

Citation:

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Mineralogy. — “*On phosphorite of the isle of Ajawi*”. By Prof. A. WICHMANN.

(Communicated in the meeting of May 29, 1915).

The isle of Ajawi or Mios Kairú, situated at $0^{\circ}16\frac{1}{2}'$ S. Lat. and $135^{\circ}5'$ E. Long. northwest of the Schouten Islands was discovered on Febr. the 15th 1700 by WILLIAM DAMPIER. When he intended to sail between this island and the neighbouring isle of Aifondi he scarcely escaped being shipwrecked. This fortunate escape induced him to call this group the Providence Islands¹⁾. Though it was afterwards often enough seen, Ajawi was never visited by Europeans. When the New Guinea Expedition of 1903 was on their way to the Mapia Islands, they were of opinion that they should not let the opportunity pass by to take likewise a view of this isolated island.

After Aifondi was left in the morning of the 19th of July by the government steamer “Zeemeeuw”, Ajawi was reached after 3½ hours' steaming. Already from a distance it appeared that the island, covered with forests, was low, but that the eastern part was formed by rocks of a phantastic shape. At about 2 km. distance from the south-coast the ship cast anchor in 13 fathoms, whereupon the yawl took all the participants to the south-west-corner. This part, rising hardly 3 m. above the level of the sea, consists of coral sand with blocks of coral besides boulders of a white rather gross-grained and hard but porous limestone which contains, according to L. RUTTEN, numerous specimens of *Rotalia*. They call the attention to the fact that the rock must be considered as subrecent²⁾. The ground is covered by a thin forest, consisting of specimens of *Pandanus*, about 16 m. high, in which enormous flocks of the beautiful Nicobara pigeons (*Caloenas nicobarica*) nestle³⁾. There were no human inhabitants and from the absence of coconut-palms the conclusion may be drawn, that permanent settlements have never existed.

In the eastern and north-eastern part of the island compact limestones occur, which however differ from the above-mentioned ones.

¹⁾ A Voyage to New Holland, etc. in the year 1699. A Collection of Voyages 3d ed. 3. London 1729, p. 195. On the map Ajawi was indicated as Little Providence and Aifondi as Great Providence.

²⁾ Foraminiferen-führende Gesteine von Niederländisch Neu-Guinea. Nova Guinea 6. 2. Leiden 1914, p. 30.

³⁾ Maatschappij ter bevordering van het Natuurkundig Onderzoek der Nederlandsche Kolonien. Bulletin No. 46. 1903, p.p. 35—36. — H. A. LORENTZ, Eenige maanden onder de Papoea's. Leiden 1905, p p. 201—202.

They are dense, of a whitish grey colour, and contain specimens of *Globigerina*, so that they are perhaps of equal age as similar rocks that are found likewise in islands to the North of New Guinea, and according to RUTTEN are not younger than old-miocene¹⁾.

The most important rock of the island is however formed by the above-mentioned ± 16 m. high phantastic rocks, some of which are likewise found isolated in the neighbourhood of the eastern shore. This rock, hitherto unknown in the Dutch East Indies, is a phosphorite which shows great resemblance to the phosphates of other islands of the Pacific. It is of a yellow to reddish-brown colour and sometimes of a pitchlike appearance. Angular, yellowish-white parts give to the rock a brecciated character. The specific weight amounts to 2.78 and the hardness is = 6.

In thin sections the rock has under the microscope the appearance of a light-yellowish, structureless mass, intersected with fine and irregular fissures. Some parts of the thin sections are rather opaque, but everywhere dispersed are dark dots which are apparently of an organic origin. Though amorphous the phosphorite shows a slight double-refraction, in which the interference-colours do not surpass the iron-grey of the first order. In some parts one discovers through the phosphate cavities filled up in zones that remind entirely of the formation of agates (fig. 1), a phenomenon that is quite common in phosphates from the Pacific²⁾.



Fig. 1.

¹⁾ l. c. p. 29—31.

²⁾ CARL ELSCHNER. Corallogene Phosphat-Inseln Austral-Oceaniens und ihre Produkte. Lübeck 1913; p. 55, pl. IIa. Such like phosphate-agates are found in the Isle of Nauru itself in rather large pieces (l. c. pl. VIIIb).

An incomplete analysis made by Dr. MAX BUCHNER at Heidelberg gave the following result:

P ² O ⁵	31.53
CO ²	7.31
Fe ² O ³	2.83
CaO	37.38
MgO	2.17
H ² O to 110° C.	1.48
H ² O from 110—1250° C.	3.86
insoluble residue	0.19
	<hr/>
	86.75

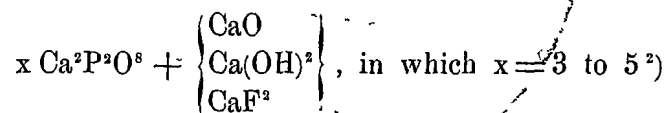
Qualitatively still a considerably large quantity of organic matter and moreover fluorine and traces of chlorine was shown. The composition points to the fact, that 68.90% tricalcium-phosphate ought to be present in the rock, which is less than with most of the phosphates from the Pacific, whose typical representatives contain 38 to 40% P²O⁵.

Whereas 31.53% P²O⁵ require for the formation of the calcium-triphosphate 37.37% CaO, for the likewise occurring 7.31% CO² however no less than 9.30% CaO is required for CaCO³, there is a residue of phosphoric acid extant that can only be bound to the magnesium and the iron. Further it appeared that not the entire CaCO³ is mechanically mixed with the other substances. When it was namely removed by means of acetic acid, the treatment with hydrochloric acid showed a very perceptible development of carbondioxyde, so that we have decidedly to do with a carbonophosphate, which are likewise the minerals Dahllite, Podolite and Francolite. The Nauruite, moreover always contains fluorine, as likewise the phosphorite of Ajawi.

P. HAMBRUCH gives as formula for this mineral



C. ELSCHNER on the contrary



It is however clear, that with the impurities, that are found in all phosphates from the Pacific, it is for the present decidedly impossible to find a satisfactory formula.

¹⁾ l. c. p. 680.

²⁾ Entstehung, Bildung und Lagerung des Phosphats auf Nauru. Zeitschr. Gesellsch. f. Erdkunde. Berlin 1912, p. 59.

With regard to the origin of the phosphorite of Ajawi there can exist no doubt, but it was formed in the same way as the other phosphates from the Pacific. From the investigations made in this respect appeared that those islands were in former times atolls or at least contained lagoons, into which the excrements of the birds producing guano were washed by the atmospheric waters. The phosphoric acid that had become free by the dissolution was the cause that the coral-limestone surrounding the lagoons was changed into phosphorite. The coral fragments that had come down to the bottom of the lagoons, the boulders of limestone etc. were likewise submitted to a similar metamorphosis, and were afterwards cemented into a compact rock ¹⁾.

Wherever such like phosphorites of coral islands make themselves apparent, it can only be the consequence of negative level-changes. For this reason the rocks of Ajawi are to be considered as the ruins of an original atoll, which has obtained its present shape after subsequent upheaval by the waves of the sea.

Now the question still needs to be answered, in what way the absence of phosphorite in the islands of the Indian Archipelago can be explained. For Ajawi belongs already to the territory of the Pacific Ocean, and Christmas Island, 10°25' S. Lat. 105°42' E. Long. ²⁾, rich in phosphorite is, it is true, situated in the Indian Ocean, but its distance from the west-point of Java amounts to 420 km., so that it does not form any longer part of the Archipelago.

As we have seen the conditions for the formation of phosphorite in the Pacific were: the existence of coral islands with lagoons and further deposits of guano. There is no doubt but there existed also during the tertiary period a great number of coral islands. Neither is it hazardous to suppose that in some of them settlements of guano-producing birds were found. Consequently it seems to me that the third condition — the existence of lagoons — was not complied with, from which would follow that no more at that time than at the present moment there were atolls in existence. At any case,

¹⁾ O. STUTZER. Ueber Phosphatlagerstätten. Zeitschrift für praktische Geologie 19. Berlin 1911, pp. 81—82. — O. STUTZER. Die wichtigsten Lagerstätten der Nichterze 1. Berlin 1911, pp. 438—440. — PAUL HAMBRUCH. Entstehung, Bildung und Lagerung des Phosphats auf Nauu. Zeitschr. Gesellsch. f. Erdkunde. Berlin 1912, p. 679. — Already as early as 1896 AD. CARNOT (Sur la mode de formation des gîtes sédimentaires de phosphate de chaux. Compt. rend. Acad. des Sc. 123. Paris, pp. 724—729) proved, that in general phosphorite and phosphate-chalk are to be considered as shore- and lagoon-formations.

²⁾ CHARLES W. ANDREWS. A Monograph of Christmas Island (Indian Ocean). London 1900, pp. 289—291.

they cannot have played a significant part. All this is of greater significance, if we cast a look at the condition of the few guano-deposits that are found in the Indian Archipelago.

For a long time it has been known that guano occurs in the Baars Island, or Kabia¹⁾ the west-point of which is situated at 6°50'55" S.Lat. and 122°12'20" E.Long.²⁾ In 1877 an application for preliminary exploration was made but "it was found inappropriate for being granted"³⁾. Apparently that refusal was the consequence of an investigation made by J. BENSBACH and G. A. L. W. SOL in the beginning of Dec. 1877 the result of which was not favourable⁴⁾. Notwithstanding this we read in a report over 1879, that a concession was granted for the time of 10 years against payment of f 1 per bouw (7096 $\frac{1}{2}$ m².) to J. H. DE SISO and TH. C. DRYSDALE at Kupang⁵⁾. According to C. C. TROMP a certain quantity of that guano had already been shipped to England, but the exploration had afterwards to be stopped on account of the depressed market⁶⁾.

When CARL RIBBE had however paid a visit to the island in 1882 he wrote, that "ein durch die tropischen Regengüsse sehr ausgelaugter und deshalb minderwertiger Guano ausgeführt wird."⁷⁾ At last MAX WEBER described Kabia as an upheaved coral reef, the rocks and trees of which were covered by a white bed of excrements originating from *Sula piscatrix*, *Sula fusca* and *Tachypetes ariel*⁸⁾.

The second finding-place of guano has become known by F. H. GUILLEMARD, who found it on the cliffs of Batu Kapal situated near the north-point of the isle of Lembé (eastward of the N.E. point of the isle of Celebes, but it was taken for chalk⁹⁾). As appeared

¹⁾ According to H. D. E. ENGELHARD the real name is Kawi Kawijang. (Het eiland Saleyer. Bijdr. tot de T. L. en Vk. (4) 8. 's Gravenhage 1884, p. 264).

²⁾ J. A. C. OUDEMANS. Verslag van de bepaling der geographische ligging van punten in Straat Makassar etc. Natuurk. Tijdschr. Ned. Indië. 31. Batavia 1871, p. 146 (table).

³⁾ Jaarboek van het Mijneven in Ned. Indië. 1878. 2. p. 233.

⁴⁾ J. E. TEYSMANN. Bekort verslag eener Botanische dienstreis naar het Gouvernement Celebes etc. Natuurk. Tijdschr. v. Ned. Ind. 30. Batavia 1878, p. 119.

⁵⁾ Jaarboek van het Mijneven. Amsterdam 1879. 2, p. 201.

⁶⁾ Tijdschr. voor Nijverheid en Landbouw Ned. Ind. 25. Batavia 1880, p. 554.

⁷⁾ OSCAR SCHNEIDER CARL RIBBE's Reisen in der Südsee. Deutsche geograph. Blätter 18. Bremen 1895, p. 374.

⁸⁾ Maatschappij ter bevordering van het Natuurk. Onderzoek der Nederl. Koloniën Bulletin N. 33, 1900, p. 7. — MAX WEBER, Introduction et description de l'expédition Siboga-Expédition 1. Leiden 1902, p. 94

⁹⁾ The Cruise of the *Murcheson* to Kamschatka and New Guinea. 2. 2d ed. London 1889, p. 334.

however from the investigations of SIDNEY J. HICKSON, the cliffs consisting of limestone were covered by a thin bed of guano, which seen from a distance looked like chalk¹⁾.

The third and last finding-place was traced by J. J. PANNEKOEK VAN RHEDEN in Pulu Batu, a little island near Pulu Seraya ketjil, westward of Flores²⁾. The guano forms there only a thin bed spread over the surface of a few ares, the quantity was valued at only about one hundred cubic meters³⁾.

From the description, at all events of that of the two first-mentioned places, it appears that the guano was leached, i.e. a not unimportant part of the phosphoric acid had found its way to the sea, by which the formation of phosphorite, as under equal circumstances in every monsoon-territory, was prevented.

The guano-beds in limestone-grottoes originating chiefly from bats will be preserved from such a fate. The quantity of these formations is however usually very slight, as will appear from the following summary.

In the S. and E. department of Borneo the grottoes of Mount Hapu are especially known, in these grottoes the existing guano-bed attains a thickness of at least 2 m. The quantity of guano that is found in the grottoes of Mount Lampinet was even valued at 10000 tons³⁾. It is however far surpassed by that of the grottoes of Gomanton on the river Kinabatangan in British North Borneo where it is said that the thickness of the guano-beds amounts to 50 feet⁴⁾.

The bottom of the numerous limestone-grottoes in Sarawak is likewise usually covered with a bed of bat- and bird-guano sometimes mixed with river-mud. It is however of no significance⁵⁾.

¹⁾ Omzwervingen in Noord Celebes. Tijdschr. Ned. Aard Genootsch. (2) 4. M. U. A. 1887, p. 135. — A Naturalist in Celebes. London 1889, p. 33.

²⁾ Overzicht van de geographische en geologische gegevens verkregen bij de Mijnbouwkundig-geologische verkenning van het Eiland Flores in 1910 en 1911. Jaarboek van het Mijnwezen 40, 1911. Batavia 1913, p. 226.

³⁾ P. J. MAIER, Scheikundig onderzoek van Vogelmest, afkomstig uit de grotten van den Goenoeng Hapoe in de afdeeling Riam Kanan en Kiwa (Zuid- en Ooster-afdeeling van Borneo). Natuurk. Tijdschr. Ned. Ind. 29, Batavia 1867, p. 114—129.

⁴⁾ Die Vogelnestgrotten von Gomanton auf Nord Borneo. Globus 46. 1884, p. 31, according to the North Borneo Herald of 1st March 1884. — H. PRYER, An Account of a Visit to the Bird's nest Caves of British North Borneo. Proceed. Zoolog. Soc. London 1884, p. 532—538. — D. D. DALY, On the Caves containing Edible bird's nests in British North Borneo. Ibid. 1888, p. 108—116.

⁵⁾ A. HART EVERETT. Report on the Exploration of the Caves of Borneo. Proc. Roy. Soc. 30. London 1880, blz. 310—313. — TH. POSEWITZ. Höhlenforschungen in Borneo. Das Ausland 61. Stuttgart-München 1880, pp. 612—613.

In Sumatra the Lyang-na-Muwap in the department of Padang Lawas, residency of Tapanuli, is especially known, the bottom of which is covered by a bed of guano of a thickness of 2 feet¹⁾. The grotto in the isle of Kluwang (5°8' S. Lat., 95°17' E. Long.), near the west coast of Atjeh, contains likewise rather much guano²⁾.

Numerous are the cavities in limestone in Java, that contain guano. Similar deposits are nowhere missing where swallows or bats are nestling. Some of them were carefully examined, but not a single one is of any significance³⁾.

Nothing has ever become known of an investigation whether in any of the above-mentioned grottoes phosphatisation has taken place i. e. whether the existing guano has caused a metamorphosis of the limestone into phosphorite.

Botany. — "*On the germination of the seeds of some Javanese Loranthaceae.*" By Dr. W. and Mrs. J. DOCTERS VAN LEEUWEN-REIJNVAAN. (Communicated by Prof. F. A. F. C. WENT).

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1. Introduction.

Only a few investigations have been published on the Javanese Loranthaceae. The last carried out by KOERNICKE⁴⁾ appeared in the Annales du Jardin botanique de Buitenzorg some years ago. It deals chiefly with the adult life of these plants. Already long before this article appeared we had occasionally been occupied with experiments on the germination of various species of *Loranthus*. Mr. KOERNICKE wrote to us (in 1911) that he had also taken with him material

¹⁾ R. C. VAN DER BOR. De Lyang na Moewap en de legende daaraan verbonden. Tijdschr. voor Ind. Taal-, Land- en Volkenk. 37, Batavia 1894, p. 201.

²⁾ L. H. WALLON, Klouwang et ses Grottes. Côtes ouest d'Atchin. Ann. de l'Extrême Orient 2, Paris 1879—80, p. 41. — X. BRAU DE SAINT-POL-LIAS. La Côte de Poivre. Voyage à Sumatra. Paris 1891, p. 224. — Zeemansgids voor den Oost-Indischen Archipel 1, 2e druk. 's Gravenhage 1904, p. 450.

³⁾ D. W. ROST VAN TONNINGEN. Scheikundig onderzoek van eene meststof (guano) afkomstig uit de afdeeling Grisse. Natuurk. Tijdsch. Ned. Indie 9, Batavia 1855, pp. 157—168. — P. F. H. FROMBERG. Verslag over den aard en de bruikbaarheid der dierske meststof aanwezig in de grot Poetjakwang te Grisse. Ibid. pp. 169—190. — J. C. BERNELOT MOENS. Guano van Telok Djambi, residentie Krawang. Ibid. 35, 1863, p. 327—328.

⁴⁾ M. KOERNICKE, Biologische Studien an Loranthaceae. Ann. d. Jard. Bot. de Buitenzorg, 3e Supplément, p. 665. 1910.