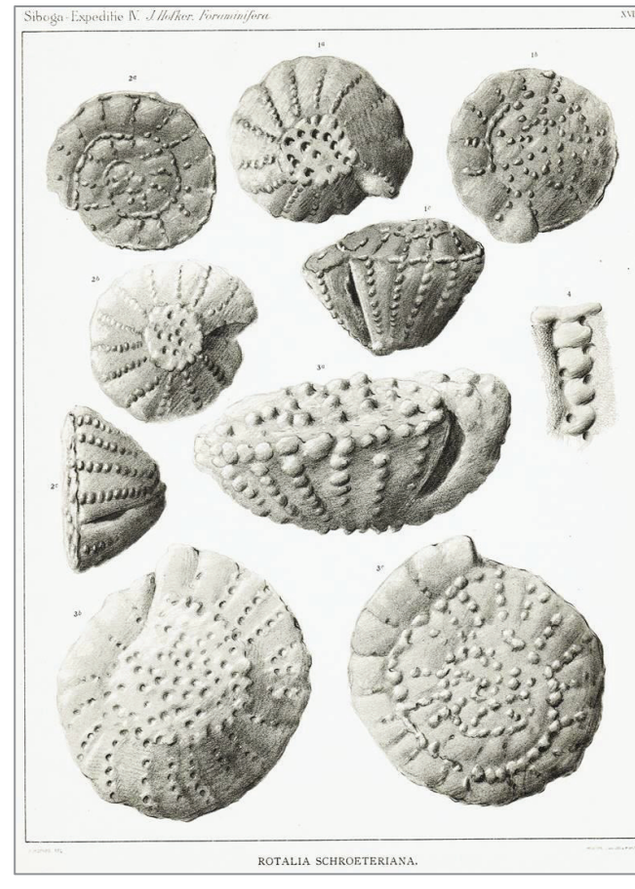


Fig. X.47. Cover of the first of 3 volumes on Foraminifera of the Siboga Expedition, which was also Hofker's doctorate thesis at the University of Leiden in 1927.

Fig. X.48. Plate XVIII of Hofker (1927), the Recent benthic foraminifer Pseudorotalia schroeteriana

126. TAN SIN HOK (Cianjur 1902- Bandung 1945)

Tan Sin Hok was a highly influential micropaleontologist, who spent his entire relatively brief professional career at the Dienst van den Mijnbouw (Geological Survey) in Bandung. He was the only native (Chinese-) Indonesian with a doctorate in geology/mining engineering from the Netherlands before World War II. His pioneering work on evolution patterns in Tertiary larger foraminifera in the 1930s was at the forefront of micropaleontology science at that time.

Tan Sin Hok was born on 28 March 1902 in Tjipadang (Cipadang) near Cianjur, West Java, where his family ran a successful *pabrik beras* (rice mill). He attended the European elementary school in Cianjur and high school (HBS) in Batavia (Jakarta), graduating in 1919.

Student in Delft, 1919-1927

After graduation from high school, at age 17, Tan Sin Hok and his brother Houw moved to the Netherlands in late 1919, for continued education. Hok was only the second (Chinese-) Indonesian to graduate with a degree in mining engineering from Delft; the other was Tan Tek Tjoen (graduated in 1918).

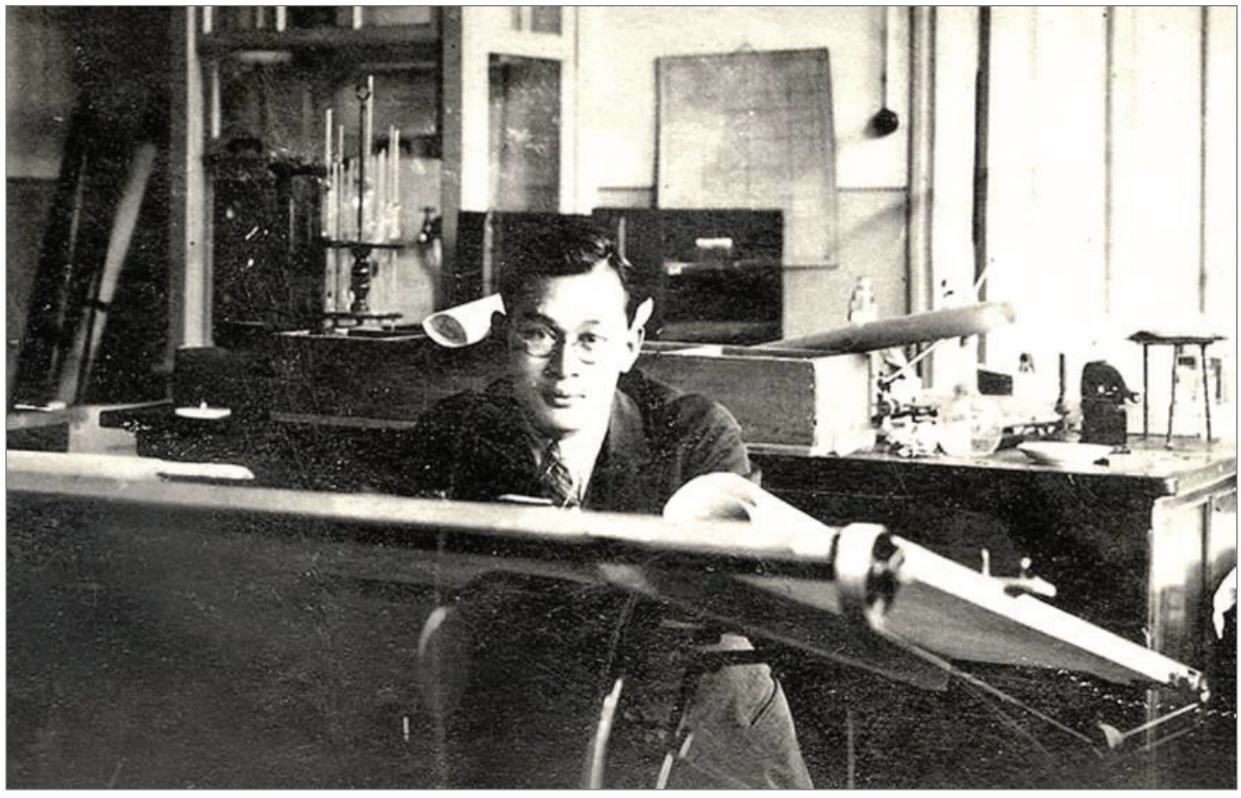


Fig. X.55. Tan Sin Hok as student in Delft in the 1920s (from www.brieven-tan-schepers.nl/).

Tan graduated as Mining Engineer at the *Technische Hogeschool Delft* (Delft Technical University) in 1925, and continued with a doctorate under Prof. H.A. Brouwer. He finished in October 1927, three months after R.W. van Bemmelen. His thesis was a remarkable, pioneering study on Cretaceous radiolaria and Neogene calcareous nannofossils from Timor and Roti islands. Both of these groups of microfossils had hardly been studied before in the Netherlands Indies.

In 1926 Tan was President of the organization of Chinese in the Netherlands, *Chung Hwa Hui*.

'Marls from the Moluccas' Ph.D. thesis, 1927

In his 1927 thesis Tan was the first to describe some key genera and species of a fossil group that was still virtually unknown at that time, the very small Neogene calcareous nannofossils (Fig. X.56, IX.57). He named new genus *Discoaster* and species *D. brouweri, D. pentaradiatus* and *D. barbadiensis*, which are names that are still frequently used in calcareous nannofossil studies today.

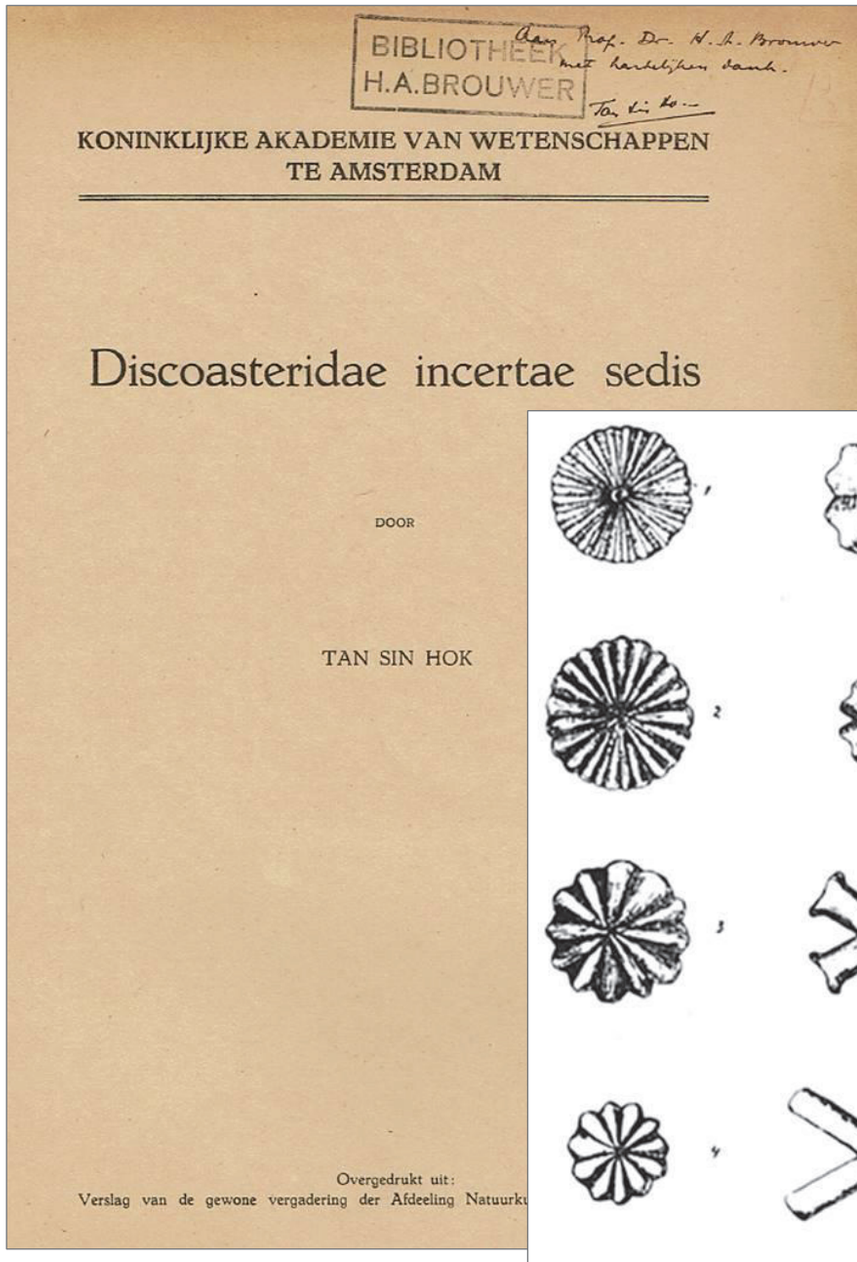


Fig. X.56 Cover of Tan's first publication 1927. a precursor of his thesis work on Neogene calcareous nannofossils (Discoasters), with hand-written dedication to his promotor, Prof. Dr. H.A. Brouwer in Delft.

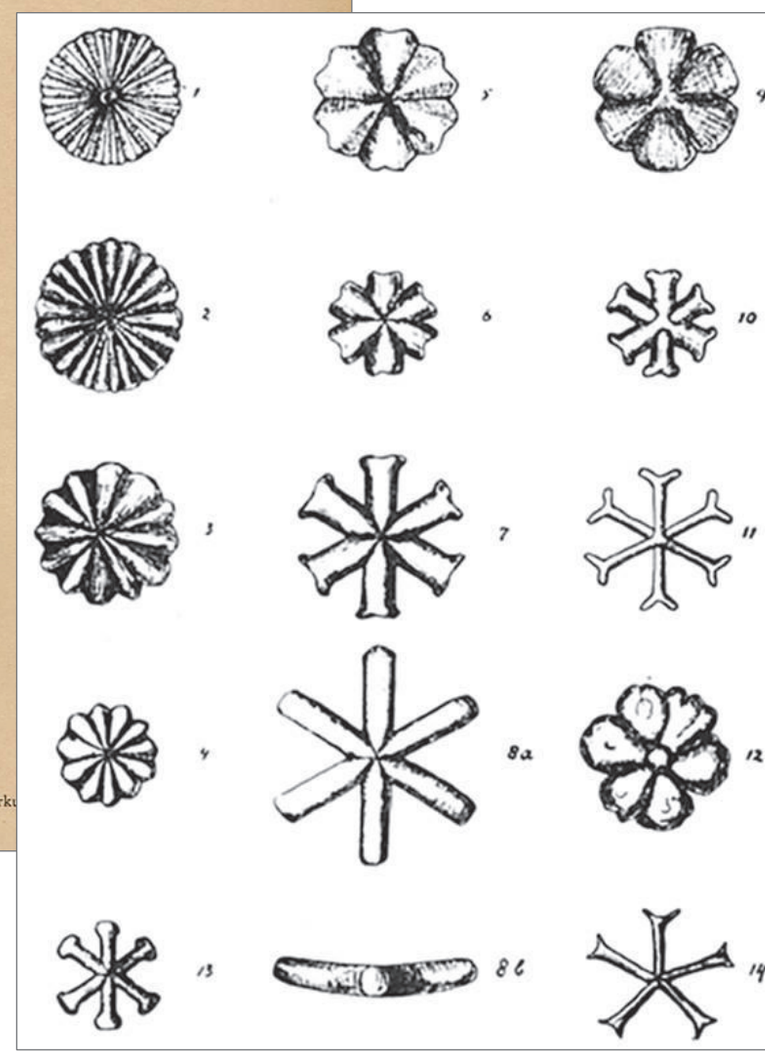
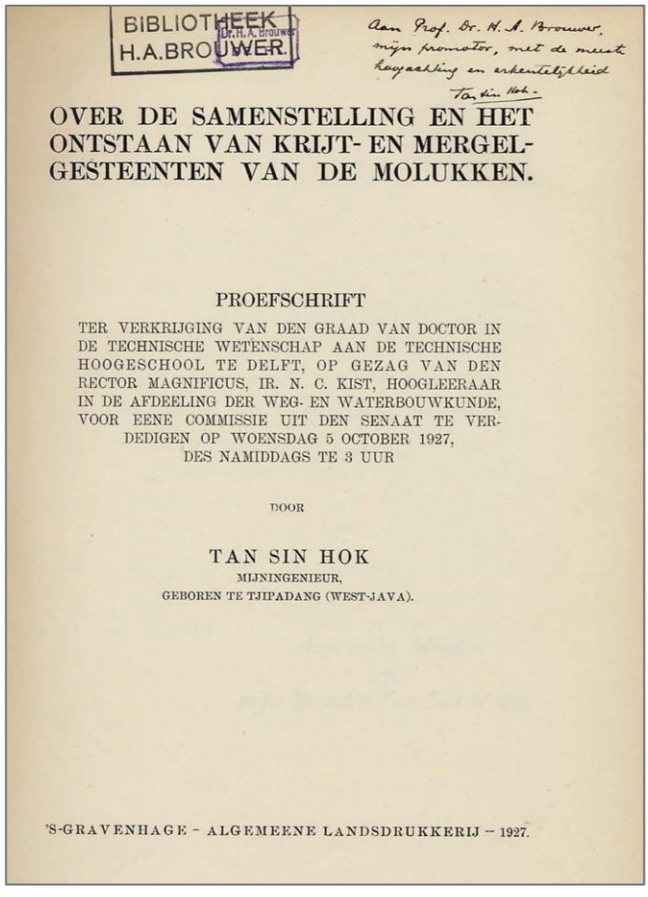


Fig. X.57. Calcareous nannofossils of the Discoaster group from the Neogene of Roti (Tan, 1927)

In his thesis, Tan also named and described many new species of Cretaceous radiolaria (Fig. X.58, X.59). Unfortunately, he did not recognize that his marl samples from Roti Island, collected by Prof. Brouwer, were not all from same Late Neogene marl formation, as he assumed, but also included marls of Early Cretaceous age. This error formed the basis of Tan's later misguided opinion that radiolaria were very long-ranging taxa and had little or no value for biostratigraphy.

Riedel (1953) was the first to point out that all of Tan's radiolaria species were of Late Jurassic-Early Cretaceous age, not Neogene. Meanwhile, Tan had repeatedly and unfairly criticized reasonable interpretations of Jurassic-Cretaceous radiolarian assemblages from the Netherlands Indies by other micropaleontologists like Hinde (1900, 1908; Borneo, Moluccas) and Hojnos (1934, East Sulawesi) (e.g., Tan Sin Hok, 1935). For more details on Tan's thesis work see Munasri and Van Gorsel (2014).



BIBLIOTHEEK
H.A.BROUWER
Dr. H. A. Brouwer

Aan Prof. Dr. H. A. Brouwer,
mijn promotor, met de meest
hoogachting en erkentelijkheid
Tan Sin Hok.

OVER DE SAMENSTELLING EN HET ONTSTAAN VAN KRIJT- EN MERGEL-GESTEENTEN VAN DE MOLUKKEN.

PROEFSCHRIFT

TER VERKRIJGING VAN DEN GRAAD VAN DOCTOR IN DE TECHNISCHE WETENSCHAP AAN DE TECHNISCHE HOOGESCHOOL TE DELFT, OP GEZAG VAN DEN RECTOR MAGNIFICUS, IR. N. C. KIST, HOOGLEERAAR IN DE AFDEELING DER WEG- EN WATERBOUWKUNDE, VOOR EENE COMMISSIE UIT DEN SENAAT TE VERDEDIGEN OP WOENSDAG 5 OCTOBER 1927, DES NAMIDDAGS TE 3 UUR

DOOR

TAN SIN HOK
MIJNINGENIEUR,
GEBOREN TE TJIPADANG (WEST-JAVA).

'S-GRAVENHAGE - ALGEMEENE LANDSDRUKKERIJ - 1927.

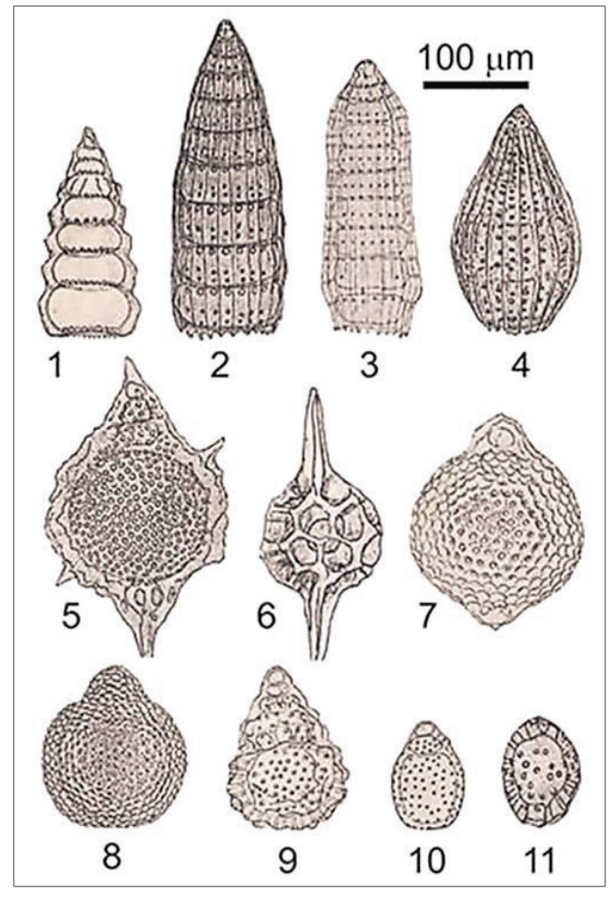


Fig. X.58. Title page of Tan Sin Hok's 1927 thesis on radiolaria and calcareous nannofossils in pelagic marls from the Moluccas.

Fig. X.59. Eleven new species of radiolaria from Bebalain, Roti Island, described and drawn by Tan.

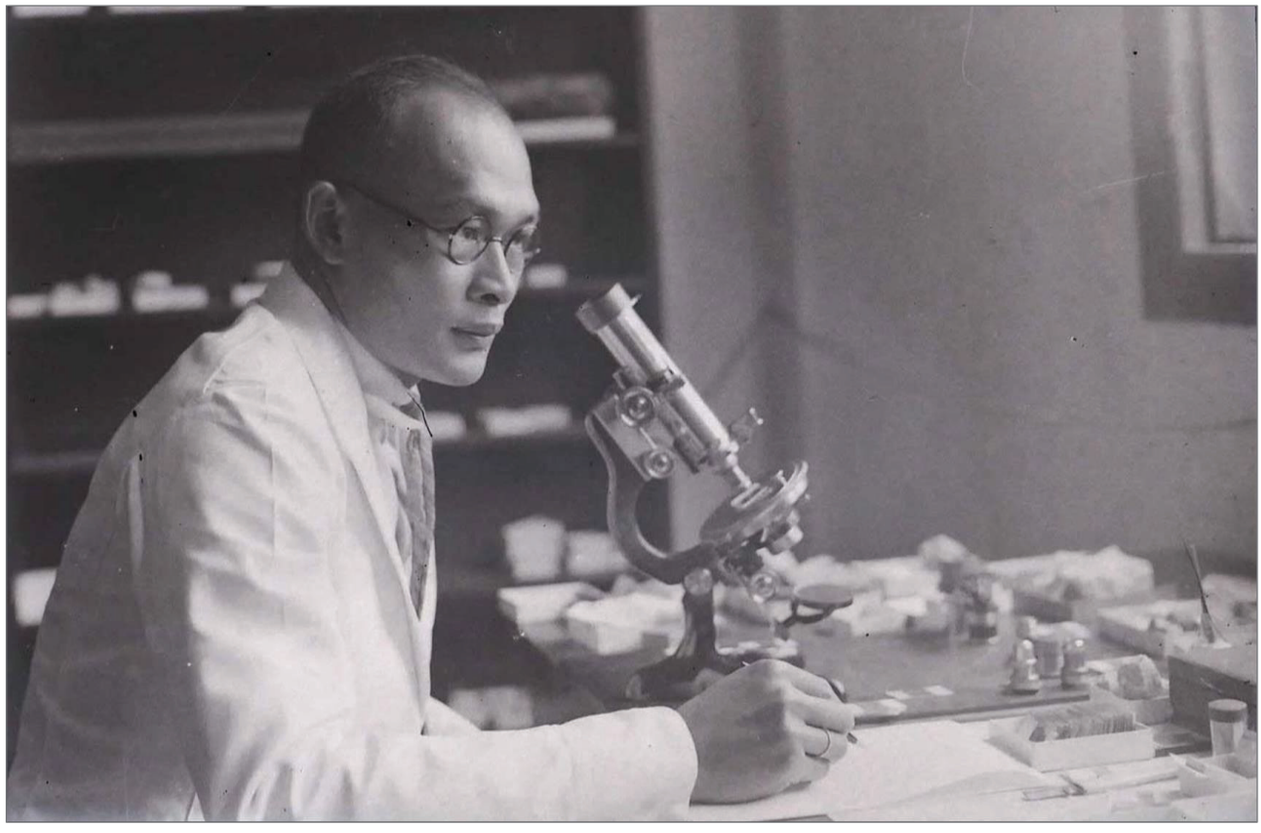


Fig. X.60. Tan Sin Hok behind his microscope in Bandung, probably in the 1930s (photo from Tan family, Amsterdam).

were difficult to reconcile with topography and known geology of the region. Tan's conclusions on the economic significance of the coal reserves were also invariably negative.

Fig. X.68. Part of Tan Sin Hok's identity card issued by the City of Bandung during the Japanese Administration in 1942 (from www.brieven-tan-schepers.nl).

Japanese internment 1943-1945, murder during 'Bersiap' period, 1945

Tan Sin Hok continued with his geological work at the Bureau of Mines in Bandung under the Japanese after the Dutch surrender of March 1942, until long after most Dutch nationals had been interned by the Japanese. However, on 1 September 1943 he was also arrested and imprisoned by the Japanese for two years *(Brieven Tan-Schepers* website). Some reports suggested this was because the Japanese discovered the Tan was a member of the Freemasons, an organization forbidden by the Japanese (Thalmann, 1949), but this was also the time when the Japanese started imprisonment of many of the Indo-Europeans.

Tan and his family ended up in separate internment camps on Java. Tan first stayed in the Sukamaskin prison in Bandung and later in Camp Cimahi, West Java. Due to his strong health Tan survived the two years in internment in relatively good health. He was released at the end of August 1945, within weeks after the Japanese surrender, and was reconciled with his wife and three children two weeks later.


ALGEMEEN HANDELSBLAD

MAANDAG 31 DECEMBER 1945

Tot onze ontsteltenis ontvingen wij uit Bandoeng bericht, dat aldaar onze geliefde Schoonzoon,

Dr. Ir. S. H. Tan,
palaeontoloog bij de G.B.,
echtgenoot van
Aleida Maria Schepers,
op 43 jarigen leeftijd den 1en December door extremisten is neergeschoten.

Dr. M. A. Schepers.
S. E. H. Schepers—Cohen.

Amsterdam,
Oranje Nassaulaan 52 bv.

Fig. X.69.
Notification in a Dutch newspaper of 31 December 1945, from Tan Sin Hok's parents-in-law in Amsterdam:
"We were shocked to receive the news from Bandoeng that our beloved son-in-law Dr. Ir. S.H. Tan, paleontologist with the Geological Survey, husband of Aleida Maria Schepers, was shot and killed by extremists at age 43 on the 1st of December"

139. Leslie W. LEROY (California 1909- Colorado 1987)

L.W. LeRoy was an oil company micropaleontologist and a significant pioneer of Neogene-Recent smaller benthic foraminifera in Sumatra and Java in the late 1930s and 1940s.

Leslie Walter ('Lett') Leroy was born in California in 1909. He graduated from the Colorado School of Mines in 1933. He joined Standard Oil Company of California in 1934 as a geologist-paleontologist, initially working on the geology of southern California Tertiary basins.

Micropaleontologist in the Netherlands Indies, 1937-1941

From 1937 until 1941, LeRoy was micropaleontologist with the *Nederlandsche Pacific Petroleum Maatschappij* (NPPM; renamed Caltex after Indonesian Independence), based in Medan, Sumatra.

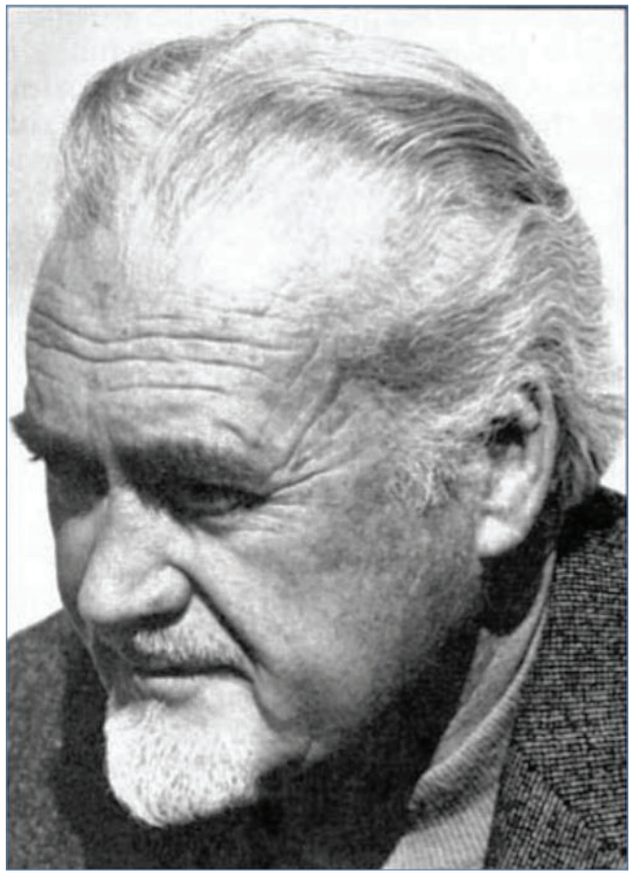
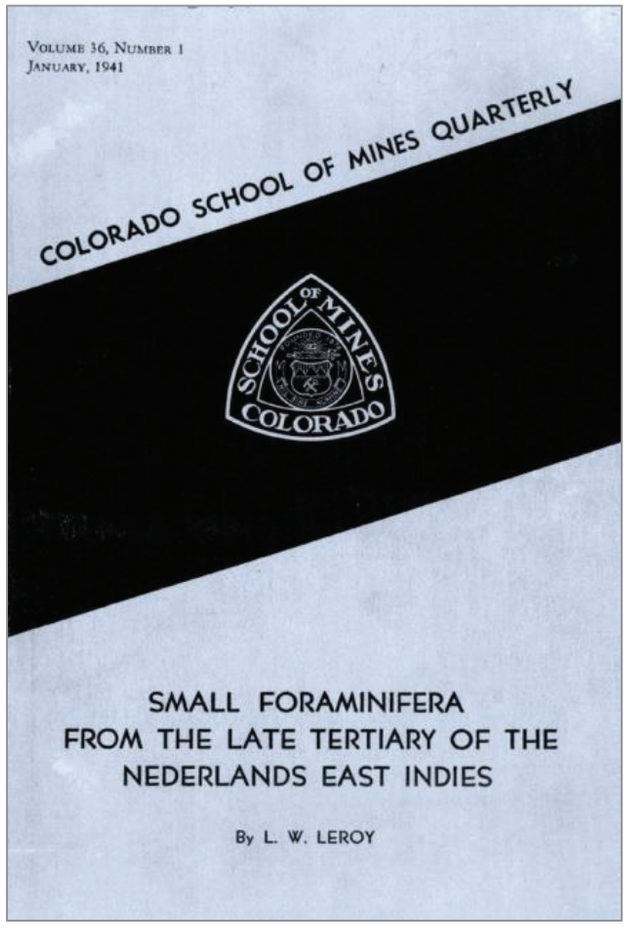


Fig. X.122.
Portrait of L.W. LeRoy
(from D. Leroy, 1988; AAPG Bulletin).

Unlike most of his micropaleontologist peers in the petroleum industry at that time, L.W. Leroy was a firm believer in trying to apply correct taxonomic species names, and in publishing the results of his investigations. Common practice in oil companies in the Netherlands Indies in the 1930s was the use of informal species numbers instead of names for microfossils, like *Texturaria 2*, *Cibicides 5*, etc. For competitive reasons oil companies did not co-ordinate these taxonomic schemes, so, for instance, *Textularia 2* of BPM-Shell was not the same as *Textularia 2* of NKPM/Stanvac. LeRoy was the first to try to break this habit of company-specific taxonomies and went through the effort of assigning proper species names and formally describing new species.

Leroy published a series of early benchmark papers on Neogene foraminifera from Sumatra, Java and NE Kalimantan (Fig. X.123). Many of the foraminiferal and ostracod species recognized and described by him are still used by biostratigraphers worldwide, e.g., planktonic foraminifera *Globorotalia siakensis*, *Globorotalia barisanensis* and *Globigerina baroemoenensis* (Figures X.124, 125), all with holotypes from the Miocene Telisa Formation in Central Sumatra.

Globorotalia barisanensis Leroy 1939, described from the Lower Palembang Formation in Central Sumatra, is technically a valid name and a senior synonym of the now more frequently used Early Middle Miocene index species name *G. peripheroacuta* Blow and Banner 1966 (Zachariasse et al., 2017).



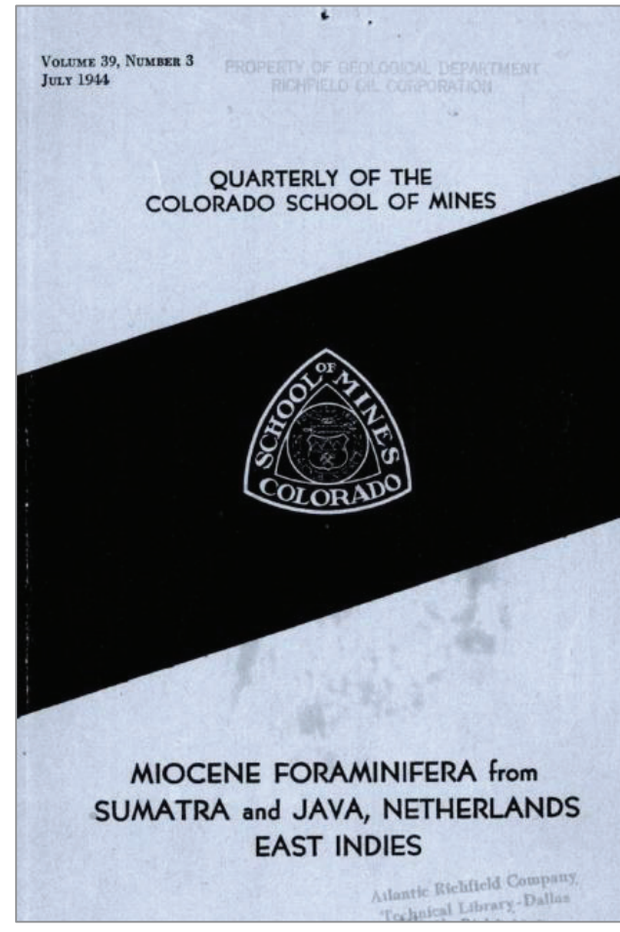


Fig. X.123. Covers of two of LeRoy's classic papers on foraminifera from the Tertiary of Indonesia.

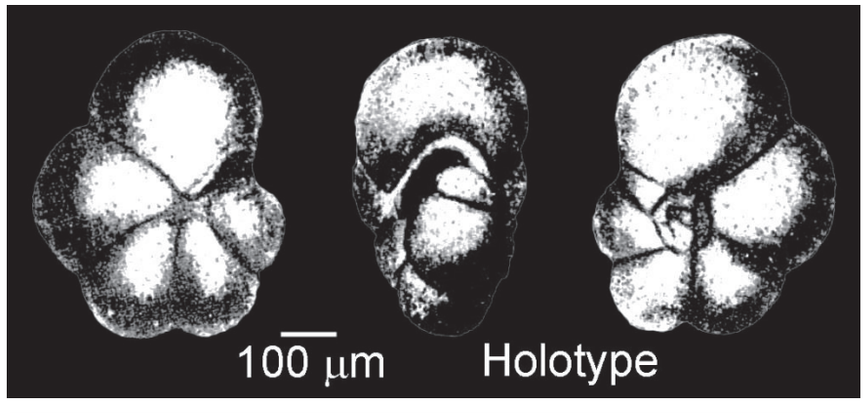


Fig. X.124.
Holotype of Globorotalia siakensis LeRoy, 1939 from the Rokan-Tapanuli region, Central Sumatra.

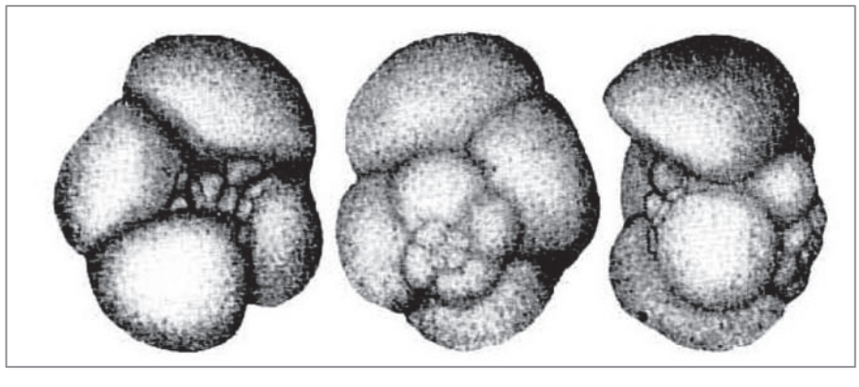


Fig. X.125.
Globigerina baroemoenensis var. quadrata n.sp. from Sumatra (LeRoy, 1939 and 1944).

LeRoy was the first micropaleontologist to recognize the biostratigraphic value of the planktonic foram species *Orbulina universa*, the first appearance of which is now widely used as a marker biohorizon near the base of the Middle Miocene (base of Zone N9 of Blow; Leroy, 1948, 1952). Among the 14 new ostracod species LeRoy described in 1941 are *Cytherelloidea rokanensis* and *C. indica*.

LeRoy managed to escape from Sumatra just ahead of the invading Japanese Army in late 1941 and returned to the USA. After a stint in Maracaibo, Venezuela in the late 1940s he became an Associate Professor of Geological engineering at the Colorado School of Mines in Golden in 1948, and from 1954-1975 became a Full professor in Colorado. His famous textbook '*Subsurface Geology*' (1949, with four updated editions until 1987) has become a must-read for generations of petroleum geologists.

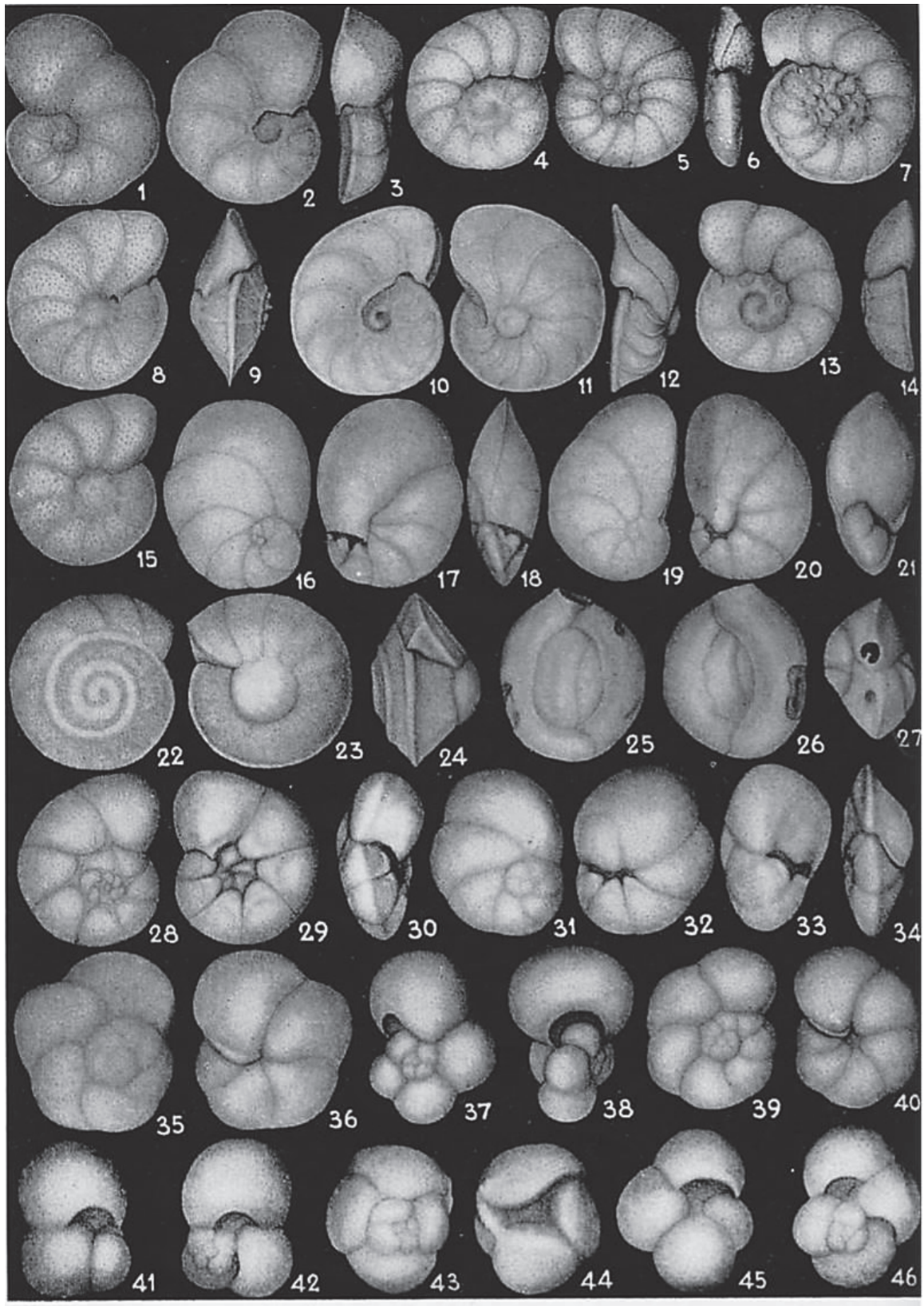
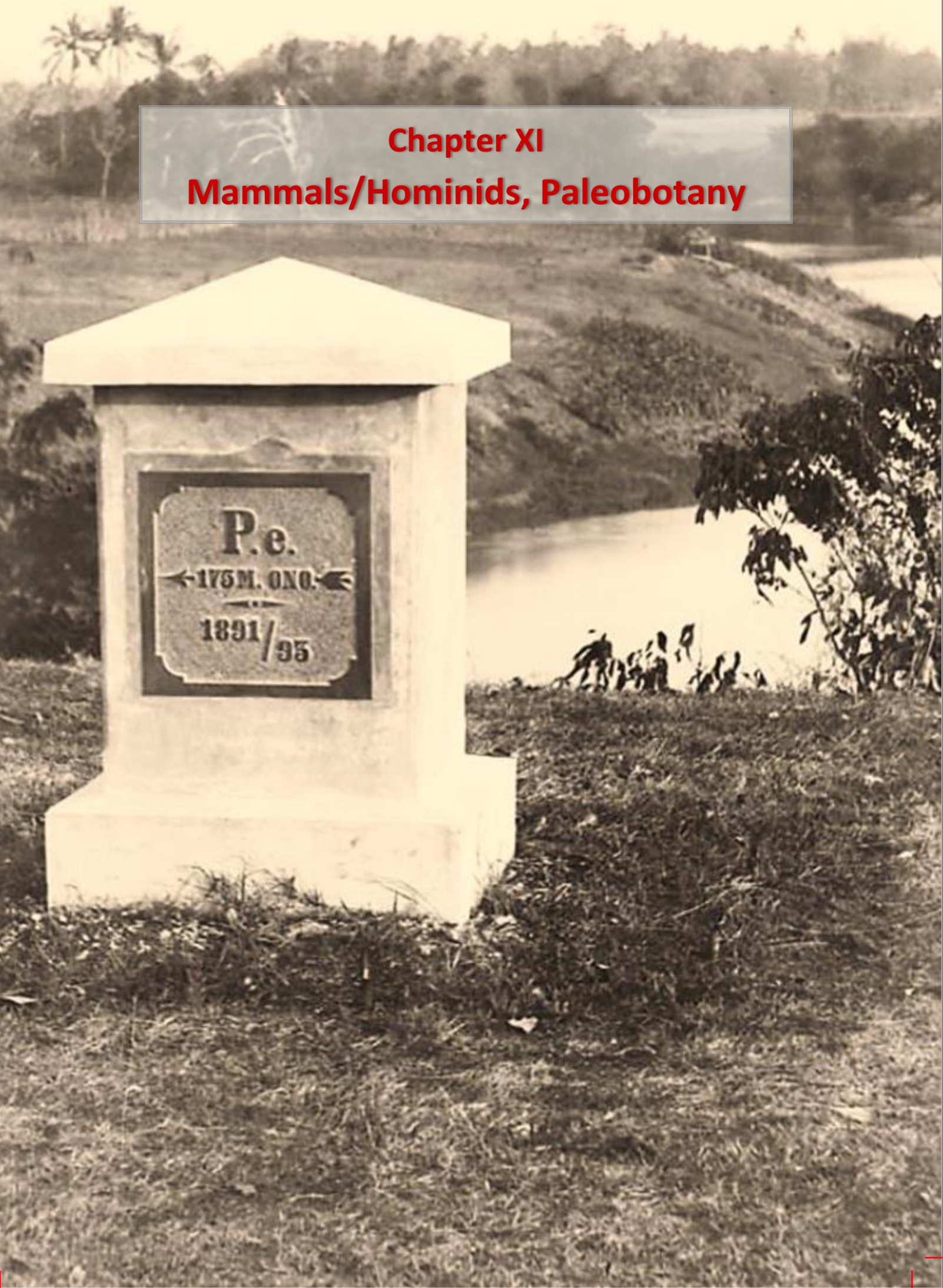


PLATE 6. *LeRoy, Miocene Fauna, Central Sumatra*

Fig. X.126. Miocene deep marine benthic and planktonic foraminifera from Central Sumatra (LeRoy 1944).

Chapter XI

Mammals/Hominids, Paleobotany



144. M. Eugene F.T. DUBOIS (Eijsden 1858- Haelen 1940)

E. Dubois is the well-known discoverer of 'Java Man' (Pithecanthropus erectus) at Trinil in Central Java in 1891, which were believed to be from the 'missing link' between apes and humans. Dubois had come to the Netherlands Indies primarily to search for the 'missing link' between apes and humans, which Charles Darwin and Ernst Haeckel had predicted to have existed. It was quite remarkable that Dubois actually found some of these extremely rare and previously unknown fossils. Dubois is viewed as one of the founders of paleoanthropology, but some of his legacy is colored by controversies during his later years, when he became a paranoid eccentric.

Marie Eugene Francois Thomas (Eugene) Dubois was born on 28 January 1858 in Eijsden near Maastricht, the Netherlands, where he attended elementary school. He attended high school in Roermond from 1870-1877. In 1877-1884 he studied medicine at the University of Amsterdam. From 1881 to 1887 he was an Assistant in the Anatomical laboratory and in 1886-1887 also Lecturer in anatomy. After almost 10 years in the Netherlands Indies from 1887-1895, Dubois returned to the University of Amsterdam as Professor of Geology in 1898.

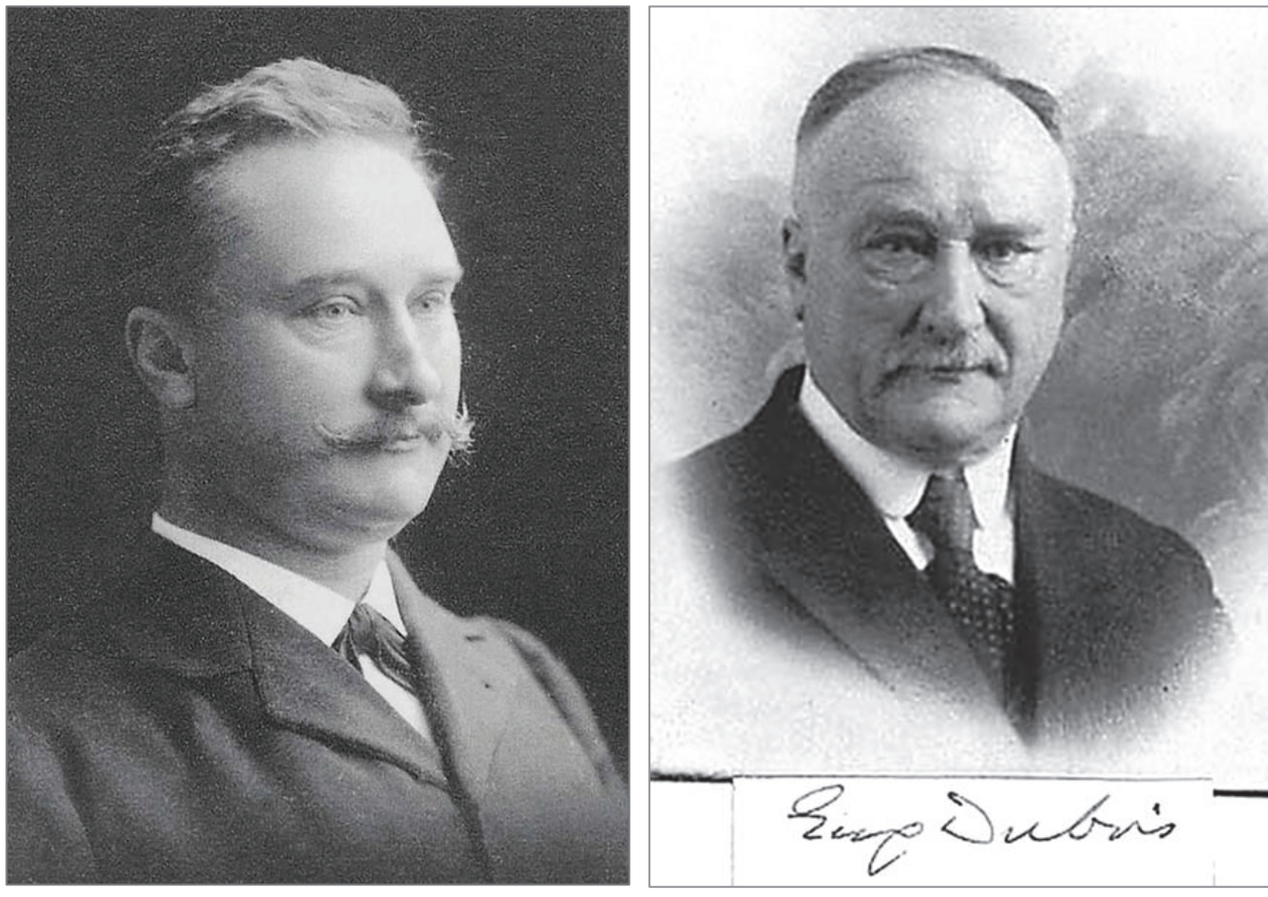


Fig. XI.18. Eugene Dubois as Professor of Geology in Amsterdam in 1902 (left) and in 1925 (right).

To Sumatra, 1887

Like Thomas Horsfield, Franz Junghuhn and Theodor Posewitz before him, E. Dubois came to the Netherlands Indies as a medical doctor/physician, but whose real passion was in the exploration of the natural world of Indonesia and SE Asia.

Inspired by the evolutionary theories proposed by Charles Darwin and Ernst Haeckel, Dubois set out to find evidence to determine whether man descended from apes. Darwin's hypothesis was that this evolutionary transition probably happened in the warm climates of the tropical belt (losing hair, the present modern distribution of man-apes). In October 1887, Dubois and family arrived in Sumatra, to work as a medical doctor with the Netherlands Indies Army (KNIL). However, his ulterior motive was to come to the Netherlands Indies to look for the 'missing link' in the evolution from apes to humans.

Dubois was initially stationed in Padang and after May 1888 in Pajakumbuh (Pajakombo) in the Padang Highlands, West Sumatra, where he started excavations in limestone caves in 1888. In March 1889, he managed

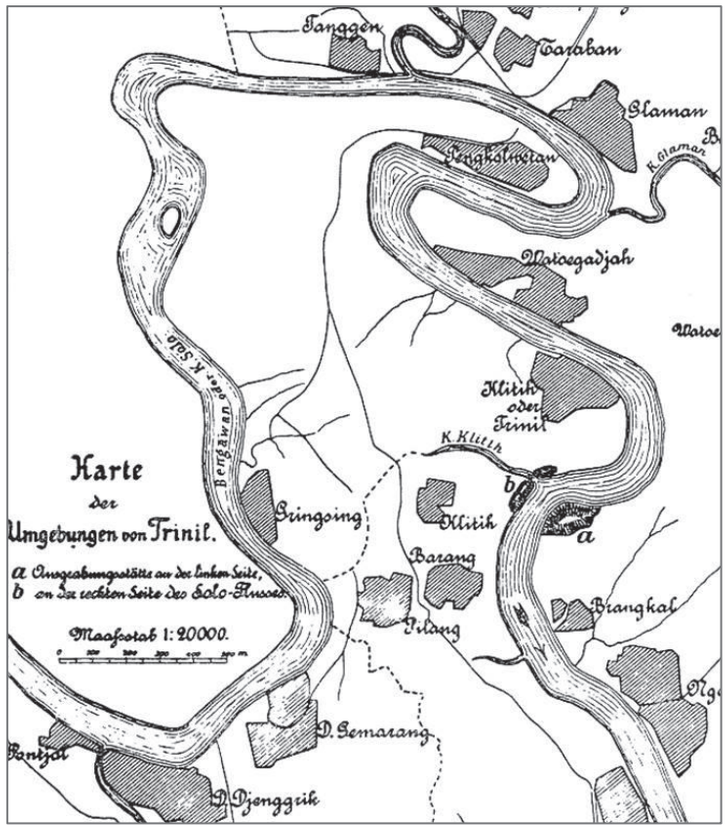
Kedung Brubus, 1890-1891

Early reports of Pleistocene land mammal bones from various sites of fluvial deposits in Central and NE Java came from Junghuhn (1857), Raden Saleh (1867) and K. Martin (1886, 1888). These encouraged Dubois to switch his search strategy from cave deposits to the Pleistocene fluvial-alluvial deposits in the more open areas of Central and East Java. Initial digs by Dubois in late 1890-early 1891 were at *Kedoeng Broeboes* (Kedung Brubus; 40 km East of Trinil in the southern Kendeng zone) and *Pati Ayam* (Jepara). Both localities had already been investigated earlier by Raden Saleh in 1866.

Although a fragment of a human mandible and various other mammal fossils were found by the Dubois team in Kedung Brubus, the work here was abandoned in mid-1891. This termination was reportedly partly due to hostilities from locals, who worried about their ongoing business of selling mammal fossils as 'dragon bones' to Chinese traders.

Similar to the Wajak material, Dubois was slow in publishing any of his early findings at Kedung Brubus. The description of the mandible, found in 1890, was not published until 1924. In 1926 he also described bones of a new species of giant pangolin (ant eater), named *Manis palaeojavanica*, which is similar to, but much larger than the still living Java pangolin *Manis javanica*. Dubois noticed that modern *Manis* species live in open and relatively dry regions, suggesting paleoclimate of Java at that time was somewhat drier than today. More details on the mammal faunas from Kedung Brubus in the Dubois collection were provided much later, by D. Hooijer and J. de Vos in the 1950s-1980s. Its age is now commonly believed to be around 0.8 Ma, presumably slightly younger than most of the Trinil faunas.

Trinil, Central Java, 1891-1893



In August 1891, Dubois moved his excavation efforts to a new site south of the village of Trinil (also called Klitik), on the left bank of the Solo River, WNW of Ngawi (Figs. X.20, X.21, X.25).

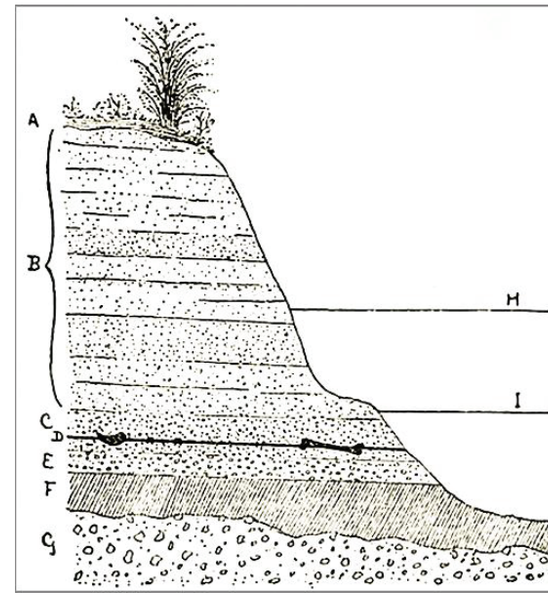


Fig. XI.20. Map of the Trinil (Klitik) excavation site along the Solo River in Central Java (Dubois, 1891). The main excavation site and Pithecanthropus erectus type locality is marked 'a'.

Fig. XI.21. The Trinil profile, with the level of Pithecanthropus fossils marked as Horizon D (also known as the 'Hauptknochenschicht', meaning 'principal bone bed').

The excavations in the river terrace deposits here were supported by 50 local convict laborers, who were supervised by sergeants G. Kriele and A. de Winter of the KNIL Army Engineer Corps. Among the rich collection of mammal fossils they found a human skull cap in 1891, which had a much smaller brain volume than modern man. In 1892 a thighbone (femur) was found that was straight and more similar to modern humans than apes and suggesting it walked upright (Fig. XI.26).

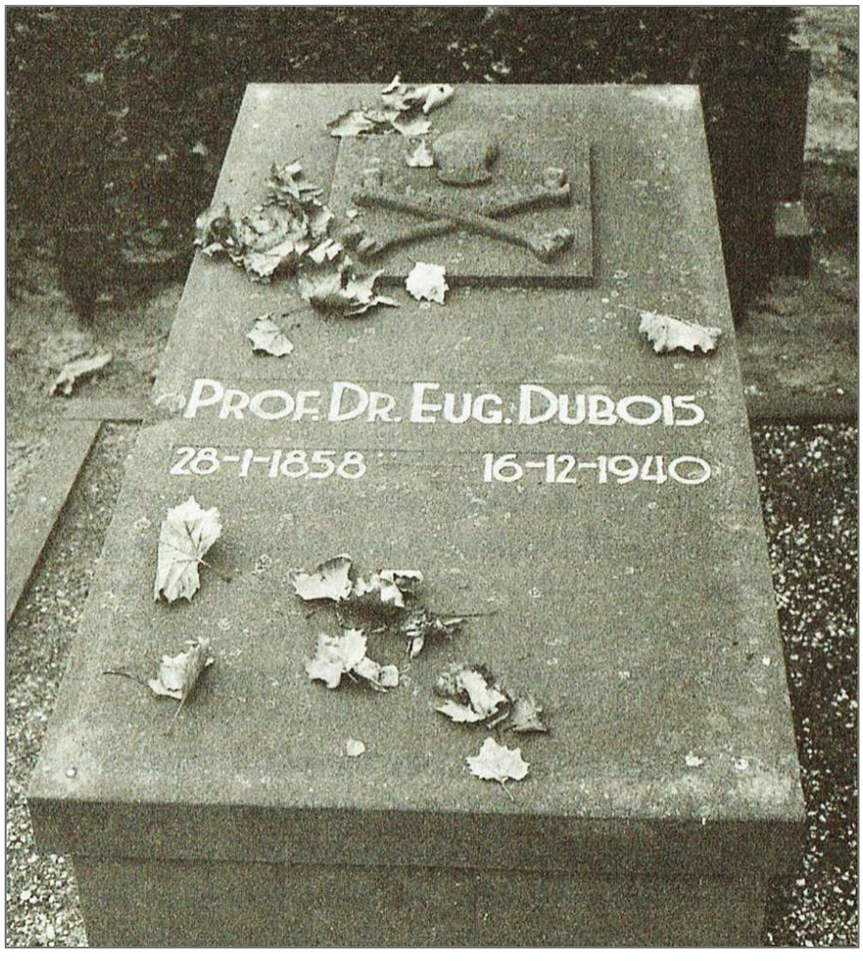
Post-Dubois work on mammals from Java

In 1907-1908, the German *Selenka Expedition* carried out additional excavations at the Trinil site of Dubois. They recovered numerous additional Pleistocene mammal fossils, but no new hominid material. The descriptions by M.L. Selenka and Blanckenhorn (1911) and co-workers on the stratigraphy at Trinil and its Pleistocene fossils (mammal and other faunas and flora) were much more comprehensive than those of Dubois, who had no team ofc0-workers, was focused on the hominid fossils, and who reportedly was not always present at the site when fossil material was uncovered by the excavation team.

In August 1926, Army doctor C.E.J. Heberlein from Surabaya bought a fossil from locals at Trinil, which he presumed to be a *Pithecanthropus* skull cap. This would have been only the second of its kind after the original of Dubois, so it caused much excitement in the world of Paleoanthropology. However, in December 1926 anatomist W.A. Mijsberg at the STOVIA (School for Education of Native Medical Doctors in Batavia) and H.J.T. Bijlmer examined the fossil and recognized it as the proximal end of the massive humerus arm bone of a *Stegodon* elephant, a species that is not uncommon in the Pleistocene of Trinil (Hrdlicka, 1930).

In the 1930s, new discoveries of hominid fossils were made in Java, at Sangiran, Ngandong and Mojokerto. Most of this new material was described by F. Oppenoorth and Ralph von Koenigswald. The aging Dubois appeared to struggle with the idea that *Pithecanthropus* material had been found that was more perfect than his, and went out of his way to discredit the new interpretations. In a 1937 paper Dubois argued that the newly discovered fossil hominid skulls in Solo River terrace deposits near Ngandong and described as *Homo soloensis* by Oppenoorth (1932) (which have often been viewed as advanced *Homo erectus*; e.g., Santa-Luca, 1980), '*has nothing in common with Pithecanthropus erectus*'.

After Von Koenigswald (1936) described the new discovery of a hominid fossil known as *Homo modjokertensis,* which he (correctly) viewed as a juvenile skull of a *Pithecanthropus* that was probably older than the Trinil fossils, Dubois was outraged and condemned the interpretation. He argued it was a modern human (Shipman, 2001). It was the start of a series of bitter public discussions between Von Koenigswald and Dubois, which ended only at Dubois' death in 1940.



Prof. Dr. M.E.F.T. Dubois passed away unexpectedly from a heart attack on 16 December 1940, at his country estate *De Bedelaer* in Haelen near Roermond, North Limburg.

Dubois had moved here permanently from Haarlem only a short time before his death.

Dubois was buried in the *Algemene Begraafplaats* cemetery of the nearby town of Venlo, because the local Catholic church would not allow the atheist Dubois in their graveyard.

Fig. XI.29. The grave of Prof. Dr. Eugene Dubois, decorated with a Pithecanthropus skull and thigh bones (photo in Shipman, 2001).

146. G.H. Ralph VON KOENIGSWALD (Berlin 1902- Bad Homburg 1982)

German-born paleontologist Ralph von Koenigswald is well known as one of the main authorities on Pleistocene hominids and the stratigraphy and taxonomy of the Pleistocene mammal faunas of Java in the 1930s. His work corroborated the initially controversial findings of Eugene Dubois about hominid evolution and built on it. In addition, he published on stone tools associated with hominid fossils, Pleistocene tektites and on the fossils from China sold for medicinal purposes in Chinese pharmacies across SE Asia.

Gustav Heinrich Ralph (Ralph) von Koenigswald was born in Berlin on 13 November 1902, as son of a geographer/ethnologist. He finished high school in Berlin in 1922 and studied geology and paleontology at the University of Berlin, the *Eberhard-Karls-Universität* in Tubingen, Cologne University, and finishing with a doctorate from the famous paleontology program at the *Ludwig-Maximilians-Universitat* in Munich in 1928 under Professor F. Broili. He stayed on in Munich from 1928-1930 as Assistant at the *Bayerische Staatssammlung fur Palaeontologie und Geologie* (Bavarian Museum for Paleontology and Geology).

Paleontologist at the Bureau of Mines in Bandung, 1931-1942 (1946)

In 1930, Von Koenigswald's former professor F. Broili informed him of an opportunity to work in Java as a vertebrate paleontologist with the *Dienst van den Mijnbouw* (Geological Survey of the Netherlands Indies). He jumped at the opportunity and arrived in Bandung in January 1931 with a five-year contract. He was tasked with working out a vertebrate fossil biostratigraphy for the Pleistocene of Java. His co-workers in the paleontology section at that time were Tan Sin Hok (micropaleontology) and C.H. Oostingh (molluscs).

Fig. XI.39.
Dr. Ralph von Koenigswald at his desk at the Geological Survey in Bandung in 1938. In his right hand is the small skull of 'Mojokerto child' (Collectie Tropenmuseum).

Solo Man, Ngandong, 1932

Von Koenigswald was lucky to arrive in Bandung at a time when geologists of the *Javakaarteering* (Java mapping program) of *Mijnbouw* (Geological Survey) discovered several new localities of Late Pliocene- Pleistocene mammal and hominid fossils in the 1930s: *Bumiayu* in 1925-1926 (Ter Haar and Zwierzycki), *Ngandong* in 1931-1933 (Ter Haar and Oppenoorth) and *Mojokerto* in 1936 (Duyfjes).

In 1931, geologist C. Ter Haar of *Mijnbouw* discovered mammal bones in the '20 meter' terrace deposits along the Solo River near Ngandong, Central Java. This led an excavation program between 1931 and 1933. It was nominally overseen by C. Ter Haar and his boss W.F. Oppenoorth, but was carried out primarily by Indonesian field assistants Samsi and Panudju. The excavation produced thousands of mammal fossils, including 11 skull

caps and two tibiae (lower leg bones) of a primitive, extinct Late Pleistocene hominid, which was described by geologist F. Oppenoorth (1932) as *Homo (Javanthropus) soloensis* ('Solo Man') (Von Koenigswald, 1933).

Von Koenigswald became involved in the descriptions of non-hominid mammal fossils from Ngandong, and made his first visit to the excavation site in June 1932 with C. Ter Haar, when he witnessed the extraction of *Homo soloensis* Skull VI (see also Huffman et al., 2010). He made two more visits to Ngandong, one in September 1933, when he was engaged in the extraction of *H. soloensis* Skull VIII. At this time, J. Zwierzycki had replaced Oppenoorth as chief of the Java Mapping Program.

Von Koenigswald (1956, 1978) viewed *Homo soloensis* as a tropical representative of *Neanderthal* man, younger than and different from the classic *Homo (Pithecanthropus) erectus* from Trinil and Sangiran. It is associated with more advanced bone and stone tools. However, there is still debate on whether *Homo soloensis* should be viewed as an evolutionary descendent of the *Homo erectus* lineage, or as a separate species (e.g., Jacob, 1978: Bartstra, 1987; Zeitoun et al., 2010: Rizal et al., 2020).

In 1934, Von Koenigswald published his first biozonation of Plio-Pleistocene composite mammal assemblages on Java. From old to young: *Djetis* (Early Pleistocene), *Trinil* (Middle Pleistocene; with *Homo erectus*) and *Ngandong* (Late Pleistocene, with *Homo soloensis*). This zonation was subsequently refined and expanded by him and many others, including G.J. Bartstra, P. Sondaar, J. de Vos, F. Aziz, J. Leinders, etc., but the basic ideas appear to be relatively unchanged.

Victim of 1934 budget cuts, Carnegie Institution funding

During one of the early 1930s episode of cutbacks at the *Dienst van den Mijnbouw* in Bandung, Von Koenigswald's position as Vertebrate Paleontologist was eliminated at the end of 1934. Despite having one more year left on his 5-year contract, Von Koenigswald was laid off. At the same time, several of his colleagues at *Mijnbouw* were also let go. Dr. R.W. van Bemmelen was told not to return from his home leave in the Netherlands and was put on leave (without pay?) in Europe for 1-2 years.

Fig. XI.40. Drawing showing French Jesuit priest-anthropologist-paleontologist Dr. Pierre Teilhard de Chardin (left) and Ralph von Koenigswald in January 1936 at the 'P.e' monument for Pithecanthropus erectus, which was erected by Dubois along the Solo River at Trinil, Java, in 1892 (from Semah et al. 1990). In April 1938 Teilhard de Chardin returned to Java with two well-known American paleontologists, H. de Terra and H.L. Movius (De Tijd, 15-04-1938).

158. Eduard H. VON BAUMHAUER (Brussels 1820- Haarlem 1883)

Chemistry Professor E.H. von Baumhauer from Amsterdam was the first to promote the investigations into oils from surface seeps in the Netherlands Indies in the mid-1800s. He also conducted pioneering work on meteorites from Java.

Edourd Henri (also spelled Eduard Hendrik or Eduard Heinrich) Von Baumhauer was born on 18 September 1820 in Brussels, where his father was Attorney General at the Court. At that time Brussels was part of the Netherlands. After the secession of Belgium from the Netherlands in 1831, the Baumhauer family chose to remain in the Netherlands and moved to Utrecht.

Von Baumhauer studied at the University of Utrecht, graduating in Classical languages in 1843 and in Natural sciences in 1844. His doctorate thesis from the University of Utrecht in 1844 (in Latin) was on the chemical analysis of meteorites.

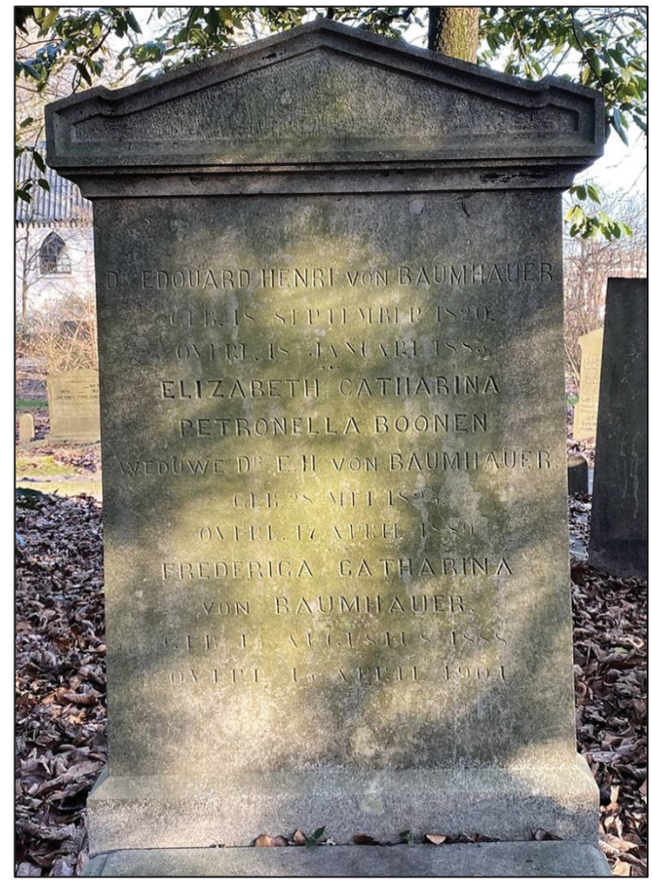


Fig. XII.26. Portrait painting of Prof. E.H. von Baumhauer by H.J. Scholten, around 1885 (University of Amsterdam).
Fig. XII.27. The Von Baumhauer family grave in Haarlem, December 2019.

From 1845 until 1847 Von Baumhauer was Professor of Physics and Chemistry at the *Atheneum* in Maastricht. In 1848-1865 he was Professor of Chemistry at the *Atheneum Illustre* (later named University of Amsterdam). He was a typical 'applied chemist', who used chemistry as a tool to test food products and water quality, as well as for characterization of soils, meteorites, diamonds and crude oils.

Chemistry of crude oils from the Netherlands Indies, 1869

By 1863 Von Baumhauer developed an interest in the chemical characteristics of crude oils and had done analyses on oils imported from America. In May 1863, he sent a letter to the Minister of Colonies and requested samples of oils from surface seeps in the Netherlands Indies for chemical analyses. The letter was forwarded to the Governor General, and then forwarded to Ir. C. de Groot, the Head of the *Dienst van het Mijnwezen* (Bureau of Mines) in Bogor. Mining engineer W.H. De Greve was then charged with the compilation of all known oil and gas seeps (De Greve, 1865).

In 1869 Von Baumhauer published the results in a report *On crude oils in the Netherlands Indies*, in which he reviewed localities of oil seeps in the Netherland Indies (44 in Java; occurrences on Borneo, Sumatra, Ceram and

Cover Chapter XIII: Gravity survey in a coastal swamp in South Sumatra by a BPM oil exploration crew

XIII. GEOPHYSICS, GEOMORPHOLOGY, ARCHEOLOGY

XIII.1. Geophysics (Seismology, Gravity)

Compared to mining engineers and geologists, geophysicists were for a long time a rare breed in the Netherlands Indies. In the 1920s and 1930s, their roles became more and more important. Several of the geophysicists in the Netherlands Indies were at the forefront of science, and Dutch geophysicists came close to discovering the process of subduction in the 1930s.

166. Felix A. VENING MEINESZ (Scheveningen 1887- Amersfoort 1966)

F.A. Vening Meinesz, also known as 'The diving Dutchman', was a world-famous geophysicist/geodesist, in the 1920s-1930s, He is known mainly for his pioneering marine gravity surveys, conducted from navy submarines in the Indonesian Archipelago, and first discovered the belts of anomalously low gravity anomalies, which could later be tied to zones of actively subducting crust.

Felix Andries Vening Meinesz was born on 30 July 1887 in Scheveningen near The Hague, as the youngest son of Sjoerd Meinesz, the Mayor of Rotterdam (and later Mayor of Amsterdam). After high school in Amsterdam he graduated as civil engineer from Delft Technical University in 1910. The same year he joined the *Rijkscommissie voor Graadmeting en Waterpassing* (later named Commission for Geodesy), specifically for gravity surveying of the Netherlands.

Early in his career Vening Meinesz designed an instrument with two pendulums, which allowed higher accuracy gravity measurements than with previous instruments. This design, and the physics theory behind it, became the subject of his Ph.D. Thesis *Contribution to the theory of pendulum observations* in 1915.

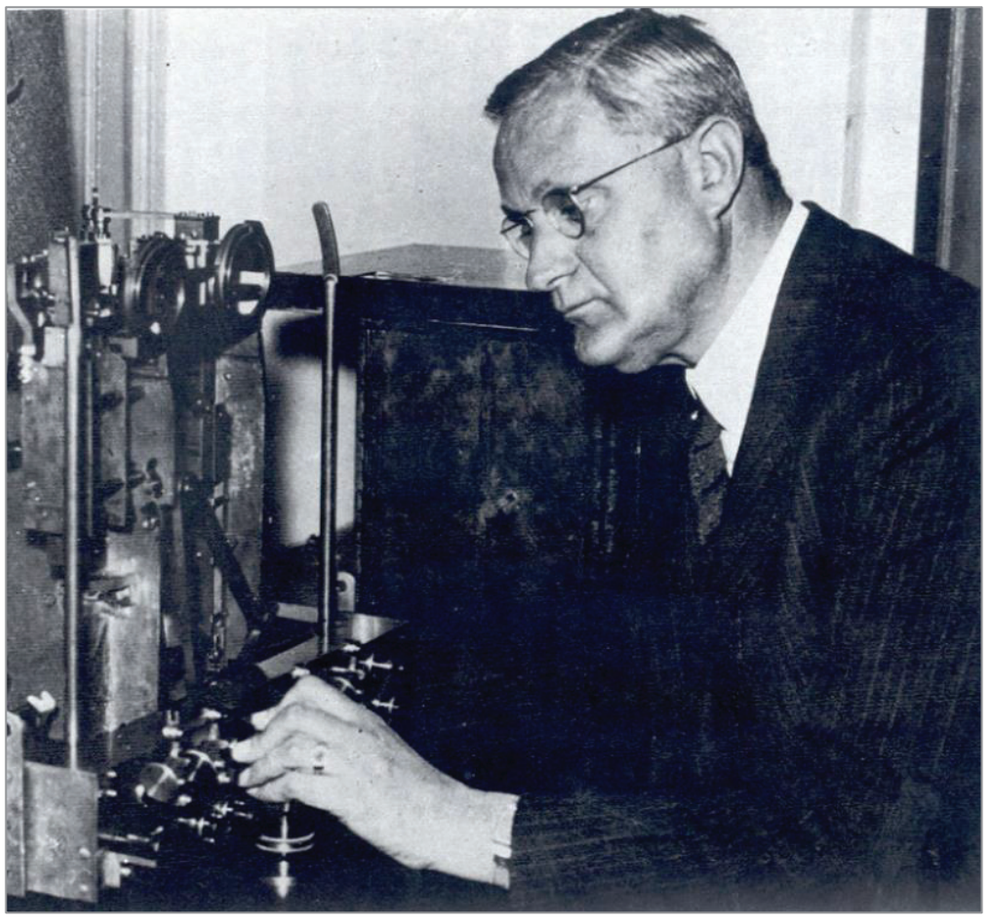


Fig. XIII.1.
A classic photo of a well-dressed Prof. Vening Meinesz at work inside a Navy submarine.
On the left is his self-designed double-pendulum gravimeter 'The Golden Calf' (Utrecht University archive).

Gravity expeditions at sea, 1923-1935

Later, Vening Meinesz built a gravimeter with 3 pendulums (nicknamed '*the golden calf*') that could perform measurements in unstable settings, like a ship at sea, something that was very hard to do before. This instrument was successfully used on Dutch navy submarines, during a series of marine gravity expeditions between 1923 and 1935. During this time, he traveled over 200,000 km in the cramped spaces. The results of his years at sea were described in 5 volumes of *Gravity Expeditions at Sea* between 1923 and 1958 (Waltman, Delft).

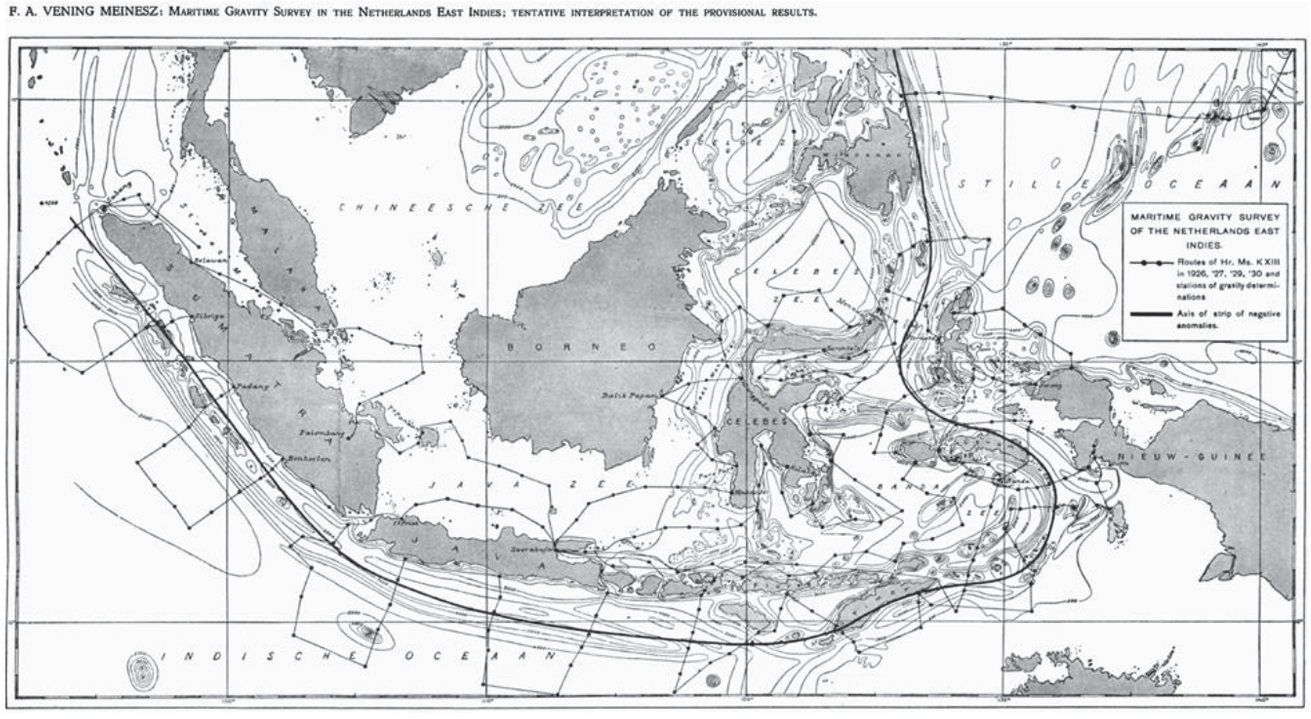


Fig. XIII.2. Veining Meinesz's first map of gravity profiles and gravity contours of the seas of the Netherlands Indies, showing routes of the K XIII submarine between 1926 and 1930 (Vening Meinesz ,1930).

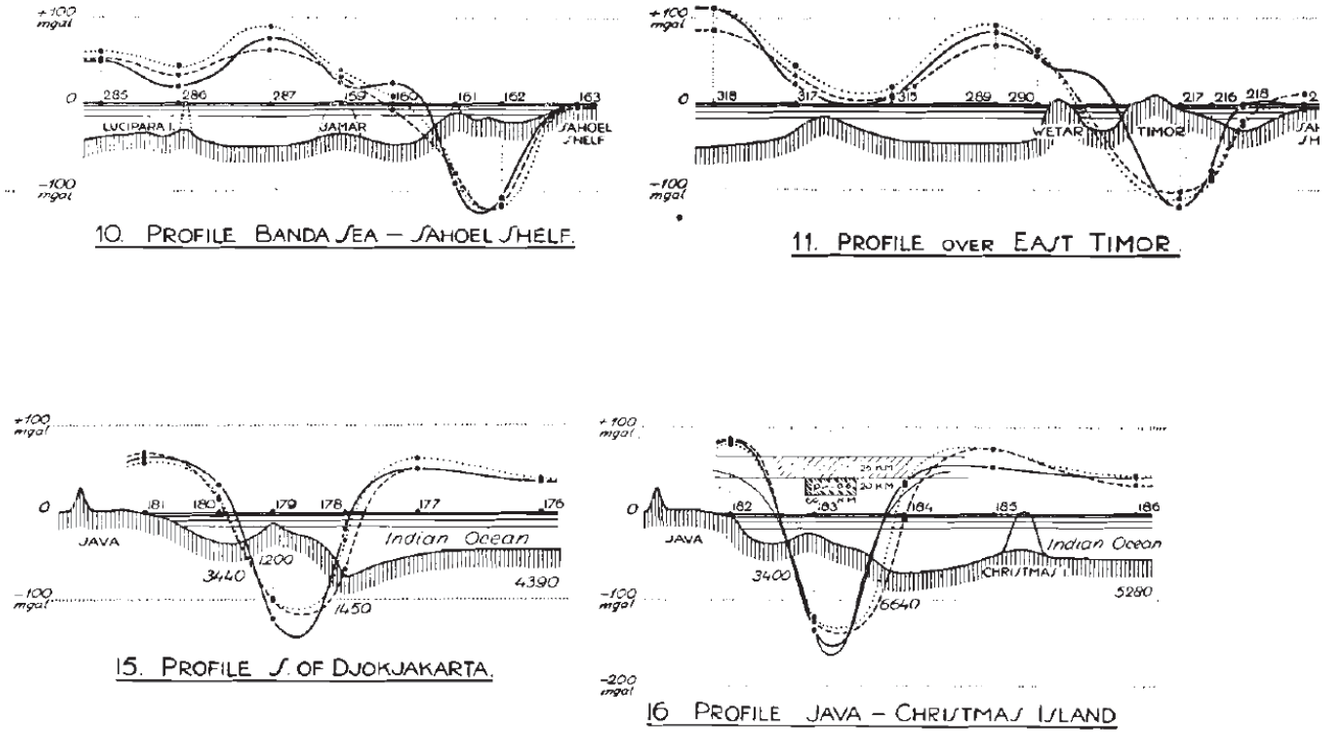


Fig. XIII.3. Examples of gravity profiles in the Indonesian region, showing the pronounced negative gravity anomalies over active subduction zones (accretionary prisms; notably including islands like Timor, Tanimbar and Seram) (Vening Meinesz, 1934).

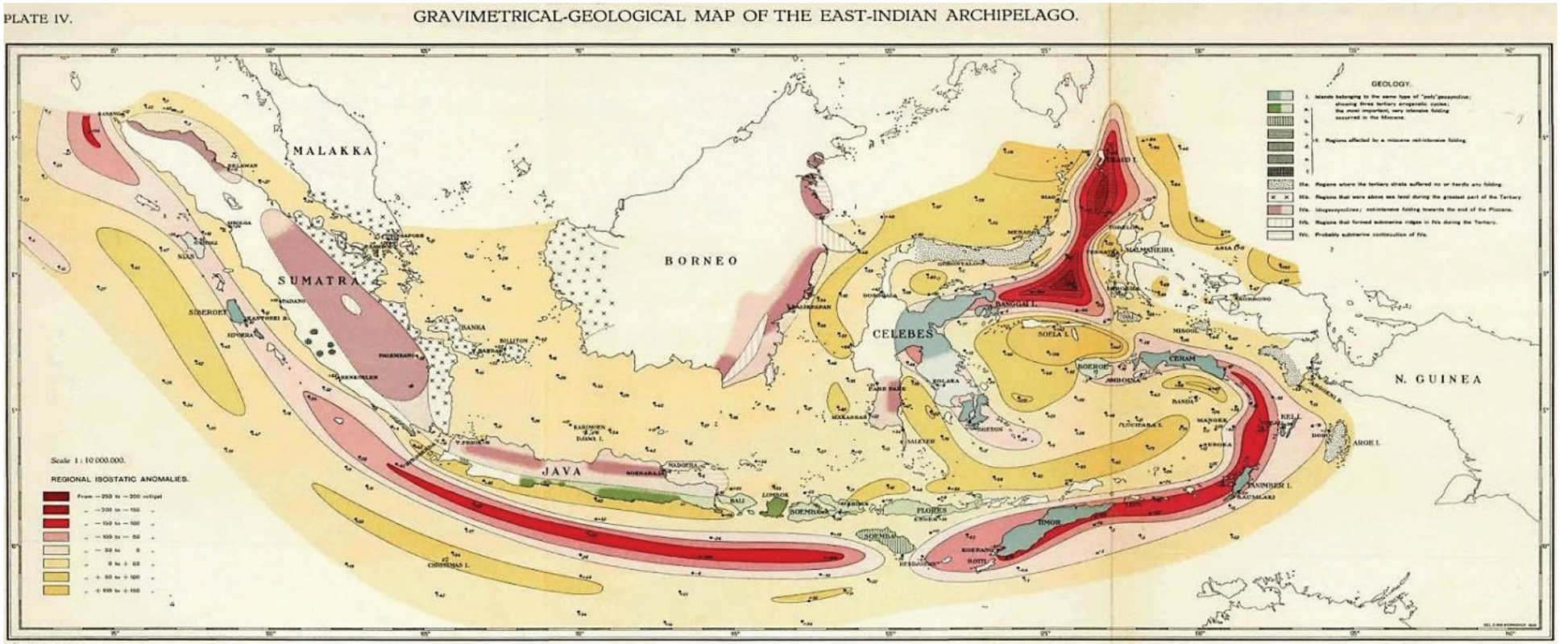


Fig. XIII.4. Belts of negative gravity anomalies (red) in the Indonesian region, interpreted as zones of ' crustal downbuckling' (Vening Meinesz 1934).

167. Hendrik P. BERLAGE Jr. (Amsterdam 1896- Utrecht 1968)

H.P. Berlage Jr. was a multi-talented geophysicist, known mainly as the first seismologist to determine that deep earthquakes in Indonesia are aligned in a plane dipping towards the Asian mainland (now known as Wadati-Benioff zone, and representing episodic movements within a subduction zone).

Hendrik Petrus Berlage (Jr.) was born in Amsterdam on 24 October 1896 as the son of a famous Dutch modern architect with the same name, who built the Amsterdam Stock Exchange and Central Station, and other landmarks. H.P. Berlage Jr. grew up in Amsterdam, and studied at the *Eidgenossische Hochschule* (ETH) in Zurich in 1915-1919.

Berlage continued with two years of study of physics and mathematics at the University of Leiden and a study of seismic registration equipment at the Dutch Meteorological Institute (KNMI) in De Bilt. In 1923 he returned to Zurich for a doctorate on seismographs and seismometric problems, which he completed in 1924.

Fig. XIII.8. Portrait of Dr. H.P. Berlage Jr. (from Snelders, 1989).

Netherlands Indies 1925- 1950

In 1925 Berlage came to the Netherlands Indies, to work at the *Koninklijk Magnetisch en Meteorologisch Observatorium* (KMMO; Royal Magnetic and Meteorological Observatory) in Batavia. Until 1922, this institute was headed by Dr. Willem van Bemmelen, father of geologist R.W. van Bemmelen.

KMMO not only kept track of weather data and Earth magnetism in the Netherlands Indies, but also of earthquakes. Here Berlage initially worked as junior scientist under Simon W. Visser, who was the 'official' seismologist at the institute when Berlage arrived.

Deep earthquakes in the Indonesian region: identifying the 'Wadati-Benioff zone'

In his thesis work at the University of Zurich, Berlage dealt with problems of locating positions of earthquake hypocenters. In a 1937 paper, Berlage discussed the distribution hypocenters of deep earthquakes in the Netherlands Indies from 1918 until 1936. Earthquake hypocenters were identifiable down to 700km deep, and Berlage could show for the first time that in the Netherlands Indies earthquake hypocenters deepen systematically in the direction of the Asian continent, and are aligned along a dipping planar surface (Fig. XIII.9).

Around the same time in the 1930s, Japanese seismologist K. Wadati had observed a similar deepening trend of deep earthquakes towards the Asian continent in Japan. His first contour map showed shallow earthquakes along the Pacific Ocean margin and increasingly deeper earthquakes towards the East Asian continent. It was published in Wadati (1935), but this remained largely unknown to the outside world, as much of his work before 1940 was published in Japanese or Japanese journals (Frohlich, 1987). Russian geophysicist H. Benioff described the same phenomenon in 1949 in the West Pacific, and was initially credited with the discovery of what became known as the *Benioff zone* or *Wadati-Benioff* zone. However, Berlage predated Benioff by 12 years, the seismogenic subduction zones should probably be called '*Wadati-Berlage* zones'.

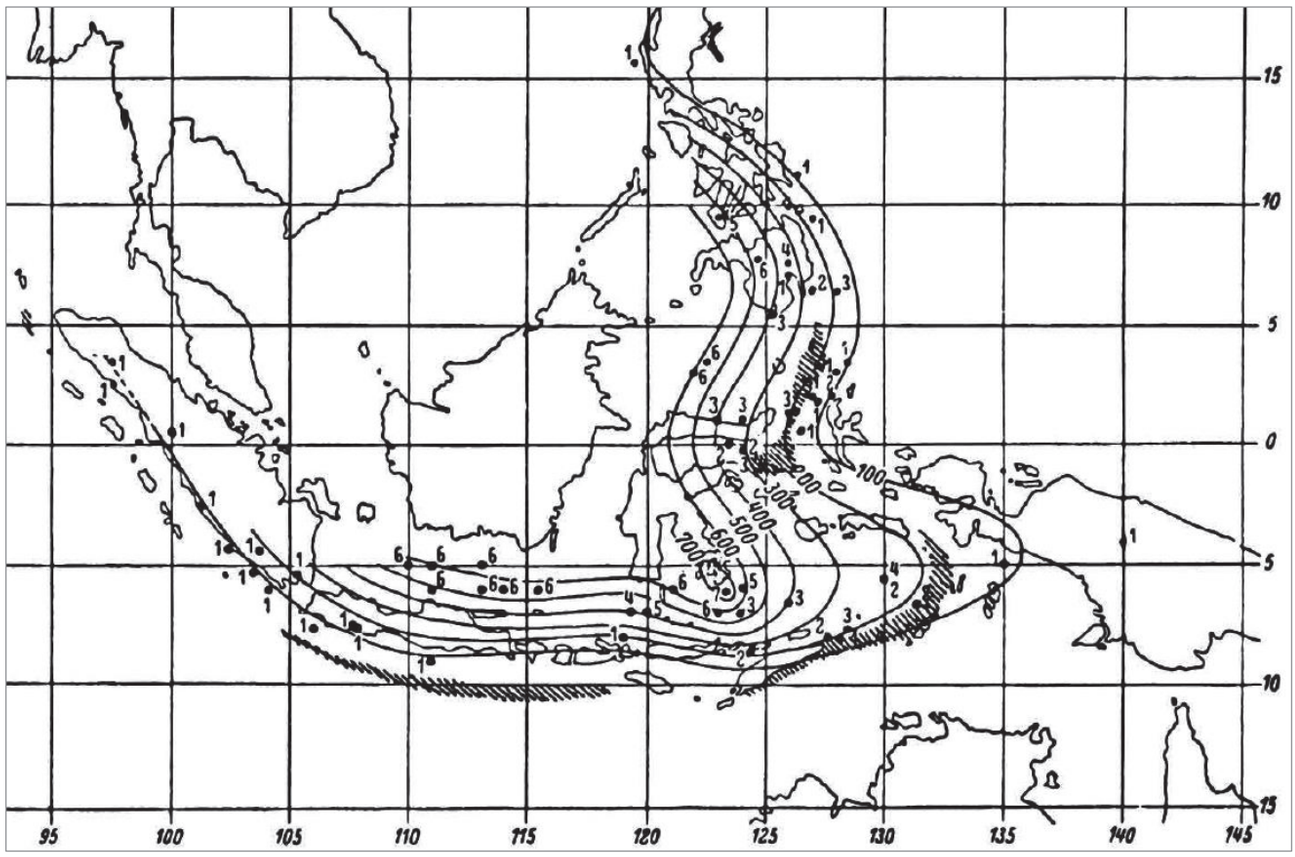


Fig. XIII.9. Locations of intermediate and deep earthquake hypocenters in the Indonesian region (Berlage, 1937; depths in 100s of km). The hypocenters are located along a plane that dips to the NW and W (Sundaland). This is now known to reflect subduction of the Indian Ocean/Australian plate, along what became known as the Wadati or Benioff seismogenic zone.

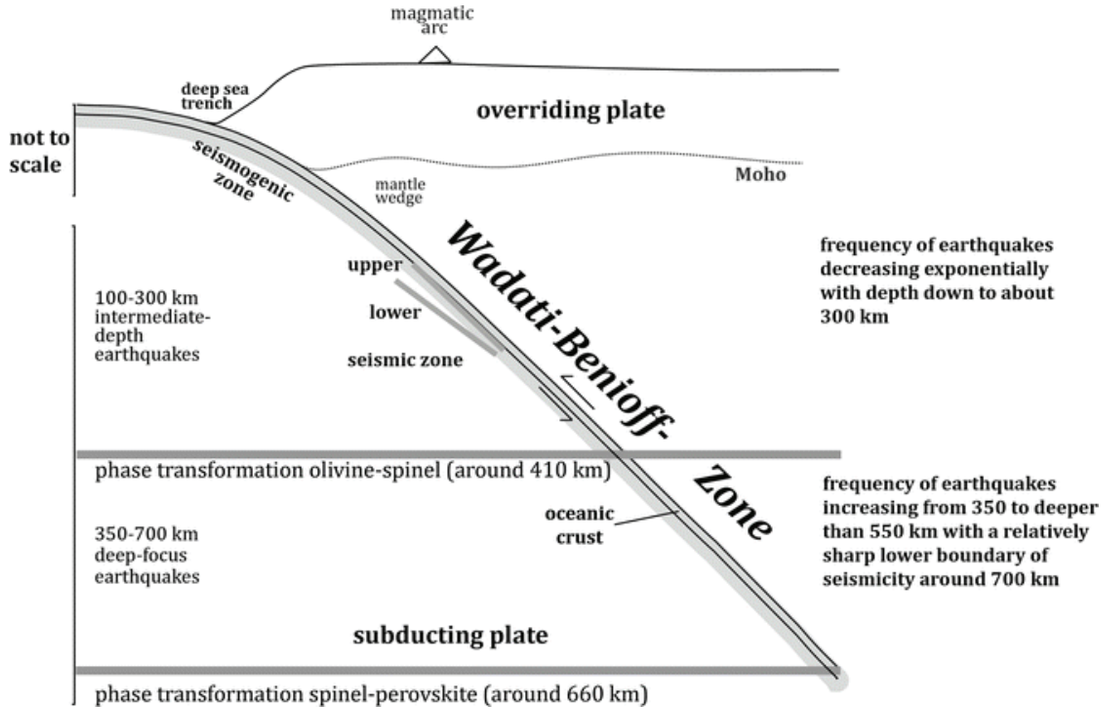
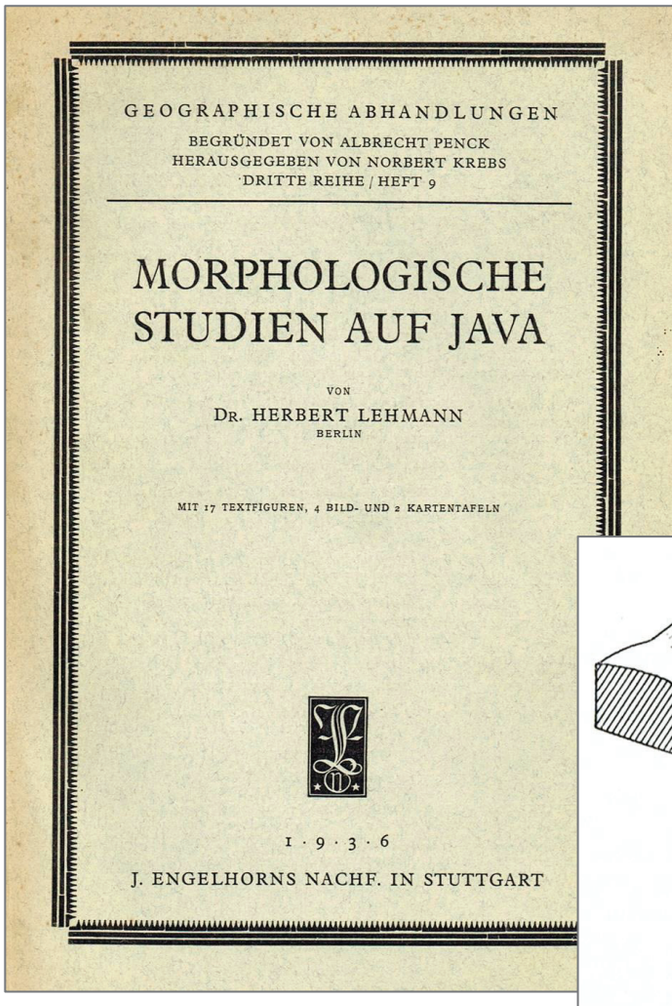


Fig. XIII.10. Schematic diagram of a 'Wadati-Benioff seismogenic zone of earthquake hypocenters' (from Kukowski, 2016). This probably should have been called the 'Wadati-Berlage zone'.

XIII.2. Geomorphology

Geomorphology is perhaps a somewhat neglected branch of geology that can provide vital clues about recent geologic changes. Some of the classic geomorphological studies of the Indonesian region include:

- Limestone karst geomorphology of the Southern Mountains of Central Java (Gunung Sewu) by Czechoslovak botanist-geographer Jiri Viktor Danes (1915), and German geographers Herbert Lehmann (1936; Figs. XIII.18, XIII.19) and Flathe and Pfeiffer (1965);
- Volcanic landform geomorphology (H. Verstappen, 1993);
- Geomorphology of coral islands (J. Umbgrove, 1930; H. Verstappen, 1950s).


GEOGRAPHISCHE ABHANDLUNGEN

BEGRÜNDET VON ALBRECHT PENCK
HERAUSGEGEBEN VON NORBERT KREBS
DRITTE REIHE / HEFT 9

MORPHOLOGISCHE STUDIEN AUF JAVA

VON

DR. HERBERT LEHMANN
BERLIN

MIT 17 TEXTFIGUREN, 4 BILD- UND 2 KARTENTAFELN

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J. ENGELHORNS NACHF. IN STUTTGART

Fig. XIII.18. Cover of one of the early classics of geomorphological studies on Java, conducted in 1933 by H. Lehmann of the University of Berlin.

It is viewed as 'the first modern work on humid tropical karst' (Haryono and Day, 2004), and is remarkably comprehensive for somebody whot visited Java for only a few months.

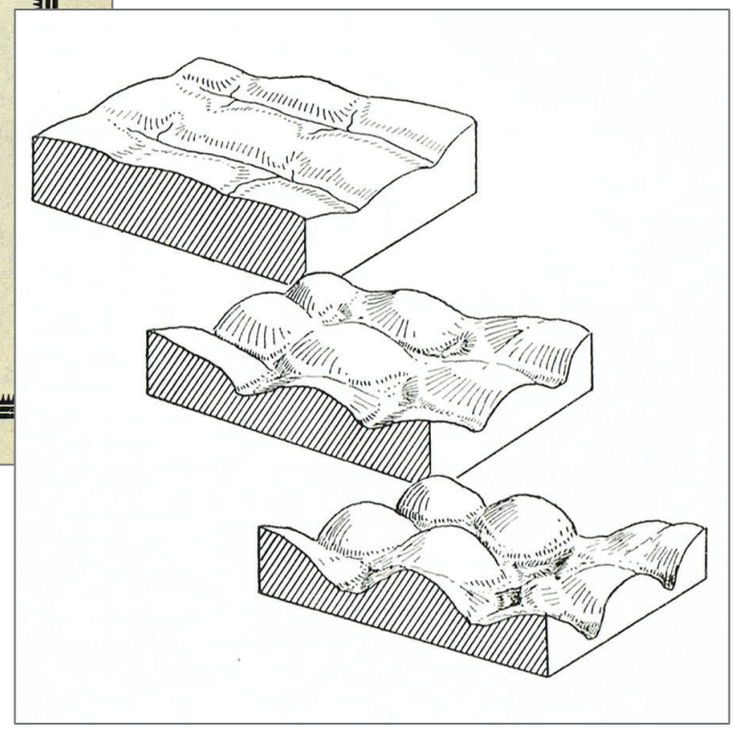

Fig. XIII.19. Block diagram showing the development of cone karst of Gunung Sewu, South Java (Lehmann, 1936).

Publications - Geomorphology

Danes, J.V. (1915)- Das Karstgebiet Goenoeng Sewoe in Java. Sitzungsberichte Koningl. Boehmische Gesellschaft Wissenschaften in Prag, Math.-Naturwiss. Kl., Prague, p. 1-90.

Lehmann, H. (1935)- Über die tropische Karstlandschaft Gunung-Sewu auf Java. Habilitationsschrift, p.

Lehmann, H. (1936)- Morphologische Studien auf Java. Geographische Abhandlungen, Stuttgart, (3), 9, p. 1-114.

Umbgrove, J.H.F. (1930)- The influence of the monsoons on the geomorphology of coral islands. Proc. 4th Pacific Science Congress, Java 1929, IIA, p. 49-64.

Verstappen, H.Th. (2000)- Outline of the geomorphology of Indonesia. lnt. Inst. Aerospace Survey and Earth Sciences (ITC), Enschede, Publ. 79, p. 1-212.