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IN MEMORIAM BETJE POLAK (1901–1980), PIONEER OF PEAT RESEARCH IN THE NETHERLANDS AND IN THE TROPICS

Betje Polak was born on 11th September 1901, in Amsterdam, the daughter of a teacher. Her father. who for many years combined his job with that of caring for the Insectarium in the zoological garden "Artis", instilled in her a love of nature at an early age. Thus it was at his express wish that Betje attended a primary school further away from home, because the teaching staff included E. Heimans who later became famous as a popularizer of natural history.

In Amsterdam Betje also attended secondary school and afterwards studied biology at the Municipal University of Amsterdam where she obtained her degree in 1926.

Subsequently she was assistant-curator at the Hortus Botanicus. During this period she contributed various popular scientific articles to newspapers and worked on her thesis. Her supervisor was Professor Th. J. Stomps, and in spite of his somewhat controversial attitude during the second world war she would always refer sympathetically to him after the war had ended.

She obtained her doctor's degree cum laude in 1929 and, with the appearance of her thesis, at once made a name for herself as a pre-eminent peat specialist. Her study was concerned with the nature and origin of the peat deposits subsided to below sea level in the western Netherlands. At that time opinions diverged widely on this subject. On one side a subaquatic origin of the low-lying peat ("laagveen") was proposed. On the other a theory was adhered to, suggesting that though the extensive and contiguous peat deposits occur at the level of a subaquatic peat, they would not have a corresponding botanical composition. It would, as far as its structure was concerned be comparable to peat grown above ground water level ("hoogveen", or raised bog).

Actually, *Sphagnum* peat was already known from a few scattered localities and J. van Baren had therefore supposed that this indicated either a subsidence of the soil or a rise in water level of the rivers. It was, however, the detailed study of Polak which demonstrated that the stratigraphical succession of the low-lying

peat progressed from eutrophic fen peat via forest peat to older and younger *Sphagnum* peat, identical to the succession in the raised bogs on the higher Pleistocene sand deposits of The Netherlands. Thus she was able to provide incontrovertible evidence for the subsidence hypothesis.

Her studies were mainly based on macrofossils which could be identified at low magnification, but she also applied pollenanalytical methods for the first time in The Netherlands. However, because of the low pollen concentration in her material, she was forced to restrict herself to a qualitative analysis. Nevertheless, she could establish that *Pinus* was native to The Netherlands, but that *Picea* did not grow here naturally.

After the defense of her thesis Polak felt that the Dutch East Indies could offer her a better future than her homeland, which suffered a severe economic crisis. In 1930 she sailed for the Far East, to carry out botanical research in the Botanical Garden at Buitenzorg (Bogor). This was made possible by a grant from the Buitenzorg Fund. The grant lasted for only half a year, but then she obtained temporary employment at the Botanical Garden for another six months, and this was extended later. On the first of July, 1931 she was appointed as a technician in the department of physiological chemistry at the Medical University in Batavia (Jakarta). It may be surmised that this was arranged so that she could continue her peat studies. On the 31st of March, 1932, she resigned and returned to The Netherlands for private reasons.

During this period in the East Indies, Polak could devote all her energy to the study of tropical peats, not an easy matter since she was the only one in this area (and possibly in south-east Asia), who occupied herself with the subject. She made several travels on Java and to Borneo and Sumatra to study peat formation. These travels, which appear out of tune with her somewhat un-athletic disposition, slow and deliberate way of movement and lack of orientation ability, demonstrated her considerable enterprise and courage. She navigated upriver accompanied with a native crew and penetrated on foot or by means of a "peat-sled", the vast peat swamps. She was aided in her studies by the local forest officers. Her travels as a woman on her own command great respect.

The first description of peat in present day Indonesia dates from 1865, but it was only in 1895 that the unexpectedly large extension of the coastal peats was discovered, mainly as a result of the Sumatra expedition led by F. W. IJzerman. During this expedition S. H. Koorders described for the first time the forest vegetation covering the peat. It was H. Potonié who realized at once the significance of Koorders' observations as the explanation for the development of coal deposits, especially those from the Carboniferous. Both investigators published a joint paper in which the forest covered deposits were interpreted as flat surfaced lowland peat. The stratigraphy of the coastal peats and their mode of origin remained poorly known, however, until Polak's study in 1933, in which she was able to demonstrate conclusively their domed and ombrogenous nature. She could confirm a most significant earlier observation by F. C. van Heurn in 1922/23, that the forest trees on the domed peat surface rooted in a deeper subsoil consisting of peaty clay, revealing the true genesis of the forest peats: they were

not preceded by a herbaceous or aquatic swamp vegetation. Polak ascribed the accumulation of peat at sea level in the tropics to high acidity, causing strongly reduced bacterial attack, continuously high atmospheric humidity and high plant productivity. This paper, based on a detailed study of the botanical composition and physiography placed the peat deposits from the Malesian area firmly in the worldwide framework of peat formation and became a minor classic.

During this study Polak also paid attention to pollen analysis. She noted and figured a great many pollen types, but owing to lack of sufficient reference material, she could only identify a few of them.

After her return to The Netherlands a difficult time followed as to the possibility for continuing peat research. She could support herself with a part-time job as assistant at the Hortus Botanicus in Amsterdam and by teaching biology for two days a week at a secondary school of domestic economy. But fortunately she could also carry out some peat study. The Soil Research Institute in Groningen asked her to analyze the botanical composition of a series of peat samples collected from the former Zuiderzee. Polak eagerly accepted this assisgnment which formed part of a soil survey of the sea bottom for future agricultural purposes in the area to be reclaimed shortly, the present Noordoostpolder.

Thanks to her scientific experience Polak was able to draw additional conclusions on the general geological history of the low-lying part of The Netherlands, behind the beach and dune barriers. She could postulate the following sequence of events which was largely confirmed later on: during an older period sedimentation of marine clay took place simultaneously with peat growth in swamps outside the sedimentation areas, and after that time a contiguous Sphagnetum developed behind the older dunes, which were breached later on by marine incursions, as a result of which the peat growth was often interrupted.

In 1939 Polak returned to Java and found employment at the Institute for Soil Science at the General Agricultural Research Station in Bogor on a temporary basis as acting soil scientist. She found herself in a scientific environment unfamiliar to her in which peat was only studied from an agricultural point of view. The change-over needed some time and her research was at first concentrated on classification and chemical composition of peats, so the connection with agriculture was rather indirect.

During the Japanese occupation (1942–1945) Polak was interned, as were all Dutch citizens. Her physical and mental health suffered severely during this camp period. After the liberation she was granted recuperation leave with a special assignment in a mentally stimulating environment. She stayed first for three months in the U.S.A. where she visited the laboratory of the well known peat specialist S. Waksman and the Department of Agriculture in Florida. This leave was followed by a stay in The Netherlands to study the problem of soil organic matter with reference to Indonesia. The practical purpose was to evaluate the suitability for agriculture of the Indonesian peat soils. This was especially important in view of the critical food situation in the country and the presence of very extensive areas of coastal peat on Sumatra and Borneo.

On these thick, acid, ombrogenous peats only slash and burn agriculture was practised by the native population at scattered localities.

In 1947 she reported on her mission to America and on the feasibility of scientifically based cultivation of peat-soils in Indonesia. Because of this report she received a special letter of commendation from the Director of Agriculture.

In January 1948 Polak returned to Indonesia and was appointed as a soil scientist on a permanent basis because of her valuable achievements. According to the rules, she had long passed the age limit for such an appointment.

She now embarked with energy on this new and direct agricultural approach and started laboratory experiments on fertilization of crops growing on peat soil as well as field trials in western Borneo. She paid special attention to trace elements, the significance of which had been impressed upon her because of close contact with E. G. Mulder during her stay in The Netherlands.

In this connection we may cite the contribution by her pupil and assistant Ir. V. R. Ehrencron on: Pot experiments with maize on acid forest peat from Borneo (Meded. Algemeen Proefstation, 1949). Polak was actually the first worker to perform experiments with crops on tropical peat.

Next to these agricultural aspects, the more fundamental study of peat was certainly not neglected. This concerned especially the search for and study of peat deposits which were less acid than the ombrogenous coastal peats and thus more suitable for cultivation. For this purpose Polak travelled in 1948 to the lake area in the upper reaches of the Kapuas river in Borneo where however, almost no peat was found. On the south coast of Java she explored in detail the low-lying Rawa Lakbok peat, which did turn out to have an eutrophic nature. Polak analyzed the botanical succession in this deposit and could classify it as a topogenous peat (POLAK 1949).

On the 1st of January 1950 Indonesia became independent and Polak was transferred to the service of the new government. In May 1952 she was promoted principal scientific officer at the Institute for Soil Science and on August 1st, 1952, she was appointed professor of botany and genetics at the Medical Faculty of the University of Jakarta.

In 1954 Polak went to The Netherlands on long leave, but at the end of this period, in 1955, she decided not to return, because the prospects in Indonesia appeared to her to be too uncertain. She was then invited by the well known Professor of Soil Science, C. H. Edelman to join the Department of Regional Soil Science of the Agricultural University in Wageningen, for palaeo-botanical research, and she accepted the offer. This included research on behalf of the Soil Survey Institute of The Netherlands.

The new assignment was diligently started. In the same year Polak spent some time in the palaeobotanical laboratory of J. Iversen in Denmark, to become acquainted with the latest pollen-analytical methods. Dutch palynologists had agreed to subdivide the Netherlands in separate areas of study and Polak should restrict her activities to the central Pleistocene province. Nevertheless, her research was characterized by a wide variety of subjects. Her strongest interest was in the development of vegetation and agriculture since Neolithic times on the

drier sandy soils which were covered until quite recently by extensive *Calluna* heaths. She also occupied herself with certain features of the ice-pushed ridges on the Veluwe, and drew attention to the mechanical corrosion of pollen grains in these mineral ridge deposits and also to the presence of reworked Tertiary pollen grains. Polak was the second investigator to establish the presence in The Netherlands of the Brørup-Interstadial.

Upon retirement in 1966 Polak ended her scientific career. However, in 1975 she came once more into the limelight in a memorable way on the occasion of a Symposium on the Quaternary of south-east Asia, held in Groningen. She took this last opportunity to sound a warning against the enormous agricultural, pedological and ecological risks involved in exploitation of the extensive coastal peat deposits of Sumatra, the Malay peninsula and Borneo. But, above all, she deplored the accompanying destruction of a unique natural environment.

Polak's work did not go unrecognized as is evident from the fact that she was awarded a knighthood in the Order of Oranje-Nassau in 1952 and made an honorary member of the Royal Netherlands Botanical Society in 1979 at a symposium held in Wageningen, on the occasion of the 50th anniversary of her doctorate.

Someone, who was very close to Polak, characterized her as a wise woman, rather introvert and on occasion melancholic, happy to be on her own, and vulnerable. She never took the centre of the stage, was modest and almost shy in large gatherings, but could, on the other hand, in smaller groups rapidly dominate by a certain self-assuredness. When the need arose she could, without preparation, address a large audience in an excellent and concise way.

Polak had a forceful personality and was also a good and very cooperative colleague with a straightforward nature. She had a special kind of "Amsterdam" humour and considerable acting and imitating ability, which was, however, not always appreciated by everybody.

Because she lost most of her Jewish relatives during the war, she ended by being rather lonely, even though she had a large number of friends. She was a sincere zionist. In 1980 she died after a long illness.

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