MICROSCOPICAL, PHYSICAL AND CHEMICAL STUDIES OF LIMESTONES AND LIMESTONE-SOILS FROM THE EAST INDIAN ARCHIPELAGO

BY

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(WITH 1 MAP, 13 PLATES, 33 MICROPHOTOGRAPHS AND 30 CHEMICAL ANALYSES)

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DEDICATED TO THE MEMORY OF

Dr. R. D. M. VERBEEK

(1845—1926)

THE FOUNDER OF THE GEOLOGY OF THE DUTCH-EAST-INDIES, IN TOKEN OF THE GRATITUDE FOR HIS LONG-ESTABLISHED FRIENDSHIP.

THE AUTHOR

INTRODUCTION.

In the year 1916 I made a scientific journey to the East Indian Archipelago in order to study the weathering of rocks and the formation of soils. I visited Java and Sumatra and brought together a collection of about 1000 numbers (rocks, soilprofiles and photographs), which is to be seen in the geological Museum of the Agricultural University at Wageningen.

Preliminary communications on the results of my researches are:

J. VAN BAREN, Report on my geological and agrogeological researches in the East Indian Archipelago (Dutch), Wageningen 1917.

J. VAN BAREN, Agrogeology as a Science (Dutch), Wageningen, 1919.

J. TH. WHITE, Description of a volcanic soil-profile near Buitenzorg (Dutch), Wageningen, 1919.

J. VAN BAREN, Agrogeology as a Science (English), printed in: A. WULFF, Bibliographia agrogeologica, Wageningen, 1921.

J. VAN BAREN, The signification of Agrogeology for Geography, (Dutch), Groningen, 1924.

J. VAN BAREN, Profiles of limestone-soils from the Tropics, (Proceedings First International Congress of Soil Science, Vol. IV, Pp. 173—193, 9 Fig.,) Washington, 1928.

What follows here, are the data of my researches both in field and laboratory concerning the weathering of limestones and the building of limestone-soils from Java, Madura, Timor and the Christmas-Isle, S. of Java.

Those from Java were collected by myself and some by Prof. MOHR (Amsterdam); those from Madura were collected by the latter; those from Timor by Prof. JONKER († 1906); those from Christmas-Isle by Dr. J. VOUTE. astronomer (Lembang).

Finally, I am much indebted to my co-operators on this laboratory: Mr. W. A. J. OOSTING, l. i., Mr. VAN AGGELEN, and Mr. VAN GUILIK; farther to Dr. H. BOS and to Dr. J. HOFKER for their valuable aid, to Professor TE WECHEL for his beautiful microphotographs and finally to the Director of the Chemical Bureau Koning & Bienfait (Amsterdam) and his staff for their kind assistance.

METHODS.

COLOUR DETERMINATION: The air-dried soils were compared with the colours of the book: Code des Couleurs par B. KLINKSIECK et TH. VALETTE, Paris, 1908.

The number of the colour which seemed most in conformity with the colour of the soils was noted. Also a more refined determination was made by means of the tintometer of LOVIBOND (the Tintometer Ltd. The Friary, Salisbury, England). The tintometrical' determinations were made by Dr. H. BOS, horticultural botanist af the „State Experiment Station for researches of Seeds", Wageningen (Holland).

Relating this method used for the first time for agro-geological purposes, Dr. H. BOS wrote me following:

„The registration of colourindication is performed by means of LOVIBOND's Tintometer, modified by myself. The colour of the object is imitated by joining together two or three slips of coloured glass (red, yellow and blue) that are disposable in diverse intensities, gradually rising. The instrument itself consists of a flat tube, blackened inside. At the distal end there are two rectangular holes next to another. Under one of them the object is placed, whose colour is to be registered; the other hole can be closed by introducing one or more of the above mentioned transparant slips of coloured glass. The numbers of those slips, whose combination gives the colour according to that of the object, compose the formula. These numbers rise from light to dark, according to the increase in quantity of colouring matter. The same numbers of the three sets give together always a light or dark grey, or a black colour. The registered numbers have only a comparative value. They allow however the investigator to reconstruct at any time the desired colour and to compare this with that of a new object.

If the object contains a special coloured matter, that is nearly the same as that of one or of a combination of more slips, the number of these will give a hint about the quantity of that matter in diverse parts or stadia of that object. This has also a meaning in the case of black colours, mixed with others (as in brown = orange + black). As the same numbers of the three sets of slips give always grey or black, the quantity of black may be noticed by the slip of that colour, that is in the minimum. This may be useful by settling or estimating the quantity of black humus in soils".

MECHANICAL ANALYSIS: The sedimentation method was used with the aid of KÜHN 's siltcylinder, as modified by KOPECKY, a kind of siphon cylinder (F. SEEMANN, Leitfaden der mineralogischen Bodenanalyse, 1914, p. 16).

HYGROSCOPIC COEFFICIENT: In an evacuated desiccator, containing 10 % sulfuric acid, 30 g. of air-dry soil (fine earth) is exposed to the same atmosphere during four days and so on, till *constant weight* is obtained (I).

In another evacuated desiccator the air-dry soil is dried above concentrated sulphuric acid, in order to determine the weight of the dry soil (II). II — I = hygroscopic water.

$\frac{II-I}{II}$ = hygroscopic coefficient, stated as percentages of the dry soil.

(Cf. Gecodificeerde voorschriften voor Grondonderzoek Buitenzorg 1913, p. 14, —

A codex for soil analysis, published by the Agr. Exp. Stations of the Netherlands-Indies.)

MAXIMUM WATERCAPACITY: In order to determine the watercapacity I used E. WOLFF's method (E. WOLFF, Anleitung zur chemischen Untersuchung landwirtschaftlich wichtiger Stoffe. Berlin 1875; F. WAHNSCHAFFE-SCHUCHT, Wissenschaftliche Bodenuntersuchung, 4th Edition, 1924, p. 162).

VOLUME EXPANSION: The rise of the soil as observed the determination of the height of the soil column at the beginning of the determination is called volume expansion.

PH VALUE: Ir. W. A. J. OOSTING, l. i., who is responsable for the determination of the PH value writes me as follows:

„As the determination of the hydrogen ion concentration of soils is still attended with many difficulties and moreover the merits of the methods in use were not sufficiently known, I found it necessary not only to use the standard hydrogen electrode, but to try other methods as well. In this way it is possible to get some idea of the merits of the different methods for each type of soil.

The methods used are:

1. Electrometric measurement of the suspensions with the hydrogen electrode.

2. Electrometric measurement of the suspensions with the quinhydrone electrode.

3. Colorimetric measurement of the filtrates.

4. Colorimetric measurement of the centrifugates.

5. Colorimetric measurement of the exarisates.

6. Comber method as modified by HISSINK (Cfr. Chemisch Weekblad, **19**, N°. 27, p. 281, 1922).

See also: Actes de la IVème conférence internationale de pédologie, Vol. II, p. 463, and International Review of the Science and Practice of Agriculture, Oct. Dec. 1924.

The suspensions were prepared by electrical stirring during twenty minutes of one part of soil (fine earth) and two parts of distilled water. Then the suspensions were allowed to settle for twenty-four hours after which they were stirred again during twenty minutes. One part of the suspensions was used for the hydrogen electrode, another part for the preparation of the filtrate, the remainder being centrifuged. Streaming hydrogen was used, and special care was taken that the rate of flow was always sufficient. During the determination with the quinhydrone electrode the suspension was stirred, till constant readings were obtained.

The filtrates were obtained by filtering the suspensions through Swedish paper (cf. OLSEN, Comptes Rend. du Lab. C. Carlsberg, Vol. 15, N°. 1).

The dialysis was executed according to the method of I. M. KOLTHOFF. (Chemisch Weekblad, **20**, N°. 51, p. 677, 1923).

20 gram of soil are mixed with 15 cc. ot distilled water, in a pleated filter of parchment-paper. This is placed in a cup-shaped glass, containing 7 cc. of distilled water. After leaving this alone for 24 hours the PH value is determined colorimetrically.

Two drops of indicator were added to 5 cc. of soil 5 cc. of standard buffer solutions with two drops of the same indicator.

The indicators of CLARK and LUBS were used, and the standard buffer solutions were prepared according to CLARK and LUBS (cf. CLARK, The Determination of Hydrogen ions, 1925, page 106/107)."

CHEMICAL ANALYSIS: The methods are taken out of HILLEBRAND, The analysis of silicate and carbonate rocks, Washington, 1919.

The chemical analyses were made by the well known Dutch Experiment Station Koning & Bienfait, Amsterdam, which has a long practice in chemical examination of rocks and soils.

The calcium carbonate determination was carried out in my own laboratory by means of the Scheibler-method.

(J. KÖNIG, Untersuchung landwirtschaftlich und gewerblich wichtiger Stoffe, 1911, p. 134.)

MINERALOGICAL ANALYSIS: For the determination of minerals were used:

R. BRAUNS, Die Mineralien der Niederrheinischen Vulkangebiete, Stuttgart 1922.

L. CAYEUX, Contribution à l'étude micrographique des terrains sédimentaires, Lille 1897.

L. CAYEUX, Introduction à l'étude pétrographique des roches sédimentaires, Paris 1916, Text and Atlas.

A. JOHANNSEN, Essentials for the microscopical determination of rock-forming minerals and rocks. Chicago 1922 .

E. S. LARSEN, The microscopic determination of the nonopaque minerals, U. S. Geol. Survey, Bulletin 679, Washington 1921.

HENRY B. MILNER, An introduction to sedimentary petrography, London 1922; Supplement to this book, edited London 1926.

H. ROSENBUSCH-WÜLFING, Mikroskopische Physiographie der Mineralien und Gesteine, 5th edition, I and II. Stuttgart 1921/1927.

J. L. C. SCHROEDER VAN DER KOLK, Anleitung zur Bestimmung der Mineralien mittelst dem Brechungsindex, 2nd Ed. Wiesbaden 1906.

R. W. VAN DER VEEN, Mineragraphy, The Hague, 1925.

The book of F. STEINRIEDE, Anleitung zur mineralogischen Bodenanalyse, 2nd Ed. Leipzig 1921 often cited has only *little* value for soil mineralogy. The book of F. SEEMANN, Leitfaden der mineralogischen Bodenanalyse, Wien 1914 is better. The best books are those of HENRY B. MILNER.

Besides these books were consulted:

D. S. CALDERON, Los minerales de España, 2 Vol., Madrid 1910.

V. GOLDSCHMIDT, Atlas der Krystallformen, with text. Heidelberg 1913—1923.

M. F. HEDDLE, The Mineralogy of Scotland, Vol. I and II, St. Andrews 1923 and 1924.

A. LACROIX, Minéralogie de la France, 5 Vol. Paris 1893—1913.

A. LACROIX, Minèralogie de Madagascar, 3 Vol., Paris 1922—1923.

O. LUEDECKE, Die Minerale des Harzes, Text and Atlas, Berlin 1896.

A. OSANN, Die Mineralien Badens, Stuttgart 1927.

A. SIGMUND, Die Minerale Niederösterreichs, Wien and Leipzig 1909.

TAN SIN HOK, The composition and origin of the limestones of the Moluccas (Dutch) The Hague 1927.

T. WADA, Minerals of Japan, Tokyo 1904.

F. ZAMBONINI, Mineralogia Vesuviana, Napoli 1910.

DESCRIPTIONS OF THE ROCKS AND SOILS.

The numbers are those of the collections of my Museum.

No. 101.

GENERAL REMARKS.

LOCALITY: Gunung (= mountain) Tjibodas, N.W. of Buitenzorg. (The Dutch oe = English u.)

GEOLOGICAL AGE: Tertiary.

HEIGHT ABOVE THE SEALEVEL: 200 metres.

CLIMATE: I. Temperature. See: Dr. C. BRAAK, The climate of the Netherlands Indies, Vol. I, Part. 5, Batavia 1924.
Station Buitenzorg. Years of observations: 1913—1918.
Height above sealevel: 200 meter.
Temperature in degrees Celsius.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
24.1	24.2	24.5	25.0	25.1	25.0	25.0	25.1	25.3	25.3	24.7	24.4	24.8

II. Rainfall.
Station: Dramaga, (N°. 44, Res. Batavia, from the work of DR. J. BOEREMA, Rainfall in the Netherlands Indies, Batavia 1925).
Years of observations: 17. Height above sealevel: 220 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
336	331	346	402	293	246	204	242	287	357	370	288	3 702 m.m.
9.1	8.9	9.4	10.9	7.9	6.6	5.5	6.5	7.8	9.6	10.0	7.8	100 %

III. Rainfactor (LANG).

$$\text{Rainfactor} = \frac{\text{Yearly rainfall}}{\text{Yearly temperature}} = \frac{3702}{24.8} = 149.$$

Cfr. R. LANG, Verwitterung und Bodenbildung, Stuttgart, 1920.

Page 108: Die Werte, die aus dem Verhältnis zwischen Feuchtigkeit und Temperatur errechnet sind, habe ich als Regenfaktoren bezeichnet, da auf je 1 Grad Temperatur die betreffende Zahl, der Regenfaktor, an Mehrfeuchtigkeit kommt" ... „Die Regenfaktoren bilden demnach Näherungswerte, die um einige Einheiten nach oben und unten schwanken dürfen. Sie sind aber für die rasche Erfassung des bodenkundlichen Gesamtbildes von der höchsten Bedeutung".

Page 118: „Unter diesen Voraussetzungen konnten für die klimatischen Bodengrenzen folgende angenäherten Grenzwerte, Regenfaktoren, festgestellt werden:

Für die Grenze

Rohhumuserde-Schwarzerde Regenfaktor .. 160
Schwarzerde-Braunerde „ .. 100
Braunerde-Gelberde bezw. Roterde bezw. Laterit Regenfaktor 60
Gelberde bezw. Roterde bezw. Laterit-Salzerde Regenfaktor 40

Optimale Bodenbildungsverhältnisse vorausgesetzt liegt somit der Bildungsbereich der

Rohhumuserden (perhumides Gebiet) bei Regenfaktoren von .... > 160
Schwarzerden (humides Gebiet) bei Regenfaktoren von .... 160—100
Braunerden (humides Gebiet) bei Regenfaktoren von .... 100—60
Gelberden, Roterden und des Laterits (humides Gebiet) bei Regenfaktoren von .... 60—40
Salzerden (arides Gebiet) bei Regenfaktoren von .... < 40"

VEGETATION: Forests.

ROCK.

MACROSCOPICAL: Limestone as an intercalation in sandstone, with a great many of little cavities filled up with loam. After removal of the loam we find in the cavities little crystals of calcite.

MICROSCOPICAL: From this limestone I studied 2 slides, one of the unweathered stone, one of the weathered stone.

Unweathered: Irregular calcite of different size and some dead spots. A single foraminifer.

Weathered: A great many of dead spots, which absorbed methylviolet; organisms absent; much limonite.

Minerals: **corundum**, very little;
plagioclase „ „
quartz „ „

CHEMICAL:	Water (110° C.)	0.16 %

ANALYSIS (dry matter).

SiO_2	0.42 %
Al_2O_3	0.01 %
Fe_2O_3	0.36 %
MgO	1.00 %
CaO	55.24 %
Alkalies	0.14 %
TiO_2	0.00 %
P_2O_5	0.009 %
SO_3	0.15 %
Loss on ignition (CO_2)	43.04 %
	100.369 %

SOIL.

MACROSCOPICAL: Brown loam with fragments of limestone.

COLOUR DETERMINATION: With naked eye: very dark-brown.
Code des Couleurs par P. KLINKSIECK et TH. VALETTE: N°. 110.

TINTOMETRICAL: Red 7.5 + yellow 11.5 + blue 4.9.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	37.8 %	(1st fraction)
0.01—0.05 m.M.	4.2 %	(2nd fraction)
0.05—0.1 m.M.	4.6 %	(3rd fraction)
0.1 —2 m.M.	53.4 %	(4th fraction)

HYGROSCOPIC COEFFICIENT: 23.56 %

MAXIMUM WATERCAPACITY: 63.8 %.

VOLUME EXPANSION: 35.8 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	7.6
Quinhydrone electrode	7.75

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.3
Centrifuged liquid	6.9
Exarisate	6.8
Comber-Hissink test 1 (after two days)	light red
Comber-Hissink test 2 (after two days)	> 6.5

CHEMICAL:

Water (110° C.)	11.68 %

ANALYSIS (dry matter).

SiO_2	42.48 %
Al_2O_3	24.38 %
Fe_2O_3	8.81 %
FeO	0.76 %
MgO	2.33 %
CaO	2.67 %
K_2O	0.53 %
Na_2O	0.61 %
CO_2	0.00 %
TiO_2	1.20 %
P_2O_5	0.05 %
SO_3	0.18 %
S.	0.00 %
MnO	0.38 %
Humic matter	4.79 %
Loss on ignition	11.40 %
	100.57 %

(Analysis according to „Van Bemmelen" Landw. Versuchsstationen Vol. 37, p. 287, 1890.)

Unweathered silicates	26.17 %	dry matter.
SiO_2 of the weathered silicates	26.68 %	

MICROSCOPICAL:

4th fraction.	3rd fraction.
amphibole, yellow and green, with many inclusions of magnetite, very much.	amphibole, yellow and green, with many inclusions of magnetite, very much.
augite, yellow and green, with many inclusions of magnetite, very much.	augite, yellow and green, many inclusions of magnetite, very much.

biotite, very little	— — — —[1]
calcite, very little	calcite, very little
epidote, little	epidote, little
hypersthene, rather much.	hypersthene, rather much
ilmenite, much.	ilmenite, rather much
kyanite, partly blue coloured; abnormal interference colours; no optical extinction; very little.	— — — —
limonite, little.	limonite, little.
magnetite, in octahedron, much; one specimen of cube, altered to limonite, non-magnetic.	magnetite, much.
orthoclase, very little.	— — — —
plagioclase with many brown and soft inclusions, much.	plagioclase with many brown and soft inclusions, much.
pyrite, little.	— — — —
quartz, little.	quartz, little
rutile, very little	rutile, very little
volcanic glass, little.	— — — —
zircon, little	zircon, little.
vegetable and animal remains	vegetable and animal remains
wood-fibres	— — — —
root-remains	— — — —
skins of insects	— — — —
Foraminifera, silicificated, some.	*Foraminifera,* silicificated, very little.

WEATHERING-FACTOR:

$$ki\ (rock) = \frac{Si\,O_2}{Al_2\,O_3} \times 1.7 = \frac{0.42}{0.01} \times 1.7 = 71.4.$$

$$ki\ (soil) = \frac{Si\,O_2}{Al_2\,O_3} \times 1.7 = \frac{42.48}{24.38} \times 1.7 = 2.96$$

$$K = \frac{2.96}{71.4} = 0.04.$$

[1] — — — — = absent.

$$ba\ (soil) = \frac{Ca\,O \times 1.822 + Na_2\,O \times 1.646 + K_2\,O \times 1.085}{Al_2\,O_3} =$$

$$= \frac{2.67 \times 1.822 + 0.61 \times 1.646 + 0.53 \times 1.085}{24.38} = 0.26.$$

Cfr. H. HARRASSOWITZ, Laterit, Berlin 1926, Pp. 24—26.

„Eine neue, speziell für Verwitterungserscheinungen passende Methode soll dafür in Vorschlag gebracht werden. Ich beschränke mich hier darauf, sie nur kurz anzudeuten, und hoffe, Ausführliches, das insbesondere die Anwendbarkeit auf alle Verwitterungsböden zeigen soll, an anderer Stelle geben zu können. Es kommt bei der Verwitterung immer zunächst auf das Verhalten der Tonerdesilikate an, die die gemeinsten Mineralien der Erdrinde darstellen. Besonders die Feldspäte mit ihren Komponenten SiO_2, Al_2O_3, $CaO + Na_2O + K_2O$ werden vor allen Dingen zu verfolgen sein. Die absoluten Werte geben aber keinen Anhaltspunkt. Daher erscheint es mir wichtig, dass man sie in Verhältnis zueinander vergleicht, weil sich dann die eingetretenen Verschiebungen sofort herausstellen müssen. Es sind also die molekularen Verhältnisse

$$ki = \frac{Si\,O_2}{Al_2\,O_3} \text{ und } ba = \frac{Ca\,O + Na_2\,O + K_2\,O}{A'_2\,O_3}$$

zu berechnen. Der Abbau primärer Mineralien ist dann sofort zu übersehen. Die Werte *ki* und *ba* geben einen schnellen Ueberblick über die Verwitterungserscheinungen, der auch sekundären Erscheinungen, wie nachträglicher Adsorptionszuführung von leichtlöslichen Salzen u. a., gerecht wird. Sehr wesentlich ist, dass Mg bei dieser Berechnung nicht berücksichtigt wird. Es spielt dadurch eine besondere Rolle, dass Magnesiaglimmer vielfach schwer verwittert und Magnesium infolgedessen besonders angereichert erscheint. Bei basischen Gesteinen ist Mg im Olivin überhaupt nicht mit Al verbunden und wird leicht weggeführt. Wenn wir nun die Quotienten *ki* und *ba* zunächst als geeignet anerkennen, so ist immer noch die Gegenüberstellung von je zwei Ziffern vorhanden. Zur Darstellung der eingetretenen Veränderung kann man eine viel kürzere Uebersicht gewinnen, wenn man die Quotienten des verwitterten Gesteins durch die des frischen dividiert. Man erhält dann die Verwitterungsziffern *K* und *B*. Mit Hilfe dieser beiden Ziffern lassen sich die grössen Gruppen der Verwitterungsböden ohne weiteres klar darstellen. Ordnet man sie in ein rechtwinkliges Koordinatensystem ein, so lassen sich sämtliche Böden klar auseinanderhalten.

Die Verwitterungsziffern sind besonders vorteilhaft zu verwenden bei sauren, feldspatreichen Gesteinen, da hier das Verhältnis von Tonerde zu den Basen allgemein = 1 : 1 ist und man daher auch einzelne Böden berechnen kann, wenn man nur das Ursprungsgestein kennt.

Bei den Verwitterungserscheinungen spielt das Verhalten des Eisens eine besondere Rolle; trotzdem ist es, was hier auseinanderzusetzen zu lange aufhalten würde, nicht unbedingt nötig, seine Verschiebungen in einer grossen Uebersicht mit darzustellen. Will man es dennoch machen, so empfiehlt es sich, einheitlich auf das Oxyd umzurechnen und die Molekularquotienten zu bilden. Setzt man den molekularen Wert des Eisenoxyds im frischen Gestein = 1 und rechnet die anderen auf dieses Verhältnis um, so ergibt sich ohne weiteres die Verschiebung in absoluten Ziffern. Eine Beziehung zu SiO_2 und Al_2O_3 auszurechnen, wie dies bei CaO, Na_2O und K_2O geschah, kommt nicht in Frage, da keine bestimmten Gesetzmässigkeiten vorliegen und ein Teil des Eisens auch nur mit Sauerstoff verbunden ist.

Die Berechnung der Quotienten *ki* und *ba* nimmt man am besten mit den abgekürzten Molekulargewichten vor, wie sie immer in der Gesteinskunde verwandt werden. Um das zeitraubende Dividieren durch das Molekulargewicht zu vermeiden, bedient man sich praktisch folgender Formeln, bei denen das Verhältnis der Molekulargewichte schon ausgerechnet ist, so dass man die Gewichtsprozente ohne weiteres einsetzen kann. Die Formeln lauten:

$$ki = \frac{Si\,O_2}{Al_2\,O_3} \times 1.7$$

$$ba = \frac{CaO \times 1.822 + Na_2O \times 1.646 + K_2O \times 1.085}{Al_2\,O_3}$$

Bei Benutzung eines Rechenschiebers lassen sich die Verhältnisse ausserordentlich schnell berechnen, besonders wenn man die Vorsicht gebraucht, bei Durchrechnung einer Reihe von Analysen alle Werte für CaO, Na_2O, K_2O je hintereinander auszurechnen.

Ein vollständiger Einblick in die eingetretenen Veränderungen lässt sich freilich auch durch die genannte Berechnungsart nicht geben. Die übliche Art der Verwendung von Bauschanalysen wird dies überhaupt nie ermöglichen. Eine exakte Darstellung würde sich nur geben lassen, wenn man auf die Raumeinheit zurückgehen könnte. Erst dann lassen sich Gewinn und Verlust richtig darstellen."

No. 102.

The same loam but removed by pluvial erosion and accumulated at the foot of the hill. The loam is *tough*, *has no fragments of the limestone*, is plastic and after drying as hard as a stone. Few calcareous concretions.

COLOUR DETERMINATION:	With naked eye: light-brown. Code des Couleurs: N°. 118.
TINTOMETRICAL:	Red 4.95 + yellow 8.6 + blue 3.0.
MECHANICAL:	Diameter of particles: < 0.01 m.M. .... 79.4 % 0.01—0.05 m.M. .... 16.9 % 0.05—0.1 m.M. .... 2.1 % 0.1 —2 m.M. .... 1.6 %
HYGROSCOPIC COEFFICIENT:	23.37 %.
MAXIMUM WATERCAPACITY:	63.2 %.
VOLUME EXPANSION:	27.2 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS: Hydrogen electrode .... 6.0 Quinhydrone electrode .... 6.1 COLORIMETRICAL DETERMINATIONS: Filtrate .... 5.7 Centrifuged liquid .... 5.9 Exarisate .... — Comber-Hissink test 1 (after two days) .. red Comber-Hissink test 2 (after two days) .. 6.5—6
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 0.00 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, brown and green, much	amphibole, green, much
augite, green, much	augite, green, little
epidote	— — — —
garnet	— — — —
glauconite	— — — —

hypersthene	————
ilmenite, little	ilmenite, little
magnetite, much	magnetite, much
plagioclase, much	plagioclase, much
quartz, little	quartz, little
rutile	————
tourmaline	————
zircon, little	zircon, little
Foraminifera, silicificated, little	*Foraminifera*, silicificated, little
————	globulites of SiO_2 from *Spongia*

No. 105.

GENERAL REMARKS.

This specimen was collected by Prof. Dr. E. C. JUL. MOHR, now Colonial Institute, Amsterdam.

LOCALITY: N. E. of Buitenzorg, in the neighbourhood of Tjiteureup.

GEOLOGICAL AGE: Tertiary.

HEIGHT: ± 125 M.

CLIMATE: I. Temperature, see N°. 101*a*.

II. Rainfall.

Station Tjiluar, (N°. 39, Res. Batavia, BOEREMA). Years of observations: 15.

Height 180 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
301	307	411	389	303	245	206	225	256	349	406	264	3 662 m.m.
8.2	8.4	11.2	10.6	8.3	6.7	5.6	6.2	7.0	9.5	11.1	7.2	100 %

III. Rainfactor (LANG): 3662 : 24.8 = 148.

VEGETATION: Coffee-shrubs.

ROCK.

Not collected.

SOIL (Sub-soil).

MACROSCOPICAL: Kind and number of minerals more numerous than in the surface-soil, but less weathered. Great number of iron concretions.

COLOUR DETERMINATION: With naked eye: light-brown.
Code des Couleurs: N°. 142.

TINTOMETRICAL: Red 5.6 + yellow 10.4 + blue 3.9.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	32.0 %
0.01—0.05 m.M.	33.8 %
0.05—0.1 m.M.	22.0 %
0.1 —2 m.M.	12.2 %

HYGROSCOPIC COEFFICIENT: 8.8 %.

MAXIMUM WATERCAPACITY:	47.1 %.	
VOLUME EXPANSION:	17.2 %.	
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	4.7
	Quinhydrone electrode	4.5
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	4.6
	Centrifuged liquid	4.5
	Exarisate	4.6
	Comber-Hissink test 1 (*after two days*)	*red*
	Comber-Hissink test 2 (after two days)	5
CHEMICAL:	$CaCO_3$ (with acetic acid)	0.00 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, brown and green, very little	amphibole, brown and green, very little
augite, colourless and green, very little	————
hypersthene, very little	————
ilmenite, very little	ilmenite, very little
limonite (in form of sphaerolitic concretions), little	————
magnetite, very little	magnetite, very little
orthoclase, very little	————
plagioclase, little	placioclase, little
pyrite, very little	————
quartz, little	quartz, little
rutile, very little	————
tourmaline, very little	————
zircon, very little	————
globulites of iron bisulfide	————
Foraminifera, silicificated and glauconitisared, very much.	*Foraminifera*, silicificated, very much
molluscs-remains	————

SOIL (Surface-soil).

MACROSCOPICAL:	Fine-granular structure; not plastic; no $CaCO_3$; with a great many unweathered fragments of the mother-rock(?) = silicificated limestone.
COLOUR DETERMINATION:	With naked eye: light-yellow. Code des Couleurs: N°. 137.
TINTOMETRICAL:	Red 4.1 + yellow 7.6 + blue 2.15.
MECHANICAL:	Diameter of particles: < 0.01 m.M. ...... 40.6 % 0.01—0.05 m.M. ...... 36.4 % 0.05—0.1 m.M. ...... 12.8 % 0.1 —2 m.M. ...... 10.2 %
HYGROSCOPIC COEFFICIENT:	17.82 %.
MAXIMUM WATERCAPACITY:	53.9 %.
VOLUME EXPANSION:	14.3 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS: Hydrogen electrode ...... 4.6 Quinhydrone electrode ...... 4.8 COLORIMETRICAL DETERMINATIONS: Filtrate ...... 4.6 Centrifuged liquid ...... 4.6 Exarisate ...... 4.6 Comber-Hissink test 1 (after two days) red Comber-Hissink test 2 (after two days) 5.5—5
CHEMICAL:	$CaCO_3$ (with acetic acid) ...... 0.00 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, little	amphibole, green, little
augite, little	augite, little
hypersthene, much	hypersthene, much
ilmenite, little	ilmenite, little
limonite, little	limonite, little
magnetite, much	magnetite, much
plagioclase, much	plagioclase, much
quartz, little	quartz, little

tourmaline, little	————
zircon, little	zircon, little
Foraminifera, silicificated, much	————
Spongia, little	*Spongia*, little
organic remains, much	————

Number and kind of minerals little. All minerals are very strong corroded and soft. A great many of brown particles in the coarse sand-fraction is covered with white, silky soft laminae of a hydrous aluminium silicate, amorphous, absorbing methylenblue; after absorbing water, the laminae are getting gelatinous characters; shrinked after drying; specific gravity ± 2.4; a **kaolin**-mineral.

A chemical analysis had the following result:

Analyst: Mr. W. A. J. OOSTING, l. i.

H_2O (110° C.) ..	5.6 %	The white particles are soluble in strong hydrochloric acid.
SiO_2	64.1 %	
Al_2O_3	18.6 %	
Fe_2O_3	2.4 %	
MgO	trace	
CaO	absent	

No. 91.

GENERAL REMARKS.

LOCALITY: Railway-station Tagok Apu at the railway Bandung—Tjiandjur (West-Java).

GEOLOGICAL AGE: Tertiary.

HEIGHT: 700 M.

CLIMATE: I. Temperature.

Station Bandung; years of observations: 1912—1918.
Height 730 M.

Temperature (in degrees Celsius).

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
22.0	21.9	22.0	22.3	25.8	24.8	24.6	24.7	25.2	25.7	26.1	26.5	26.5

II. Rainfall.

Station Tjiburuj, (N°. 146, Res. Preanger, BOEREMA).
Years of observations: 17. Height: 740 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
202	188	188	164	88	53	40	48	67	146	185	206	1 575 m.m.
12.8	11.9	11.9	10.5	5.6	3.4	2.5	3.0	4.3	9.3	11.7	13.1	100 %

III. Rainfactor (LANG): 1575: 25.8 = 61.

VEGETATION: Grass and bushes.

ROCK.

MACROSCOPICAL: Massive rock with veins of secundary calcite. On the fracture of the rock many iron-spots.

MICROSCOPICAL:

amphibole, green .... little.
augite .... „
calcite .... „
garnet .... „
ilmenite .... „
limonite (globulites) .... „
magnetite .... „
plagioclase .... „
quartz .... „
Foraminifera.

CHEMICAL: Water (110° C.) .... not determined

ANALYSIS (dry matter).

SiO_2	0.23 %
Al_2O_3 + Fe_2O_3	0.37 %
MgO	0.78 %
CaO	54.85 %
CO_2	43.15 %
P_2O_5	0.02 %
SO_3	0.89 %
	100.29 %

SOIL.

MACROSCOPICAL: Dark-brown soil with little fragments of limestone filling up irregular cavities in the limestone.

COLOUR DETERMINATION: With naked eye: dark-brown. Code des Couleurs: N°. 110.

TINTOMETRICAL: Red 7.4 + yellow 10.4 + blue 4.8.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	48.5 %
0.01—0.05 m.M.	17.5 %
0.05—0.1 m.M.	7.4 %
0.1 —2 m.M.	26.6 %

HYGROSCOPIC COEFFICIENT: 15.1 %.

MAXIMUM WATERCAPACITY: 41.8 %.

VOLUME EXPANSION: 16.67 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.5
Quinhydrone electrode	7.8

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.3
Centrifuged liquid	6.9
Exarisate	7.4
Comber-Hissink test 1 (after two days)	pink
Comber-Hissink test 2 (after two days)	> 6.5

CHEMICAL: Water (110° C.) .... not determined.

ANALYSIS (dry matter).

SiO_2	44.42 %
$Al_2O_3 + Fe_2O_3$	33.49 %
CaO	3.55 %
TiO_2	0.72 %
P_2O_5	0.13 %
Loss on ignition	15.24 %
Rest (MgO, K_2O, Na_2O, SO_3, etc.)	2.45 %
	100.00 %
Carbon	2.66 %
Humic matter (calculated with factor 1.724)	4.59 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green	amphibole, green and brown
— — — —	**apatite**
augite	augite
— — — —	biotite
calcite	calcite
epidote	epidote
hypersthene	hypersthene
ilmenite	ilmenite
— — — —	**leucoxene**
limonite	limonite
magnetite	magnetite
plagioclase	plagioclase
quartz	quartz
— — — —	tourmaline
zircon	zircon
plant-remains	— — — —
Foraminifera, silicificated and non-silicificated	*Foraminifera*

WEATHERING-
FACTOR:

$$sq\ (rock) = \frac{Si\,O_2}{Al_2\,O_3 + Fe_2\,O_3} = \frac{0.23\,\%}{0.37\,\%} = \frac{0.003814\,^{1)}}{0.0029} = 1.31.$$

$$sq\ (soil) = \frac{Si\,O_2}{Al_2\,O_3 + Fe_2\,O_3} = \frac{44.42\,\%}{33.49\,\%} = \frac{0.7366}{0.2687} = 2.74.$$

$$SQ = \frac{2.74}{1.31} = 2.09.$$

See: H. HARRASSOWITZ, Studien über mittel- und südeuropäische Verwitterung. (Geologische Rundschau, Sonderband, Berlin 1926, Pp. 112—210).

P. 129: „Zahlreiche Errechnungen eines Quotienten Sq = $SiO_2/Al_2O_3 + Fe_2O_3$ ergaben, dass das Eisen im allgemeinen so sehr mit dem Aluminium mitgeht, dass des Quotient ki schon genügt."

P. 201: „Dazu scheint sich aber die Notwendigkeit zu ergeben, einen weiteren Quotienten zu benutzen, den ich Sq bezeichnete. Er gibt das Verhältnis der salzsäurezersetzlichen Kieselsäure zur Summe der Sesquioxyde an."

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1) Calculated with the aid of H. VON ECKERMANN, Molekular Quotienten Uppsala, 1925.

No. 145.

GENERAL REMARKS.

LOCALITY: Foot of the Gunung Kromong in the vicinity of Cheribon. Sheet B IV of the geological map of Java and Madura, scale 1 : 200 000, shows at the foot of the tertiary G(unung) Kromong a spot, market M_8 = tertiary limestone. From this spot to the main road Cheribon-Djatiwangi the map shows a colour with the signification: Quaternary. This quaternary consists of yellow, stiff loam, cut by a great number of little ravines, in the dry season free of water. These ravines are getting deeper if we are nearer to the tertiary volcano Kromong. The loam is limeless and contains boulders of augite-andesite, limestone and flints. These flints show chalcedony (radial-fibrous) and coal-particles.

HEIGHT: ± 100 M.

CLIMATE: I. Temperature.

Station Batavia. Years of observations: 1866—1928.

Height: 8 M.

Temperature in degrees Celsius:

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
25.3	25.3	25.7	26.2	26.3	25.9	25.7	25.9	26.2	26.3	26.0	25.6	25.9

II. Rainfall.

Station Parundjaja (N°. 36, Res. Cheribon, BOEREMA).

Years of observations: 15. Height 90 M.

Jan.	Febr.	March	April	Mey	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
600	416	442	261	163	93	53	28	47	106	272	385	2 866 m.m.
20.9	14.5	15.4	9.1	5.7	3.3	1.9	1.0	1.6	3.7	9.5	13.4	100 %

III. Rainfactor (LANG): 2866 : 25.9 = 111.

VEGETATION: Grass.

ROCK.

MACROSCOPICAL:	Grey, granular limestone.
MICROSCOPICAL:	amphibole. augite. biotite. epidote. ilmenite. magnetite. plagioclase. quartz. rutile. zircon. *Foraminifera.* organic remains.
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 46.8 %

SOIL.

MACROSCOPICAL:	See under Locality.
COLOUR DETERMINATION:	With the naked eye: brown-yellow. Code des Couleurs: N°. 89.
TINTOMETRICAL:	Red 6.0 + yellow 9.6 + blue 5.2.
MECHANICAL:	Diameter of the particles: < 0.01 m.M. .... 42.8 % 0.01—0.05 m.M. .... 26.4 % 0.05—0.01 m.M. .... 13.6 % 0.1 —2 m.M. .... 17.2 %
HYGROSCOPIC COEFFICIENT:	9.64 %.
MAXIMUM WATERCAPACITY:	44 %.
VOLUME EXPANSION:	11.44 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS: Hydrogen electrode .... 7.4 Quinhydrone electrode .... 7.0 COLORIMETRICAL DETERMINATIONS: Filtrate .... 6.8 Centrifuged liquid 6.8

	Exarisate	6.8
	Comber-Hissink test 1 (after two days)..	red
	Comber-Hissink test 2 (after two days)..	6.5—6
CHEMICAL:	$CaCO_3$ (with acetic acid)	0.00 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, brown and green	amphibole, brown and green
	augite, green	augite, green
	— — — —	amphibole of augite (brown-burnt)
	biotite	— — — —
	epidote	epidote
	garnet.	garnet.
	hypersthene	hypersthene
	ilmenite	ilmenite
	limonite	limonite
	magnetite	magnetite
	plagioclase	plagioclase
	quartz	quartz
	— — — —	rutile
	staurolite	staurolite
	tourmaline	tourmaline
	zircon	zircon
	Foraminifera	*Foraminifera*
	organic remains	organic remains
	wood-remains (carbonized)	— — — —
	Small fragments of andesite and flints	— — — —

No. 305.

Soil from a subterranean limestone-cavern and mixed with excrements of flittermouses. Collected for me by Mr. VAN LENNEP, forester.

LOCALITY:	Traju, N. of Bodja.
GEOLOGICAL AGE:	Tertiary limestone-ridge (Km_2, according to the nomenclature on the geological map of Java and Madura lying in young tertiary marls (M^2).
HEIGHT:	Of the limestone-ridge ± 300 M.
MACROSCOPICAL:	Black-brown soil.
COLOUR DETERMINATION:	With the naked eye: black-brown. Code des Couleurs: N°. 65.
MECHANICAL:	Diameter of particles:

< 0.01 m.M.	27.2 %
0.01—0.05 m.M.	2.8 %
0.05—0.1 m.M.	9.6 %
0.1 —2 m.M.	60.4 %

HYGROSCOPIC COEFFICIENT:	28.8 %.
MAXIMUM WATERCAPACITY:	137.8 %.
VOLUME EXPANSION:	50 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	5.6
Quinhydrone electrode	5.4

COLORIMETRICAL DETERMINATIONS:

Filtrate	5.7
Centrifuged liquid	5.7
Exarisate	—
Comber-Hissink test 1	—
Comber-Hissink test 2	—

CHEMICAL: Water (110° C.) .... 12.85 %

ANALYSIS (dry matter).

SiO_2	5.22 %
Al_2O_3	1.91 %
Fe_2O_3	1.04 %
MgO	0.94 %

CaO	4.85 %
Alkalies	1.20 %
CO_2	0.33 %
TiO_2	0.12 %
P_2O_5	3.41 %
SO_3	0.79 %
S	0.22 %
MnO	trace
Loss on ignition	80.32 %
	100.35 %

Total carbon	42.85 %
Carbon from carbonates	0.13 %
Organic carbon	42.72 %
Humic matter (with factor: 1.742)	74.39 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, little	amphibole, green, little
asphalt, little	**asphalt,** little
augite, with a burned habitus, little	augite, green, little
baryte, little	**baryte,** little
biotite, little	biotite, little
calcite, much	calcite, little
copper, native, little	————
epidote, little	————
hypersthene, little	————
ilmenite, little	ilmenite, little
limonite, much	limonite, little
magnetite, much	magnetite, little
microcline, little	————
muscovite, little	muscovite, little
plagioclase, much	plagioclase, litte
pyrite, much	pyrite, little
quartz, much	quartz, little
rutile, little	rutile, little
tourmaline, little	————

	tremolite, little	**tremolite,** little
	magnetic particles with figures of „Widmannstätten"(?)	————
	organic animal remains	organic animal remains
	globulites of iron-pyrite	————
WEATHERING-FACTOR:	$ki = \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{5.22}{1.91} \times 1.7 = 4.65.$	

No. 707.

GENERAL REMARKS.

LOCALITY: Pulu Pandjang, coral-island, W. of Djapara, Res. Semarang.
Pulu = Island.

GEOLOGICAL AGE: Quaternary.

HEIGHT: 1 M.

CLIMATE: I. Temperature.

Station Pekalongan; years of observations: 1912—1918.
Height: 9 M.

Temperature in degrees Celcius.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
25.2	25.5	26.1	26.6	26.8	26.4	26.2	26.3	26.8	27.2	26.5	26.0	26.3

II. Rainfall.

Station Djapara (N°. 143, Res. Semarang, BOEREMA).
Years of observations: 17. Height 3 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
705	571	383	179	90	42	20	16	55	98	241	508	2 908 m.m.
23.9	19.7	13.2	6.2	3.1	1.5	0.7	0.6	1.9	3.4	8.3	17.5	100 %

III. Rainfactor (LANG): 2908 : 26.3 = 110.

VEGETATION: Cocos-palms.

ROCK.

MACROSCOPICAL: White limestone with corallogene structure and cavities filled with soil. **This is the only limestone, completely soluble in acetic acid.**

MICROSCOPICAL: amphibole, very little.
augite, very little.
magnetite, very little.
quarz, very little.
zircon, very little.
Foraminifera, some.

CHEMICAL: Water (110° C.) .... 0.45 %

ANALYSIS (dry matter).

SiO_2	0.32 %
Al_2O_3	0.29 %
Fe_2O_3	0.12 %
MgO	0.42 %
CaO	54.02 %
Alkalies	0.77 %
TiO_2	0.00 %
P_2O_5	0.01 %
SO_3	0.56 %
Cl	0.04 %
S	0.02 %
MnO	0.00 %
Loss on ignition (CO_2, hydratic water)	43.88 %
	100.45 %

SOIL.

MACROSCOPICAL: Black soil with many fragments of the coral-limestone; rests of herbaceous plants; non-marine molluscs.

COLOUR DETERMINATION: With naked eye: black.
Code des Couleurs: N°. 143.

TINTOMETRICAL: Red 7.2 + yellow 9.6 + blue 7.1.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	8.5 %
0.01—0.05 m.M.	5.0 %
0.05—0.1 m.M.	5.5 %
0.1 —2 m.M.	81.0 %

HYGROSCOPIC COEFFICIENT: 4.5 %.

MAXIMUM WATERCAPACITY: 44 %.

VOLUME EXPANSION: 0.00 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.5
Quinhydrone electrode	8.0

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.2
Centrifuged liquid	7.4

Exarisate	7.3
Comber-Hissink test 1 (after two days)	red.
Comber-Hissink test 2 (after two days)	6.5

CHEMICAL:

Water (110° C.)	3.04 %

ANALYSIS (dry matter)

SiO_2	5.40 %
Al_2O_3	3.50 %
Fe_2O_3	1.52 %
MgO	0.78 %
CaO	45.13 %
Alkalies	0.54 %
CO_2	32.46 %
TiO_2	0.24 %
P_2O_5	0.23 %
SO_3	0.41 %
S	0.03 %
MnO	0.32 %
Loss on ignition	9.60 %
	100.16 %
Unweathered silicates	28.99 %
SiO_2 of the weathered silicates	3.16 %
Total carbon	12.06 %
Carbon from carbonates	8.85 %
Organic carbon	3.21 %
Humic matter (with factor: 1.742)	5.59 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green and brown, little	amphibole, green, little
augite, little	augite, little
biotite, little	biotite, little
garnet, grossularite, rare	— — — —
glauconite, little	— — — —
hypersthene, little	hypersthene, little
ilmenite, little	ilmenite, little
limonite, little	limonite, little
magnetite, much	magnetite, little
plagioclase, much	plagioclase, much

pyrite, little	————
quartz, little	quartz, little
zircon, little	zircon, little
Foraminifera.	————
corals.	————
molluscs.	————

The black colour of the first (i. c. the finest) fraction is getting red (= iron) after ignition, the black colour of the fourth fraction grey (= humus).

The second, third and fourth fraction are principally composed of small fragments of coral and wood; besides the minerals seem to be burnt.

WEATHERING-FACTOR:

$$ki\ (rock) = \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{0.32}{0.29} \times 1.7 = 1.87.$$

$$ki\ (soil) = \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{5.40}{3.50} \times 1.7 = 2.62.$$

$$K = \frac{2.62}{1.87} = 1.40.$$

No. 320.

GENERAL REMARKS.

LOCALITY: Forest-division (Dutch: Houtvesterij) Manggar, Residency: Semarang. Collected by Prof. MOHR (Amsterdam).

GEOLOGICAL AGE: Tertiary.

HEIGHT: 0—250 M.

CLIMATE: I. Temperature.

Station Sawahan. Years of observations: 1906—1915; 1927—1918.
Height: 25 M.

Temperature in degrees Celcius.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
25.7	25.7	26.0	26.3	26.2	25.9	25.8	26.3	27.0	27.0	26.4	26.4	26.2

II. Rainfall.

Station: Temur, (N°. 142, Res. Semarang, BOEREMA), Years of observations: 12. Height: 13 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
326	265	268	212	117	57	35	61	97	160	260	279	2 137 m.m.
15.3	12.4	12.5	9.9	5.5	2.7	1.6	2.9	4.5	7.5	12.2	13.0	100 %

III. Rainfactor (LANG): 2137 : 26.2 = 82.

VEGETATION: Teak-forests.

ROCK.

Not collected.

SOIL (Sub-soil, depth 0.4 M.).

MACROSCOPICAL: Grey, sandy limestone-soil.

COLOUR DETERMINATION: With naked eye: light-grey.
Code des Couleurs: N°. 178a.

TINTOMETRICAL: Red 1.2 + yellow 2.4 + blue 1.35.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	24.6 %
0.01—0.05 m.M.	21.2 %
0.05—0.1 m.M.	14.8 %
0.1 —2 m.M.	39.4 %

HYGROSCOPIC COEFFICIENT:	6 %.
MAXIMUM WATERCAPACITY:	34 %.
VOLUME EXPANSION:	7.15 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:
	Hydrogen electrode 8.2
	Quinhydrone electrode 7.8
	COLORIMETRICAL DETERMINATIONS:
	Filtrate 7.6
	Centrifuged liquid 7.3
	Exarisate 7.3
	Comber-Hissink test 1 (after two days) .. pink
	Comber-Hissink test 2 (after two days) .. 6.5
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 71.2 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green and brown, very little	amphibole, green and brown, very little
	augite, green, very little	augite, green, very little
	calcite, much	calcite, very much
	epidote, very little	————
	ilmenite, very little	ilmenite, little
	limonite, very little	————
	magnetite, little	magnetite, little
	plagioclase, little	plagioclase, little
	quartz, little	quartz, little
	rutile, very little	rutile, very little
	tubules of lime, much.	————
	remains of *Spongia*, little.	————
	globules of iron bisulfide on limonite	————
	Foraminifera, very much	————

SOIL (Surface soil).

MACROSCOPICAL:	Black-grey with a very great disposition to the building of crumbs and clods. The difference between the colour of this soil and the sub-soil is very striking.

COLOUR DETERMINATION:	With naked eye: black-grey. Code des Couleurs: N°. 145.
TINTOMETRICAL:	Red 4.9 + yellow 6.8 + blue 4.9.
MECHANICAL:	Diameter of particles:

	< 0.01 m.M.	53.5 %
	0.01—0.05 m.M.	26.8 %
	0.05—0.1 m.M.	8.5 %
	0.1 —2 m.M.	11.2 %

HYGROSCOPIC COEFFICIENT:	16.5 %.
MAXIMUM WATERCAPACITY:	60.6 %.
VOLUME EXPANSION:	44.3 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.6
Quinhydrone electrode	7.8

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.2
Centrifuged liquid	7.2
Exarisate	7.3
Comber-Hissink test 1 (after two days)	pink
Comber-Hissink test 2 (after two days)	> 6.5

CHEMICAL: $CaCO_3$ (with acetic acid) .... 3.8 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, little	amphibole, green and brown, very little
————	apatite, green, very little
augite, little	augite, green, very little
————	biotite, little
calcite, much	calcite, very little
epidote, little	————
garnet, very little	————
hypersthene, little	hypersthene, little
ilmenite, little	ilmenite, little
limonite, little	————

magnetite, little	magnetite, little
plagioclase, much	plagioclase, little
quartz, little	quartz, much
rutile, very little	rutile, very little
tourmaline, 1 ex.	————
————	**vivianite,** blue irregular scales, very little
zircon, very little	zircon, very little
Foraminifera, much	————

No. 321.

GENERAL REMARKS.

LOCALITY:	Forest-division: Manggar, Residency: Semarang. Collected by Prof. MOHR.
GEOLOGICAL AGE:	Tertiary.
HEIGHT:	0—250 M.
CLIMATE:	I. Temperature see N°. 320. II. Rainfall see N°. 320. III. Rainfactor see N°. 320.
VEGETATION:	Teak-forests.

ROCK.

Not collected.

SOIL (Sub-soil).

MACROSCOPICAL:	Grey soil with brown spots; crumbling; after moistening greasy (between the fingers).
COLOUR DETERMINATION:	With naked eye: light-grey. Code des Couleurs: N°. 203b.
TINTOMETRICAL:	Red 3 + yellow 4.9 + blue 2.5
MECHANICAL:	Diameter of particles:

Diameter of particles	%
< 0.01 m.M.	56.3 %
0.01—0.05 m.M.	28.5 %
0.05—0.1 m.M.	10.0 %
0.1 —2 m.M.	5.2 %

HYGROSCOPIC COEFFICIENT:	14.2 %.
MAXIMUM WATERCAPACITY:	61.8 %.
VOLUME EXPANSION:	22.9 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:

ELECTROMETRICAL DETERMINATIONS	
Hydrogen electrode	8.5
Quinhydrone electrode	8.1

COLORIMETRICAL DETERMINATIONS	
Filtrate	7.4
Centrifuged liquid	not made
Exarisate	not made
Comber-Hissink test 1 (after two days)	colourless
Comber-Hissink test 2 (after two days)	> 6.5

CHEMICAL:	$CaCO_3$ (with acetic acid) .... 21.6 %	
MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, brown and green, little	amphibole, little
	augite, little	augite, little
	calcite, much	calcite, much
	epidote, little	epidote, little
	hypersthene, little	hypersthene, little
	ilmenite, little	ilmenite, little
	limonite, little	limonite, little
	magnetite, little	magnetite, little
	plagioclase, much	plagioclase, much
	quartz, much	quartz, much
	rutile, little	rutile, little
	staurolite, little	————
	tourmaline, little	tourmaline, little
	volcanic glass.	————
	zircon, little	zircon, little
	Foraminifera, little	————
	fragments of marl, rather much	————

SOIL (Surface-soil).

MACROSCOPICAL: See sub-soil; colour grey-black.

COLOUR DETERMINATION: With naked eye: grey-black.
Code des Couleurs: No 145.

TINTOMETRICAL: Red 5.4 + yellow 9.4 + blue 6.2.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	63.4 %
0.01—0.05 m.M.	21.0 %
0.05—0.1 m.M.	8.5 %
0.1 —2 m.M.	7.1 %

HYGROSCOPIC COEFFICIENT: 16 %.

MAXIMUM WATERCAPACITY: 57.9 %.

VOLUME EXPANSION:	22.9 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:
	Hydrogen electrode 8.3
	Quinhydrone electrode 7.4
	COLORIMETRICAL DETERMINATIONS:
	Filtrate 6.9
	Centrifuged liquid 8.1
	Exarisate .... not made
	Comber-Hissink test 1 (after two days) .. pink
	Comber-Hissink test 2 (after two days) > 6.5
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 0.00 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, little	amphibole, very little
augite, little	augite, very little
calcite, much	calcite, little
epidote, little	epidote, little
ilmenite, much	ilmenite, little
limonite, much	limonite, much
magnetite, little	magnetite, little
muscovite, little	— — — —
plagioclase, much	plagioclase, little
quartz, much	quartz, little
zircon, little	— — — —

rounded ferruginous concretions; studied microscopically: particles of quartz bedded in an iron-mass.

plant-remains, little.	— — — —

No. 322.

LOCALITY: W. of Gundih, S. W. of Purwodadi, Residency: Semarang.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 150—200 M.

CLIMATE: I. Temperature see N°. 320. (Yearly: 26.2).

II. Rainfall.

Station Togaldjeruk (N°. 208, Res. Semarang, BOEREMA). Years of observations: 8. Height: 34 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
358	274	294	196	153	44	28	68	108	181	276	339	2 319 m.m.
15.4	11.8	12.7	8.5	6.6	1.9	1.2	2.9	4.7	7.8	11.9	14.6	100 %

III. Rainfactor (LANG): 2319: 26.2 = 88.

VEGETATION: Shrubs.

ROCK.

MACROSCOPICAL: Grey; compact; with conchoidal fracture.

MICROSCOPICAL:

amphibole, little.
apatite, little.
augite, little.
baryte with Sr (= *coelestobaryte*). Ba and Sr were found spectroscopically.
epidote, little.
glauconite, some.
ilmenite, little.
limonite, little.
plagioclase, much; with inclusions of apatite, zircon and glauconite.
tourmaline, some.
zircon, very little.
globulites of iron-bisulfide.
Foraminifera, glauconitisated.
Foraminifera, silicificated, much.
Foraminifera, with granules of iron-pyrite, little.
Foraminifera, phosphatisated.

Among the organic remains, I recognised:

FORMA PROBLEMATICA

Discoaster, identic with „the stellate bodies" of A. J. JUKES BROWNE and J. B. HARRISON in their „Memoir on the Geology of Barbados". (Quaterly Journal Geological Society of London, Vol. XLVIII, 1892, p. 177): „The stellate bodies consist of rays which emanate from a common centre, in number from five (rarely three) to sixteen, and between these extremes every variation occurs the most common forms being those of eight to twelve rays. In those which have the smallest number the rays are shaped like elongated parellelograms arranged on a common base; they occasionally bifurcate at their summits. This latter peculiarity is rare in the calcareous earths, but occurs commonly in the foraminiferal muds to be hereafter noticed".

With the aid of the valuable book: Dr. TAN SIN HOK, Over de samenstelling en het ontstaan van krijt- en mergel-gesteenten van de Molukken. (Jaarboek v. h. Mijnwezen in Nederlandsch Oost-Indië, 1926, verhandeling III) I recognised:

Discoaster Brouweri nov. spec. var. (T. S. H., pl. II, fig. 13).

Discoaster Brouweri nov. spec. var. (T. S. H., pl. II, fig. 7).

Discoaster Brouweri nov. spec. var. (T. S. H., pl. II, fig. 8*a* and 8*b*.

Discoaster Molengraaffi nov. spec. var. (T. S. H., pl. II, fig 10 and 11).

Discoaster pentaradiatus, nov. spec. var. (T. S. H., pl. II, fig. 14).

See also:

TAN SIN HOK, On a young Tertiary Limestone of the Isle of Rotti with Coccolithes, Calci- and Manganese-peroxide-Spherulites. (Proc. of the Royal Society of Sciences in Amsterdam, Vol. XXIX, N°. 8, 1926, pp. 1095—1105).

TAN SIN HOK, Discoasteridae incerta sedis. (Ib. Vol. XXX, N°. 3, 1927, pp. 411—419).

FLAGELLATAE.

Pontosphaera pellucida, (Lohmann).
Pontosphaera Huxleyi, (Lohmann).
Coccolithophora pelagica, (Wallich).
Coccolithophora leptophora, (Murr & Blackman).

FORAMINIFERA.
(Cayeux, Plate XXVII).

Rotalina Haueri, (d'Orb.).
Orbulina universa, (d'Orb.).
Globigerina bulloïdes, (d'Orb.).

RADIOLARIA.
(Cayeux, Plate XXXI).

Cornutella sethoconus, (Haeckel).
Archicapsa triforis, (Haeckel).
Protosphaera hexagonalis, (Cayeux).

SPONGIA.
(Cayeux, Plate XXXIV).

Spicula cf. *Tetracladina* and *Hexactellinida.*

CHEMICAL: Water (110° C.) .... 4.49 %

ANALYSIS (dry matter).

SiO_2	24.96 %
Al_2O_3	6.20 %
Fe_2O_3	3.02 %
MgO	0.94 %
CaO	34.31 %
Alkalies	0.60 %
TiO_2	0.24 %
P_2O_5	0.17 %
SO_3	0.15 %
S	0.01 %
MnO	0.37 %
Loss on ignition (CO_2, hydratic water)	29.20 %
	100.17 %

SOIL.

MACROSCOPICAL: Loamy and soft.

COLOUR DETERMINATION: With naked eye: light-grey.
Code des Couleurs: N°. 178 c.

TINTOMETRICAL:	Red 3.1 + yellow 4.5 + blue 2.7.
MECHANICAL:	Diameter of particles:
	< 0.01 m.M. .... 52.4 %
	0.01—0.05 m.M. .... 27.8 %
	0.05—0.1 m.M. .... 9.2 %
	0.1 —2 m.M. .... 10.6 %
HYGROSCOPIC COEFFICIENT:	13.33 %.
MAXIMUM WATERCAPACITY:	54.2 %.
VOLUME EXPANSION:	0.00 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:
	Hydrogen electrode 7.7
	Quinhydrone electrode 7.3
	COLORIMETRICAL DETERMINATIONS:
	Filtrate 7.2
	Centrifuged liquid 7.1
	Exarisate 7.2
	Comber-Hissink test 1 (after two days) colourless
	Comber-Hissink test 2 (after two days) > 6.5
CHEMICAL:	Water (110° C.) .... 6.01 %

ANALYSIS (dry matter).

SiO_2	35.82 %
Al_2O_3	17.62 %
Fe_2O_3	1.92 %
MgO	1.82 %
CaO.	16.57 %
Alkalies	0.69 %
CO_2	10.98 %
TiO_2	0.54 %
P_2O_5	0.20 %
SO_3	2.10 %
S	0.03 %
MnO	2.15 %
Loss on ignition	9.60 %
	100.04 %
Unweathered silicates	37.43 %
SiO_2 of the weathered silicates	14.19 %

Total carbon	3.20 %
Carbon from carbonates	2.99 %
Organic carbon	0.21 %
Humic matter (with factor: 1.742)	0.37 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, little	amphibole, little
apatite, little	apatite, little
augite, little	augite, little
baryte, little	baryte, little
epidote, little	epidote, little
glauconite, some	glauconite, some
globulites of iron-bisulfide	globulites of iron-bisulfide
ilmenite, little	ilmenite, little
limonite, little	limonite, little
plagioclase, much, with inclusions of apatite, zircon and glauconite	plagioclase, much, with inclusions of apatite, zircon and glauconite
tourmaline, some	tourmaline, some
zircon, very little	zircon, very little

Foraminifera, Radiolaria, Spongia, Forma Problematica, etc. the same as in the rock.

WEATHERING-FACTOR:

$$ki\ (rock)\ \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{24.96}{6.20} \times 1.7 = 6.84.$$

$$ki\ (soil)\ \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{35.82}{17.62} \times 1.7 = 3.45.$$

$$K = \frac{3.45}{6.84} = 0.50.$$

No. 323.

GENERAL REMARKS.

LOCALITY: W. of Gundih, S. W. of Purwodadi, Residency: Semarang.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 150—200 M.

CLIMATE: I. Temperature.

Station Sawahan, see N°. 320 (Yearly: 26.2).

II. Rainfall.

Station Tegaldjeruk (N°. 208, Res. Semarang, BOEREMA). Years of observations: 8. Height: 34 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
358	274	294	196	153	44	28	68	108	181	276	339	2 319 m.m.
15.4	11.8	12.7	8.5	6.6	1.9	1.2	2.9	4.7	7.8	11.9	14.6	100 %

III. Rainfactor (LANG) 2319 : 26.2 = 88.

VEGETATION: A cultivation of *Leucaena glauca*-Benth. (Javanese: Kemlandingan, Lantana), a plant used as green manure.

ROCK.

Not collected.

SOIL.

MACROSCOPICAL: Clay, originated by weathering from marl (= loamy-limestone); tough and hard, when dry; greasy when wet. A great quantity of organic remains.

COLOUR DETERMINATION: With naked eye: black-grey.
Code des Couleurs: N°. 145.

TINTOMETRICAL: Red 4.9 + yellow 6.6 + blue 5.2.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	54.4 %
0.01—0.05 m.M.	18.8 %
0.05—0.1 m.M.	9.6 %
0.1 —2 m.M.	17.2 %

HYGROSCOPIC COEFFICIENT:	14.46 %.
MAXIMUM WATERCAPACITY:	59.1 %.
VOLUME EXPANSION:	0.00 %.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.5
Quinhydrone electrode	7.5

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.3
Centrifuged liquid	6.8
Exarisate	7.3
Comber-Hissink test 1 (after two days)	red
Comber-Hissink test 2 (after two days)	>6.5

CHEMICAL:

Water (110° C.)	5.80 %

ANALYSIS (dry matter).

SiO_2	37.50 %
Al_2O_3	13.57 %
Fe_2O_3	4.67 %
MgO	0.91 %
CaO	17.74 %
Alkalies	0.95 %
CO_2	10.66 %
TiO_2	0.34 %
P_2O_5	0.11 %
SO_3	0.13 %
S.	0.01 %
MnO	0.79 %
Loss on ignition	12.63 %
	100.01 %

Total carbon	6.15 %
Carbon from carbonates	3.43 %
Organic carbon	2.72 %
Humic matter (with factor: 1.742)	4.74 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, white and green, little	amphibole, green, little
augite, little	augite, green, little
calcite, little	calcite, little

epidote	— — — —
garnet	— — — —
ilmenite, little	ilmenite, little
magnetite, little	magnetite, little
plagioclase, little	plagioclase, little
Foraminifera, much	*Foraminifera,* much
wood-remains	— — — —
plant-remains	plant-remains, very much

WEATHERING-FACTOR: $ki\ (soil)\ \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{37.50}{13.57} \times 1.7 = 4.70.$

No. 324.

GENERAL REMARKS.

LOCALITY:	W. of Gundih, S. W. of Purwodadi, Residency: Semarang.
GEOLOGICAL AGE:	Tertiary.
HEIGHT:	± 100 M.
CLIMATE:	I. Temperature: see N°. 320. II. Rainfall: see N°. 323. III. Rainfactor: see N°. 323.
VEGETATION:	Grass.

ROCK.

Not collected.

SOIL.

MACROSCOPICAL:	Calcareous loam, surface-soil, burnt, because the vegetation was often destroyed by fire.
COLOUR DETERMINATION:	With naked eye: black-grey. Code des Couleurs: N°. 148.
TINTOMETRICAL:	Red 3.8 + yellow 5.0 + blue 3.9.
MECHANICAL:	Diameter of particles: < 0.01 m.M. .... 48.6 % 0.01—0.05 m.M. .... 21.6 % 0.05—0.1 m.M. .... 13.2 % 0.1 —2 m.M. .... 16.6 %
HYGROSCOPIC COEFFICIENT:	16.1 %.
MAXIMUM WATERCAPACITY:	56.2 %.
VOLUME EXPANSION:	21.5 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS: Hydrogen electrode .... 8.5 Quinhydrone electrode .... 8.0 COLORIMETRICAL DETERMINATIONS: Filtrate .... 7.3 Centrifuged-liquid .... 7.5 Exarisate .... 7.4 Comber-Hissink test 1 (after two days) .. — Comber-Hissink test 2 (after two days) .. —

CHEMICAL: $CaCO_3$ (with acetic acid) .... 25.6 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, much	amphibole, green, much
— — — —	**apatite,** little
augite, green, much	augite, much
calcite, rather much	calcite, little
epidote, little	epidote, little
garnet, rather much	— — — —
hypersthene, little	hypersthene, much
ilmenite, little	ilmenite, little
limonite, little	— — — —
magnetite, little	magnetite, little
plagioclase, much	plagioclase, much
quartz, little	— — — —
rutile, little	rutile, little
staurolite, little	staurolite, little
tourmaline, very little	tourmaline, little
zircon, very little	zircon, little

Foraminifera, very much; partly soluble in HCl and in this case leaving behind a skeleton of colloidal SiO_2. Some Foraminifera impregnated with colloidal Fe_2O_3.
Much organic remains as *Discoaster*, *Coccolithophora* etc. as is described on pg. 47.
Burnt remains of leaves and wood.

No. 335.

GENERAL REMARKS.

LOCALITY: Redjoso, W. of Djokja. Collected by Prof. MOHR.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 100—250 M.

CLIMATE: I. Temperature.

Station Wedi; years of observations 1905—1915; 1917—1928. Height: 150 M.
Temperature in degrees Celcius.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
24.9	24.8	25.1	25.6	25.4	25.0	24.6	24.6	25.2	25.7	25.3	25.1	25.1

II. Rainfall.

Station Djokjakarta (N°. 53, Res. Djokjakarta, BOEREMA), Years of observations: 44. Height: 113 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
356	349	315	213	137	94	47	30	41	104	248	365	2 299 m.m.
15.5	15.2	13.7	9.3	5.6	4.1	2.1	1.4	1.8	4.6	10.8	15.9	100 %

III. Rainfactor (LANG): 2299 : 25.1 = 92.

VEGETATION: Unknown.

ROCK.

MACROSCOPICAL: Soft and weak rock, easily to be rubbed to fine powder.

MICROSCOPICAL: Few minerals (amphibole, augite, ilmenite, plagioclase, quartz), but substantially *Foraminifera*, besides *Diatoms, Radiolaria, Spongia, Coccoliths*, etc. (see p. 47).
Dr. J. HOFKER determined the following (in alphabetical order):

FORAMINIFERA.

Bolivina costata (d'Orbigny).
Discorbina bertheloti (d'Orbigny).
Globigerina cretacea (d'Orbigny).

Globigerina bulloides (cretacea?) (d'Orbigny).
Globigerina bulloides (d'Orbigny).
Lagena marginata (Reuss).
Nodosaria perversa (Schwager).
Orbulina universa (d'Orbigny).

Among the *radiolaria* Dr. HOFKER recognized:

Hymenactura.
Tripocalpis.
Theopera.
Lythocyclia.
Tricholampe.
Phorticium.
Cannobotrys.
Spongoxiplum.

Other organic remains:

FORMA PROBLEMATICA.

The same *Discoaster*-species as in N°. 322.

FLAGELLATAE.

The same species of *Pontosphaera* and *Coccolitophora* as in N°. 322.

SPONGIA.

Spiculae and Globulites of *Monactinellidae, Tetractellinidae* and *Hexactellinidae.*

CHEMICAL: $CaCO_3$ (with acetic acid) .... 58.7 %

SOIL (Sub-soil depth 40—20 cm).

MACROSCOPICAL: Grey-black soil with a disposition to crumble, some fragments of the underlying rock.

COLOUR DETERMINATION: With naked eye: grey-black.
Code des Couleurs: N°. 145.

TINTOMETRICAL: Red 4.9 + yellow 6.8 + blue 4.8.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	34.7 %
0.01—0.05 m.M.	16.3 %
0.05—0.1 m.M.	11.5 %
0.1 —2 m.M.	37.5 %

HYGROSCOPIC COEFFICIENT: 14 %.

MAXIMUM WATERCAPACITY:	66.2 %.	
VOLUME EXPANSION:	37.2 %.	
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.1
	Quinhydrone electrode	8.3
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	7.3
	Centrifuged liquid	7.4
	Exarisate	—
	Comber-Hissink test 1 (after two days)	colourless
	Comber-Hissink test 2 (after two days)	>6.5
CHEMICAL:	$CaCO_3$ (with acetic acid)	6.9 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green and brown, little	amphibole, green and brown, little
	————	**apatite**, little
	augite, green, little	augite, green, little
	————	calcite, little
	————	**cordierite**, rare
	————	epidote, rare
	hypersthene, little	————
	ilmenite, much	ilmenite, little
	magnetite, much	magnetite, much
	muscovite, little	muscovite, little
	plagioclase, little	plagioclase, little
	quartz, much	quartz, much
	————	**vivianite**, little
	————	zircon, little

Foraminifera, much.

needles of *Spongia*, much.

other organic remains, much.

SOIL (Surface-soil, depth 20—10 cm).

MACROSCOPICAL: Black-grey soil with some fragments of the underlying rock.

COLOUR DETERMINATION:	With naked eye: black-grey. Code des Couleurs: N°. 150.
TINTOMETRICAL:	Red 5.0 + yellow 6.6 + blue 4.9.
MECHANICAL:	Diameter of particles: < 0.01 m.M. .... 59.1 % 0.01—0.05 m.M. .... 9.2 % 0.05—0.1 m.M. .... 7.2 % 0.1 —2 m.M. .... 24.5 %
HYGROSCOPIC COEFFICIENT:	15.9 %.
MAXIMUM WATERCAPACITY:	64.1 %.
VOLUME EXPANSION:	37.2 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS: Hydrogen electrode .... 8.2 Quinhydrone electrode .... 8.1 COLORIMETRICAL DETERMINATIONS: Filtrate .... 7.3 Centrifuged liquid .... 7.4 Exarisate .... 7.4 Comber-Hissink test 1 (after two days) .. pink Comber-Hissink test 2 (after two days) > 6.5
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 0.2 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green and brown, little	amphibole, green and brown, little
— — — —	**apatite,** little
augite, green, little	augite, green, little
hypersthene, little	— — — —
ilmenite, little	ilmenite, little
magnetite, much	magnetite, much
muscovite, little	— — — —
plagioclase, little	plagioclase, litte
quartz, much; (in crystals with inclusions)	quartz, much (in crystals with inclusions)
— — — —	**vivianite,** little

— — — —	zircon, little
Foraminifera, very much	*Foraminifera,* very much
needles of *Spongia,* very much	*Spongia,* very much
Radiolaria and other organic remains, very much	*Radiolara* and other organic remains, very much

No. 566 — 567 — 568.

GENERAL REMARKS.

These samples were collected by Dr. J. SCHMUTZER in the neighbourhood of Suroh-djolok (= Surotjolok = Surolojo), east of Kreteg and ± 10 K.M. north of the south-coast of Java. The country is a real Karst-landscape with karren, dolinas (Javanese: luwangs), caverns, subterranean rivers, etc. The first description of this Karst-landscape, which extends from Kreteg till Rongkop is from the great naturalist F. W. JUNGHUHN (1809—1864), who visited it in the year 1836. What he wrote in his booklet: Topographische und naturwissenschaftliche Reisen durch Java, Magdeburg 1845 (with atlas) is very unknown in the literature. I cite here from p. 102—108 the following very interesting lines:

„Man trifft hier im Schatten sich überwölbender Bäume eine tiefe Grube an, eine Senkung, wie durch einen Erdfall entstanden, in deren Hintergrunde, sich zwischen Steinmassen verlierend, ein gewölbtes Felsenthor sich aufthut. Bis zu dieser Höhle ist ein Weg gebahnt. Man bemerkt an dem Gestein, dass die umliegenden Dorfbewohner hier Kalk zu holen pflegen. Nach der Versicherung meiner Begleiter laufen hier in der Regenzeit alle Gewässer zusammen und verschwinden auf unterirdischen Wegen. Man nennt solche Höhlen Luwang's und sie befinden sich in zahlloser Menge im Tausendgebirge. Entweder ist ihr Boden geschlossen und söhlig; dann sammelt sich das Regenwasser in ihnen an und dient den Bewohnern, in Ermangelung aller Quellen und Bäche, zu Trink- und Kochwasser, obgleich seine trübe, milchige Farbe nicht eben zum Genusse einladet; oder, was bei weitem häufiger der Fall ist, ihr ungleicher Boden dringt tiefer in die Erde ein, mit welcher er durch schmale Spalten und zackige Klüfte in Verbindung steht; dann verläuft sich das Regenwasser schnell in ihnen. — Gewöhnlich öffnen sich diese Höhlen oder Löcher in den Thalvertiefungen zwischen den Hügeln und sind mit üppiger Vegetation, mit Bäumen und Gesträuchen trügerisch überwachsen.

O könnte ich meinen Lesern ein Bild geben von diesem einsamen Gebirge, von diesem stillentlegenen Erdwinkel, der an Schönheit Alles, was ich bis jetzt auf Java sah, übertrifft!

Man denke sich abgerundete, halbkugelige Berge von 100 bis 200 Fusz Höhe, die sich einer neben dem andern weit und breit zu Hunderten erheben und die nur durch schmale, labyrinthisch mit einander verbundene Zwischenthäler getrennt sind. Einer gleicht dem andern; alle sind mit der üppigsten, dichtesten Waldung geschmückt, mit Bäumen der verschiedensten Arten, die sich hoch emporwölben! Man kann das Auge nicht abwenden von dem mannigfaltigen Grün, das sich darbietet! In den Zwischenthälern wächst hochaufgeschossenes Gras, das nicht selten Ross und Reiter überragt, die in den schmalen, hineingehauenen Pfaden dahineilen. Hier breiten sich, hoch über dem Wandrer, die schirmartigen Zweige einer Acacia (s.oben) aus, durch deren zartes, wie aus Flor gewebtes Laub der blaue Himmel gar lieblich durchblickt. Die Abhänge der Hügel schmücken hie und da wilde Pisangpflanzen (*Musa paradisiaca*), die sich öfters an dem schroffsten Gestein hinaufziehen. — Malerisch ragen ihre lichtgrünen, mächtigen Blätter aus dem Dunkel umgebender Gebüsche hervor. — Kein störender Laut unterbricht hier die heilige Stille; nur von Zeit zu Zeit vernimmt man das Girren einer Turteltaube oder das Gekreisch eines wilden Hahnes, der in den Gebüschen nistet.

Wandert man zwischen solchen Umgebungen einsam dahin, so erheben sich immer neue Berge im Vordergrunde und immer bieten sich malerische Aussichten dar. Zwar sind sie, ihrer Höhe und ihrer abgerundeten hemisphärischen Gestalt nach, einander ausserordentlich ähnlich, auch liegen sie in fast gleichen Entfernungen auseinander, aber desto mannigfaltiger ist die Waldespracht, welche sie bedeckt; einer scheint den andern an Schönheit zu übertreffen. Das hohe Gras, das alle Thäler ausfüllt, zieht sich zwischen den Baumstämmen und Sträuchern bis in die Wälder hinein und macht hier die Wildniss noch undurchdringlicher.

Der Boden, der diese üppige Vegetation hervorbringt, ist ein harter, milchweisser Kalkstein, der das ganze Gebirge mit allen seinen Hügeln zu bilden scheint. Ueberall, sowohl in den Thälern als an den schroffen Abhängen der Hügel, geht er unter der trügerischen Decke hoher Allangs zu Tage aus. Er bildet Klippen, die aus dem Boden hervorstehen und mit unzähligen, ausgerundeten Vertiefungen, kleinen Gruben, Löchern und wirklichen Durchgängen versehen sind, zwischen denen überall scharfe Zacken und ausgefurchte Kanten hervorstehen. Nicht selten gleichen sie Korallen oder zeigen eine solche Beschaffenheit, dass man glauben sollte, sie seien durch Menschenhände ausgekräuselt. Zwischen ihren Spalten wurzeln die mächtigsten Bäume, und dem bräunlichen Humus, der ihre Gruben und Vertiefungen ausfüllt, entsprichen saftige Kräuter und Sträucher der verschiedensten Art."

.... „In geringer Entfernung senkt sich in einer Thalvertiefung zwischen zwei steilen Hügelwänden, trichterförmig ein tiefes Loch hinab. Sein oberer Rand ist mit hohem Gesträuch bewachsen, das den gefährlichen Abgrund trügerisch überwölbt. Unten öffnet sich eine Spalte, ein schmaler, zackiger Gang, zwischen den Kalkfelsen, welcher mit ungleichen Krümmungen, sich mehr oder minder von der vertikalen Richtung entfernend, in die Tiefe dringt. Ich folgte ihm, an den ausgefressenen Zacken des Gesteins hinabklimmend, ziemlich weit; meine Begleiter aber behaupteten, dass seine Tiefe nicht zu ergründen sei. Sie erzählen, dass die kleinen Ströme, die sich nach anhaltenden Regen bilden, sich alle in solche Höhlen, Luangs, ergiessen und darin verschwinden. Die Menge der Luang's ist ungezählt; überall trifft man sie im Gunung Sebu an. Sie öffnen sich meistens in der tiefstgelegenen Gegend der Thäler, wo sich diese zwischen den Hügeln kesselförmig hinabsenken. Sie erwähnten ferner als einer im Regenmousson sehr gewöhnlichen Erscheinung, des plötzlichen Emporsteigens trüben Wassers aus der blauen Fluth des Meeres, wenn man dieses von der 200 Fusz hoch hinabgestürzten Küste in die Tiefe blicke. „Wenn es dann lange Zeit stark geregnet habe, so fange das Meer, oft in grosser Entfernung von der Küste, an zu kochen, und ein rötliches Wasser steige empor, das die Bläue des Meeres umher treibe".

.... „Von diesem Felsenrande aus geniesst man einen überraschenden Anblick. Man sieht im Osten der langen Südküste Java's entlang, fast bis Patjitan hin, wo sie sich in duftige Ferne verliert. Es sind die grünen Hügel des Gunung Sebu, die sich hier plötzlich endigen und sich senkrecht in das Meer hinabstürzen. Es erscheint das Gebirge, das einst viel grösser gewesen sein muss, wie abgeschnitten; viele seiner Hügel sind mitten durchgespalten und stehen nur noch halb; aber bis zum scharfen Rande hin drängt sich ihr freundliches Grün, gleichsam den Verlust der andern Hälfte bedauernd, die im Meer begraben liegt. So entstehen Felsenwände, deren einige in das Meer hervorragen und die hinter ihnen liegenden verbergen. — Da das Tausendgebirge selbst eine ungleiche Höhe hat und seine Hügel stets sich 100 bis 200 Fuss über seine Zwischenthäler erheben, so ist auch diese Küstenwand, die gleichsam den vertikalen Durchschnitt des Gunung Sebu darstellt; ungleich hoch und steigt van 100 zu 300 Fuss und darüber an; sie müstte viel höher sein, wenn die Gebirgsmasse nicht schon bei Djero-wudal anfinge sich gleichmässig herabzusenken. Nur einige Felsenbuchten, die zwischen hervorragenden Wänden übrig blieben und zwischen denen die Brandungen hineinrollen, sind von geringerer Höhe.

Alle diese Wände stürzen sich senkrecht herab, bis etwa 40 bis 30 Fuss über dem Meere; hier wenden sie sich nach innen und bilden überhängende Buchten, tief ausgewaschene Vertiefungen, in welche die heranwälzenden Fluthen mit wildem Getöse eintreten, so dass der zurückgeworfene Schaum 50 Fuss hoch emporspritzt, — und hier unter diesen ausgerundeten, schattigen Buchten öffnen sich zahlreiche Höhlen, in welchen die *Hirundo esculenta* ihre Nester zu bauen pflegt. — Der untere Fuss der Buchten ragt wieder, indem er sich hinabsenkt, etwas hervor; er zeigt eine röthliche Farbe und eine ausgefressene, gleichsam krause Beschaffenheit; doch wird er nur dann sichtbar, wenn im wechselnden Spiele der Brandung die Wasser auf eine Zeitlang zurücktreten. Seine rothe Farbe verdankt er (wie ich mich später überzeugte) einer Conservenart. — Uebrigens erscheinen die Felsenwände in einem schmutzig-grauen Kolorit, das mit Weiss, Schwarz und Braun abwechselt. Sie zeigen Unebenheiten, Vertiefungen und Furchen aller Art; doch kann man bei vielen parallele, quere Spalten oder Risse erkennen, gleichsam als seien sie aus verschiedenen Stücken oder Schichten aufeinander gethürmt. Viele ihrer hervorragenden Kanten sind wunderbar ausgezackt und mit unzähligen kleinen Gruben und Löchern durchbohrt".

......„So der Anblick der Küste".

JUNGHUHN travelled from Djokja along Piungan and Semanu to Rongkop at the southcoast and I studied the country around Piungan, Bunder, Wonosari and Kreteg.

The soil, described as N°. 568 is compared with the real *terra rossa* of the Mediterranean region, a supposition, which is not proved till now.

What is terra rossa? Literally: Red earth.

What do we know about its properties (chemical, physical, mineralogical)? Little.

H. HARRASSOWITZ writes in „Studien über mittel-und südeuropäische Verwitterung": „Die Roterden des Mittelmeeres sind die „popülärsten" klimatischen Bodenbildungen. Eine Fülle von Einzelbeobachtungen und Analysen liegen von ihnen vor. Noch ist aber kein sicheres Profil beschrieben und richtig untersucht worden, noch immer weiss man nicht, ob ein darüber liegender Humushorizont eine Ausnahme oder die Regel bildet. Noch immer ist nicht mit Sicherkeit festgestellt, ob sie sich überhaupt jetzt bilden oder ob nicht zum mindesten ein grosser Teil der Karstroterden fossil ist. Nur eines ist von den Roterden sicher, dass sie sich nur auf Kalken bilden, und dass kristalline Gesteine nichts von ihnen zeigen". (Festschrift GUSTAV STEINMANN, p. 124, Berlin 1926.)

R. LANG writes in „Ueber die Bildung von Roterde und Laterit": „Leider ist das genaue geologische Schichtprofil der Böden und damit die Höhenlage und das Alter der Roterden und Laterite in ihnen bisher vielfach nicht genügend berücksichtigt und untersucht worden". (Actes de la IVème Conférence Internationale de Pédologie, Vol. II, Rome 1926, p. 669.)

E. BLANCK und F. GIESECKE write in: „Ueber die Entstehung der Roterde im nördlichsten Verbreitungsgebiet ihres Vorkommens":

„Es ist hinlänglich bekannt, dass über die Entstehung keiner Bodenart wohl so wesentlich verschiedene Ansichten geäussert worden sind, als gerade über die „terra rossa" des Mittelmeergebietes. Vielleicht kann sich nur noch der Laterit **in dieser Beziehung** mit der „terra rossa" messen". (Chemie der Erde, Band 3. Jena 1927, p. 46.)

What do we want? We must collect facts, facts and still more facts and in the following century it is perhaps possible to compare the red limestone-soil of this country of Java with the red soil of other limestone-countries of the world. Now the time has not yet arrived to do so.

GEOLOGICAL AGE:	566 Tertiary	567 Tertiary	568 Tertiary
HEIGHT:	190 M.	280 M.	300 M.

CLIMATE: I. Temperature.

Station Wedi. Years of observations: 1905—1915; 1917—1918. Heigth: 150 M.

Temperature in degrees Celcius:

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
24.9	24.8	25.1	25.6	25.4	25.0	24.6	24.6	25.2	25.7	25.3	25.1	25.1

II. Rainfall.

Station Pundong, (N°. 62, Res. Djokjakarta, BOEREMA). Years of observations: 25. Height: 25 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
361	400	306	171	121	67	38	27	38	108	226	424	2 287 m.m.
15.8	17.5	13.4	7.5	5.3	2.9	1.6	1.2	1.6	4.7	9.9	18.6	100 %

III. Rainfactor (LANG): 2287 : 25.1 = 91.

VEGETATION:	Grass	Grass	Grass
MACROSCOPICAL:	Clay with a crumble structure.	Clay with a crumble structure and some fragments of the underlying rock.	Clay with a very fine structure.
COLOUR:	dark-brown.	brown-yellow.	brown-red.
Code des Coul.	84	90	103
TINTOMETRICAL:	7.75 + 10.4 + 4.9	4.6 + 7.2 + 2.3	9.2 + 14.5 + 6.0
MECHANICAL: < 0.01 m.M.	41.1 %	34.3 %	57.2 %
0.01—0.05 m.M.	17.8 %	13.0 %	22.9 %
0.05—0.1 m.M.	16.6 %	9.1 %	13.2 %
0.1 —2 m.M.	24.5 %	43.6 %	6.7 %
HYGROSCOPIC COEFFICIENT:	19.16 %	20.11 %	21.08 %
MAXIMUM WATERCAPACITY:	48.7 %	42.9 %	48.7 %
VOLUME EXPANSION:	22.9 %	17.2 %	11.4 %

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	7.6	8.2	7.6
Quinhydrone electrode	7.6	8.1	6.2

COLORIMETRICAL DETERMINATIONS:

Filtrate	—	7.3	5.9
Centrifuged liquid	6.8	7.3	6.3
Exarisate	—	—	6.2
Comber-Hissink test 1 (after two days)	red	pink	red
Comber-Hissink test 2 (after two days)	6.5-6	6.5	6.5-6

CHEMICAL: $CaCO_3$ (with acetic acid) . . . . . 0.00 % 0.6 % 0.4 %

No. 566.

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, white and green, much	amphibole, little
	amphibole, brown-black, little	————
	augite, green, little	augite, little
	epidote, little	epidote, little
	garnet, little	————

heulandite,[1] little	**heulandite,** much
hypersthene, much	hypersthene, much
ilmenite, much	ilmenite, much
kyanite, little	————
limonite, little	limonite, little
magnetite, much	magnetite, much
plagioclase, much	plagioclase, much
quartz, much	quartz, much
tourmaline, little	tourmaline, little
vivianite, little	————
volcanic glass, little	volcanic glass, little
zircon, little	zircon, little
Foraminifera	————
needles of *Spongia*	————
other organic remains	————

No. 567.

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, little	amphibole, green, little
amphibole, colourless, little	amphibole, colourless, little
augite, green, little	augite, green, little
epidote, little	epidote, little
hypersthene, much	hypersthene, much
ilmenite, little	ilmenite, little
limonite, earthy, much	limonite, earthy, much
limonite, pisolitic, much	limonite, pisolitic, much
magnetite, very much	magnetite, very much
plagioclase, little	plagioclase, little
quartz, little	————
zircon, little	————

[1] Also found in a hard limestone-breccia with much glauconite and molluscs collected in 1916 by Mr. B. J. GRUTTERINK in the neighbourhood of Ngrajung, N. of Redjoso, district N. Kediri.

No. 568.

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, brown and green, little	amphibole, brown and green, little
	andalusite, little	————
	augite, little	augite, green, little
	calcite, little	calcite, little
	epidote, little	epidote, little
	hypersthene, little	hypersthene, little
	ilmenite, little	ilmenite, little
	limonite, earthy, much	limonite, much
	limonite, pisolitic, much	————
	magnetite, very much	magnetite, very much
	plagioclase, little	plagioclase, little
	quartz, little	quartz, little
	rutile, little	rutile, little
	————	**vivianite,** little
	plant-remains	————
	Foraminifera	————
	Spongia, rare.	————

No. 535.

GENERAL REMARKS.

LOCALITY: In the neighbourhood of Bunder, along the road from Piungan to Wonosari, S. E. of Djokja, where the geological map of VERBEEK and FENNEMA notes M_2 (petrographically: marls) and the newer geological sketch-map of VAN VALKENBURG and WHITE: trachytic and liparitic-tuff, age: oligocene-miocene.
(Cf. Jaarverslag van den Topografischen Dienst in Nederl.-Indië over 1923, Batavia 1924, p. 127).

GEOLOGICAL AGE: Tertiary.

HEIGHT: 250—500 M.

CLIMATE: I. Temperature.
Station Wedi, (see N°. 335), Yearly 24.1.

II. Rainfall.
Station Gawok, (N°. 74, Res. Djokjakarta, BOEREMA). Years of observations: 6. Height: 100 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
295	364	279	225	143	121	68	79	104	139	268	371	2 456 m.m.
12	14.8	11.4	9.2	5.8	4.9	2.8	3.2	4.2	5.7	10.9	15.1	100 %

III. Rainfactor (LANG): 2456 : 25.1 = 98.

VEGETATION: Trees.

ROCK.

MACROSCOPICAL: A soft, grey coloured limestone, with yellow and brown spots.

MICROSCOPICAL:
amphibole, green, much.
amphibole, brown, much.
asphalt.
augite, few.
fluorite, few.
hypersthene, much.
ilmenite, few.
limonite, much.
magnetite, few.

plagioclase, much.
quartz, little.
rutile, few.
tremolite, few.
zircon, few.
Coccolithes and *Discoaster* (See p. 47) very rare.
Foraminifera, silicificated and others filled with glauconite.
needles of *Spongia,* very rare.

CHEMICAL: Water (110° C.) .... 5.22 %

ANALYSIS (dry matter).

SiO_2	25.60 %
Al_2O_3	9.73 %
Fe_2O_3	5.99 %
MgO	1.41 %
CaO	30.63 %
Alkalies	0.90 %
CO_2	21.70 %
TiO_2	0.48 %
P_2O_5	0.00 %
SO_3	0.15 %
S	0.02 %
MnO	0.20 %
Loss on ignition	3.30 %
	100.11 %

SOIL (Sub-soil, first stadium).

MACROSCOPICAL: Fragments of limestone, yellow and yellow-brown concretions, some soil formed by weathering. Thickness: 0.3 m.

COLOUR DETERMINATION: With naked eye: yellow-brown.
Code des Couleurs: N°. 116.

TINTOMETRICAL: Red 4.7 + yellow 8.2 + blue 2.2.

MECHANICAL: Diameter of particles:

$<$ 0.01 m.M.	28.24 %
0.01—0.05 m.M.	26.80 %
0.05—0.1 m.M.	17.36 %
0.1 —2 m.M.	27.60 %

HYGROSCOPIC COEFFICIENT:	24.62 %.
MAXIMUM WATERCAPACITY:	82.3 %.
VOLUME EXPANSION:	38.89 %.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.0
Quinhydrone electrode	7.3

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.1
Centrifuged liquid	7.3
Exarisate	7.3
Comber-Hissink test 1 (after two days)	pink
Comber-Hissink test 2 (after two days)	6.5

CHEMICAL: Water (110° C.) .... 13.54 %

ANALYSIS (dry matter).

SiO_2	44.51 %
Al_2O_3	18.56 %
Fe_2O_3	14.95 %
MgO	1.49 %
CaO	2.16 %
Alkalies	0.22 %
CO_2	0.00 %
TiO_2	0.96 %
P_2O_5	0.06 %
SO_3	0.15 %
S	0.02 %
MnO	0.41 %
Loss on ignition	17.07 %
	100.56 %
Unweathered silicates	20.74 %
SiO_2 of the weathered silicates	30.75 %
Organic carbon	0.33 %
Humic matter (factor: 1.742)	0.75 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, much	amphibole, green, much
augite, green, much	augite, green, much
calcite, little	calcite, little
chlorite, few	————

— — — —	epidote, little
garnet, little	— — — —
— — — —	glauconite, little (perhaps Greenalite)
hypersthene, little	— — — —
ilmenite, little	ilmenite, little
kyanite, few	— — — —
limonite, much	limonite, much
magnetite, much	magnetite, much
muscovite, little	— — — —
plagioclase, much	plagioclase, much
quartz, much	quartz, much
rutile, little	rutile, few
tourmaline, little	tourmaline, few
tremolite, little	**tremolite,** litte
zircon, few	zircon, little
Foraminifera, silicificated	*Foraminifera*, silicificated
needles of *Spongia*	needles of *Spongia*
Radiolaria	*Radiolaria*
chlorite-schist, fragment of a rock	— — — —

CHEMICAL ANALYSIS OF A CONCRETION FROM THE SOIL (First stadium).

Water (110° C.)	2.75 %

ANALYSIS (dry matter).

SiO_2	41.22 %
Al_2O_3	26.21 %
Fe_2O_3	9.65 %
MgO	1.64 %
CaO	2.09 %
Alkalies	0.41 %
CO_2	0.04 %
TiO_2	0.74 %
P_2O_5	trace
SO_3	0.17 %
S	0.04 %
MnO	0.10 %
Loss on ignition	18.21 %
	100.52 %

Total carbon	0.96 %
Carbon from carbonates	0.01 %
Organic carbon	0.95 %
Humic matter (with factor: 1.742)	1.65 %

SOIL (Sub-soil, second stadium).

MACROSCOPICAL: The soil has a very crumble structure.

COLOUR DETERMINATION: With naked eye: yellow-brown.
Code des Couleurs: N°. 105.

TINTOMETRICAL: Red 6.25 + yellow 10.4 + blue 3.8.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	47.56 %
0.01—0.05 m.M.	24.24 %
0.05—0.1 m.M.	14.8 %
0.1 —2 m.M.	13.4 %

HYGROSCOPIC COEFFICIENT: 25.03 %.

MAXIMUM WATERCAPACITY: 65.4 %.

VOLUME EXPANSION: 22.22 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	5.8
Quinhydrone electrode	5.8

COLORIMETRICAL DETERMINATIONS:

Filtrate	5.4
Centrifuged liquid	5.8
Exarisate	5.5
Comber-Hissink test 1 (after two days)	red
Comber-Hissink test 2 (after two days)	6.5

CHEMICAL: Water (110° C.) 7.19 %

ANALYSIS (dry matter).

SiO_2	41.67 %
Al_2O_3	27.39 %
Fe_2O_3	9.38 %
MgO	1.40 %
CaO	1.60 %
Alkalies	0.69 %
CO_2	0.00 %
TiO_2	0.55 %

P_2O_5	trace
SO_3	0.10 %
S	0.02 %
MnO	0.21 %
Loss on ignition	17.02 %
	100.03 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, much	amphibole, green, few
amphibole, brown, few	amphibole, brown, few
apatite, few	**apatite,** few
augite, much	augite, few
epidote, few	epidote, few
fluorite, little	— — — —
garnet, little	garnet, few
hypersthene, few	hypersthene, few
ilmenite, little	ilmenite, much
limonite, few	limonite, few
magnetite, much	magnetite, much
plagioclase, much	plagioclase, much
pyrite, few	pyrite, much
quartz, much	quartz, much
rutile, few	rutile, few
— — — —	tourmaline, few
tremolite, few	**tremolite,** few
zircon, rare	zircon, few
iron-manganese concretions	— — — —
needles of *Spongia*, much	needles of *Spongia*
Foraminifera, silicificated, few	*Foraminifera*, silicificated
Radiolaria, little	*Radiolaria*, little

A great many burnt minerals and organisms, caused by tertiary volcanic eruptions, whose existence is proved by the presence of volcanic tuff, red weathered, and intercalated in the limestone itself.

SOIL (Surface-soil).

MACROSCOPICAL:	The uppermost layer of the soil-profile consisting of soil with a quantity of humic matter; organic remains are present, definite structure absent.
COLOUR DETERMINATION:	With naked eye: black. Code des Couleurs: N°. 114.
TINTOMETRICAL:	Red 6.45 + yellow 10.2 + blue 4.7.
MECHANICAL:	Diameter of particles:
	< 0.01 m.M. .... 53.2 %
	0.01—0.05 m.M. .... 16.8 %
	0.05—0.1 m.M. .... 11.04 %
	0.1 —2 m.M. .... 18.96 %
HYGROSCOPIC COEFFICIENT:	20.24 %.
MAXIMUM WATERCAPACITY:	54.9 %.
VOLUME EXPANSION:	27.78 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:
	Hydrogen electrode 6.5
	Quinhydrone electrode 6.7
	COLORIMETRICAL DETERMINATIONS:
	Filtrate 6.7
	Centrifuged liquid 6.8
	Exarisate 6.3
	Comber-Hissink test 1 (after two days) .. red
	Comber-Hissink test 2 (after two days) .. 6.5
CHEMICAL:	Water (110° C.) .... 6.37 %

ANALYSIS (dry matter).

SiO_2	40.39 %
Al_2O_3	22.53 %
Fe_2O_3	12.59 %
MgO	1.35 %
CaO	1.82 %
Alkalies	0.22 %
CO_2	0.05 %
TiO_2	0.60 %
P_2O_5	0.14 %
SO_3	0.13 %

S	0.00 %
MnO	0.33 %
Loss on ignition	19.92 %
	100.07 %

Unweathered silicates	14.16 %
SiO_2 of the weathered silicates	15.33 %
Total carbon	2.18 %
Carbon from carbonates	0.02 %
Organic carbon	2.16 %
Humic matter (with factor: 1.742)	3.72 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, much	amphibole, green, much
amphibole, brown, little	amphibole, brown, little
augite, little	augite, green, little
epidote, little	epidote, little
fluorite, few	— — — —
graphite, much	**graphite**, much
hypersthene, few	hypersthene, few
ilmenite, much	ilmenite, much
limonite, much	limonite, much
magnetite, much	magnetite, much
plagioclase, much	plagioclase, much
quartz, much	quartz, much
rutile, few	rutile, few
sillimanite, few	**sillimanite**, few
tourmaline, few	tourmaline, few
— — — —	**tremolite**, few
zircon, few	zircon, few
iron-manganese concretions, much	— — — —
Foraminifera, silicificated	*Foraminifera*, silicificated
— — — —	*Spongia*-needles

WEATHERING-FACTOR:

$$ki\ (rock) = \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{25.60}{9.73} \times 1.7 = 4.47.$$

$$ki\ (soil\ I) = \frac{44.51}{18.56} \times 1.7 = 4.08.$$

$$ki\ (\textit{concretion from soil I}) = \frac{41.22}{26.21} \times 1.7 = 2.69.$$

$$ki\ (\textit{soil II}) = \frac{41.67}{27.39} \times 1.7 = 2.59.$$

$$ki\ (\textit{soil III}) = \frac{40.39}{22.53} \times 1.7 = 3.04.$$

$$K\ \frac{\textit{soil I}}{\textit{rock}} = \frac{4.08}{4.47} = 0.91.$$

$$K\ \frac{\textit{concretion}}{\textit{rock}} = \frac{2.69}{4.47} = 0.60.$$

$$K\ \frac{\textit{soil II}}{\textit{rock}} = \frac{2.59}{4.47} = 0.58.$$

$$K\ \frac{\textit{soil III}}{\textit{rock}} = \frac{3.04}{4.47} = 0.68.$$

$$K\ \frac{\textit{soil I}}{\textit{rock}} = \frac{4.08}{4.47} = 0.91.$$

$$K\ \frac{\textit{soil II}}{\textit{soil I}} = \frac{2.59}{4.08} = 0.63.$$

$$K\ \frac{\textit{soil III}}{\textit{soil II}} = \frac{3.04}{2.59} = 1.17.$$

No. 570, 571 and 569.

GENERAL REMARKS.

LOCALITY: In the neighbourhood of Wonosari (= Wanasari), where the geological map of VERBEEK and FENNEMA notes M_3 (petrographically: limestone) and the sketch-map of VAN VALKENBURG and WHITE: Pliocene Globigerina-limestone, I found (October 1916) two remarkable types of limestone, which I named *knotted limestone* (570) (Dutch: knobbelkalk) and *wratted limestone* (571) (Dutch: wrattenkalk). N°. 569 is the soil of N°. 570 and 571.

GEOLOGICAL AGE: Tertiary.

HEIGHT: ± 200 M.

CLIMATE: I. Temperature.

Station Medi, (see N°. 335). Yearly 25.1.

II. Rainfall.

Station Wonosari (N°. 76, Res. Djokjakarta, BOEREMA). Years observations: 14. Height: 210 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
309	336	247	175	116	71	24	18	43	122	204	282	1 947 m.m.
15.9	17.3	12.7	9	6	3.6	1.2	0.9	2.2	6.3	10.5	14.4	100 %

III. Rainfactor (LANG): 1947 : 25.1 = 78.

VEGETATION: absent.

No. 570.

MACROSCOPICAL: Grey and hard limestone, with a great many lighter coloured spots, which give the impression of a puddingstone. The stone is corroded.

MICROSCOPICAL: A great many *Foraminifera* and fragments of other organic remains. The white spots, the knots, are irregular cavities filled up with calcite! Besides: Spherulites of radial-fibrous texture, consisting of calcium carbonate.

Further were found:

amphibole, very little.

augite, very little.

calcite, much.

corundum, much.

glauconite, little, as casts of foraminifera.

graphite, little.

ilmenite, very little.

magnetite, little.

plagioclase, very little.

quartz, clear like water and often in well-formed crystals.

vivianite, very little.

Foraminifera, very much.

CHEMICAL: $CaCO_3$ (with acetic acid) .... 90.7 %

No. 571.

MACROSCOPICAL: Grey, hard limestone with a great many of irregular cavities and different spots, covered with wrats (this limestone is covered with a thin black rind on several places).

MICROSCOPICAL: A great many spherulites of calciumcarbonate, demonstrating an uniaxial optically negative interference figure, by using *parallel* polarised light without condensor. (Cfr. ROSENBUSCH-WÜLFING. Mikroskopische Physiographie, Fifth edition, Stuttgart 1924, I, 1, p. 802).

Further, were found:

amphibole, very little.

augite, very little.

calcite, much.

corundum, much.

ilmenite, very little.

magnetite, little.

plagioclase, very little.

quartz, very little.

staurolite, very little.

zircon, very little.

Foraminifera, casts, consisting of iron-hydroxyde, very little.

CHEMICAL:	Water (110° C.)	0.76 %
	ANALYSIS (dry matter).	
	SiO_2	2.51 %
	Al_2O_3	0.92 %
	Fe_2O_3	1.27 %
	MgO	0.43 %
	CaO	53.64 %
	Alkalies	0.16 %
	TiO_2	0.06 %
	P_2O_5	0.03 %
	SO_3	0.08 %
	S.	0.02 %
	MnO	trace
	Loss on ignition (hydratic water, CO_2)	41.40 %
		100.52 %

No. 569.

MACROSCOPICAL: Hard and stiff clay, breaking in great, big pieces, with a great quantity of globular iron-concretions and fine, white speckles of limestone.
The iron concretions (brown, black and yellow) consist of hydrous iron-manganese-oxyde and possess often in the centre a mineral or a plantfibre. The white speckles are great *Foraminifera*, fragments of other remains and minutely fragments of limestone.

COLOUR DETERMINATION: With naked eye: brown-black.
Code des Couleurs: 130.

TINTOMETRICAL: Red 5.0 + yellow 6.6 + blue 3.9.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	41.4 %
0.01—0.05 m.M.	14.4 %
0.05—0.1 m.M.	8.4 %
0.1 —2 m.M.	35.8 %

HYGROSCOPIC COEFFICIENT: 19.2 %.

MAXIMUM WATERCAPACITY: 40.8 %.

VOLUME EXPANSION: 25.7 %.

PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.2
	Quinhydrone electrode	8.4
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	7.1
	Centrifuged liquid	7.5
	Exarisate	7.5
	Comber-Hissink test 1 (after two days)	red
	Comber-Hissink test 2 (after two days)	6.5
CHEMICAL:	Water (100° C.)	7.58 %
	ANALYSIS (dry matter).	
	SiO_2	44.21 %
	Al_2O_3	20.16 %
	Fe_2O_3	14.53 %
	MgO	1.02 %
	CaO	4.31 %
	Alkalies	0.47 %
	CO_2	1.42 %
	TiO_2	0.80 %
	P_2O_5	0.13 %
	SO_3	0.09 %
	S.	0.01 %
	MnO	1.50 %
	Loss on ignition	12.09 %
		100 74 %
	Unweathered silicates	21.32 %
	SiO_2 of the weathered silicates	27.37 %
	Total carbon	1.36 %
	Carbon from carbonates	0.39 %
	Organic carbon	0.97 %
	Humic matter (with factor: 1.742)	1.69 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green and colourless, much	amphibole, green and colourless, much
	andalusite, little	————
	augite, little	augite, green, little
	calcite, rather much	calcite, much
	epidote, little	epidote, little
	globulites of iron-manganese, very much	globulites of iron-manganese, very much

hypersthene, little	hypersthene, much
ilmenite, much	ilmenite, much
limonite, much	————
magnetite, much	magnetite, in well-built crystals
plagioclase, much	plagioclase, fragments; in very beautiful crystals with zonal structure
quartz, much	quartz, very much, often hexagonal pyramids with gas or fluid inclusions
rutile, little	rutile, little
————	volcanic glass, black (obsidian ?), 1 fragment
zircon, little	zircon, little.
Foraminifera, rather much	————
————	plant-remains, carbonized (Dutch: verkoold)

WEATHERING-FACTOR:

$$ki\ (rock)\ \frac{SiO_2}{Al_2O_3} \times 1.7 = \frac{2.51}{0.92} \times 1.7 = 4.64.$$

$$ki\ (soil)\ \frac{SiO_2}{Al_2O_3} \times 1.7 = \frac{44.21}{20.16} \times 1.7 = 3.72.$$

$$K\ \frac{3.72}{4.64} = 0.80.$$

N . 537, 538, 539.

GENERAL REMARKS.

LOCALITY: 9 K.M. W. of Grobogan, N. of Purwodadi, Res. Semarang.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 100—250 M.

CLIMATE: I. Temperature.

Station Sawahan, see N°. 320. Yearly temperature: 26.2.

II. Rainfall.

Station Grobogan, (N°. 197, Res. Semarang, BOEREMA). Years of observations: 25. Height: 38 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
353	288	248	171	122	79	46	46	101	182	222	318	2176 m.m.
16.2	13.2	11.4	7.9	5.6	3.6	2.1	2.1	4.7	8.4	10.2	14.6	100 %

III. Rainfactor (LANG): 2176 : 26.2 = 83.

VEGETATION: Teak-forests.

ROCK.

MACROSCOPICAL: Hard limestone with an iron-coated surface and a great many irregular cavities. Moreover very hard and fossiliferous beddings, without fissures or cavities.

MICROSCOPICAL:
amphibole, very little.
andalusite, very little.
augite, very little.
calcite, very little.
epidote, very little.
limonite, very little.
magnetite, very little.
plagioclase, very little.
quartz, very little.
rutile, 1 ex.
tourmaline, very little.
volcanic glass, 1 ex.
zircon, very little.

CHEMICAL:	Water (110° C.)	5.72 %
	ANALYSIS (dry matter).	
	SiO_2	2.86 %
	Al_2O_3	0.86 %
	Fe_2O_3	0.89 %
	MgO	0.45 %
	CaO	52.31 %
	Alkalies	0.41 %
	TiO_2	0.06 %
	SO_3	0.06 %
	S	0.02 %
	MnO	0.00 %
	Loss on ignition (CO_2, hydratic water)	42.08 %
		100.00 %

N°. 539, SOIL (collected on the slope).

MACROSCOPICAL: Brown-yellow soil in fissures or cavities of the limestone.

COLOUR DETERMINATION: With naked eye: brown-yellow.
Code des Couleurs: N°. 103 C.

TINTOMETRICAL: Red 2.3 + yellow 3.3 + blue 0.6.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	35.4 %
0.01—0.05 m.M.	16.0 %
0.05—0.1 m.M.	7.0 %
0.1 —2 m.M.	41.6 %

HYGROSCOPIC COEFFICIENT: 6.2 %.

MAXIMUM WATERCAPACITY: 41 %.

VOLUME EXPANSION: 6 %.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	7.8
Quinhydrone electrode	8.3

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.1
Centrifuged liquid	7.1
Exarisate	7.1
Comber-Hissink test 1 (after two days)	colourless
Comber-Hissink test 2 (after two days)	6.5

CHEMICAL:	Water (110° C.)	3.56 %
	ANALYSIS (dry matter).	
	SiO_2	77.05 %
	Al_2O_3	9.25 %
	Fe_2O_3	6.39 %
	MgO	0.14 %
	CaO	0.98 %
	Alkalies	1.26 %
	CO_2	0.00 %
	TiO_2	0.66 %
	P_2O_5	0.004 %
	SO_3	0.16 %
	S	0.06 %
	MnO	0.39 %
	Loss on ignition	4.14 %
		100.484 %
	Unweathered silicates	7.41 %
	SiO_2 of the weathered silicates	8.64 %
	Total carbon	0.77 %
	Organic carbon	0.77 %
	Humic matter (with factor: 1.742)	1.34 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green, very little	amphibole, green, few
	apatite, little	————
	augite, little	augite, green, few
	epidote, little	epidote, very little
	garnet, very little	————
	glauconite, very little	————
	hypersthene, very little	hypersthene, very little
	ilmenite, little	ilmenite, very little
	limonite, little	limonite, little
	magnetite, little	magnetite, little
	plagioclase, litte	plagioclase, little
	quartz, much	quartz, much
	rutile, very little	————
	tourmaline, very little	tourmaline, few
	zircon, little	zircon, few
	Foraminifera, limonitisated	————

A great many minerals are cemented into a brown, loamy mass.

No. 538.

The same soil as 539, but collected at the foot of the hill.

MACROSCOPICAL:	Hard and tough clay, when dry building little clods; with fragments of fossiliferous limestone.
COLOUR DETERMINATION:	*With naked eye: brown-yellow.* Code des Couleurs: N°. 138.
TINTOMETRICAL:	Red 5.2 + yellow 8.9 + blue 4.0.
MECHANICAL:	Diameter of particles: < 0.01 m.M. .... 25.6 % 0.01—0.05 m.M. .... 23.5 % 0.05—0.1 m.M. .... 24.6 % 0.1 —2 m.M. .... 26.3 %
HYGROSCOPIC COEFFICIENT:	6.4 %.
MAXIMUM WATERCAPACITY:	42.4 %.
VOLUME EXPANSION:	28.6 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS: Hydrogen electrode .... 7.3 Quinhydrone electrode .... 6.8 COLORIMETRICAL DETERMINATIONS: Filtrate .... 6.6 Centrifuged liquid .... 6.7 Exarisate .... 6.6 Comber-Hissink test 1 (after two days) red Comber-Hissink test 2 (after two days) 6.5—6

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green and brown, little	amphibole, green and brown, few
augite, green, little	augite, green, few
biotite, few	biotite, few
epidote, few	epidote, few
garnet, some	————
glaucophane, some	————
hypersthene, few	hypersthene, few

ilmenite, little	ilmenite, some
limonite, little	————
magnetite, little	magnetite, some
plagioclase, much	plagioclase, much
pyrite, few	————
quartz, much	quartz, much
rutile, few	rutile, some
tourmaline, little	tourmaline, very little
zircon, little	zircon, very little

fragments of limestone (the soil is lime-less) and plants (partly burnt).

WEATHERING-FACTOR:

$$ki\ (rock)\ \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{2.86}{0.86} \times 1.7 = 5.65.$$

$$ki\ (soil)\ \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{77.05}{9.25} \times 1.7 = 14.16.$$

$$K\ \frac{14.16}{5.65} = 2.51.$$

No. 557.

GENERAL REMARKS.

LOCALITY: Southerly slope of the Gg. Lasem, E. of Rembang. Collected by Prof. MCHR.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 100—250 M.

CLIMATE: I. Temperature.

Station Sawahan, see N°. 320. Yearly temperature: 26.2.

II. Rainfall.

Station Pamotan (N°. 15, Res. Rembang, BOEREMA). Years of observations: 10. Height: 40 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
343	307	289	167	133	65	23	36	55	105	164	259	1 946 m.m.
17.6	15.8	14.9	8.6	6.8	3.3	1.2	1.9	2.8	5.4	8.4	13.3	100 %

III. Rainfactor (LANG): 1946 : 26.2 = 74.

VEGETATION: Unknown.

ROCK.

Not collected.

SOIL.

MACROSCOPICAL: Brown-red, fine-sandy loam.

COLOUR DETERMINATION: With naked eye: brown-red.
Code des Couleurs: N°. 137.

TINTOMETRICAL: Red 6.6 + yellow 9.0 + blue 3.5.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	15.2 %
0.01—0.05 m.M.	44.7 %
0.05—0.1 m.M.	29.5 %
0.1 —2 m.M.	10.6 %

HYGROSCOPIC COEFFICIENT: 4.89 %.

MAXIMUM WATERCAPACITY: 40.3 %.

VOLUME EXPANSION: 0.00 %.

PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	6.1
	Quinhydrone electrode	5.8
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	—
	Centrifuged liquid	5.7
	Exarisate	—
	Comber-Hissink test 1 (after two days)	red
	Comber-Hissink test 2 (after two days)	5.5—6
CHEMICAL:	$CaCO_3$ (with acetic acid)	0.00 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green and colourless, little	amphibole, green and colourless, little
	augite, little	augite, little
	corundum, little	— — — —
	epidote, little	epidote, little
	glaucophane, little	— — — —
	hypersthene, little	hypersthene, little
	ilmenite, little	ilmenite, little
	limonite, in globular concretions, little	limonite, in globular concretions, little
	magnetite, little	magnetite, much
	plagioclase, much	plagioclase, much
	quartz, little	quartz, much
	zircon, few	zircon, few
	Foraminifera	— — — —
	organic remains	— — — —
	globular concretions of iron-manganese	globular concretions of iron-manganese

No. 551.

GENERAL REMARKS.

LOCALITY: N.W. of Tjabak and S.E. of Djepon.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 150 M.

CLIMATE: I. Temperature.

Station Sawahan, see N°. 320. Yearly temperature: 26.2.

II. Rainfall.

Station Djiken (N°. 23, Res. Rembang, BOEREMA). Years of observations: 22. Heigth: 110 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
304	251	250	113	109	40	29	56	63	109	188	241	1 753 m.m.
17.3	14.3	14.3	6.4	6.2	2.3	1.7	3.2	3.6	6.2	10.7	13.8	100 %

III. Rainfactor (LANG): 1753 : 26.2 = 67.

VEGETATION: Teak-forests.

ROCK.

MACROSCOPICAL: Dark-red, sandy limestone, corresponding in its features with „Bunter Sandstone".

MICROSCOPICAL: All minerals with a rough surface are covered with an iron coat; all minerals with a smooth surface are free of iron.

amphibole, very little.

augite, very little.

epidote, very little.

ilmenite, very little.

limonite, very little.

muscovite, little.

plagioclase, much.

quartz, much.

rutile, very little.

zircon, very little.

Foraminifera, very much.

CHEMICAL:	Water (110° C.)	18.4 %
	ANALYSIS (dry matter).	
	SiO_2	18.75 %
	Al_2O_3	3.09 %
	Fe_2O_3	17.18 %
	MgO	0.74 %
	CaO	32.75 %
	Alkalies	0.59 %
	TiO_2	0.29 %
	P_2O_5	0.14 %
	SO_3	0.02 %
	S	0.00 %
	MnO	0.65 %
	Loss on ignition (CO_2, hydratic water)	25.88 %
		100.08 %

SOIL.

MACROSCOPICAL: Sandy, brown-red loam, with a fine crumble structure.

COLOUR DETERMINATION: With naked eye: brown-red.
Code des Couleurs: N°. 78.

TINTOMETRICAL: Red 7.65 + yellow 10.2 + blue 3.9.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	7.0 %
0.01—0.05 m.M.	7.5 %
0.05—0.1 m.M.	16.0 %
0.1 —2 m.M.	69.5 %

HYGROSCOPIC COEFFICIENT: 9.9 %.

MAXIMUM WATERCAPACITY: 41.8 %.

VOLUME EXPANSION: 0.00 %.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	6.6
Quinhydrone electrode	6.7

COLORIMETRICAL DETERMINATIONS:

Filtrate	6.1
Centrifuged liquid	6.1
Exarisate	6.1

	Comber-Hissink test 1 (after two days)	very pink
	Comber-Hissink test 2 (after two days)	6.5—6
CHEMICAL:	Water (110° C.)	3.28 %

ANALYSIS (dry matter).

SiO_2	70.90 %
Al_2O_3	8.80 %
Fe_2O_3	8.15 %
MgO	1.09 %
CaO	1.70 %
Alkalies	0.97 %
CO_2	1.01 %
TiO_2	0.67 %
P_2O_5	0.14 %
SO_3	0.06 %
S	0.00 %
MnO	0.37 %
Loss on ignition	6.59 %
	100.45 %

Unweathered silicates '	64.44 %
SiO_2 of the weathered silicates	12.99 %
Total carbon	0.53 %
Carbon from carbonates	0.28 %
Organic carbon	0.25 %
Humic matter (with factor: 1.742)	0.44 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, little	amphibole, green, very little
andalusite, rather much	————
augite, little	augite, green, little
cordierite, little	**cordierite,** little
epidote, little	epidote, little
glauconite, little	————
ilmenite, little	ilmenite, little
limonite, little	limonite, little
magnetite, little	magnetite, little
muscovite, little	muscovite, little

plagioclase, much	plagioclase, much
quartz, rather much	quartz, much
rutile, little	rutile, little
tourmaline, little	————
vivianite, little	————
zircon, rather much	zircon, rather much
organic remains, much	organic remains, few

WEATHERING-FACTOR:

$$ki\ (rock)\ \frac{SiO_2}{Al_2O_3} \times 1.7 = \frac{18.75}{3.09} \times 1.7 = 10.32.$$

$$ki\ (soil)\ \frac{SiO_2}{Al_2O_3} \times 1.7 = \frac{70.90}{8.80} \times 1.7 = 13.70.$$

$$K = \frac{13.70}{10.32} = 1.32.$$

No. 548, 549.

GENERAL REMARKS.

LOCALITY:	In the neighbourhood of the little village (dessa) Tjabak (also the name of the Forest-division).
GEOLOGICAL AGE:	Tertiary.
HEIGHT:	150 M.
CLIMATE:	I. Temperature: Station Sawahan, see N°. 320. Yearly temperature: 26.2. II. Rainfall. Station Djiken, see N°. 551. Yearly rainfall: 1753 m.M. III. Rainfactor (LANG): 1753 : 26.2 = 67.
VEGETATION:	Teak-forests.

ROCK.

MACROSCOPICAL:	Soft, yellow limestone.
MICROSCOPICAL:	amphibole, green, little. augite, green, little. biotite, little. calcite, little. epidote, little. glauconite, little. ilmenite, little. **kaolinite,** in brown, grey or white, irregular soft scales, with silky lustre; low hardness and low specific gravity; absorbing methylenblue; optical properties not to determine. limonite, in brown scales and in globulites, much. magnetite, little. microcline, little. plagioclase, little. quartz, little. rutile, little. tourmaline, little. zircon, little. *Foraminifera,* limonitisated, very much.

After solution in acetic acid we remark a great many agglomerates of minerals and organisms cemented by siliciumdioxyde and ironhydroxide.

The same *Coccoliths* and other organic remains described on page 47, but very rare.

CHEMICAL: Water (110° C.) .... 1.41 %

ANALYSIS (dry matter).

SiO_2	37.50 %
Al_2O_3	3.79 %
Fe_2O_3	2.69 %
MgO	0.66 %
CaO	29.16 %
Alkalies	1.05 %
TiO_2	0.33 %
P_2O_5	trace
SO_3	0.10 %
S	0.00 %
MnO	0.25 %
Loss on ignition (CO_2, hydratic water)	24.49 %
	100.02 %

SOIL (Sub-soil).

MACROSCOPICAL: Light-yellow-coloured soil with many fragments of limestone.

COLOUR DETERMINATION: With naked eye: light-yellow. Code des Couleurs: N°. 128c.

TINTOMETRICAL: Red 3.1 + yellow 4.6 + blue 2.2.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	17.4 %
0.01—0.05 m.M.	30.4 %
0.05—0.1 m.M.	27.6 %
0.1 —2 m.M.	24.6 %

HYGROSCOPIC COEFFICIENT: 4.35 %.

MAXIMUM WATERCAPACITY: 42.8 %.

VOLUME EXPANSION: 0.00 %.

PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.3
	Quinhydrone electrode	8.1
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	7.3
	Centrifuged liquid	7.1
	Exarisate	7.4
	Comber-Hissink test 1 (after two days)	pink
	Comber-Hissink test 2 (after two days)	> 6.5
CHEMICAL:	Water (110° C.)	1.81 %
	ANALYSIS (dry matter).	
	SiO_2	36.37 %
	Al_2O_3	4.12 %
	Fe_2O_3	2.90 %
	MgO	0.75 %
	CaO.	29.49 %
	Alkalies	1.20 %
	CO_2	21.53 %
	TiO_2	0.30 %
	P_2O_5	0.23 %
	SO_3	0.10 %
	S	0.00 %
	MnO	0.63 %
	Loss on ignition	2.48 %
		100.10 %
	Unweathered silicates	37.17 %
	SiO_2 of the weathered silicates	4.99 %
	Total carbon	5.88 %
	Carbon from carbonates	5.87 %
	Organic carbon	0.00 %
	Humic matter	0.00 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green, little	amphibole, green, very little
	apatite, very little	**apatite**, very little
	augite, little	augite, very little
	biotite, little	biotite, little
	calcite, rather much	calcite, rather much
	epidote, little	epidote, little

glauconite, little	glauconite, very little
— — — —	garnet, very little
ilmenite, little	ilmenite, little
kaolinite, much	— — — —
limonite, rather much	limonite, little
magnetite, little	magnetite, little
— — — —	muscovite, little
plagioclase, much	plagioclase, much
quartz, little	quartz, much
rutile, little	rutile, very little
tourmaline, little	tourmaline, very little
zircon, little	zircon, little
Foraminifera, partly limonitisated, much	*Foraminifera*, very much

N°. 549, SOIL (Surface-soil).

MACROSCOPICAL: Grey, hard and heavy clay with calcareous concretions and some brown spots.

COLOUR DETERMINATION: With naked eye: grey.
Code des Couleurs: 103 c.

TINTOMETRICAL: Red 0.8 + yellow 1.9 + blue 0.6.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	44.8 %
0.01—0.05 m.M.	10.8 %
0.05—0.1 m.M.	9.6 %
0.1 —2 m.M.	34.8 %

HYGROSCOPIC COEFFICIENT: 17 %.

MAXIMUM WATERCAPACITY: 43.6 %.

VOLUME EXPANSION: 15.7 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.5
Quinhydrone electrode	7.85

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.3
Centrifuged liquid	7.1

	Exarisate	7.3
	Comber-Hissink test 1 (after two days) ..	—
	Comber-Hissink test 2 (after two days) ..	—
CHEMICAL:	$CaCO_3$ (with acetic acid)	15.7 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, very little	amphibole, green, very little
	— — — —	**apatite,** very little
	augite, very little	augite, very little
	— — — —	biotite, very little
	calcite, rather much	calcite, much
	— — — —	epidote, very little
	ilmenite, little	ilmenite, little
	kaolinite, much	**kaolinite,** litte
	limonite, little	limonite, globular, little
	magnetite, little	magnetite, little
	— — — —	muscovite, little
	— — — —	orthoclase, altered to kaolinite, very little
	plagioclase, little	plagioclase, little
	quartz, little	quartz, little
	rutile, very little	rutile, very little
	— — — —	tourmaline, very little
	volcanic ash, black, much	**volcanic ash,** little
	— — — —	zircon, little
	Foraminifera, much	*Foraminifera*, much
	Organic remains, much	Organic remains, much

WEATHERING-FACTOR:

$$ki\ (rock)\ \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{37.50}{3.79} \times 1.7 = 16.82.$$

$$ki\ (sub\text{-}soil)\ \frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{36.37}{4.12} \times 1.7 = 15.01.$$

$$K = \frac{15.01}{16.82} = 0.90.$$

No. 550.

LOCALITY:	In the neighbourhood of the little village (= dessa) Nglebur, S. E. of Blora, in a plain between two ridges of limestone-hills.
MACROSCOPICAL:	Clay, consisting of fragments of limestone, fragments of limestone-soil with calcareous concretions and fluvial or pluvial deposited material.

A. The grey, fluvial- or pluvial-deposited material.

COLOUR DETERMINATION:	With naked eye: grey. Code des Couleurs: N°. 148.
TINTOMETRICAL:	Red 2.4 + yellow 2.9 + blue 2.7.
MECHANICAL:	Diameter of particles: $<$ 0.01 m.M. .... 85.0 % 0.01—0.05 m.M. .... 8.0 % 0.05—0.1 m.M. .... 1.5 % 0.1 —2 m.M. .... 5.5 %
HYGROSCOPIC COEFFICIENT:	14.2 %.
MAXIMUM WATERCAPACITY:	59 %.
VOLUME EXPANSION:	18.1 %.
PH VALUE:	Not determined.
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 18.1 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, very little	amphibole, green, very little
apatite, very litte	apatite, very little
augite, very little	augite, very little
biotite, very little	biotite, very little
calcite, little	calcite, little
epidote, very little	epidote, very little
garnet, very little	— — — —
glauconite, very little	glauconite, very little
hypersthene, very little	— — — —

ilmenite, little	ilmenite, very little
limonite, little	limonite, little
magnetite, little	magnetite, little
muscovite, very little	muscovite, very little
plagioclase, little	plagioclase, little
pyrite, in crystals, in metallic yellow-coloured globulites and in stalactites of crystalline pyrite. Observed crystalforms: cube, octahedron, dodekahedron, pyritohedron.	pyrite, very little
quartz, very much	quartz, very much
rutile, very little	rutile, very little
siderite, very little	————
sillimanite, little	————
tourmaline, very little	tourmaline, very little
volcanic glass, blue with impressions like fossil raindrops	————
zircon, very little	zircon, very little
Foraminifera and molluscs, very much	*Foraminifera*, very much

Colourless tubes of calcium-carbonate, soluble in acetic acid, with many black inclusions, resembling **pseudo-chiastolite**; index of refraction = 1.63 (daylight).

B. The black material with many fragments of limestone and with calcareous concretions.

COLOUR DETERMINATION: With naked eye: black.
Code des Couleurs: N°. 139.

TINTOMETRICAL: Red 3.8 + yellow 5.8 + blue 3.7.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	31.3 %
0.01—0.05 m.M.	15.0 %
0.05—0.1 m.M.	16.0 %
0.1 —2 m.M.	37.7 %

HYGROSCOPIC COEFFICIENT:	10.8 %.	
MAXIMUM WATERCAPACITY:	45.2 %.	
VOLUME EXPANSION:	12.9 %.	
PH VALUE:	Not determined.	
CHEMICAL:	$CaCO_3$, (with acetic acid) .... 15.2 %	
MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green, litte	amphibole, green little
	amphibole, brown, very little	————
	andalusite, very little	————
	apatite, little	**apatite**, very little
	augite, little	augite, little
	biotite, little	————
	calcite, little	calcite, little
	epidote, little	epidote, little
	garnet, little	garnet, very little
	glauconite, very little	glauconite, little
	glaucophane, little	————
	hypersthene, much	hypersthene, much
	ilmenite, much	ilmenite, little
	limonite, much	limonite, much
	magnetite, much	magnetite, much
	plagioclase, much	plagioclase, much
	pyrite, in crystals and in globulites of iron-bisulfide	pyrite, in crystals and in globulites of iron-bisulfide
	quartz, with inclusions of brown needles, not to determine, much	quartz, much
	rutile, little	rutile, little
	tourmaline, little	tourmaline, very little
	vivianite, little	————

zircon, much	zircon, much
Foraminifera, very much	*Foraminifera*, much
1 terrestrial mollusc (a kind of *Melania*)	————

CHEMICAL ANALYSIS OF A CALCAREOUS CONCRETION FROM 550.

Water (110° C.) .... 0.78 %

ANALYSIS (dry matter).

SiO_2	4.41 %
Al_2O_3	0.69 %
Fe_2O_3	3.21 %
MgO	0.51 %
CaO	49.10 %
Alkalies	0.75 %
CO_2	39.10 %
TiO_2	0.10 %
P_2O_5	0.00 %
SO_3	trace
S	0.00 %
Cl	0.00 %
MnO	0.00 %
Loss on ignition	2.22 %
	100.09 %

MICROSCOPICAL ANALYSIS OF A CONCRETION FROM 550.

After boiling in H_2O the following minerals were found:

amphibole, little.

asphalt, very much.

augite, little.

calcite, very much.

epidote, little.

quartz, little.

volcanic glass, very much .

STRUCTURE OF A CALCAREOUS CONCRETION FROM 550.

If we make a thin slide of a concretion from the margin to the centre, we remark the following: The outside is often white, covered with irregular, worm-like forms of calcium-carbonate and resembles rapidly dried lime-mud. In this outside-layer are many shells of foraminifera, while the casts consist of particles of calcite of radial-fibrous calcium-carbonate.

Under the white outside-layer exists a brown layer (owing to the presence of ironhydroxide) with a great many dendrites of MnO_2, building together a black band.

The centre consists of dull brown particles and many shells of foraminifera, filled up with calcite; often fissures filled up with clear calcite. Of course, the structure of the concretions is not always the same, but that which is described here is the structure of the most interesting concretion.

No. 545, 546.

GENERAL REMARKS.

LOCALITY: S. of the little village (= dessa) Ngliron, N. E. of Randu-Blatung, W. of Djepon.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 100 M.

CLIMATE: I. Temperature:

Station Sawahan, see N°. 320. Yearly temperature: 26.2.

II. Rainfall.

Station Kedung tuban (N°. 25, Res. Rembang, BOEREMA). Years of observations: 12. Height: 80 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
283	196	219	142	140	56	20	27	75	143	199	232	1 732 m.m.
16.3	11.3	12.6	8.2	8.1	3.2	1.2	1.6	4.3	8.3	11.5	13.4	100 %

III. Rainfactor (LANG): 1732 : 26.2 = 66.

VEGETATION: Teak-forests, but in a very bad condition.

ROCK (N°. 545).

MACROSCOPICAL: Green-greyish, sandy limestone with brown spots, consisting of glauconite, argillaceous matter and a great many *Foraminifera*. Kind of minerals few. This limestone is a beautiful example for diagenetic *Foraminifera*-Ooze! The limestone was covered with remains of *Algae*.

MICROSCOPICAL:
amphibole, green, much.
amphibole, brown, little.
augite, green, much.
calcite, little.
garnet, very little.
ilmenite, very little.
magnetite, very little.
plagioclase, very little.
zircon, little.

CHEMICAL: $CaCO_3$ (with acetic acid) .... 64 %

SOIL (Sub-soil).

MACROSCOPICAL:	Greyish loam, hard and tough when dry, plastic and greasy when wet. After heavy rains the soil creeps down and causes *landslides.*
COLOUR DETERMINATION:	With naked eye: grey-brown. Code des Couleurs: N°. 203a.
TINTOMETRICAL:	Red 3.65 + yellow 6.2 + blue 2.8.
MECHANICAL:	Diameter of particles: $<$ 0.01 m.M. .... 33.0 % 0.01—0.05 m.M. .... 36.5 % 0.05—0.1 m.M. .... 5.0 % 0.1 —2 m.M. .... 25.5 %
HYGROSCOPIC COEFFICIENT:	12.8 %.
MAXIMUM WATERCAPACITY:	48 %.
VOLUME EXPANSION:	14.3 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS: Hydrogen electrode .... 8.6 Quinhydrone electrode .... 8.7 COLORIMETRICAL DETERMINATIONS: Filtrate .... 7.6 Centrifuged liquid .... 7.6 Exarisate .... 7.6 Comber-Hissink test 1 (after two days) colourless Comber-Hissink test 2 (after two days) 6.5
CHEMICAL:	Water (100° C.) .... 9.63 %

ANALYSIS (dry matter).

SiO_2	55.76 %
Al_2O_3	15.02 %
Fe_2O_3	9.83 %
MgO	1.91 %
CaO	4.70 %
Alkalies	0.91 %
TiO_2	0.72 %
P_2O_5	0.03 %
SO_3	0.15 %
S	0.00 %
MnO	0.47 %
Loss on ignition	10.53 %
	100.13 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, colourless, green and red-brown, little	amphibole, very little
	augite, little	augite, very little
	calcite, rare	calcite, rare
	epidote, little	epidote, very little
	hypersthene, little	hypersthene, very little
	ilmenite, little	ilmenite, little
	kaolinite, much	**kaolinite,** much
	limonite, much	limonite, little
	magnetite, little	magnetite, little
	plagioclase, much	plagioclase, little
	pyrite, little	pyrite, very little
	quartz, much	quartz, little
	rutile, little	————
	tourmaline, very little	————
	volcanic ash, much	volcanic ash, much
	zircon, little	zircon, little
	Foraminifera, little	*Foraminifera,* little
	organic remains, little	————
	coral-fragments (burnt) little	————

SOIL (Surface-soil)

MACROSCOPICAL: Black-greyish loam with beginning of a crumble structure.

COLOUR DETERMINATION: With naked eye: black-grey.
Code des Couleurs: N°. 172.

TINTOMETRICAL: Red 4.8 + yellow 7.4 + blue 4.6.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	....	55.5 %
0.01—0.05 m.M.	....	37.0 %
0.05—0.1 m.M.	....	5.0 %
0.1 —2 m.M.	....	2.5 %

HYGROSCOPIC COEFFICIENT:	14.5 %.
MAXIMUM WATERCAPACITY:	50.2 %.
VOLUME EXPANSION:	17.2 %.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	6.6
Quinhydrone electrode	6.8

ELECTROMETRICAL DETERMINATIONS:

Filtrate	6.4
Centrifuged liquid	6.3
Exarisate	6.6
Comber-Hissink test 1 (after two days)	red
Comber-Hissink test 2 (after two days)	6.5—6

CHEMICAL:

Water (110° C.)	5.41 %

ANALYSIS (dry matter).

SiO_2	57.00 %
Al_2O_3	15.28 %
Fe_2O_3	10.10 %
MgO	1.34 %
CaO	1.42 %
Alkalies	0.90 %
CO_2	0.00 %
TiO_2	0.72 %
P_2O_5	trace
SO_3	0.09 %
S	0.01 %
MnO	0.28 %
Loss on ignition	13.40 %
	100.54 %

Unweathered silicates	43.77 %
SiO_2 of the weathered silicates	23.34 %
Total carbon	1.08 %
Humic matter (with factor: 1.742)	1.88 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green and brown, little	amphibole, green and brown, little
augite, little	augite, little
biotite, little	————

calcite, little	————
epidote, little	epidote, little
hypersthene, much	hypersthene, much
ilmenite, little	ilmenite, little
kaolinite, much	**kaolinite**, much
limonite, much	limonite, little
magnetite, much	magnetite, little
plagioclase, much	plagioclase, little
pyrite, little	————
quartz, much	quartz, little
rutile, little	————
tourmaline, little	————
vivianite, very little	————
zircon, little	zircon, little
concretions, yellow and brown, much	concretions, yellow and brown, much
Foraminifera, little	*Foraminifera*, little
organic remains, little	organic remains, little

WEATHERING-FACTOR: *ki (first stadium)* $\frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{55.76}{15.02} \times 1.7 = 6.31.$

ki (second stadium) $\frac{Si\,O_2}{Al_2O_3} \times 1.7 = \frac{57.00}{15.28} \times 1.7 = 6.34.$

$$K\ \frac{6.34}{6.31} = 1.00.$$

No. 553.

GENERAL REMARKS.

LOCALITY: Forest-division Ledok, S. E. of Blora, Res. Semarang. Collected by Prof. MOHR.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 100 M.

CLIMATE: I. Temperature.

Station Sawahan (see N°. 320). Yearly temperature: 26.2.

II. Rainfall.

Station Sambong (N°. 24, Res. Semarang, BOEREMA). Years of observations 8. Height: 75 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
371	257	258	211	124	88	17	58	69	198	220	275	2 146 m.m.
17.3	12	12	9.8	5.8	4.1	0.8	2.7	3.2	9.2	10.3	12.8	100 %

III. Rainfactor (LANG) 2146 : 26.2 = 82.

VEGETATION: Teak-forests.

ROCK.

Not collected.

SOIL.

MACROSCOPICAL: Brown-red, sandy loam.

COLOUR DETERMINATION: With naked eye: brown-red.
Code des Couleurs: N°. 102.

TINTOMETRICAL: Red 10.4 + yellow 14.0 + ble 4.8. .

MECHANICAL: Diameter of particles:

< 0.01 m.M.	17.8 %
0.01—0.05 m.M.	19.7 %
0.05—0.1 m.M.	10.3 %
0.1 —2 m.M.	52.2 %

HYGROSCOPIC COEFFICIENT: 8.8 %.

MAXIMUM WATERCAPACITY: 47.4 %.

VOLUME EXPANSION: 0.00 %.

PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	6.0
	Quinhydrone electrode	6.5
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	5.8
	Centrifuged liquid	5.9
	Exarisate	5.9
	Comber-Hissink test 1 (after two days)	red
	Comber-Hissink test 2 (after two days)	6.5—6
CHEMICAL:	$CaCO_3$ (with acetic acid)	0.00 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green en colourless, little	amphibole, green and colourless, little
	andalusite, little	— — — —
	augite, little	augite, little
	calcite, little	— — — —
	— — — —	**chlorite,** few
	epidote, little	epidote, little
	garnet, little	garnet, little
	glauconite, little	glauconite, little
	ilmenite, little	ilmenite, little
	leucoxene, much	leucoxene, much
	limonite, very much	limonite, little
	magnetite, very much	magnetite, much
	— — — —	muscovite, little
	plagioclase, much	plagioclase, much
	pyrite, little	pyrite, little
	quartz, very much	quartz, very much
	rutile, little	rutile, few
	tourmaline, little	tourmaline, few
	— — — —	**vivianite,** little
	— — — —	volcanic glass
	zircon, much	zircon, little
	organic remains, much	— — — —
	organic remain, green, fibrous, 1	— — — —
	fragment of a plagioclase-amphibole rock 1	— — — —

No. 502, 520 and 521.

I will give here some information about a breccia of molluscs, wood and glauconitic limestone, absolutely unweathered, which were collected for me by the Chief-forester J. B. GRUTTERINK in 1916. N°. 502 was collected in the neighbourhood of Banju-asin, forestdivision N. W.-Kediri; N°. 520 and 521 in the neighbourhood of Ngrajung, N. of Redjasa.

MICROSCOPICAL ANALYSIS OF N°. 502.

amphibole, green and brown, much.
augite, green, little.
calcite, in clear grains in fissures and cavities.
epidote, little.
hypersthene, little.
ilmenite, very little.
magnetite, very little.
plagioclase, much.
quartz, much.
rutile, very little.
zircon, little.
molluscs, much.
Foraminifera little.

MICROSCOPIAL ANALYSIS OF N°. 520.

amphibole, green and brown, much.
augite, green little.
calcite, much.
epidote, very little.
glauconite, little.
heulandite, rather much.
hypersthene, rather much.
ilmenite, little.
magnetite, little.
orthoclase with albite, little.
plagioclase, rather much.

vivianite, little.

organic remains, little.

MICROSCOPICAL ANALYSIS OF N°. 521.

amphibole, green, much.

augite, much.

calcite, in cavities of the wood.

epidote, very little.

hypersthene, little.

magnetite, much.

plagioclase, very much.

quartz, very much.

tremolite, very little.

zircon, very little.

In a fragment of the wood, boiled with HCl, the following minerals were found:

amphibole.

plagioclase.

quartz.

In the casts of the molluscs:

amphibole.

quartz.

plagioclase.

zircon.

No. 728.

GENERAL REMARKS.

LOCALITY: Along the road Pamekasan-Tamberu, N. of Pamekasan, Isle of Madura. Collected by Prof. MOHR.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 250 M.

CLIMATE: I. Temperature.

Station Sarokka. Years of observations: 1912—1918. Heigth: 2 M. Temperature in degrees Celcius:

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
26.3	26.5	26.8	27.5	27.3	26.9	26.5	26.6	27.0	27.7	27.8	26.9	27.0

II. Rainfall.

Station Pegantenan (N°. 17, Madura, BOEREMA). Years of observations: 19. Heigth: 312 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
290	232	214	157	85	40	18	15	26	82	168	184	1 511 m.m.
19.2	15.4	14.2	10.4	5.6	2.6	1.2	1.0	1.7	5.4	11.1	12.2	100 %

III. Rainfactor (LANG): 1511 : 27.0 = 56.

VEGETATION: Unknown.

ROCK.

Not collected.

SOIL (Sub-soil).

MACROSCOPICAL: Grey-yellow clay, in clods.

COLOUR DETERMINATION: With naked eye: grey-yellow.
Code des Couleurs: N°. 167.

TINTOMETRICAL: Red 3.2 + yellow 4.1 + blue 2.0.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	34.2 %
0.01—0.05 m.M.	23.0 %
0.05—0.1 m.M.	16.4 %
0.1 —2 m.M.	26.4 %

HYGROSCOPIC COEFFICIENT:	12.9 %.	
MAXIMUM WATERCAPACITY:	41.3 %.	
VOLUME EXPANSION:	10 %.	
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.3
	Quinhydrone electrode	8.0
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	7.3
	Centrifuged liquid	7.3
	Exarisate	7.2
	Comber-Hissink test 1 (after two days)	colourless
	Comber-Hissink test 2 (after two days)	< 6.5
CHEMICAL:	$CaCO_3$ (*with acetic acid*)	2.1 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, rather much	amphibole, little
augite, little	augite, little
epidote, little	epidote, very little
hypersthene, little	hypersthene, very little
ilmenite, little	ilmenite, little
— — — —	limonite, little
magnetite, little	magnetite, little
— — — —	muscovite, little
plagioclase, much	plagioclase, very much
quartz, much	quartz, very much
rutile, little	rutile, very little
tourmaline, little	tourmaline, little
zircon, little	zircon, much
Foraminifera, little	*Foraminifera*, little
organic remains, much	organic remains, much
fragments of limestone	

SOIL (Surface-soil).

MACROSCOPICAL: Grey clay, in clods, with plant-remains.

COLOUR DETERMINATION: With naked eye: dark-grey.
Code des Couleurs: N°. 168.

TINTOMETRICAL:	Red 3.7 + yellow 4.5 + blue 2.7.
MECHANICAL:	Diameter of particles:
	< 0.01 m.M. .... 31.6 %
	0.01—0.05 m.M. .... 22.4 %
	0.05—0.1 m.M. .... 11.4 %
	0.1 —2 m.M. .... 34.6 %
HYGROSCOPIC COEFFICIENT:	12.2 %.
MAXIMUM WATERCAPACITY:	41.4 %.
VOLUME EXPANSION:	11.4 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:
	Hydrogen electrode 8.0
	Quinhydrone electrode 7.5
	COLORIMETRICAL DETERMINATIONS:
	Filtrate 6.8
	Centrifuged liquid 6.9
	Exarisate .... —
	Comber-Hissink test 1 (after two days) colourless
	Comber-Hissink test 2 (after two days) < 6.5
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 0.00 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, rather much	amphibole, little
— — — —	apatite, zonal, little
augite, little	augite, little
— — — —	biotite, very little
epidote, little	epidote, very little
hypersthene, little	hypersthene, very little
ilmenite, little	ilmenite, little
— — — —	limonite, little
magnetite, little	magnetite, little
— — — —	muscovite, little
plagioclase, much	plagioclase, very much
— — — —	pyrite, very little
quartz, much	quartz, very much
rutile, little	rutile, very little

— — — —	**sillimanite**, very little
tourmaline, little	tourmaline, little
— — — —	**vivianite**, very little
zircon, little	zircon, much

A green-blue mineral soluble in NH_4OH; pleochroitic from dark-blue till pale-blue; s.g. > 3.3; index ± 1.74; double refraction: high. A **copper mineral?**

Foraminifera, little	— — — —
organic remains, much	— — — —

No. 729.

GENERAL REMARKS.

LOCALITY: N. of Bulang, along the road Sampang-Ketapang, Isle of Madura. Collected by Prof. MOHR.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 250 M.

CLIMATE: I. Temperature.

Station Sarokka, see N°. 728. Yearly temperature: 27.0.

II. Rainfall.

Station Bulang (N°. 11, Madura, BOEREMA). Years of obsersations: 13. Height: 20 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
368	315	322	274	198	66	34	15	37	121	189	300	2 239 m.m.
16.4	14.1	14.4	12.2	8.8	2.9	1.5	0.7	1.7	5.4	8.5	13.4	100 %

III. Rainfactor (LANG): 2239 : 27.0 = 83.

VEGETATION: Unknown.

ROCK.

Not collected.

SOIL (Sub-soil, depth: 20—50 c.M.).

MACROSCOPICAL: Yellow clay, in clods.

COLOUR DETERMINATION: With naked eye: yellow.
Code des Couleurs: N°. 166.

TINTOMETRICAL: Red 4.3 + yellow 9.0 + blue 2.5.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	32.2 %
0.01—0.05 m.M.	39.6 %
0.05—0.1 m.M.	12.6 %
0.1 —2 m.M.	15.6 %

HYGROSCOPIC COEFFICIENT: 7.2 %.

MAXIMUM WATERCAPACITY: 35. 6 %.

VOLUME EXPANSION: 11.4 %.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.4
Quinhydrone electrode	7.8

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.5
Centrifuged liquid	7.5
Exarisate	7.5
Comber-Hissink test 1 (after two days)	very pink
Comber-Hissink test 2 (after two days	>6.5

CHEMICAL: $CaCO_3$ (with acetic acid) .... 29.7 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, very little	amphibole, very little
————	**apatite,** very little, in crystals, in one case as **eggshaped, colourless inclusions in apatite itself**
augite, very little	augite, very little
biotite, very little	biotite, very little
calcite, very little	calcite, little
epidote, very little	epidote, very little
garnet, very little	garnet, very little (as a crystal, 1 ex.)
————	**graphite,** little
————	hypersthene, very little
ilmenite, little	ilmenite, very little
limonite, little	limonite, little
magnetite, little	magnetite, little
muscovite, very little	muscovite, much
plagioclase, little	plagioclase, little
pyrite, very little	pyrite, little
quartz, little	quartz, little
rutile, very little	rutile, very little
tourmaline, very little	tourmaline, little
vivianite, very little	**vivianite,** little

zircon, very little	zircon, little
Foraminifera, very much	*Foraminifera*, very much
globulites of iron, little	————
————	remains of *Spongia*, little

SOIL (Surface-soil, depth: 0—20 c.M.)

MACROSCOPICAL: Crumble clay.

COLOUR DETERMINATION: With naked eye: brown-yellow.
Code des Couleurs: N°. 133.

TINTOMETRICAL: Red 5.3 + yellow 12.0 + blue 4.5.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	36.4 %
0.01—0.05 m.M.	27.8 %
0.05—0.1 m.M.	22.0 %
0.1 —2 m.M.	13.8 %

HYGROSCOPIC COEFFICIENT: 8.7 %.

MAXIMUM WATERCAPACITY: 40.1 %.

VOLUME EXPANSION: 11.4 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	7.8
Quinhydrone electrode	8.1

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.2
Centrifuged liquid	7.4
Exarisate	7.3
Comber-Hissink test 1 (after two days)	colourless
Comber-Hissink test 2 (after two days)	> 6.5

CHEMICAL: $CaCO_3$ (with acetic acid) .... 1.5 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, rather much	amphibole, very little
andalusite, very little	————
————	**apatite**, very little
augite, rather much	augite, very little.
calcite, very little	————

epidote, very little	epidote, little
garnet, very little	garnet, very little
graphite, very little	**graphite,** little
hypersthene, little	hypersthene, very little
ilmenite, little	ilmenite, little
limonite, little	limonite, little
magnetite, rather much	magnetite, much
muscovite, very little	muscovite, little
plagioclase, rather much	plagioclase, much
pyrite, very little	pyrite, little
quartz, much	quartz, much
rutile, very little	rutile, little
tourmaline, little	*tourmaline*, much
vivianite, very little	**vivianite,** little
zircon, little	zircon, much
Foraminifera, little	*Foraminifera,* little
globulites of iron, rather much	————
————	remains of plants, little

No. 730.

GENERAL REMARKS.

LOCALITY: In the neighbourhood of Ketapang, N. coast of the isle of Madura. Collected by Prof. MOHR.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 5 M.

CLIMATE: I. Temperature.

Station Sarokka, see N°. 728. Yearly temperature: 27.0.

II. Rainfall.

Station Ketapang-daja (N°. 18, Madura, BOEREMA). Years of observations: 13. Height: 0 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
188	171	148	105	75	36	11	20	13	37	87	159	1 050 m.m.
17.9	16.3	14.1	10	7.1	3.4	1.1	1.9	1.2	3.5	8.3	15.2	100 %

III. Rainfactor (LANG): 1050 : 27.0 = 39.

VEGETATION: Unknown.

ROCK.

Not collected.

SOIL.

MACROSCOPICAL: Brown-red, sandy loam.

COLOUR DETERMINATION: With naked eye: brown-red.
Code des Couleurs: N°. 127.

TINTOMETRICAL: Red 7.2 + yellow 11.0 + blue 3.0.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	6.0 %
0.01—0.05 m.M.	10.0 %
0.05—0.1 m.M.	9.8 %
0.1 —2. m.M.	74.2 %

HYGROSCOPIC COEFFICIENT: 7.6 %.

MAXIMUM WATERCAPACITY: 31.3 %.

VOLUME EXPANSION: 0.00 %.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	7.2
Quinhydrone electrode	6.4

COLORIMETRICAL DETERMINATIONS:

Filtrate	6.2
Centrifuged liquid	6.2
Exarisate	—
Comber-Hissink test 1 (after two days)	red
Comber-Hissink test 2 (after two days)	6.5

CHEMICAL: $CaCO_3$ (with acetic acid) .... 0.00 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, very little	amphibole, very little
andalusite, much	**andalusite,** much
apatite, very little	**apatite,** very little
augite, very little	augite, very little
epidote, little	epidote, little
eukolite?, very little	**eukolite ?,** very little
garnet, very litte	garnet, very little
glauconite, very little	————
glaucophane, very little	————
hypersthene, very little	————
ilmenite, much	ilmenite, much
leucoxene, little	leucoxene, little
limonite, globulitic, little	limonite, globulitic, little
magnetite, much	magnetite, much
muscovite, litte	muscovite, little
plagioclase, with inclusions of rutile, much	plagioclase, with inclusions of rutile, much
quartz, with inclusions of rutile, very much	quartz with inclusions of rutile, very much
rutile, little	rutile, little
staurolite, litte	staurolite, little
tourmaline, little	tourmaline, little
volcanic glass, little	volcanic glass, little
zircon, much	zircon, much
organic remains, little	organic remains, little

No. 744.

GENERAL REMARKS.

LOCALITY: Bitoni, near bivouac Oilolok, Isle of Timor. Collected by the late Prof. H. G. JONKER on the 22nd of April 1916.

GEOLOGICAL AGE: Permian.

HEIGHT: 420 M.

CLIMATE: I. Temperature.

Station Kupang. Years of observations: 1912—1918. Height: 345 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
26.3	26.0	26.3	26.3	26.1	25.3	25.0	25.6	26.3	27.0	27.4	26.9	26.2

II. Rainfall.

Station Niki-Niki (470, Timor, BOEREMA). Years of observations: 44. Height: 15 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
258	268	244	111	108	63	42	12	3	33	87	235	1 464 m.m.
17.6	18.3	16.7	7.6	7.3	4.3	2.9	0.8	0.2	2.3	5.9	16.1	100 %

III. Rainfactor (LANG): 1464 : 26.2 = 56.

VEGETATION: Grass.

ROCK.

MACROSCOPICAL: Hard, red limestone with veins of calcite.

CHEMICAL: Water (110° C.) .... 2.05 %

ANALYSIS (dry matter).

SiO_2	6.74 %
Al_2O_3	2.50 %
Fe_2O_3	4.55 %
MgO	1.13 %
CaO	47.18 %
Alkalies	0.09 %
TiO_2	0.88 %
P_2O_5	0.07 %
SO_3	0.33 %
S	0.00 %
MnO	0.27 %
Loss on ignition (CO_2, hydratic water)	37.02 %
	100.76 %

MICROSCOPICAL:	amphibole, very little.
	augite, very little.
	calcite, very much, with perfect cleavage, sometimes lamellar in form.
	epidote, very little.
	garnet, pale rose-red, very little.
	ilmenite, very little.
	limonite, very little.
	magnetite, very little.
	plagioclase, very little.
	quartz, very little.
	rutile, very little.
	tourmaline, very little.
	Foraminifera, very much; often impregnated with iron-oxyde.
	Spongia, some.
	Radiolaria, some.

SOIL.

MACROSCOPICAL:	Red clay with crumble structure, containing some pieces of red limestone.
COLOUR DETERMINATION:	With naked eye: red. Code des Coulours: N°. 52.
TINTOMETRICAL:	Red 7.8 + yellow 7.4 + blue 3.5.
MECHANICAL:	Diameter of particles:

Diameter of particles	%
< 0.01 m.M.	20.7 %
0.01—0.05 m.M.	17.8 %
0.05—0.1 m.M.	9.5 %
0.1 —2 m.M.	52.0 %

HYGROSCOPIC COEFFICIENT:	11.9 %.
MAXIMUM WATERCAPACITY:	45 %.
VOLUME EXPANSION:	14 %.
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.2
Quinhydrone electrode	7.9

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.5
Centrifuged liquid	7.6
Exarisate	7.4
Comber-Hissink test 1 (after two days)	red
Comber-Hissink test 2 (after two days)	> 6.5

CHEMICAL:

Water (110° C.)	8.00 %

ANALYSIS (dry matter)

SiO_2	24.30 %
Al_2O_3	10.87 %
Fe_2O_3	14.48 %
MgO	1.94 %
CaO	19.00 %
Alkalies	2.36 %
CO_2	13.07 %
TiO_2	2.28 %
P_2O_5	0.12 %
SO_3	traces
S	0.00 %
MnO	0.26 %
Loss on ignition	11.04 %
	99.72 %
Unweathered silicates	12.37 %
SiO_2 of the weathered silicates	21.53 %
Total carbon	5.85 %
Carbon from carbonates	3.57 %
Organic carbon	2.28 %
Humic matter (with factor: 1.724)	3.98 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green, very little	amphibole or augite, very little
augite, green, very little	————
calcite, with perfect cleavage, sometimes lamellar in form, very much	calcite, with perfect cleavage sometimes lamellar in form, very much
epidote, very little	epidote, very little
garnet, pale rose-red, very little	garnet, pale rose-red, very little
glauconite, very little	glauconite, very little

ilmenite, little	ilmenite, very little
limonite, very little	limonite, very little
magnetite, little	magnetite, very little
orthoclase, very little	————
plagioclase, very little	plagioclase, very little
quartz, much	quartz, little
rutile, very little	————
tourmaline, very little	tourmaline, very little
zircon, very little	————
organic remains, rather much	————
red-brown agglomerates, much	————

WEATHERING-FACTOR:

$$ki\ (rock)\ \frac{SiO_2}{Al_2O_3} \times 1.7 = \frac{6.74}{2.50} \times 1.7 = 4.58.$$

$$ki\ (soil)\ \frac{SiO_2}{Al_2O_3} \times 1.7 = \frac{24.30}{10.87} \times 1.7 = 3.8.$$

$$K = \frac{3.80}{4.58} = 0.82.$$

No. 745.

GENERAL REMARKS.

LOCALITY:	Fatu-Ino, in the neighbourhood of Niki-Niki, Isle of Timor. Collected by Prof. JONKER.
GEOLOGICAL AGE:	**Permian.**
HEIGHT:	570 M.
CLIMATE:	I. Temperature. Station Kupang, see N°. 744, Yearly temperature: 26.2. II. Rainfall. Station Niki-Niki, see N°. 744, Yearly rainfall 1464. III. Rainfactor (LANG): 1464 : 26.2 = 56.
VEGETATION:	Grass.

ROCK.

MACROSCOPICAL:	Hard, grey limestone (Crinoïd-limestone). Originally the limestone was red.
MICROSCOPICAL:	amphibole, very little. augite, very little. calcite, very little. glauconite, very little. ilmenite, very little. limonite, very little. plagioclase (= albite) with many inclusions of air, which resemble apatite or zircon. quartz, rather much. organic remains, much.
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 72.00 %

SOIL (Surface-soil; thickness: 30 c.M.).

MACROSCOPICAL:	Red clay with grey spots.
COLOUR DETERMINATION:	With naked eye: red. Code des Couleurs: N°. 62.
TINTOMETRICAL:	Red 6.0 + yellow 5.0 + 2.0.

MECHANICAL:	Diameter of particles:	
	< 0.01 m.M.	37.6 %
	0.01—0.05 m.M.	21.0 %
	0.05—0.1 m.M.	14.2 %
	0.1 —2 m.M.	27.2 %
HYGROSCOPIC COEFFICIENT:	12.2 %.	
MAXIMUM WATERCAPACITY:	48.4 %.	
VOLUME EXPANSION:	10 %.	
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.5
	Quinhydrone electrode	8.1
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	7.3
	Centrifuged liquid	7.7
	Exarisate	7.5
	Comber-Hissink test 1 (after two days)	very pink
	Comber-Hissink test 2 (after two days)	> 6.5
CHEMICAL:	$CaCO_3$ (with acetic acid)	7.8 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green, very little	amphibole, very little
	augite, green, strongly altered, very litle	augite, very little
	calcite, much	calcite, very much
	— — — —	glauconite, very little
	limonite, rather much	limonite, rather much
	magnetite, little	magnetite, very little
	plagioclase, very little	plagioclase, very little
	quartz, very little	quartz, very little
	organic remains, very much	organic remains, very little

No. 746.

GENERAL REMARKS.

LOCALITY: Baun (Baoen), district Amarassi, Isle of Timor. Collectrd by Prof. JONKER.

GEOLOGICAL AGE: Tertiary.

HEIGHT: 400 M.

CLIMATE: I. Temperature:

Station Kupang, see N°. 744. Yearly temperature: 26.2.

II. Rainfall:

Station Kupang, (470, Timor, BOEREMA). Years of observations: 44. Height: 15 M.

Jan.	Febr.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
401	382	224	66	32	11	5	3	3	20	88	253	1 488 m.m.
27	25.6	15.1	4.4	2.2	0.7	0.3	0.2	0.2	1.4	5.9	17	100 %

III. Rainfactor (LANG): 1488 : 26.2 = 57.

VEGETATION: Maize.

ROCK.

MACROSCOPICAL: Grey, porous limestone.

MICROSCOPICAL: limonite, very little.
plagioclase, very little.
quartz, very little.
chert, brown with splintery fracture.
Foraminifera, silicificated, much.
organic remains, much.

CHEMICAL: $CaCO_3$ (with acetic acid) .... 85.2 %

SOIL (Sub-soil; depth: 15—40 c.M.).

MACROSCOPICAL: Clay with a crumble structure and many pieces of limestone.

COLOUR DETERMINATION: With naked eye: dark-grey.
Code des Couleurs: N°. 73.

TINTOMETRICAL: Red 3.2 + yellow 3.9 + blue 3.3.

MECHANICAL:	Diameter of particles:	
	< 0.01 m.M.	39.1 %
	0.01—0.05 m.M.	18.0 %
	0.05—0.1 m.M.	9.8 %
	0.1 —2 m.M.	33.1 %
HYGROSCOPIC COEFFICIENT:	11.6 %.	
MAXIMUM WATERCAPACITY:	51 %.	
VOLUME EXPANSION:	10 %.	
PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.3
	Quinhydrone electrode	8.5
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	7.4
	Centrifuged liquid	7.6
	Exarisate	7.3
	Comber-Hissink test 1 (after two days)	colourless
	Comber-Hissink test 2 (after two days)	> 6.5
CHEMICAL:	$CaCO_3$ (with acetic acid)	28.7 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green, very little	amphibole, green and brown, very little
	augite, very little	————
	calcite, rather much	calcite, very much
	epidote, very little	————
	limonite, little	limonite, little
	magnetite, little	magnetite, very little
	plagioclase, little	plagioclase, little
	pyrite, very little	pyrite, very little
	quartz, little	quartz, little
	fragments of limestone	————
	chert, brown with splintery fracture, rather much	————
	Foraminifera, silicificated, very much	*Foraminifera*, silicificated much

Radiolaria	————
organic remains, very much	organic remains, much
coppermineral, soluble in NH_4OH	————

SOIL (Surface-soil; depth: 0—15 c.M.).

MACROSCOPICAL: Grey-black clay, with a crumble structure, containing some pieces of limestone.

COLOUR DETERMINATION: With naked eye: grey-black.
Code des Couleurs: N°. 75.

TINTOMETRICAL: Red 3.6 + yellow 3.8 + blue 3.4.

MECHANICAL: Diameter of particles:

< 0.01 m.M.	31.1 %
0.01—0.05 m.M.	9.5 %
0.05—0.1 m.M.	9.4 %
0.1 —2 m.M.	50.0 %

HYGROSCOPIC COEFFICIENT: 12.6 %.

MAXIMUM WATERCAPACITY: 60 %.

VOLUME EXPANSION: 9.5 %.

PH VALUE: ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.2
Quinhydrone electrode	8.3

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.5
Centrifuged liquid	7.3
Exarisate	7.5
Comber-Hissink test 1 (after two days)	pink
Comber-Hissink test 2 (after two days)	> 6.5

CHEMICAL: $CaCO_3$ (with acetic acid) .... 19.9 %

MICROSCOPICAL:

4th fraction	3rd fraction
amphibole, green and brown, very little	amphibole, green and brown, very little
augite, very little	augite, very little
calcite, little	calcite, much
limonite, little	limonite, very little

magnetite, very little	magnetite, very little
plagioclase, very little	plagioclase, very little
— — — —	pyrite, very little
quartz, little	quartz, little
tourmaline, very little	— — — —
zircon, very little	— — — —
chert, brown with splintery fracture, rather much	— — — —
Foraminifera, much	*Foraminifera*, much
Radiolaria, much	— — — —
organic remains, much	organic remains, much

No. 747.

GENERAL REMARKS.

LOCALITY:	Niki-Niki, Isle of Timor, Collected by Prof. JONKER.
GEOLOGICAL AGE:	Tertiary.
HEIGHT:	770 M.
CLIMATE:	I. Temperature: Station Kupang, see N°. 744. Yearly temperature: 26.2. II. Rainfall: Station Niki-Niki, see N°. 745. Yearly rainfall: 1464 m.M. III. Rainfactor (LANG): 1464 : 26.2 = 56.
VEGETATION:	Grass.

ROCK.

MACROSCOPICAL:	White, soft limestone, (*Globigerina*-limestone).
MICROSCOPICAL:	amphibole, very little. augite, very little. calcite, much. limonite, little. magnetite, very little. plagioclase, very little. pyrite, very little. quartz, little volcanic glass, very little. organic remains, much.
CHEMICAL:	$CaCO_3$ (with acetic acid) .... 90.5 %

SOIL. (Surface-soil; thickness: 15 c.M.).

MACROSCOPICAL:	Grey-black clay with many pieces of limestone.
COLOUR DETERMINATION:	With naked eye: grey-black. Code des Couleurs: N°. 143.
TINTOMETRICAL:	Red 2.5 + yellow 2.7 + blue 1.85.

MECHANICAL:	Diameter of particles:	
	< 0.01 m.M.	16.8 %
	0.01—0.05 m.M.	11.0 %
	0.05—0.1 m.M.	9.6 %
	0.1 —2 m.M.	62.6 %
HYGROSCOPIC COEFFICIENT:	6.72 %.	
MAXIMUM WATERCAPACITY:	60.4 %.	
VOLUME EXPANSION:	1 %.	

PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.3
	Quinhydrone electrode	7.8
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	7.5
	Centrifuged liquid	7.5
	Exarisate	7.3
	Comber-Hissink test 1 (after two days)	very pink
	Comber-Hissink test 2 (after two days)	> 6.5
CHEMICAL:	$CaCO_3$ (with acetic acid)	69.2 %

MICROSCOPICAL:	4th fraction	3rd fraction
	amphibole, green very little	amphibole, green, very little
	augite, very little	augite, very little
	calcite, little	calcite, little
	corundum, very little	— — — —
	— — — —	epidote, very little
	limonite, little	limonite, little
	magnetite, little	magnetite, little
	plagioclase, little	plagioclase, little
	pyrite, very little	pyrite, very little
	quartz, very little	quartz, very little
	rutile, very little	— — — —
	volcanic glass	— — — —
	Foraminifera, much	*Foraminifera,* much
	Radiolaria, much	— — — —
	organic remains	organic remains

CHRISTMAS-ISLAND.

In 1922 Dr. J. VOÛTE, director of the Bosscha-Observatory, Lembang (Java) collected 1 fragment of rock and 2 soil-samples in the neighbourhood of Dolly Beach. Before I communicate the results of my own researches, some information are given here about this island, derived from: CH. ANDREWS, A Monograph of Christmas-Island, London 1900:

„Christmas Island, a British possession under the government of the Straits Settlements, situated in the eastern part of the Indian Ocean (in 10° 25′ S., 105° 42′ E.), about 190 m. S. of Java.

The island is the flat summit of a submarine mountain more than 15 000 ft. high, the depth of the platform from which it rises being about 14 000 ft., and its height above the sea being upwards of 1000 ft. The submarine slopes are steep, and within 20 m. of the shore the depth of the sea reaches 2400 fathoms. It consists of a central plateau descending to the water in three terraces, each with its „tread" and „rise". The shore terrace descends by a steep cliff to the sea, forming the „rise" of a submarine „tread" in the form of fringing reef which surrrounds the island and is never uncovered, even at low water, except in Flying Fish Cove, where the only landing-place exists. The central plateau is a plain whose surface presents „rounded, flat-topped hills and low ridges and reefs of limestone", with narrow intervening valleys. On its northern aspect this plateau has a raised rim having all the appearances of being once the margin of an atoll. On these rounded hills occurs the deposit of phosphate of lime which gives the island its commercial value. The phosphatic deposit has doubtless been produced by the long-continued action of a thick bed of sea-fowl dung, which converted the carbonate of the underlying limestone into phosphate. The flat summit is formed by a succession of limestones — all deposited in shallow water — from the Eocene (or Oligocene) up to recent deposits in the abovementioned atoll with islands on its reed. The geological sequence of events appears to have been the following: — After the deposition of the Eocene (or Oligocene) limestone — which reposes upon a floor of basalts and trachytes — basalts and basic tuffs were ejected, over which, during a period of very slow depression, orbitoidal limestones of Miocene age — which seem to make up the great mass of the island — were deposited; then elapsed a long period of rest, during which the atoll condition existed and the guano deposit was formed; from then down to the present time there has succeeded a series of sea-level subsidences, resulting in the formation of the terraces and the accumulation of the detritus now seen on the first inland cliff, the old submarine slope of the island."......

„The climate is healthy, the temperature varying from 75° to 84° F."......

„The rainfall in the wet season is heavy, but not excessive, and during the dry season the ground is refreshed with occasional showers and heavy dews."......

„The soil which covers the greater part of the terraces and plateau, with the exception of the areas occupied by the reefs and groups of pinnacles described above, is a rich brown loam, often strewn with nodules of phosphate and here and there with fragments of volcanic rock. One of the most notable features about the island is the great depth to which, in many places, the soil extends. For instance, near the northern angle of the plateau Mr. ROSS sank a well nearly forty feet without reaching the bed rock, and even on the shore terrace near Flying Fish Cove a shaft some fifteen feet deep was entirely in soil in which some blocks of limestone were embedded. Reefs of bare limestone may occur quite close to such places, and it appears therefore that the soil fills great inequalities in the surface of the island. It seems impossible that a soil so abundant can have resulted merely from the disintegration of limestone and the decay of vegetation, and no doubt it is to a considerable extent the product of the decomposition of volcanic rock which must have been exposed in many places on the higher land, either in consequence of the incompleteness of the limestone covering of the volcanic basis of the island, or through the removal of portions of that covering through denudation, or possibly in a few cases through the extrusion of volcanic material in the form of lava-flows or tuff beds."......

„At present the chief plants introduced include coconut-palm, date-palm, bamboo, sugar-cane, banana, pineapple, pomegranate, papaia, nutmeg, cacao, coffee, chillies, custard-apple, pumpkins, gourds, maize, tobacco, *Cassia siamea*, and probably several others."

No. 244.

ROCK.

MACROSCOPICAL: Yellow fragment injected by a great many veins of colloidal hydrated aluminium.

MICROSCOPICAL: amphibole, green, little.
magnetite, very little.
quartz, very little.
turquois, little.
zircon, very little.
organic remains, very little.

SOIL (Sub-soil?).

MACROSCOPICAL: Colour: greyish, with a great many small fragments of the rock and a great many well-rounded concretions: grey, brown and black.

MICROSCOPICAL: These concretions are composed of H_2O, Fe, Mn; they are soluble in warm dilute hydrochloric acid. A little colloidal SiO_2 rests after solution. The globular concretions possess a spheroidal structure. Studied microscopically we see that the concretions possess a zonal structure.

amblygonite, very little.
amphibole, green, very little.
ilmenite, very little.
limonite, little.
magnetite, very little.
plagioclase, very little.
quartz, very little.
turquois, little.
zircon, very little.
organic remains, little.

PH VALUE:

ELECTROMETRICAL DETERMINATIONS:

Hydrogen electrode	8.3
Quinhydrone electrode	8.0

COLORIMETRICAL DETERMINATIONS:

Filtrate	7.1
Centrifuged liquid	7.0

Exarisate	7.0
Comber-Hissink test 1 (after two days)	green
Comber-Hissink test 2 (after two days)	6.5

CHEMICAL: Water (110° C.) .... 1.89 %

ANALYSIS (dry matter).

SiO_2	0.10 %
Al_2O_3	46.72 %
Fe_2O_3	8.24 %
MgO	0.38 %
CaO	21.50 %
Alkalies	0.37 %
CO_2	1.74 %
TiO_2	1.06 %
P_2O_5	2.53 %
SO_3	0.27 %
S	0.05 %
MnO	1.62 %
Loss on ignition (hydratic water)	15.97 %
	100.55 %

SiO_2 of the weathered silicates	0.10 %
Organic carbon	1.26 %
corresponding with humic matter	2.19 %
Calcium carbonate	3.96 %

SOIL (Surface-soil).

MICROSCOPICAL: Many concretions: long-elongated, soft, brown and often cemented to an aggregate. One piece of coral-rock; a single foraminifera.

amphibole, green, little.

ilmenite, very little.

limonite, little.

magnetite, little.

plagioclase, very little.

pyrite, very little.

quartz, very little.

turquois, little.

organic remains, little.

PH VALUE:	ELECTROMETRICAL DETERMINATIONS:	
	Hydrogen electrode	8.5
	Quinhydrone electrode	8.0
	COLORIMETRICAL DETERMINATIONS:	
	Filtrate	6.5
	Centrifuged liquid	6.7
	Exarisate	6.5
	Comber-Hissink test 1 (after two days)	colourless
	Comber-Hissink test 2 (after two days)	6.5
CHEMICAL:	Water (110° C.)	3.42 %

ANALYSIS (dry matter).

SiO_2	0.70 %
Al_2O_3	50.14 %
Fe_2O_3	11.19 %
MgO	0.27 %
CaO	10.22 %
Alkalies	0.28 %
CO_2	0.73 %
TiO_2	1.22 %
P_2O_5	3.66 %
SO_3	0.28 %
S	0.05 %
MnO	1.70 %
Loss on ignition (hydratic water)	20.13 %
	100.57 %
SiO_2 of the weathered silicates	0.70 %
Organic carbon	1.93 %
corresponding with humic matter	3.36 %

RECAPITULATION.

TABLE I.

THE RELATION BETWEEN TEMPERATURE, RAINFALL AND RAINFACTOR.

	WEST-JAVA.				CENTRAL-JAVA.											
Yearly Temperature . . .	24.8	24.8	26.5	25.9	26.3	26.2	26.2	25.1	25.1	25.1	25.1	26.2	26.2	26.2	26.2	26.2
Yearly Rainfall .	3702	3662	1575	2866	2908	2137	2319	2299	2287	2456	1947	2176	1946	1753	1732	2146
Rainfactor according to R. Lang	149	148	61	111	110	82	88	92	91	98	78	83	74	67	66	82

	MADURA.			TIMOR.	
Yearly Temperature . . .	27.0	27.0	27.0	26.2	26.2
Yearly Rainfall .	1511	2239	1050	1464	1488
Rainfactor according to R. Lang	56	83	39	56	57

TABLE II.

THE RELATION BETWEEN RAINFALL, TEMPERATURE, VEGETATION, HEIGHT, HUMIC MATTER AND COLOUR.

GREY.

Number.	Monthly Rainfall in m.M.		Monthly Temperature in degrees Celsius.		Vegetation.	Height in M.	Humic matter in %.	Colour of the rock.	Tintometrical.		
	Lowest.	Highest.	Lowest.	Highest.					Red.	Yellow.	Blue.
320	35	326	25.7	27.0	teak-forests	0—250	—	?	4.9	6.8	4.9
321	35	326	25.7	27.0	teak-forests	0—250	—	?	5.4	9.4	6.2
323	28	358	25.7	27.0	Leucaena glauca	150—200	4.74	?	4.9	6.6	5.2
324	28	358	25.7	27.0	grass	100	—	?	3.8	5.0	3.9
322	28	358	25.7	27.0	shrubs	150—200	0.37	grey	3.1	4.5	2.7
335	30	365	24.6	25.7	?	100—250	—	white	5.0	6.6	4.9
549	29	304	25.7	27.0	teak-forests	150	—	yellow	0.8	1.9	0.6
546	20	283	25.7	27.0	teak-forests	100	1.88	?	4.8	7.4	4.6
728	15	290	26.3	27.8	?	250	—	?	3.7	4.5	2.7

RED.

Number.	Rainfall Lowest.	Rainfall Highest.	Temperature Lowest.	Temperature Highest.	Vegetation.	Height in M.	Humic matter in %.	Colour of the rock.	Red.	Yellow.	Blue.
568	27	424	24.6	25.7	grass	300	—	?	9.2	14.5	6.0
557	23	343	25.7	27.0	?	100—250	—	?	6.6	9.0	3.5
551	29	304	25.7	27.0	teak-forests	150	0.44	red	7.65	10.2	3.9
553	17	371	25.7	27.0	teak-forests	100	—	?	10.4	14.0	4.8
730	11	188	26.3	27.8	?	5	—	?	7.2	11.0	3.0
744	3	268	25.0	27.4	grass	420	3.98	red	7.8	7.4	3.5
745	3	268	25.0	27.4	grass	570	—	grey	6.0	5.0	2.0

YELLOW.

102	204	402	24.1	25.3	forests	200	—	yellow	4.95	8.6	3.0
105	206	411	24.1	25.3	coffee-shrubs	125	—	?	4.1	7.6	2.15
145	28	600	25.3	26.3	grass	100	—	yellow	6.0	9.6	5.2
567	27	424	24.6	25.7	grass	280	—	?	4.6	7.2	2.3
539	46	353	25.7	27.0	teak-forests	100—250	1.34	yellow	2.3	3.3	0.6
538	46	353	25.7	27.0	teak-forests	100—250	—	yellow	5.2	8.9	4.0
729	15	368	26.3	27.8	?	250	—	?	5.3	12.0	4.5

BLACK.

707	16	705	25.2	27.2	cocospalms	1	5.59	white	7.2	9.6	7.1
535	68	371	24.6	25.7	trees	250—500	3.72	grey	6.45	10.2	4.7
569	18	336	24.6	25.7	absent	200	1.69	grey	5.0	6.6	3.9
746	3	401	25.0	27.4	maize	400	—	grey	3.6	3.8	3.4
747	3	268	25.0	27.4	grass	770	—	white	2.5	2.7	1.85

BROWN.

101	204	402	24.1	25.3	forests	200	4.79	yellow	7.5	11.5	4.9
91	40	206	21.9	26.5	grass and bushes	700	4.59	yellow	7.4	10.4	4.8
566	27	424	24.6	25.7	grass	190	—	?	7.75	10.4	4.9

The mineralogical composition of the Rocks, Sub-soils and Surface-soils.

No.	WEST-JAVA.								
	101	101	102	105	105	91	91	145	145
	Rock.	Surf.	Surf.	Sub.	Surf.	Rock.	Surf.	Rock.	Surf.
1. Amblygoniet.									
2. Amfibool.		■	■	■	■	■	■	■	■
3. Andalusiet.									
4. Apatiet.							■		
5. Asphalt.									
6. Augiet.		■	■	■	■	■	■	■	■
7. Bariet.									
8. Biotiet.		■					■	■	■
9. Calciet.	■	■				■	■		
10. Chiastoliet (pseudo).									
11. Chloriet.									
12. Cordieriet.									
13. Cyaniet.		■							
14. Enstatiet ?									
15. Epidoot.		■	■				■	■	■
16. Eucoliet ?									
17. Fluoriet.									
18. Glaukofaan.									
19. Glaukoniet.			■						
20. Grafiet.									
21. Granaat.			■			■			■
22. Heulandiet.									
23. Hypersthéen.		■	■	■	■		■		■
24. Ilmeniet.		■	■	■	■	■	■	■	■
25. Kaoliniet.					■				
26. Koper.									
27. Koper mineraal.									
28. Korund.	■								
29. Kwarts.	■	■	■	■	■	■	■	■	■
30. Leucoxeen.							■		
31. Limoniet.	■	■		■	■	■	■		■
32. Magnetiet.		■	■	■	■	■	■	■	■
33. Mikroklien.									
34. Muscoviet.									
35. Orthoklaas.		■		■					
36. Plagioklaas.	■	■	■	■	■	■	■	■	■
37. Pyriet.		■		■					
38. Rutiel.		■	■	■				■	■
39. Sideriet.									
40. Sillimaniet.									
41. Stauroliet.									■
42. Toermalijn.			■	■	■		■		■
43. Tremoliet.									
44. Turkoois.									
45. Vivianiet.									
46. Vulkanische asch.									
47. Vulkanisch glas.		■							
48. Zirkoon.		■	■	■	■		■	■	■
Totally:	5	17	13	12	11	9	15	10	15

No.	CENTRAL-JAVA.																			
	305	707	707	320	320	321	321	322	322	323	324	335	335	335	566	567	568	535	535	535
	Surf.	Rock.	Surf.	Sub.	Surf.	Sub.	Surf.	Rock.	Surf.	Surf.	Surf.	Rock.	Sub.	Surf.	Surf.	Surf.	Surf.	Rock.	Sub.	Sub.
1. Amblygoniet.																				
2. Amfibool.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3. Andalusiet.																	■			
4. Apatiet.					■			■	■		■		■	■						■
5. Asphalt.	■																	■		
6. Augiet.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
7. Bariet.	■							■	■											
8. Biotiet.	■		■		■															
9. Calciet.	■			■	■	■	■			■	■		■				■		■	
10. Chiastoliet (pseudo).																				
11. Chloriet.																			■	
12. Cordieriet.													■							
13. Cyaniet.															■				■	
14. Enstatiet ?																				
15. Epidoot.	■			■	■	■	■	■	■	■	■		■		■	■	■		■	■
16. Eucoliet ?																				
17. Fluoriet.																		■		■
18. Glaukofaan.																				
19. Glaukoniet.			■					■	■										■	
20. Grafiet.																				
21. Granaat.			■		■					■	■				■				■	■
22. Heulandiet.															■					
23. Hypersthéen.	■		■		■	■					■		■	■	■	■	■	■	■	■
24. Ilmeniet.	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
25. Kaoliniet.																				
26. Koper.	■																			
27. Koper mineraal.																				
28. Korund.																				
29. Kwarts.	■	■	■	■	■	■	■				■	■	■	■	■	■	■	■	■	■
30. Leucoxeen.																				
31. Limoniet.	■		■	■	■	■	■	■	■		■				■	■	■	■	■	■
32. Magnetiet.	■	■	■	■	■	■	■			■	■		■	■	■	■	■	■	■	■
33. Mikroklien.	■																			
34. Muscoviet.	■						■						■	■					■	
35. Orthoklaas.																				
36. Plagioklaas.	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
37. Pyriet.	■		■					■	■											■
38. Rutiel.	■			■	■	■					■						■	■	■	■
39. Sideriet.																				
40. Sillimaniet.																				
41. Stauroliet.						■					■									
42. Toermalijn.	■				■	■		■	■		■				■				■	■
43. Tremoliet.	■																	■	■	■
44. Turkoois.																				
45. Vivianiet.					■								■	■	■		■			
46. Vulkanische asch.																				
47. Vulkanisch glas.						■									■					
48. Zirkoon.		■	■		■	■	■	■	■		■		■	■	■	■		■	■	■
Totally:	20	5	13	10	17	15	11	12	12	8	16	5	14	11	16	10	13	13	19	17

No.	CENTRAL-JAVA. (cont.)																				
	535	570	571	569	537	539	538	557	551	551	548, 549	548, 549	548, 549	550	545	546	546	553	502	520	521
	Surf.	Rock.	Rock.	Surf.	Rock.	Surf.	Surf.	Surf.	Rock.	Surf.	Rock.	Sub.	Surf.	Surf.	Rock.	Sub.	Surf.	Surf.	Rock.	Rock.	Rock.
1. Amblygoniet.																					
2. Amfibool.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3. Andalusiet.				■	■					■				■				■			
4. Apatiet.						■						■	■	■							
5. Asphalt.																					
6. Augiet.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
7. Bariet.																					
8. Biotiet.							■				■	■	■	■			■				
9. Calciet.		■	■	■	■						■	■	■	■	■	■	■	■	■	■	■
10. Chiastoliet (pseudo).														■							
11. Chloriet.																		■			
12. Cordieriet.										■											
13. Cyaniet.																					
14. Enstatiet ?																					
15. Epidoot.	■			■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■
16. Eucoliet ?																					
17. Fluoriet.	■																				
18. Glaukofaan.							■	■						■							
19. Glaukoniet.		■				■				■	■	■		■				■		■	
20. Grafiet.	■	■																			
21. Granaat.						■	■					■		■	■			■			
22. Heulandiet.																				■	
23. Hypersthéen.	■			■		■	■	■						■		■	■		■	■	■
24. Ilmeniet.	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
25. Kaoliniet.											■	■	■			■	■				
26. Koper.																					
27. Koper mineraal.																					
28. Korund.		■	■					■													
29. Kwarts.	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■		■
30. Leucoxeen.																		■			
31. Limoniet.	■			■	■	■	■	■	■	■	■	■	■	■		■	■	■			
32. Magnetiet.	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■
33. Mikroklien.											■										
34. Muscoviet.									■	■		■	■	■				■			
35. Orthoklaas.													■							■	
36. Plagioklaas.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
37. Pyriet.							■							■		■	■	■			
38. Rutiel.	■			■	■	■	■		■	■	■	■	■	■		■	■	■	■		
39. Sideriet.														■							
40. Sillimaniet.	■													■							
41. Stauroliet.			■																		
42. Toermalijn.	■				■	■	■			■	■	■	■	■		■	■	■			
43. Tremoliet.	■																				■
44. Turkoois.																					
45. Vivianiet.		■								■				■			■	■		■	
46. Vulkanische asch.													■			■					
47. Vulkanisch glas.				■	■									■				■			
48. Zirkoon.	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■
Totally:	16	11	10	14	13	15	16	12	10	16	16	18	18	26	8	16	17	21	11	12	10

No.	MADURA.					TIMOR.									CHRISTMAS ISLAND.			No.
	728	728	729	729	730	744	744	745	745	746	746	746	747	747	244	244	244	
	Sub.	Surf.	Sub.	Surf.	Surf.	Rock.	Surf.	Rock.	Surf.	Rock.	Sub.	Surf.	Rock.	Surf.	Rock.	Sub.	Surf.	
1. Amblygoniet.																■		1. Amblygonite.
2. Amfibool.	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	2. Amphibole.
3. Andalusiet.				■	■													3. Andalusite.
4. Apatiet.		■	■	■	■													4. Apatite.
5. Asphalt.																		5. Asphalt.
6. Augiet.	■	■	■	■	■	■	■	■	■		■	■	■	■				6. Augite.
7. Bariet.																		7. Baryte.
8. Biotiet.		■	■															8. Biotite.
9. Calciet.			■	■		■	■	■	■		■	■	■	■				9. Calcite.
10. Chiastoliet (pseudo).																		10. Chiastolite (pseudo).
11. Chloriet.																		11. Chlorite.
12. Cordieriet.																		12. Cordierite.
13. Cyaniet.																		13. Kyanite.
14. Enstatiet ?					■													14. Enstatite ?
15. Epidoot.	■	■	■	■	■	■	■				■			■				15. Epidote.
16. Eucoliet ?					■													16. Eukolite ?
17. Fluoriet.																		17. Fluorite.
18. Glaukofaan.					■													18. Glaucophane.
19. Glaukoniet.					■		■	■	■									19. Glauconite.
20. Grafiet.			■	■														20. Graphite.
21. Granaat.			■	■	■	■	■											21. Garnet.
22. Heulandiet.																		22. Heulandite.
23. Hypersthéen.	■	■	■	■	■													23. Hypersthene.
24. Ilmeniet.	■	■	■	■	■	■	■	■								■	■	24. Ilmenite.
25. Kaoliniet.																		25. Kaolinite.
26. Koper.																		26. Copper.
27. Koper mineraal.		■									■							27. Copper mineral.
28. Korund.														■				28. Corundum.
29. Kwarts.	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	29. Quartz.
30. Leucoxeen.					■													30. Leucoxene.
31. Limoniet.	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	31. Limonite.
32. Magnetiet.	■	■	■	■	■	■	■		■		■	■	■	■	■	■	■	32. Magnetite.
33. Mikroklien.																		33. Microcline.
34. Muscoviet.	■	■	■	■	■													34. Muscovite.
35. Orthoklaas.							■											35. Orthoclase.
36. Plagioklaas.	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	36. Plagioclase.
37. Pyriet.		■	■	■							■	■	■	■			■	37. Pyrite.
38. Rutiel.	■	■	■	■	■	■	■							■				38. Rutile.
39. Sideriet.																		39. Siderite.
40. Sillimaniet.		■																40. Sillimanite.
41. Stauroliet.					■													41. Staurolite.
42. Toermalijn.	■	■	■	■	■	■	■					■						42. Tourmaline.
43. Tremoliet.																		43. Tremolite.
44. Turkoois.															■	■	■	44. Turquois.
45. Vivianiet.		■	■	■														45. Vivianite.
46. Vulkanische asch.																		46. Volcanic ash.
47. Vulkanisch glas.					■								■	■				47. Volcanic glass.
48. Zirkoon.	■	■	■	■	■		■					■			■	■		48. Zircon.
Totally:	13	19	20	20	23	12	15	8	8	3	10	10	9	12	5	9	8	

Sub. = Sub-soil.
Surf. = Surface-soil.

TABLE IV.

FREQUENCY OF THE MINERALS FOUND.

	WEST-JAVA.			CENTRAL-JAVA.			MADURA.		TIMOR.			CHRISTMAS-ISLAND.		
	Rock.	Sub-soil.	Surface-soil.	Rock.	Sub-soil.	Surface-soil.	Sub-soil.	Surface-soil.	Rock.	Sub-soil.	Surface-soil.	Rock.	Sub-soil.	Surface-soil.
Samples examined	3	1	5	13	7	21	2	3	4	1	4	1	1	1
Amblygonite	—	—	—	—	—	—	—	—	—	—	—	—	1	—
Amphibole	2	1	5	13	7	21	2	3	3	1	4	1	1	1
Andalusite	—	—	—	1	—	4	—	2	—	—	—	—	—	—
Apatite	—	—	1	1	3	7	1	3	—	—	—	—	—	—
Asphalt	—	—	—	1	—	1	—	—	—	—	—	—	—	—
Augite	2	1	5	13	7	21	2	3	3	1	4	—	—	—
Baryte	—	—	—	1	—	2	—	—	—	—	—	—	—	—
Biotite	1	—	3	1	1	7	1	1	—	—	—	—	—	—
Calcite	2	—	2	8	6	11	1	1	3	1	4	—	—	1
Chiastolite (pseudo-)	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Chlorite	—	—	—	—	1	1	—	—	—	—	—	—	—	—
Copper	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Coppermineral	—	—	—	—	—	—	—	1	—	1	—	—	—	—
Cordierite	—	—	—	—	1	1	—	—	—	—	—	—	—	—
Corundum	1	—	—	2	—	1	—	—	—	—	1	—	—	—
Enstatite?	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Epidote	1	—	4	7	7	19	2	3	1	1	2	—	—	—
Eukolite	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Fluorite	—	—	—	1	1	1	—	—	—	—	—	—	—	—
Garnet	1	—	2	1	3	9	1	2	1	—	1	—	—	—

Glauconite	—	—	1	4	2	6	—	1	1	—	2	—	—	—
Glaucophane	—	—	—	—	—	3	—	1	—	—	—	—	—	—
Graphite	—	—	—	1	—	1	1	1	—	—	—	—	—	—
Heulandite	—	—	—	1	—	1	—	—	—	—	—	—	—	—
Hypersthene	—	1	5	4	5	15	2	3	—	—	—	—	—	—
Ilmenite	2	1	5	10	7	21	2	3	2	—	1	—	1	1
Kaolinite	—	—	1	1	2	2	—	—	—	—	—	—	—	—
Kyanite	—	—	1	—	1	1	—	—	—	—	—	—	—	—
Leucoxene	—	—	1	—	—	1	—	1	—	—	—	—	—	—
Limonite	2	1	4	5	6	19	2	3	4	1	4	—	1	1
Magnetite	2	1	5	10	7	20	2	3	2	1	4	1	1	1
Microcline	—	—	—	1	—	1	—	—	—	—	—	—	—	—
Muscovite	—	—	—	1	3	7	2	3	—	—	—	—	—	—
Orthoclase	—	1	1	1	—	1	—	—	—	—	1	—	—	—
Plagioclase	3	1	5	12	7	21	2	3	4	1	4	—	—	1
Pyrite	—	1	1	1	2	7	1	2	1	1	2	—	—	1
Quartz	3	1	5	10	7	19	2	3	4	1	4	1	1	1
Rutile	1	1	3	5	6	13	2	3	1	—	2	—	—	—
Siderite	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Sillimanite	—	—	—	—	—	2	—	1	—	—	—	—	—	—
Staurolite	—	—	1	1	1	1	—	1	—	—	—	—	—	—
Tourmaline	—	1	4	3	5	13	2	3	1	—	2	—	—	—
Tremolite	—	—	—	2	2	2	—	—	—	—	—	—	—	—
Turquois	—	—	—	—	—	—	—	—	—	—	—	1	1	1
Vivianite	—	—	—	2	1	8	1	2	—	—	—	—	—	—
Volcanic ash	—	—	—	—	1	1	—	—	—	—	—	—	—	—
Volcanic glass	—	—	1	1	1	4	—	1	1	—	1	—	—	—
Zircon	1	1	5	10	6	18	2	3	—	—	2	1	—	1

TABLE V.

CHEMICAL COMPOSITION OF THE LIMESTONES.

— = not determined.

	West-Java		Central-Java							Timor
No.	101	91	707	322	535	571	537	551	548	744
Geological age . .	Tertiary.		Quaternary.	Tertiary.						Permian.
Water (110° C.) .	0.16	—	0.45	4.49	5.22	0.76	5.72	18.40	1.41	2.05
SiO_2	0.42	0.23	0.32	24.96	25.60	2.51	2.86	18.75	37.50	6.74
Al_2O_3	0.01	0.37 (Al₂O₃ + Fe₂O₃)	0.29	6.20	9.73	0.92	0.86	3.09	3.79	2.50
Fe_2O_3	0.36		0.12	3.02	5.99	1.27	0.89	17.18	2.69	4.55
MgO	1.00	0.78	0.42	0.94	1.41	0.43	0.45	0.74	0.66	1.13
CaO	55.24	54.85	54.02	34.31	30.63	53.64	52.31	32.75	29.16	47.18
Alkalies.	0.14	—	0.77	0.60	0.90	0.16	0.41	0.59	1.05	0.09
TiO_2	0.00	—	0.00	0.24	0.48	0.06	0.06	0.29	0.33	0.88
P_2O_5	traces	0.02	0.01	0.17	0.00	0.03	—	0.14	traces	0.07
SO_3	0.15	0.89	0.56	0.15	0.15	0.08	0.06	0.02	0.10	0.33
Cl	—	—	0.04	—	—	—	—	—	—	—
S	—	—	0.02	0.01	0.02	0.02	0.02	0.00	0.00	0.00
MnO	—	—	0.00	0.37	0.20	traces	0.00	0.65	0.25	0.27
Loss on ignition (CO_2. Hydratic-water)	43.04	43.15	43.88	29.20	25.00	41.40	42.08	25.88	24.49	37.02

TABLE VI.

CHEMICAL COMPOSITION OF THE SURFACE-SOILS.

— = not determined.

	West-Java		Central-Java.								Timor.	Christmas Island
N°.	101	91 *)	707	322	323	535	569	539	551	546	744	244
Geological age	Tertiary.		Quaternary.	Tertiary.							Permian.	
Water (110° C. %	11.68	—	3.04	6.01	5.80	6.37	7.58	3.56	3.28	5.41	8.00	3.42
SiO_2	42.48	44.42	5.40	35.82	37.50	40.39	44.21	77.05	70.90	57.00	24.30	0.70
Al_2O_3	24.38	33.49	3.50	17.62	13.57	22.53	20.16	9.25	8.80	15.28	10.87	50.14
Fe_2O_3	9.57		1.52	1.92	4.67	12.59	14.53	6.39	8.15	10.10	14.48	11.19
MgO	2.33	—	0.78	1.82	0.91	1.35	1.02	0.14	1.09	1.34	1.94	0.27
CaO	2.67	3.55	45.13	16.57	17.74	1.82	4.31	0.98	1.70	1.42	19.00	10.22
Alkalies	1.14	—	0.54	0.69	0.95	0.22	0.47	1.26	0.97	0.90	2.36	0.28
CO_2	0.00	—	32.46	10.98	10.66	0.05	1.42	0.00	1.01	0.00	13.07	0.73
TiO_2	1.20	0.72	0.24	0.54	0.34	0.60	0.80	0.66	0.67	0.72	2.28	1.22
P_2O_5	0.05	0.13	0.23	0.20	0.11	0.14	0.13	traces	0.14	traces	0.12	3.66
SO_3	0.18	—	0.41	2.10	0.13	0.13	0.09	0.16	0.06	0.09	traces	0.28
S	0.00	—	0.03	0.03	0.01	0.00	0.01	0.06	0.00	0.01	0.00	0.05
MnO	0.38	—	0.32	2.15	0.79	0.33	1.50	0.39	0.37	0.28	0.26	1.70
Loss on ignition	11.40	15.24	9.60	9.60	12.63	19.92	12.09	4.14	6.59	13.40	11.04	20.13
Unweathered silicates	26.17	—	28.99	37.43	—	14.16	21.32	7.41	64.44	43.77	12.37	0.00
SiO_2 of the weathered silicates	26.68	—	3.16	14.19	—	15.33	27.37	8.64	12.99	23.34	21.53	0.70
Humic matter	4.79	4.59	5.59	0.37	4.74	3.72	1.69	1.34	0.44	1.88	3.98	3.36

*) Rest (K_2O, MgO, Na_2O, SO_3, etc.) 2.45 %.

TABLE VII.

LOSS OR GAIN OF ANORGANIC SUBSTANCES.

N°. 101. GUNUNG TJIBODAS, N. W. OF BUITENZORG.

	Rock.	Soil.	Loss.	Gain.
Water (110° C.) . .	0.16	11.68		11.52
SiO_2	0.42	42.48		42.06
Al_2O_3	0.01	24.38		24.37
Fe_2O_3	0.36	9.57		9.21
MgO.	1.00	2.33		1.33
CaO.	55.24	2.67	52.57	
Alkalies	0.14	1.14		1.00
TiO_2	0.00	1.20		1.20
P_2O_5	traces	0.05		0.05
SO_3	0.15	0.18		0.03
S		0.00		
MnO.		0.38		0.38
Loss on ignition . . (CO_2)	43.04	11.40	31.64	

N°. 91. TAGOG APU, NEAR BANDUNG.

	Rock.	Soil.	Loss.	Gain.
Water (110° C.) . .				
SiO_2	0.23	44.42		44.19
Al_2O_3 } Fe_2O_3 }	0.37	33.49		33.12
MgO	0.78	*)		
CaO	54.85	3.55	51.30	
Alkalies				
TiO_2		0.72		
P_2O_5	0.02	0.13		0.11
SO_3	0.80			
S				
MnO				
Loss on ignition . . (CO_2)	43.15	15.24	27.91	

*) Rest (MgO, K_2O. Na_2O, SO_3, etc.) 2.45.

N°. 707. PULU PANDJANG, W. OF DJAPARA.

	Rock.	Soil.	Loss.	Gain.
Water (110 ° C.) . .	0.45	3.04		2.59
SiO_2.	0.32	5.40		5.08
Al_2O_3	0.29	3.50		3.21
Fe_2O_3	0.12	1.52		1.40
MgO	0.42	0.78		0.36
GaO	54.02	45.13	8.89	
Alkalies	0.77	0.54	0.23	
TiO_2	0.00	0.24		0.24
P_2O_5	0.01	0.23		0.22
SO_3	0.56	0.41	0.15	
Cl	0.04		0.04	
S	0.02	0.03		0.01
MnO	0.00	0.32		0.32
Loss on ignition . . (CO_2, Hydratic water)	43.88	42.06	1.82	

N°. 322. GUNDIH, S. W. OF PURWODADI.

	Rock.	Soil.	Loss.	Gain.
Water (110 ° C.) . .	4.49	6.01		1.52
SiO_2.	24.96	35.82		10.86
Al_2O_3	6.20	17.62		11.42
Fe_2O_3	3.02	1.92	1.10	
MgO	0.94	1.82		0.88
CaO.	34.31	16.57	17.74	
Alkalies	0.60	0.69		0.09
TiO_2.	0.24	0.54		0.30
P_2O_5.	0.17	0.20		0.03
SO_3	0.15	2.10		1.95
S	0.01	0.03		0.02
MnO	0.37	2.15		1.78
Loss on ignition . . (CO_2, Hydratic water)	29.20	20.58	8.62	

N°. 535. BUNDER, NEAR WONOSARI.

	Rock.	Surface-soil.	Sub-soil.	Sub-soil.	Rock-Soil I		Rock-Soil II		Rock-Soil III		Soil I-Soil II		Soil II-Soil III	
					Loss.	Gain.	Loss.	Gain.	Loss.	Gain.	Loss.	Gain.	Loss.	Gain.
Water (110° C.)	5.22	13.54	7.19	6.37		8.32		1.97		1.15	6.35		0.82	
SiO_2	25.60	44.51	41.67	40.39		18.91		16.07		14.79	2.84		1.28	
Al_2O_3	9.73	18.56	27.39	22.53		8.83		17.66		12 80		8.83	4.86	
Fe_2O_3	5.99	14.95	9.38	12.59		8.96		3.39		6.60	5.57			3.21
MgO	1.41	1.49	1.40	1.35		0.08	0.01		0.06		0.09		0.05	
CaO	30.63	2.16	1.60	1.82	28.47		29.03		28.81		0.56			0.22
Alkalies	0.90	0.22	0.69	0.22	0.68		0.21		0.68			0.47	0.47	
TiO_2	0.48	0.96	0.55	0.60		0.48		0.07		0.12	0.41			0.05
P_2O_5	0.00	0.06	traces	0.14		0.06		traces		0.14	0.06			0.14
SO_3	0.15	0.15	0.10	0.13		0.00	0.05		0.02		0.05			0.03
S.	0.02	0.02	0.02			0.00		0.00	0.02				0.02	
MnO	0.20	0.41	0.21	0.33		0.21		0.01		0.13	0.20			0.12
Loss on ign.	3.30	17.07	17.02	19.92		13.77		13.72		16.62	0.05			2.90
CO_2	21.70	0.00	0.00	0.05	21.70		21.70		21.65					0.05

N°. 571 and 569. WONOSARI.

	Rock.	Soil.	Loss.	Gain.
Water (110 ° C.) . .	0.76	7.58		6.82
SiO_2.	2.51	44.21		41.70
Al_2O_3	0.92	20.16		19.24
Fe_2O_3	1.27	14.53		13.26
MgO	0 43	1.02		0.59
CaO.	53.64	4.31	49.33	
Alkalies	0.16	0.47		0.31
TiO_2	0.06	0.80		0.74
P_2O_5.	0.03	0.13		0.10
SO_3	0.08	0.09		0.01
S.	0.02	0.01	0.01	
MnO	traces	1.50		1.50
Loss on ignition . . (CO_2, Hydratic water)	41.40	13.51	27.89	

N°. 537, 539. GROBOGAN.

	Rock.	Soil.	Loss.	Gain.
Water (110 ° C.) . .	5.72	3.56	2.16	
SiO_2.	2.86	77.05		74.19
Al_2O_3	0.86	9,25		8.39
Fe_2O_3	0.89	6.39		5.50
MgO	0.45	0.14	0.31	
CaO	52.31	0.98	51.33	
Alkalies	0.41	1.26		0.85
TiO_2	0.06	0.66		0.60
P_2O_5		traces		traces
SO_3	0.06	0.16		0.10
S.	0.02	0.06		0.04
MnO	0.00	0.39		0.39
Loss on ignition . . (CO_2, Hydratic water)	42.08	4.14	37.84	

N°. 551. N. W. OF TJABAK, S. E. OF DJEPON.

	Rock.	Soil.	Loss.	Gain.
Water (110 ° C.) . .	18.40	3.28	15.12	
SiO_2.	18.75	70.90		52.15
Al_2O_3	3.09	8.80		5.71
Fe_2O_3	17.18	8.15	9.03	
MgO	0.74	1.09		0.35
CaO.	32.75	1.70	31.05	
Alkalies	0.59	0.97		0.38
TiO_2	0.29	0.67		0.38
P_2O_5.	0.14	0.14		
SO_3	0.02	0.06		0.04
S	0.00	0.00		
MnO	0.65	0.37	0.28	
Loss on ignition . . (CO_2, Hydratic water)	25.88	7.60	18.28	

N°. 548. TJABAK.

	Rock.	Sub-soil.	Loss.	Gain.
Water (110 ° C.) . .	1.41	1.81		0.40
SiO_2.	37.50	36.37	1.13	
Al_2O_3	3.79	4.12		0.33
Fe_2O_3	2.69	2.90		0.21
MgO	0.66	0.75		0.09
CaO.	29.16	29.49		0.33
Alkalies	1.05	1.20		0.15
TiO_2	0.33	0.30	0.03	
P_2O_5.	traces	0.23		0.23
SO_3	0.10	0.10		
S	0.00	0.00		
MnO	0.25	0.63		0.38
Loss on ignition . . (CO_2, Hydratic water)	24.49	24.01	0.48	

N°. 546. NGLIRON, W. OF DJEPON.

	Sub-soil.	Surface-soil.	Loss.	Gain.
Water (110° C.)	9.63	5.41	4.22	
SiO_2	55.76	57.00		1.24
Al_2O_3	15.02	15.28		0.26
Fe_2O_3	9.93	10.10		0.17
MgO	1.91	1.34	0.57	
CaO	4.70	1.42	3.28	
Alkalies	0.91	0.90	0.01	
TiO_2	0.72	0.72		
P_2O_5	0.03	traces	0.03	
SO_3	0.15	0.09	0.06	
S	0.00	0.01		0.01
MnO	0.47	0.28	0.19	
Loss on ignition (CO_2, Hydratic water)	10.53	13.40		2.87

N°. 744. BITONI, TIMOR.

	Rock.	Soil.	Loss.	Gain.
Water (110° C.)	2.05	8.00		5.95
SiO_2	6.74	24.30		17.56
Al_2O_3	2.50	10.87		8.37
Fe_2O_3	4.55	14.48		9.93
MgO	1.13	1.94		0.81
CaO	47.18	19.00	28.18	
Alkalies	0.09	2.36		2.27
TiO_2	0.88	2.28		1.40
P_2O_5	0.07	0.12		0.05
SO_3	0.33	traces	0.33	
S	0.00	0.00		
MnO	0.27	0.26	0.01	
Loss on ignition (CO_2, Hydratic water)	37.02	24.11	12.91	

N°. 244. CHRISTMAS-ISLAND.

	Sub-soil.	Surface-soil.	Loss.	Gain.
Water	1.89	3.42		1.53
SiO_2	0 10	0.70		0.60
Al_2O_3	46.72	50.14		3.42
Fe_2O_3	8.24	11.19		2.95
MgO	0.38	0.27	0.11	
CaO.	21.50	10.22	11.28	
Alkalies	0.37	0.28	0.09	
TiO_2	1.06	1.22		0.16
P_2O_5	2.53	3.66		1.13
SO_3	0.27	0.28		0.01
S	0.05	0.05		
MnO	1.62	1.70		0.08
Loss on ignition (Hydratic water)	15.97	20.13		4.16
CO_2	1.74	0.73	1.01	

TABLE VIII.

WEATHERINGFACTOR.
(ACCORDING TO HARRASSOWITZ.)

	West-Java.	Central-Java.							Timor.
No.	101	707	322	535	571, 569	539, 537	551	548	744
ki (rock) . .	71.4	1.87	6.84	4.47	4.64	5.65	10.32	16.82	4.58
ki (soil) . .	2.96	2.62	3.45	3.04	3.72	14.16	13.70	15.01 Sub-Soil	3.80
K.	0.04	1.40	0.50	0.68	0.80	2.51	1.32	0.90	0.82

TABLE IX.

PHYSICAL PROPERTIES

	West-Java					Central-								
Geological age . .	Tertiary					Quater-nary	Ter							
N°.	101	102	105	91	145	707	320	321	322	323	324	335	566	567
Diameter of particles:	%	%	%	%	%	%	%	%	%	%	%	%	%	%
< 0.01 m.M. .	37.8	79.4	40.6	48.5	42.8	8.5	53.5	63.4	52.4	54.4	48.6	59.1	41.1	34.3
0.01 — 0.05 m.M. .	4.2	16.9	36.4	17.5	26.4	5.0	26.8	21.0	27.8	18.8	21.6	9.2	17.8	13.0
0.05 — 0.1 m.M. .	4.6	2.1	12.8	7.4	13.6	5.5	8.5	8.5	9.2	9.6	13.2	7.2	16.6	9.1
0.1 — 2.— m.M. .	53.4	1.6	10.2	26.6	17.2	81.0	11.2	7.1	10.6	17.2	16.6	24.5	24.5	43.6
Hygroscopic coefficient	23.56	23.37	17.82	15.1	9.64	4.5	16.5	16.0	13.33	14.46	16.1	15.9	19.6	20.11
Maximum water-capacity	63.8	63.2	53.9	41.8	44.0	44.0	60.6	57.9	54.2	59.1	56.2	64.1	48.7	42.9
Volume expansion .	35.8	27.2	14.3	16.67	11.4	0.0	44.3	22.9	0.0	0.0	21.5	37.2	22.9	17.2
P_H value	7.6	6.0	4.6	8.5	7.4	8.5	8.6	8.3	7.7	8.5	8.5	8.2	7.6	8.2

OF THE SURFACE-SOILS.

Java											Madura			Timor			
tiary											Tertiary			Permian		Tertiary	
568	535	569	539	538	557	551	549	550	546	553	728	729	730	744	745	746	747
%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
57.2	53.2	41.4	35.4	25.6	15.2	7.0	44.8	31.3	55.5	17.8	31.6	36.4	6.0	20.7	37.6	31.1	16.8
22.9	16.8	14.4	16.0	23.5	44.7	7.5	10.8	15.0	37.0	19.7	22.4	27.8	10.0	17.8	21.0	9.5	11.0
13.2	11.04	8.4	7.0	24.6	29.5	16.0	9.6	16.0	5.0	10.3	11.4	22.0	9.8	9.5	14.2	9.4	9.6
6.7	18.96	35.8	41.6	26.3	10.6	69.5	34.8	37.7	2.5	52.2	34.6	13.8	74.2	52.0	27.2	50.0	62.6
21.08	20.24	19.2	6.2	6.4	4.89	9.9	17.0	10.8	14.5	8.8	12.2	8.7	7.6	11.9	12.2	12.6	6.72
48.7	54.9	40.8	41.0	42.4	40.3	41.8	43.6	45.2	50.2	47.4	41.4	40.1	31.3	45.0	48.4	60.0	60.4
11.4	27.78	25.7	6.0	28.6	0.0	0.0	15.7	12.9	17.2	0.0	11.4	11.4	0.0	14.0	10.0	9.5	1.0
7.6	6.5	8.2	7.8	7.3	6.1	6.6	8.5	—	6.6	6.0	8.0	7.8	7.2	8.2	8.5	8.2	8.3

TABLE X.

PHYSICAL PROPERTIES OF THE SUB-SOILS.

	West-Java	Central-Java						Madura		Timor
Geological age	Ter-tiary	Tertiary						Tertiary		Ter-tiary
No.	105	320	321	335	535	548	546	728	729	746
Diameter of particles:	%	%	%	%	%	%	%	%	%	%
< 0.01 m.M. . . .	32.0	24.6	56.3	34.7	47.56	17.4	33.0	34.2	32.2	39.1
0.01 — 0.05 m.M. . . .	33.8	21.2	28.5	16.3	24.24	30.4	36.5	23.0	39.6	18.0
0.05 — 0.1 m.M. . . .	22.0	14.8	10.0	11.5	14.8	27.6	5.0	16.4	12.6	9.8
0.01 — 2.— m.M. . . .	12.2	39.4	5.2	37.5	13.4	24.6	25.5	26.4	15.6	33.1
Hygroscopic coefficient .	8.8	6.0	14.2	14.0	25.03	4.35	12.8	12.9	7.2	11.6
Maximum watercapacity.	47.1	34.0	61.8	66.2	65.4	42.8	48.0	41.3	35.6	51.0
Volume expansion . . .	17.2	7.15	22.9	37.2	22.22	0.0	14.3	10.0	11.4	10.0
P_H value.	4.7	8.2	8.5	8.1	5.8	8.3	8.6	8.3	8.4	8.3

GENERAL CONCLUSIONS.

The communications here given are the result of an investigation commenced in 1916 in the Dutch East Indies and only now (1928) concluded.

So much time was required in consequence of the scantiness of the auxiliary apparatus (means) at the disposal of the author. He would gladly have given more (and more extensive) chemical analyses if the financial supplies had permitted this; his laboratory is not equipped for the examination of rocks and soils either chemically or by means of the spectroscope or X rays, besides his staff is insufficient.

For mechanical analyses only KOPECKY's silting cylinder could be used where a more modern apparatus would have been required. In consequence thereof his study has not fully attained the goal aimed at. However, some valuable details illustrating the originating of tropical soils from limestones are brought to light, as shown by the recapitulation given on p. 143—160 and by the general considerations hereunder.

I. SOIL AND ROCK.

It is well known that originally the examination of the soil was limited to surface-soil, afterwards to surface-soil and sub-soil and still later to rock and surface-soil. In modern time the study of profiles (vertical sections) is propagated, but it is a remarkable fact that here the study of the rocks is often neglected. In my opinion this is a fundamental error and I have arrived at this conclusion through foresaid study and through the general experience with respect to the formation of soils which I have gathered (ever since 1916) in other parts of Europe and Africa. **In the beginning was the rock and the rock was mother to the soil,** this should never be forgotten. The properties of the rock pass on to the soil, either wholly or in part. The soil afterwards acquires new properties. Consequently we must distinguish between **inherited** properties and such as are **acquired.** These two sets of properties stamp the soil as a living object and it falls to the task of the investigator to trace these properties by means of an examination of the rock **and** the soil.

II. THE NECESSITY OF A MICROSCOPICAL EXAMINATION OF THE ROCK AND THE SOIL.

To know a soil we have to study its anatomy, physiology and morphology.

Its morphology and physiology we study in the field; its anatomy is investigated in the laboratory. Anatomical study includes not only the mechanical composition, the percentage of colloids etc., but also all its organic and inorganic elements. Microscopic examination starts with the binocular and ends with the polarisation-microscope. It has to include all components, not some only, as is actually the case. A thorough microscopical examination of Javanese limestones and limestone-soils has taught me the following:

After treating the rock with cold and warm water and subsequently with hydrochloric acid, each residue must be examined separately with both microscopes; after this the soil is to be elutriated with cold water. The finest and the coarsest fractions must then be examined. My own researches have taught me:

1. Various inorganic and organic components were found in the finest fraction only (0.05—0.1 mM), here called fraction N°. 3, and **not** in the next (4th.) fraction. Often the contrary was the case. Therefore in the analysis component is placed against component and its absence indicated by the sign ————. Moreover the quantity of the minerals found was estimated as closely as could be done.

2. In the Java soil we find components not occuring in the limestone below. They are either due to causes as volcanic eruptions, wind and rain, or have subsequently originated in the soil. To the first components we may ascribe i.a. magnetite, ilmenite etc; to the second ones globulites of iron-bisulfide, etc.

3. One of the chemical analyses showed the presence of sulphuric acid; the microscopical examination revealed its composition with Ba and Sr to coelestobaryte. *This baryte came from the limestone* and was formed in it.

A similar experience I had with the mineral heulandite. This zeolite was not formed in the soil but in the limestone and — from it — passed on to the soil. The silicic acid of the chemical analysis sometimes was of colloidal origin either free or in conjunction with Al_2O_3, sometimes it originated from quartz and other silicates. Again it was found to originate from kaolinite and this kaolinite was **not** formed in the soil but in the rock and originated from muscovite, although it is generally assumed that muscovite does not alter. This alteration of muscovite into kaolinite was first noticed as far as I know, by S. TOMKEIEFF in his study: On the Occurrence and Mode of Origin of certain Kaolinite-bearing Nodules in the Coal Measures (Proceedings of the Geologist's Association Vol. XXXVIII 1927, pp. 518—547). He however starts from the assumption that muscovite is the intermediate product of the transformation of felspar into kaolinite, which assumption does not apply to the limestones I studied. In this case the kaolinite originates direct from muscovite, and muscovite may be considered as a mineral transported to the limestone during its formation. But kaolinite may also appear as a product of the crystallization of colloidal alumosilicate, this composition appearing more or less in all limestones.

4. Another interesting observation was made with regard to the foraminifera often appearing in limestones. We may distinguish the following cases:

a. the foraminifera pass unaltered from the rock into the soil, and the coarsest residue (4th fraction) contains so many foraminifera, all beautifully preserved, as to justify the name of foraminifera-sand. In the soil they have been preserved by a thin coating of soil which can easily be removed by silting it with distilled water;

b. in the soil we repeatedly find concretions of hydrated ironoxide. This iron originates in the first place from glauconite and also from augite and amphibole whereas e. g. magnetite and ilmenite yield little iron. This iron impregnates the foraminifera in such a manner that they may be called limonitisated foraminifera. Foraminifera may also be impregnated by ironbisulfide, silicic acid, calcium phosphate and glauconite. They can therefore be altered in the soil in *five* different ways.

Foraminifera from the limestone also contains silicic acid. [1])

5. Repeatedly it was observed that minerals were recently formed in the limestone, either primarily by cristallization from colloidal mixtures or secondarily from existing minerals. I have noticed i. a. apatite, baryte, calcite, fluorite, glauconite, heulandite, quartz, plagioclase, siderite, tremolite.

The fact that these minerals were formed in the limestone and were not imported follows from:

I. their perfect shape showing no traces whatever of rounding by transport (e. g. quartz, plagioclase, siderite);

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[1]) F. W. CLARKE and W. C. WHEELER, The inorganic constituents of marine invertebrates. (United States Geological Survey, Professional Paper 102, Washington 1917).

II. the way in which they lie *in* the rock. I point to tremolite as an example. Its formation from calcite could be studied perfectly well. Another example is the presence of a coppermineral soluble in ammonia, which I found twice (see p. 116, 131).

Further there are minerals which have got into the limestone by endogenetic causes. Amongst them I number asphalt, graphite, metallic copper, colloidal calciumphosphate (turquois?), found in soils from Christmas Island in limestone with veins of Al_2O_3.

6. Finally there is a certain number of minerals imported into the limestone during its formation by sea and rivers, and washed out of older rocks like granite and slate, which now do not occur on the surface at Java. I mention i. a. andalusite, kyanite, garnet, corundum, microcline, muscovite, rutile, staurolite, tourmaline and zircon.

When tabulated the above gives the following exposition.

PROBABLE ORIGIN OF MINERALS IN LIMESTONES AND SOILS.

Limestones	A. Primary	I. Originated by cooling of gaseous solutions.
		II. Originated by crystallization of solutions or colloidal suspensions.
	B. Secondary.	III. Imported by currents and rivers and originating from older rocks.
		IV. Resulting from submarine pre-tertiary volcanic eruptions.
Soils	A. Primary	V. Originated by crystallization of solutions or colloidal suspensions.
		VI. Originating from minerals already present.
	B. Secondary	VII. Originating from the rock.
		VIII. Originating from post-tertiary volcanic eruptions.

I.	II.	III.	IV.
asphalt	baryte	andalusite	amphibole
copper (metallic)	calcite	apatite	augite
graphite.	coppermineral	corundum	biotite
	cordierite	epidote	glaucophane
	eukolite	garnet	hypersthene
	fluorite	glaucophane	ilmenite
	glauconite	kyanite	magnetite
	globulites of iron-bisulfide	microcline	plagioclase
	heulandite	muscovite	volcanic ash
	kaolinite	quartz	volcanic glass
	limonite	rutile	zircon.
	orthoclase	sillimanite	
	plagioclase	staurolite	
	pyrite	tourmaline	
	quartz	zircon.	
	tremolite		
	turquois		
	vivianite		
	zircon.		

V.	VI.	VII.	VIII.
calcite	kaolinite	amphibole	amphibole
globulites of iron-bisulfide	leukoxene	augite	augite
limonite	limonite.	baryte	biotite
quartz		biotite	hypersthene
siderite		coppermineral	ilmenite
vivianite.		corundum	magnetite
		eukolite	plagioclase
		fluorite	quartz
		garnet	volcanic ash
		glauconite	volcanic glass.
		glaucophane	
		heulandite	
		kaolinite	
		magnetite	
		microcline	
		muscovite	
		orthoclase	
		plagioclase	
		quartz	
		rutile	
		sillimanite	
		staurolite	
		tourmaline	
		zircon.	

III. THE RELATION BETWEEN THE CLIMATE AND THE RED COLOUR OF THE SOIL.

A generally accepted assumption is that *the* Tropics are characterised by high temperature and strong rainfall resulting in a strong leaching and in a red colour of the soil. This argument also has been reversed and it is argued that if the local climate is *not* tropical, the red soil is a fossil soil, a relict, and a proof of change of climate. If the region in question is far from the present Tropics, then it is argued that there has been either a horizontal displacement of the continents or a displacement of the terrestrial axis. I seldom saw a more complicated compound of sophisms. To mention only the simplest facts: We do not even know the percentage of iron enveloping the finest parts of the soil with a gelatinous pellicle nor in what state the iron is present, either colloidal or crypto-crystalline (to be ascertained by X rays) nor do we know the origin of the iron (to be investigated by microscope). And yet it is often said and written: Red = tropical colour = tropical climate = heavy washing out = fossil climate = continental displacement or shifting of the poles.

With this accumulation of sophisms periodicals and books are filled, and each treatise starts again from theses still waiting for experimental proofs.

Against these conceptions I wish to oppose mine, founded on field-and laboratorystudies during many years.

Assuming that the red colour is constant and does not alter in grey as soon as the soil has been desiccated in the laboratory;

assuming that the red colour does not depend on the red colour of the mother-rock;

assuming that the red colour has been fixed tinto-metrically and is composed of red $\pm$ 10, yellow $\pm$ 14 and blue $\pm$ 5;

assuming that the microscopical examination has proved that the red colour is due to the presence of a pellicle of colloidal iron around the finest parts of the soil, that this iron is magnetic and that this magnetism is increased by heating up to 100° C, and then suddenly disappears;

assuming therefore that we have a *real* colour, then the only conclusion we are permitted to make is this one: that *the red colour points only to the presence of colloidal ironoxyde.*

It is independent of temperature, rainfall, orographic height, vegetation and quantity of humus (see table II) and proves nothing with regard to transformation through exposure to a humid and hot climate. When studying carefully table II we may even go one step further and conclude that the colour of a limestone-soil is independent of climate.

The cause of the red colour has to be investigated separately in each case as well in the field as in the laboratory, and rather than to put forward a theory we ought to have the courage to say: *We don't know.* Attention should be called to the following fact: After examination in my laboratory it was found that red sands in the Netherlands had, generally speaking, a smaller percentage of colloidal iron (= 0.88 %; average of 6 samples), than yellow sands in their immediate neighbourhood (= 1.38 %; average of 2 samples).

IV. THE RAINFACTOR OF LANG.

As demonstrated at an earlier date than I did myself, by F. KERNER, W. MEYER and A. REIFENBERG for Europe, viz. that the so-called rainfactor of **Lang** is unavailable, I found this to be also the case for Java (see table I). If so is it possible to express the influence of climate on the soil in another way?

In my opinion the reply is a negative one.

What is climate? The result of a number of factors which we do not even know from region to region. These factors refer to a column of air at so many meters above the earth, but what do we know of the influence of climate from the surface of the soil to 2 M. above it, i. c. of the layer of air in immediate contact with the soil?

Our first knowledge on this subject with regard to the tropics is still to be acquired and as long as we do not create agro-climatology as an independent science, we shall not advance one step as regards our knowledge of *the* tropical climate, the laterite climate, the terra-rossa climate, etc, etc, and even these expressions will be void of sense. An exact determination has to precede theoretical conclusions.

V. THE ALTERATION OF LIMESTONE IN SOIL ON JAVA, MADURA AND TIMOR.

How did a soil originate from the limestone, and how great is the volume of soil from a known quantity of rock?

These are weighty questions, to which we do not know the answer. In the present state of our knowledge we can only try to find an approximate answer. What follows is a diffident effort in only one direction.

Selecting three cases from those examined (see table p. 168) differing in rainfall and geological age of the rock, we find that **rainfall** and its oscillations, both horizontally and vertically is the most **important factor in the tropical weatheringprocess of limestone.** The longer the action of the rain lasts the more the rock is leaching.

The structure of the rock is the second factor. This follows from the data of N°. 322 (see p. 46) a hard limestone, where the loss of calcium carbonate expressed in % of the $CaCO_3$ of the rock is only 56 %, whereas that of the soft limestone, of the same geological age, varies between 94 and 100 %.

A third important factor is the mineralogical composition of the rock. The relative richness of silicates causes a strong concentration of SiO_2 in the soil, and added to this, the constant addition of minerals by volcanic eruptions has caused the high percentage of SiO_2 and Al_2O_3.

Free Al_2O_3 does not appear; colloidal alumosilicate and kaolinite do this well.

Number.	707.	101.	744.
Locality	Central-Java	West-Java	Timor
Geological age	Quaternary	Tertiary	Permian
Yearly rainfall in m.M.	2908	3702	1464
Loss of $CaCO_3$ in % of the rock	20.75	97.28	61.91
SiO_2 of te weathered silicates	3.16 %	26.68 %	21.53 %
Water of the soil	3.04 %	11.68 %	8.00 %
First fraction, diameter of particles < 0.01 m.M.	8.5 %	37.8 %	20.7 %
Hygroscopic coefficient	4.5 %	23.56 %	11.9 %
P_H value	8.5	7.6	8.2
ki (soil)	2.62	2.96	3.80
Height in M.	1	200	420
Vegetation	palm-trees	forests	grasses and shrubs

The limestone-soil examined, is for its properties, solely dependent on the limestone and its properties: the limestone-soil is an edaphic soil.

This conclusion is not only valid for the Indian limestone-soil but also for the limestone-soil, which I studied in the vicinity of Aix-la-Chapelle, Southerly Spain and Marocco, Sicily, Alger, Southerly France, etc. Still more. It is not remarkable that the soil of the quarternary calcareous tufa near Syracuse (Sicily) is a black one and the quaternary calcareous tufa at the East-coast of Sumatra, according to the communication of Dr. C. H. OOSTINGH, Overzicht van de gronden in het Tabaksgebied van

Deli. (Mededeelingen van het Deli-proefstation te Medan, Tweede Serie, No. LIV, 1928, p. 42), also?

The Russian-soil-scientists have adopted the relation between climate and soil as the only foundation of their classification of soils, but how would have been their classification, if they had begun in the Tropics instead of in Russia?

An answer to the question of the relation between a given volume of rock and the quantity of soil, formed therefrom must be reserved for the future.

APPENDIX.

I. SUMMARY OF THE MINERALS FOUND.

Quaternary limestone	Tertiary limestone	Permian limestone	Quaternary soil	Tertiary soil	Permian soil
Amphibole	Amphibole	Amphibole	Amphibole	Amphibole	Amphibole
—	Andalusite	—	—	Andalusite	—
—	Apatite	—	—	Apatite	—
—	Asphalt	—	—	Asphalt	—
Augite	Augite	Augite	Augite	Augite	Augite
—	Baryte	—	—	Baryte	—
—	Biotite	—	Biotite	Biotite	—
—	Calcite	Calcite	—	Calcite	Calcite
—	—	—	—	Chiastolite	—
—	—	—	—	Chlorite	—
—	—	—	—	Copper	—
—	—	—	—	Coppermineral	—
—	—	—	—	Cordierite	—
—	Corundum	—	—	Corundum	—
—	—	—	—	Enstatite	—
—	Epidote	Epidote	—	Epidote	Epidote
—	—	—	—	Eukolite	—
—	Fluorite	—	—	Fluorite	—
—	Garnet	Garnet	Garnet	Garnet	Garnet
—	Glauconite	Glauconite	Glauconite	Glauconite	Glauconite
—	—	—	—	Glaucophane	—
—	Graphite	—	—	Graphite	—
—	Heulandite	—	—	Heulandite	—
—	—	—	Hypersthene.	—	—
—	Ilmenite	Ilmenite	Ilmenite	Ilmenite	Ilmenite
—	Kaolinite	—	—	Kaolinite	—

	—	—	—	—	Kyanite	—
	—	—	—	—	Leucoxene	—
	—	Limonite	Limonite	Limonite	Limonite	Limonite
	Magnetite	Magnetite	Magnetite	Magnetite	Magnetite	Magnetite
	—	Microcline	—	—	Microcline	—
	—	Muscovite	—	—	Muscovite	—
	—	Orthoclase	—	—	Orthoclase	Orthoclase
	—	Plagioclase	Plagioclase	Plagioclase	Plagioclase	Plagioclase
	—	Pyrite	—	Pyrite	Pyrite	—
	Quartz	Quartz	Quartz	Quartz	Quartz	Quartz
	—	Rutile	Rutile	—	Rutile	Rutile
	—	—	—	—	Siderite	—
	—	—	—	—	Sillimanite	—
	—	Staurolite	—	—	Staurolite	—
	—	Tourmaline	Tourmaline	—	Tourmaline	Tourmaline
	—	Tremolite	—	—	Tremolite	—
	—	Vivianite	—	—	Vivianite	—
	—	Volcanic ash	—	—	Volcanic ash	—
	—	Volcanic glass	—	—	Volcanic glass	—
	Zircon	—	—	Zircon	Zircon	Zircon
Total . .	5	32	13	13	45	15

REMARKS ABOUT SOME MINERALS FOUND IN THE LIMESTONES AND IN THE LIMESTONE-SOILS.

The micro-photographs, which belong to these considerations were selected from a collection of 700 numbers.

1. AMPHIBOLE.

The monoclinic amphibole (German: Hornblende) is the most occurring one. Always green, sometimes brown, with inclusions of magnetite and zircon. Once I found a transition between amphibole and tremolite (rock N°. 521). The specific gravity was that of tremolite, the refractory index that of amphibole. The mineral was colourless and the habit characteristic by the typical spires.

Amphibole alters little; there is only a precipitation of yellow ironhydroxide along the planes of cleavage.

Photograph N°. 1, from N°. 728 (soil), prep. N°. 446.

Photograph N°. 2, from N°. 521 (rock), prep. N°. 374.

2. ANDALUSITE.

The colour is bluegrey; pale-red and then pleochroitic from red to colourless; colourless, often with inclusions of carbonaceous matter and fragments of rutile.

Remarkable is the find of an organic lime-tube with black inclusions with the same refractory index and right extinction as andalusite. I should like to name it: *pseudo-chiastolite.* It was found in N°. 550.

Photograph N°. 3, from N°. 566 (soil), prep. N°. 322.

Photograph N°. 4, from N°. 550 (soil), prep. N°. 566.

3. APATITE.

This mineral is often considered as the source of phosphoric acid in the soil, but that is, to my opinion, inaccurate.

N°.	% P_2O_5 of the rock.		% P_2O_5 of the soil.	
101	traces	—	0.05	—
91	0.02	—	0.13	+
707	0.01	—	0.23	—
322	0.17	+	0.20	+
535	0.00	—	0.06 —; traces +; 0.14 —.	
571, 569	0.03	—	0.13	—
537, 539	0.00	—	traces	+
551	0.14	—	0.14	—
548	traces	—	0.23	+
744	0.07	—	0.12	—

\+ = apatite present. — = apatite absent.

We see this mineral relatively rarely. Apatite is *unknown* in the quaternary coral-limestone (this rock is, mineralogically spoken, very poor) and in the Permian limestone on Timor and in their soils.

The phosphoric acid we find in the limestone is from the sea water, which contains enough phosphorus to permit the deposition of phosphatic salts at an appreciable rate, wherever the required biochemical conditions are present.

The phosphoric acid in the soil is inherited from the rock itself. Christmas Island makes an exception. Here is the limestone phosphatized perhaps by birds, and after this process hot springs, producing Al_2O_3, have penetrated the phosphatized limestone and have built colloidal alumophosphates.

Photograph N°. 5, from N°. 729 (soil), prep. N°. 635.

Photograph N°. 6, from N°. 550 (soil), prep. N°. 570.

4. AUGITE.

Always green with many inclusions. Titanaugite is only once found in N°. 707 (quaternary coral limestone).

Photograph N°. 7, from N°. 707 (soil), prep. N°. 214.

5. BARYTE.

It was very remarkable to see in the analyses of 322 (soil) 2.10 % SO_3.

The microscopical research demonstrated the presence of baryte, the spectroscopical that of coelesto-baryte (baryte with Sr). The question concerning the origin of this baryte was solved by discovering coelestobaryte in the limestone in which it was formed.

Cfr. O. B. BÖGGILD, Meeresgrundproben der Siboga-Expedition. Mit 1 Tafel und 1 Karte, Monographie LXV der Siboga-Expeditie, Leiden 1916., in which the author describes the presence of baryte in the marine deposits of the Seas of the Indian-Archipelago.

Photograph N°. 8, from N°. 322 (soil), prep. N°. 243.

6. BIOTITE.

Brown, green, yellow; by alteration bleaching.

Photograph N°. 9, from N°. 305 (soil), prep. N°. 457.

7. CALCITE.

Mostly in fragments with distinct planes of cleavage, sometimes in crystals.

Photograph N°. 10, from N°. 744 (soil), prep. N°. 509.

8. CORDIERITE.

Rare. Once found as an altered, blue-pale, non-pleochroitic grain and an other time altered in a green-spotted mineral (prasiolite? or chlorophyllite?).

9. CORUNDUM.

Very seldom. Colour always blue.
Photograph N°. 11, from N°. 557 (soil), prep. N°. 277.

10. FELSPAR-GROUP.

In soils as well as in rocks I found all possible felspars from orthoclase to bytownite, but the oligoclase-andesine is the most common one. Characteristic are the **well built** crystals and the very beautifully developed zonal structure. To my opinion the plagioclase-crystals are formed in the limestone, a thesis which first is proclaimed by A. DRIAN (1861) and later on by other authors.

BIBLIOGRAPHY.

1. CAYEUX, L. Sur la présence de cristaux macroscopiques d'albite dans les dolomies du Trias de la Crète. Compt. Rend. Acad. Sci. Paris, 1903, vol. 136, pp. 1703—1704.
2. DALY, R. A. Low-temperature formation of alkaline feldspars in limestone. Proc. Nat. Acad. Sci. U.S.A., 1917, vol. 3, pp. 659—665 (Min. Abstr., vol. 2, p. 435).
3. DRIAN, A. Notice sur les cristaux d'albite renfermés dans les calcaires magnésiens des environs de Modane. Bull. Soc. Géol. France, 1861, ser. 2, vol. 18, pp. 804—805.
4. GRANDJEAN, F. Propiétés optiques et genèse du feldspath néogène des sédiments du bassin de Paris. Compt. Rend. Acad. Sci. Paris, 1909, vol. 148, pp. 723—725.
5. —— Le feldspath néogène des terrains sédimentaires non métamorphiques. Bull. Soc. Franç. Min., 1909, vol. 32. pp. 103—133.
6. —— Deuxième note sur le feldspath néogène des terrains sédimentaires non métamorphiques. Bull. Soc. Franç. Min., 1910, vol. 33, pp. 92—97.
7. KAUFMANN, F. J. Kleine Dolomit-, Quarz- und Feldspathkrystalle in neptunischen Sedimenten. Beitr. Geol. Karte Schweiz, 1866, vol. 24. pt. 1, pp. 581—584.
8. LACROIX, A. Minéralogie de la France, 1896, vol. 2, pp. 158—168.

9. LAPPARENT, J. DE Sur les cristaux du feldspaths développés dans les calcaires du Crétacé supérieur pyrénéen. Compt. Rend. Acad. Sci. Paris, 1918, vol. 167, pp. 784—786. (Min. Abstr., vol. 1, p. 276).
10. —— Cristaux de feldspath et de quartz dans les calcaires du Trias moyen d'Alsace et de Lorraine. Compt. Rend. Acad. Sci. Paris, 1920, vol. 171, pp. 862—865.
11. LORY, C. Sur la présence habituelle de cristaux microscopiques de feldspath dans les calcaires magnésiens et les cargneules du Trias des Alpes occidentales. Rev. Soc. Savantes, Sci. Math. Phys. Nat. Paris, 1868, ser. 2, vol. 2 (for 1867), pp. 235—239.
12. ——. Présence de cristaux microscopiques de feldspath orthose, dans le résidu de la dissolution, par les acides, de divers calcaires jurassiques des Alpes occidentales. Arch. Sci. Phys. Nat. Genève, 1886, ser. 3, vol. 16, pp. 237—239.
13. —— Sur la présence de cristaux microscopiques de minéraux du groupe des feldspaths, dans certains calcaires jurassiques des Alpes. Compt. Rend. Acad. Sci. Paris, 1886, vol. 103, pp. 309—311.
14. ROSE, G. Ueber die Krystallform des Albits von dem Roctourné und von Bonhomme in Savoyen und des Albits in Allgemeinen. Pogg. Ann. Phys. Chem. 1865, vol. 125, pp. 457—468.
15. SPENCER, E. Albite and other authigenic minerals in limestone from Bengal. Min. Mag., Sept. 1925, Vol. XX, N°. 110, pp. 365—381.

The last author said on page 378 following:

„From the available evidence, it appears highly probable that the albite in the Cuddapah limestone is authigenic, and this view is strengthened by a comparison with other occurrences of felspar in limestones and dolomites. The evidence for an authigenic origin for the idiomorphic quartz crystals, the mica, the pyrites and rutile, and possibly for the tourmaline crystals, is also strong."

The alteration of the felspars is very scanty. We see the mineral getting turbid and along the cleavage planes penetrates iron, derived from the (to my opinion) authigenic pyrite, from limonite and authigenic glauconite.

Photograph N°. 17, from N°. 566 (soil), prep. N°. 290. Plagioclase.
Photograph N°. 18, from N°. 571 (rock), prep. N°. 512. Plagioclase.

11. FLUORITE.

Photograph N°. 12, from N°. 535 (soil), prep. N°. 624.

12. GARNET.

Common colour: pale-red; scarcely brown; always in grains, once a dodecahedron.
Photograph N°. 13, from N°. 729 (soil), prep. N°. 634.

13. GLAUCONITE.

Glauconite occurs always in small globular masses or grains and in Foraminifera, but once I found a very remarkable great dark-green fragment, which much resembles the „Greenalite", in Europe found in cretaceous limestone of France by L. CAYEUX, and considered by KARL C. BERZ as „Chamosite".

Cfr. L. CAYEUX, Introduction à l'étude pétrographique des roches sédimentaires, Paris 1916, p. 252.
K. C. BERZ, Ueber die Natur und Bildungsweise der marinen Eisensilikate insbesondere der chamositischen Substanzen, Berlin 1926.

14. HEULANDITE.

The find of this mineral (optically and microchemically studied) of the zeolite group is very interesting because I found them at first in the soils and afterwards in the rock. I thought that heulandite was formed in the soil as a *real* soil-zeolite, the discovery of the heulandite in the limestone convinced me that the presence in the soil was to be considered as an inheritance of the rock.

15. HYDRARGILLITE.

I did not found till now this, from a geochemical point of view, very interesting mineral, in the limestone as well as in the limestone-soils. On the contrary I found kaolinite, a mineral, which is very difficult to distinguish from hydrargillite, (see page 177).

16. HYPERSTHENE.

I often found the hypersthene in the limestone with characteristic „ragged" ends like spires.
Photograph N°. 15, from N°. 520 (rock), prep. N°. 337.

17. ILMENITE.

Ilmenite is a common constituent in the limestone and the limestone-soils. It is often very difficult to distinguish from magnetite, for I found:

a. magnetic magnetite,
b. magnetic ilmenite,
c. non-magnetic magnetite.

With regard to the crystalform I found a gradation between ilmenite and magnetite.

The crystal of ilmenite is often corroded and sometimes altered to a whitish or brown aggregate (leukoxene).

18. KAOLINITE.

The study of the microscopical composition of the limestones and the limestone-soils tought me to distinguish:

a. primary kaolinite,

b. secondary kaolinite.

The first is from colloidal origin, the second is formed by alteration of muscovite. I once remarked, that biotite was partly altered in muscovite and orthoclase was altered in kaolinite.

I give here a summary of the properties of hydrargillite and kaolinite as I found in the mineralogical literature.

	Hydrargillite.	Kaolinite.
Chem. Comp.:	$Al_2O_3 . 3 H_2O$.	$Al_2O_3 . 2 SiO_2 . 2 H_2O$.
System.:	Monocline.	Monocline.
Habit:	Hexagonal-plates.	Pseudo-hexagonal plates.
Structure:	Commonly in laminated or stalactitic aggregates.	Commonly in laminated aggregates.
Cleavage:	Basal	Basal.
Hardness:	2—3½	2—3.
Spec. Gravity:	2.34—2.5	2.6—2.63.
Lustre:	Pearly.	Pearly, otherwise dull or earthy.
Colour:	White, grey, yellow, red, green.	White, yellow, brown, green, blue.
Optical Prop.:	$N = 1.566 + 0.021$ (Larsen) $N = 1.535 + 0.069$ (Brögger) $N = 1.535 + 0.019$ (Lacroix) Biaxial positive	$N = 1.56 - 0.006$ (Larsen). $N = 1.56 - 0.007$ (Cayeux). Biaxial negative. May be confused with muscovite, which gives a good interference figure in cleavage flakes; K.not.
Solubility:	Wholly in strong KOH.	Partly in diluted KOH.

From this summary we learn, that the only characteristic difference between H and K lays in the optical properties.

19. KYANITE.

Rare. Once found as a blue-spotted mineral with abnormal interference colours. No extinction.

Photograph N°. 16, from N°. 101 (soil), prep. N°. 159.

20. MAGNETITE.

See also under ilmenite, p. 176.
The most common crystalform is the octahedron, a single time I observed twin crystals (octahedron and tetrahedron). See Table XVII, fig. 4 in HEDDLE, Mineralogy of Scotland, Vol. I.; often irregularly shaped crystals with corroded surface.

21. PYRITE.

We have to distinguish pyrite (crystals) and globulites of ironbisulfide.
Photograph N°. 14, from N°. 550 (soil), prep. N°. 568.

22. QUARTZ.

The most common mineral, often in well-formed euhedral crystals, resembling hexagonal bipyramids (also in twins), with and without inclusions, once an optical abnormal interference figure, perhaps caused by the fact, that this quartz possesses a zonal structure (from N°. 571, rock).
Photograph N°. 20, from N°. 91 (soil), prep. N°. 256.
Photograph N°. 21, from N°. 535 (soil), prep. N°. 248.

23. SIDERITE.

Photograph N°. 22, from N°. 550 (soil), prep. N°. 563.

24. SILLIMANITE.

These examples were green-coloured.
Photograph N°. 23, from N°. 550 (soil), prep. N°. 564.
Photograph N°. 24, from N°. 535 (soil), prep. N°. 612.

25. STAUROLITE.

Photograph N°. 25, from N°. 730 (soil), prep. N°. 418.

26. TOURMALINE.

Photograph N°. 26, from N°. 538 (soil), prep. N°. 204.

27. VIVIANITE.

The first discovery of vivianite in the soils of Dutch East Indies was made by the late Dr. A. L. VAN BYLERT, Professor of Agriculture at Wageningen (1910). He found vivianite in peat of the East-coast of Sumatra. I found vivianite in the rock as well as in the soil of different localities of Java and Madura.

28. ZIRCON.

This is also one of the minerals which will be very often found in rock and soil. Usually colourless, a single time *purple*. (P. BOSWELL, On the distribution of purple zircon in British sedimentary rocks. Mineralogical Magazine XXI, Sept., 1927, N°. 118, pp. 310—317).
Crystalforms always present and well-built.

We can distinguish:

a. broad, thick forms;
b. small, high forms;
c. small, short forms.

Photograph N°. 27, from N°. 729 (soil), prep. N°. 637.
—— *N°. 28,* from N°. 730, (soil), prep. N°. 420.
—— *N°. 29,* from N°. 550 (soil), prep. N°. 302.
—— *N°. 30,* from N°. 538 (soil), prep. N°. 202.
—— *N°. 31,* from N°. 145 (rock), prep. N°. 386.

—— *N°. 32.* Fourth fraction from N°. 322 (soil), prep. N°. 25.
—— *N°. 33.* Third fraction from N°. 322 (soil), prep. N°. 24.

The ALTERATION of the minerals is very scanty and only the following minerals are altered, not *always* but *occasionally.*

AMPHIBOLE, AUGITE:	hydrated oxide of iron is precipitated along the planes of cleavage.
FELSPAR:	cloudy and along the planes of cleavage penetrate fine argillaceous matter.
BIOTITE:	bleached.
MAGNETITE:	coated with yellow ironhydroxide.
GLAUCONITE:	getting yellow.

GENERAL CONCLUSION:

The minerals are little altered; they are only disintegrated by mechanical powers.

THE SIGNIFICATION OF MINERALOGICAL RESEARCHES OF SEDIMENTS AND SOILS.

The answer to the question in how far mineralogical researches are useful for the study of sedimentary rocks is given us by P. H. BOSWELL, the well-known petrologist of the Liverpool University, who has been studying since 1915 the minerals of the British sediments.

In the „Proceedings of the Liverpool Geological Society" Vol. XIV, 1924, he informs us in his presidential address as follows:

„Although many of the problems which arise from a study of British sedimentary rocks must long remain unsolved, common agreement exists regarding several well-known principles concerned with the distribution of heavy minerals which are found in them.

Amongst these principles may be mentioned the following:

1. Sediments derived from crystalline (igneous or metamorphic) rocks display greater variety in their constituent minerals, both as regards species and physical characters, than those derived from pre-existing sediments.

2. The variety of minerals in one and the same sediment (except as indicated under paragraph 3 below) varies inversely as the distance from the source. Simplification and, in part, sorting are more effective as the distance of transport increases.

3. The proportion of heavy minerals varies with the mechanical composition. Sediments of coarse grade (diameter greater than 0.5 mm.) are usually deficient in heavy minerals, the proportion often being much less than 0.01 per cent. Those of medium grade (including medium sand 0.25 to 0.5 mm., fine sand 0.1 to 0.25 mm., and superfine sand or coarse silt 0.05 to 0.1 mm. (diameter) contain a relatively high proportion. The minerals in the grades of fine silt and clay cannot, because of the resistance offered to gravitational subsidence by surface area, be separated with sufficient accuracy to enable us to form conclusions as to the proportion of heavy residues in them. Sediments of coarse grade even near to their source may thus show but few heavy detrital minerals.

4. Bands or streaks exceptionally rich quantitatively in heavy minerals („pay-streaks"), although often deficient in variety, are the result of oscillatory action in the superficial layers of the sediment caused by wind and water-currents. They indicate fluviatile, shore or shallow-water conditions, often accompanied by contemporaneous erosion which itself causes a concentration of heavy minerals. Such pay-streaks are unlikely to occur in

sediments deposited below the limit of wave-action. Colour-banding, due to such mineral concentrates, is thus usually a marginal feature.

5. The effect of denudation on a rock-succession of varying petrology is to reverse the order of characteristic constituents in the sediments produced.

6. A general tendency exists for progressive mineralogical simplification and increasing uniformity with decreasing geological age in a series of beds laid down in a basin of deposition or geosynclinal. Such a result is partly due to the subjection of the relief of the neighbouring land-masses (when the time occupied in transport is greater), to the elimination of less stable mineral varieties, and, in the later stages, to the effects of contemporaneous erosion and to the denudation of the older sediments which are themselves upraised to form the margins of the geosynclinals. More variety occurs in marginal deposits and less in those occupying the centre of the basin.

7. The least petrological variation is likely to be found in marine sediments of isopic facies and of uniform and similar grading, deposited at some distance from a shore-line or towards the close of a period of continuous sedimentation.

8. Although the deposits may all conform to a general type characteristic of the formation to which they belong, much more variety will be noted in those land down in epicontinental seas, especially if the area is broken up by many small land-masses. Archipelago-conditions yield numerous separate areas of deposition, each of which may differ petrologically from the others.

9. Most variation in petrology in beds of a particular age is to be noted if they have been deposited under continental or entirely terrestrial conditions. Isolated basins of deposition result and the extensive land-area exposed at the time is likely to offer varying types of rocks to the denuding agents. High gradients and rapid currents produce less effective selection and sorting.

10. Tectonic movements, which frequently cause the uplift of land-masses consisting in part of crystalline rocks, result in the „rejuvenation" of sediments in the matter of variety of constituent minerals. The relative abundance of detrital minerals also increases accordingly. Conversely, changes in mineral composition may throw light on the age and character of earth-movements, and of the rocks exposed.

11. The detrital minerals of most frequent occurrence in sediments belong to the group of „stress-minerals" of Dr. A. HARKER. The species included in the „anti-stress" group occur much less frequently and indeed are only abundant in glacial and recent

deposits. It is evident that stress-minerals are much more stable in sedimentary rocks than anti-stress species.

12. Unconformities are likely to be marked by petrological, as by palaeontological breaks."

The time to confirm or to agglect these conclusions with relation to the Indian Archipelago has not yet come. *Much* and once more *much* microscopical work has to be done, before we arrived to definitive conclusions.

And now the signification of mineralogical research of the soil. This research is *worthless*, when it is a *flying survey*, *valuable*, when it is detailed and profound, and combined with that of the mother-rock.

A. We learn to know, which minerals are *new* for the soil, which are inherited from the rock. The newbuilt minerals give us the best view in the chemical processes which the soil has undergone since its building.

B. We learn howfar the soils are exposed processes of enrichment or impoverishment.

C. We learn the age of the soil.

D. We learn in howfar the soil is a building *in-situ* (residual or eluvial deposit) or transported (colluvial).

BIBLIOGRAPHY.

Anyone wanting more references about the literature on sedimentary mineralogy, will have to consult the following bibliographies:

I. BOSWELL, P. G. H., Some aspects of the petrology of sedimentary rocks. Proceedings of the Liverpool Geological Society, Vol. XIII, part IV, 1923, pp. 231—303.

II. BOSWELL, P. G. H., Some further considerations of the petrology of sedimentary rocks. Proceedings of the Liverpool Geological Society, Vol. XIV, 1924, 33 pp.

III. BOSWELL, P. G. H., Some recent work on the petrography of sedimentary rocks. Proceedings of the Liverpool Geological Society, part IV, Vol. XIV, 1927.

IV. CLERICI, E., Saggio bibliografico di psammografia Italiana. Bollettino della Società Geologica Italiana, Vol. XLIII — 1924 — Fasc. 1. Roma 1924.

Literature on the mineralogy of the different soil-types must still be written. Who read Dutch may consult: Dr. H. LOOS, Contribution to the knowledge of some soils of Java and Sumatra, 216 pp. with XV plates, containing 153 microphotographs of soil-minerals. Publisher: Veenman and Sons, Wageningen, 1924.

LOOS gives a description of 31 soil-minerals.

NOTE I.

While this memoir was being printed, I found in the West Indian Bulletin, Volume XVIII, 1921 a study of Mr. J. B. HARRISON with the misleading title: THE GENESIS OF A FERTILE SOIL (p. 77—99).

The author describes the building of a soil of corallogene limestone of Barbados, by which the chemical work was checked by microscopical examination.

The plan of his investigation was to determine the compositions of the soils and the proportions of their constituents soluble respectively in boiling hydrochloric acid, and in large excess of 10-per cent, hydrochloric acid, normal, decinormal and centinormal hydrocloric, nitric, oxalic, and citric acids, and normal, decinormal and centinormal solutions of ammonium oxalate, ammonium citrate, ammonium nitrate, and ammonium sulphate, acting in the cold, but his transfer to British Guiana prevented the enquiry. What was done about the composition of the red residual soils on coralrock follows here.

Ultimate chemical composition of Mount Misery coral (1), High-level corals (2), High-level beach-rock (3), Low-level corals (4), Low-level beach-rock (5).

ULTIMATE CHEMICAL COMPOSITIONS.

	1	2	3	4	5
Quartz	nil.	0.06	2.12	13.06	20.11
Silica (organic)	2.07	1.65	1.49	6.54	4.07
Combined silica	41.08	35.58	44.44	36.36	32.82
Combined water	11.59	11.87	9.37	4.82	8.13
Alumina	27.47	27.32	22.03	16.68	21.38
Iron peroxide	13.26	14.49	12.64	10.95	6.15
Iron protoxide	0.88	2.24	0.79	2.59	2.27
Manganese oxide	nil.	0.37	0.84	nil.	nil.
Titanium oxide	1.75	2.58	2.00	1.98	1.52
Calcium oxide	0.45	0.21	0.70	2.60	0.20
Magnesium oxide	1.44	1.47	1.83	1.21	1.39
Potassium oxide	0.27	0.59	1.43	1.09	0.92
Sodium oxide	0.39	1.45	0.35	2.70	0.90
Phoshoric anhydride	0.02	0.01	0.01	0.02	0.01
	100.67	99.89	100.04	100.60	99.87

The analyses were made so as to separate the constituents of the residue unattacked by hot sulphuric acid from those constituents which are thereby rendered soluble in dilute acids or, in the case of silica, in a warm dilute alkaline solution. The constituents of the acid-resistant fractions are shown in the following table:

Percentage compositions of
the mineral constituents not decomposable by hot sulphuric acid.

	1	2	3	4	5
Quartz	nil.	1.05	39.77	33.26	64.09
Combined silica	72.10	74.57	43.63	40.30	22.64
Alumina	6.60	11.13	8.68	11.05	6.68
Iron peroxide	nil.	nil.	nil.	2.55	nil.
Iron protoxide	5.07	7.56	4.63	1.63	1.46
Titanium oxide	nil.	nil.	0.58	0.18	0.19
Calcium oxide	9.64	0.84	0.39	3.70	0.64
Magnesium oxide	4.06	1.68	1.16	1.04	1.11
Potassium oxide	2.03	1.05	0.78	1.35	0.76
Sodium oxide	0.51	2.10	0.39	5.12	2.41
	100.01	99.98	100.01	100.18	99.98

Some if not all of the quartz in the residue from the rocks of the higher levels is secondary crystalline silica, whilst part, if not the whole, of that from the lower-level corals and beach-rock is clastic, and derived from the quartz-sands beds of the Scotland Series exposed on the eastern section of the island. The analyses therefore have been re-calculated to eliminate the quartz. The results are as follows:

Percentage compositions of
the mineral constituents other than quartz.

	1	2	3	4	5
Combined silica	72.10	75.35	72.43	60.22	63.04
Alumina	6.60	11.25	14.42	16.51	18.60
Iron peroxide	nil.	nil.	nil.	3.81	nil.
Iron protoxide	5.07	7.64	7.69	2.43	4.06
Titanium oxide	nil.	nil.	0.96	0.27	0.53
Calcium oxide	9.64	0.85	0.64	5.53	1.78
Magnesium oxide	4.06	1.70	1.92	1.55	3.09
Potassium oxide	2.03	1.06	1.28	2.03	2.11
Sodium oxide	0.51	2.12	0.64	7.65	6.71
	100.01	99.97	99.98	100.00	99.92

These analyses of the extraneous mineral constituents of the Barbados limestones indicate that in addition to ferruginous kaolinite which may have been derived from extremely finely-divided clay held in suspension, or even in colloidal solution, in the sea or ocean waters, they consist of minerals of volcanic origin.

Microscopical was found:

Mount Misery coral	High-level corals and beach-rock	Low-level corals and beach-rock
amphibole	amphibole	— — — —

augite	augite	augite
biotite	biotite	————
hematite	hematite	————
————	————	hornblende
hypersthene	hypersthene	hypersthene
ilmenite	ilmenite	ilmenite
kaolinite	kaolinite	kaolinite
limonite	————	limonite
————	magnetite	————
————	orthoclase	orthoclase
plagioclase	plagioclase	plagioclase
————	pyrite	————
————	quartz	quartz
sanidine	————	————
————	tourmaline	————
————	volc. glass	volc. glass
zircon	————	————

HIGH-LEVEL RED RESIDUAL SOILS ON CORALROCK, BARBADOS.

	1	2	3	4
Per cent. of water retained by air-dried soil	14.7	10.7	11.9	12.1
Percentage compositions of the soils dried at 105° C.				
Combined water	12.000	10.494	11.662	10.964
(1) Humus	0.381	0.336	0.295	0.910
Root and other vegetable debris	2.960	2.098	2.565	3.355
Soluble in water and in cold dilute (10 % HCl) hydrochloric acid.				
Chlorine	0.036	0.008	0.006	0.005
Nitric anhydride	0.013	0.020	trace	0.025
Sulphuric anhydride	0.141	0.057	0.166	0.155
Phosphoric anhydride	0.150	0.105	0.107	0.151
Chalcedonic and combined silica (soluble in 20 % sodium hydrate solution) ..	25.228	22.702	16.482	4.604
Alumina	6.266	4.319	7.402	6.852
Iron peroxide	10.885	8.243	9.906	8.755
Iron protoxide	0.161	0.785	0.878	0.820
Manganese oxide	0.161	0.140	0.142	0.159
Calcium carbonate	0.334	1.400	2.148	3.752
Calcium oxide (as sulphate and silicate)	1.506	1.098	nil.	0.609
Magnesium oxide	0.485	0.343	0.307	0.328
Potassium oxide	0.090	0.042	0.033	0.132
Sodium oxide	0.033	0.005	0.003	0.003

Rendered soluble by boiling hydrochloric and sulphuric acids.

	1	2	3	4
Phosphoric anhydride	0.030	0.184	0.114	0.072
Silica (combined)	17.866	14.749	20.112	24.732
Titanium oxide	1.994	1.479	2.256	2.778
Alumina	12.961	11.410	15.623	20.694
Iron peroxide	0.373	1.254	1.090	1.503
Iron protoxide	0.760	1.290	0.900	0.615
Manganese oxide	0.055	0.053	0.027	0.025
Calcium oxide	0.274	0.408	0.355	0.081
Magnesium oxide	0.232	0.161	0.041	0.358
Potassium oxide	0.476	0.380	0.227	0.310
Sodium oxide	0.344	0.158	0.312	0.144
Quartz (insoluble)	3.818	16.215	7.040	7.458
	100.013	99.936	100.199	100.349
(1) Containing nitrogen	0.230	0.126	0.185	0.247

„To produce 8 inches of earth would entail the destruction by weathering of 100 feet of the limestone-rock."

NOTE II.

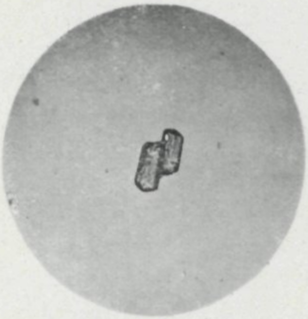
Exchangeable Ca obtained by treating the soil with a 10 % solution of NaCl.

(by T. W. G. DAMES).

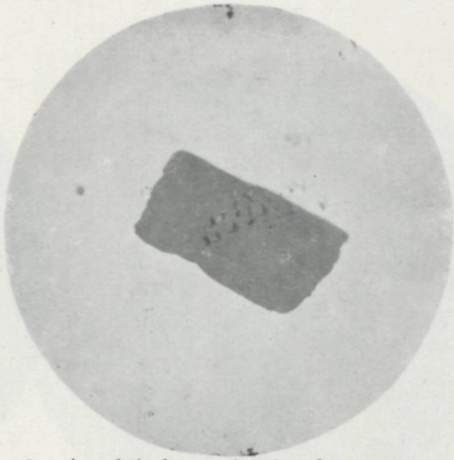
N°.	Page.	% CaO.	N°.	Page.	% CaO.
101, soil	13	0.088	548, sub-soil . . .	95	0.048
102, soil	19	0.0979	549, surface-soil . .	97	0.078
91, soil	26	0.079	546, sub-soil . . .	105	0.070
145, soil	30	0.056	546, surface-soil . .	106	0.078
707, soil	36	0.042	728, sub-soil . . .	113	0.084
322, soil	48	0.101	728, surface-soil . .	114	0.071
323, soil	51	0.097	729, sub-soil . . .	117	0.051
324, soil	54	0.082	729, surface-soil . .	119	0.055
535, sub-soil. . . .	70	0.094	730, soil	121	0.015
535, sub-soil. . . .	73	0.064	744, soil	124	0.080
535, surface-soil . .	75	0.039	745, surface-soil . .	127	0.085
569, soil	80	0.050	746, sub-soil . . .	129	0.055
539, soil	84	0.045	747, surface-soil . .	133	0.047
538, soil	86	0.047	244, sub-soil . . .	137	0.069
551, soil	91	0.043	244, surface-soil . .	138	0.026

MICRO-PHOTOGRAPHS OF SOME SOIL-MINERALS.

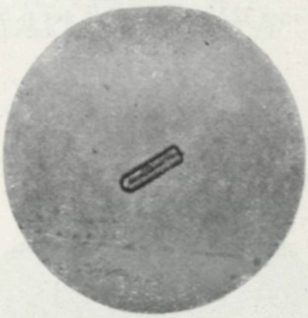
Photographer: Prof. A. TE WECHEL (Wageningen).



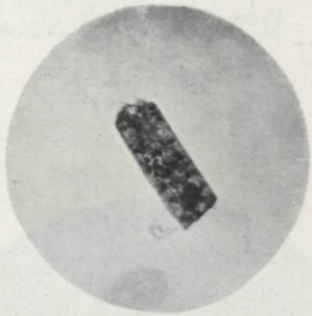
1. Amphibole 40 ×
From 728, sub-soil, see p. 114.



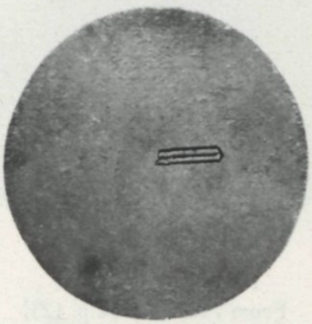
2. Amphibole or Augite, burnt 40 ×
From 521, rock, see p. 112.



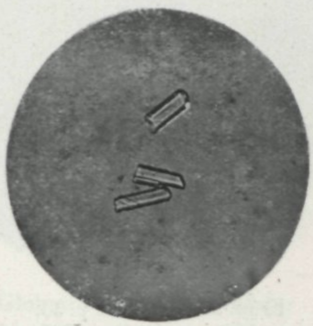
3. Andalusite. 40 ×
From 568, soil, see p. 68.



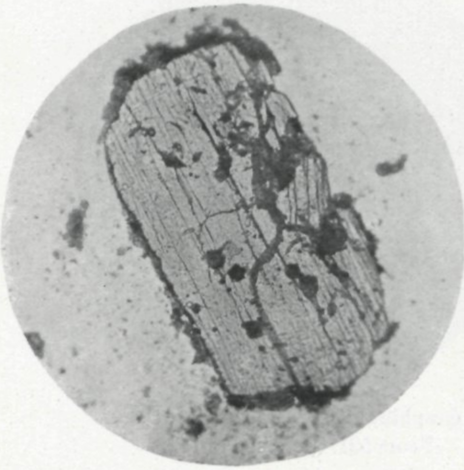
4. Pseudo-chiastolite 40 ×
From 550, soil, see p. 100.



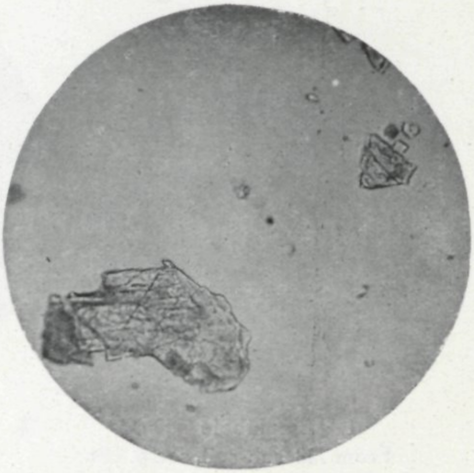
5. Apatite 40 ×
From 729, sub-soil, see p. 118.



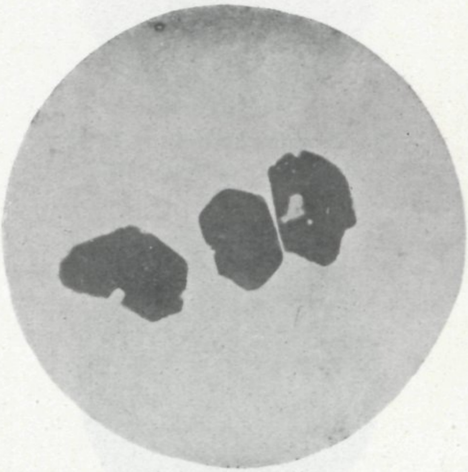
6. Apatite 40 ×
From 550, soil, see p. 99.



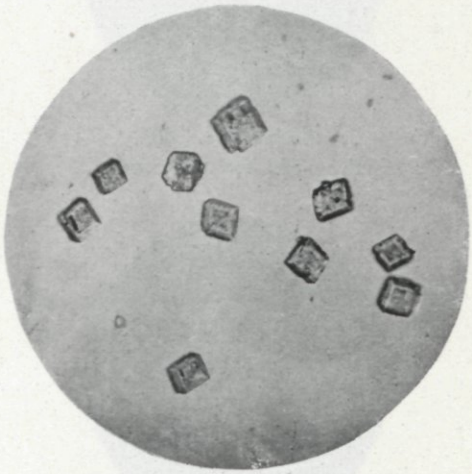
7. Augite. 40 ×
From 707, soil, see p. 37.



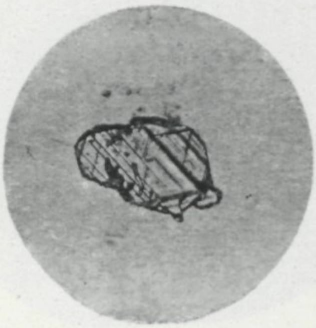
8. Baryte 40 ×
From 322, surface-soil, see p. 50.



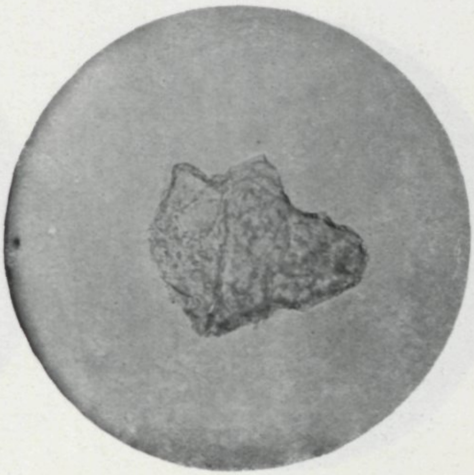
9. Biotite 40 ×
From 305, soil, see p. 33.



10. Calcite 40 ×
From 744, soil, see p. 125.

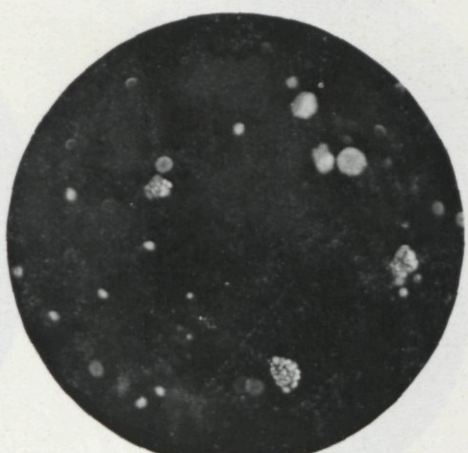


11. Corundum 40 ×
From 557, soil, see p. 89.

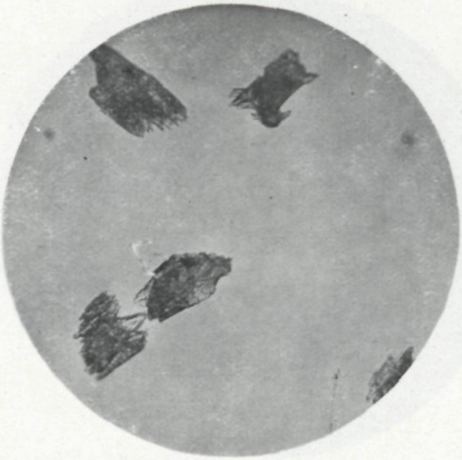


12. Fluorite 40 ×
From 535, sub-soil, see p. 74.

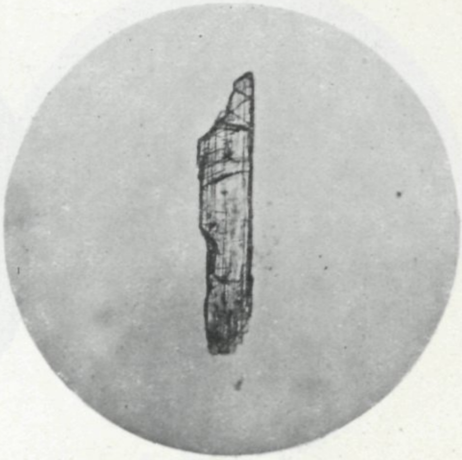
13. Garnet 100 ×
From 729, sub-soil, see p. 118.



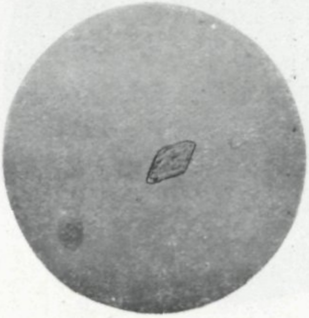
14. Globulites of ironbisulfide.
From 550, soil, see p. 100.



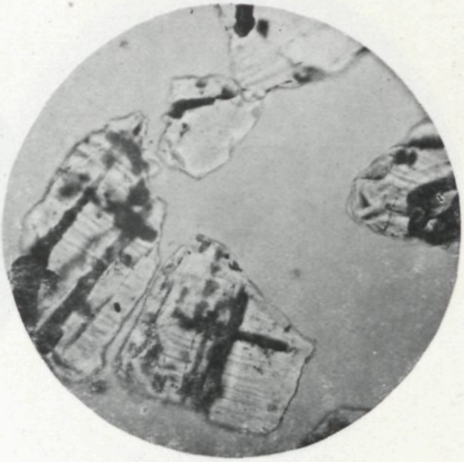
15. Hypersthene („ragged") 40 ×
From 520, rock, see p. 111.



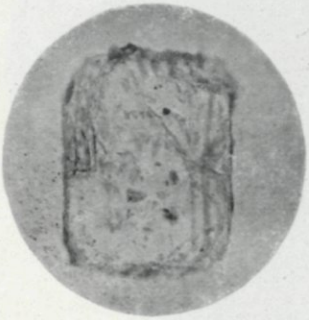
16. Kyanite 40 ×
From 101, soil, see p. 15.



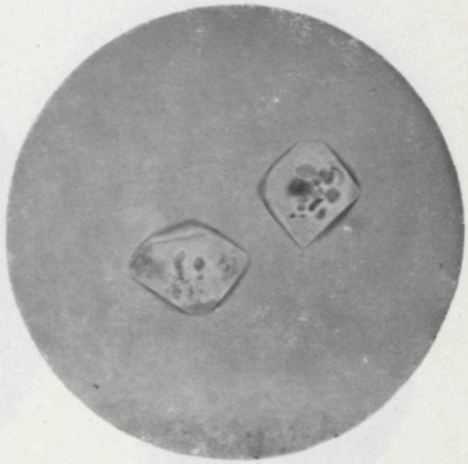
17. Plagioclase 40 ×
From 566, see p. 67.



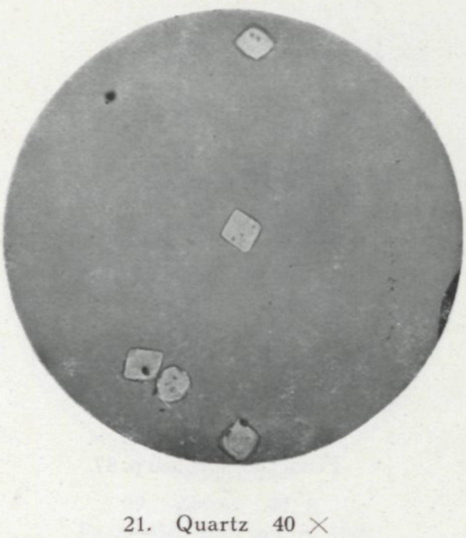
18. Plagioclase 40 ×
From 571, rock, see p. 79.



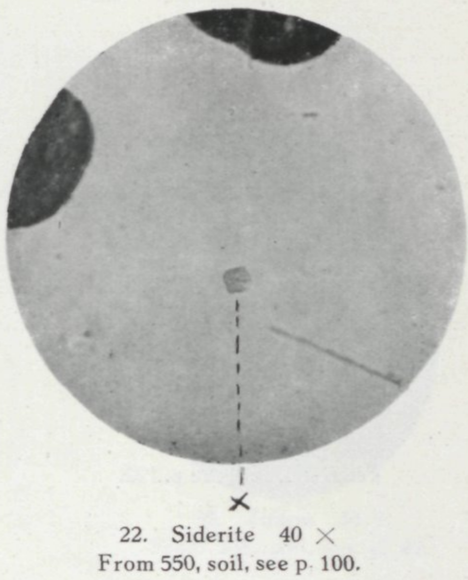
19. Plagioclase 40 ×
From 745, rock, see p. 127.



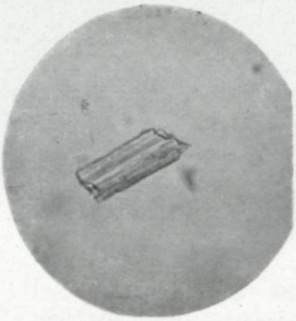
20. Quartz 40 ×
From 91, soil, see p. 27.



21. Quartz 40 ×
From 535, surface-soil, see p. 76.

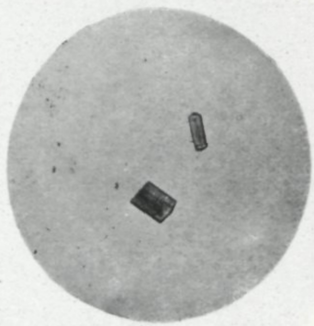


22. Siderite 40 ×
From 550, soil, see p. 100.


23. Sillimanite 40 ×
From 550, soil, see p. 100.


24. Sillimanite 40 ×
From 535, surface-soil, see p. 76.


25. Staurolite 40 ×
From 730, soil, see p. 122.

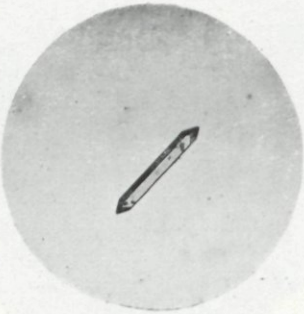

26. Tourmaline 40 ×
From 538, soil, see p. 87.

27. Zircon 40 ×
From 729, surface-soil, see p. 120.

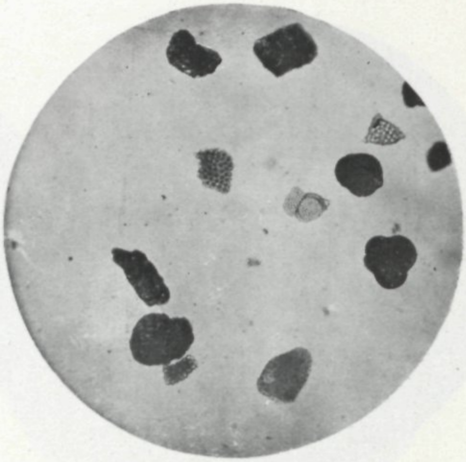
28. Zircon 40 ×
From 730, soil, see p. 122.

29. Zircon 40 ×
From 550, soil, see p. 100.

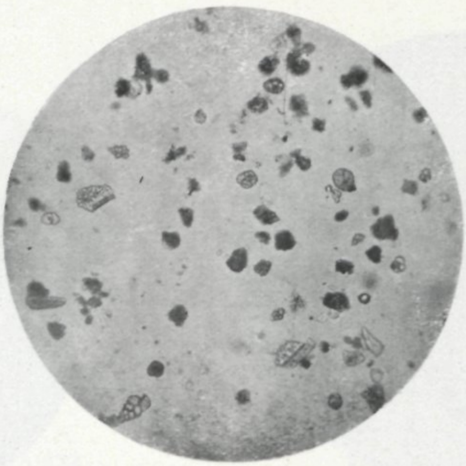
30. Zircon 40 ×
From 538, soil, see p. 87.



31. Zircon 40 ×
From 145, rock, see p. 30.



32. Fourth fraction 40 ×
From 322, soil, see p. 50.



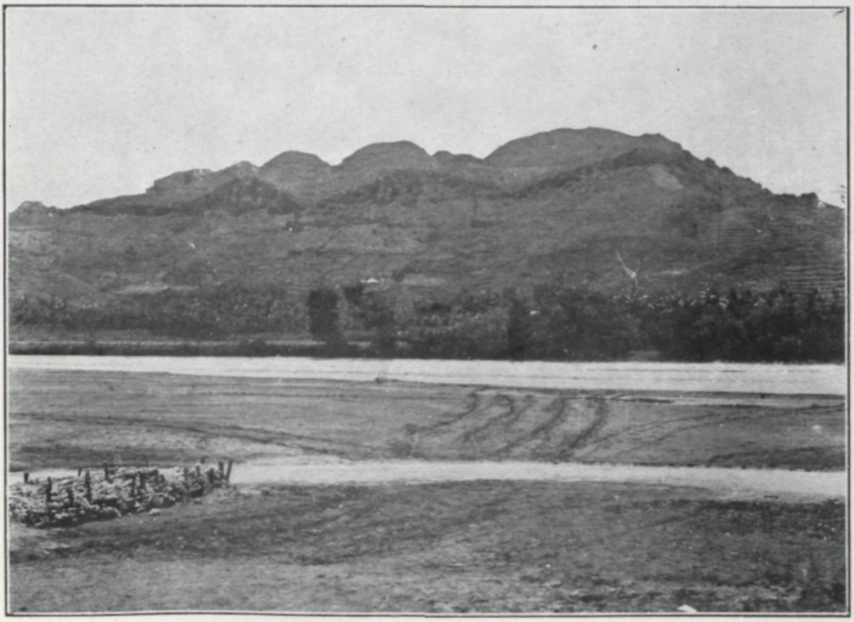
33. Third fraction 40 ×
From 322, soil, see p. 50.

PLATES

PLATE I

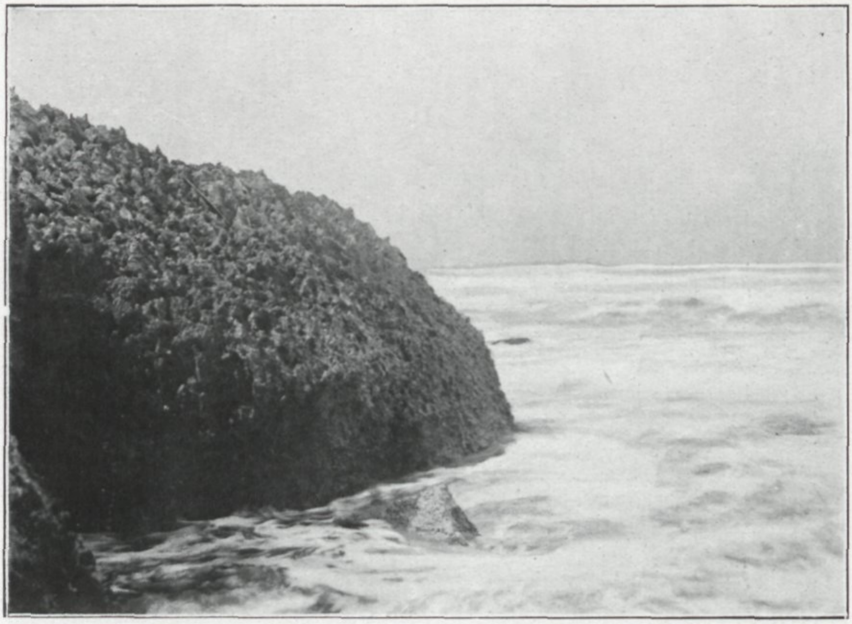
Landscape in the neighbourhood of Tagok Apu. Here was collected N°. 91, see p. 25. Photographed: Aug. 1916.

PLATE II.



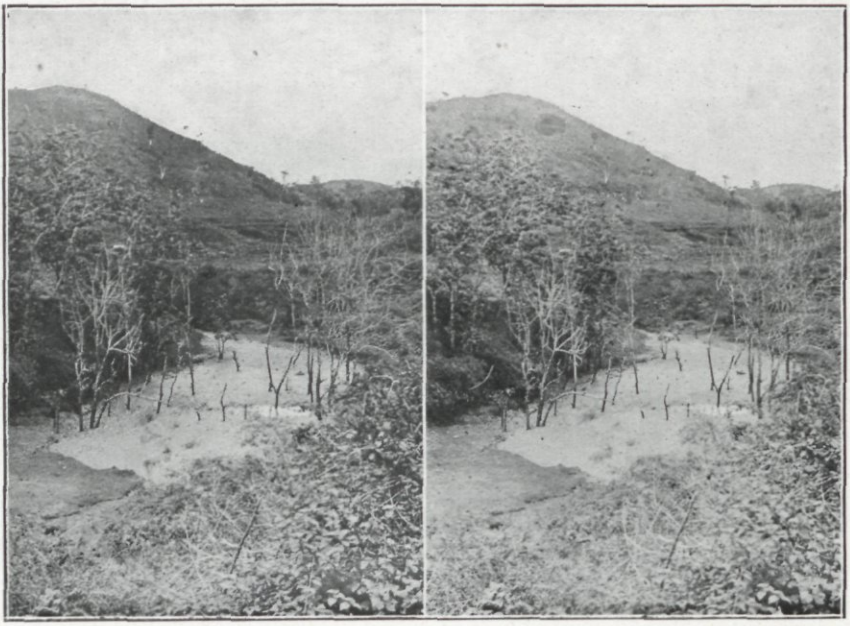
Karst-landscape, East of the river Opak (on the foreground). Here was collected N°. 566, 567 and 568, see p. 61. Photographed: October 1916.

PLATE III.

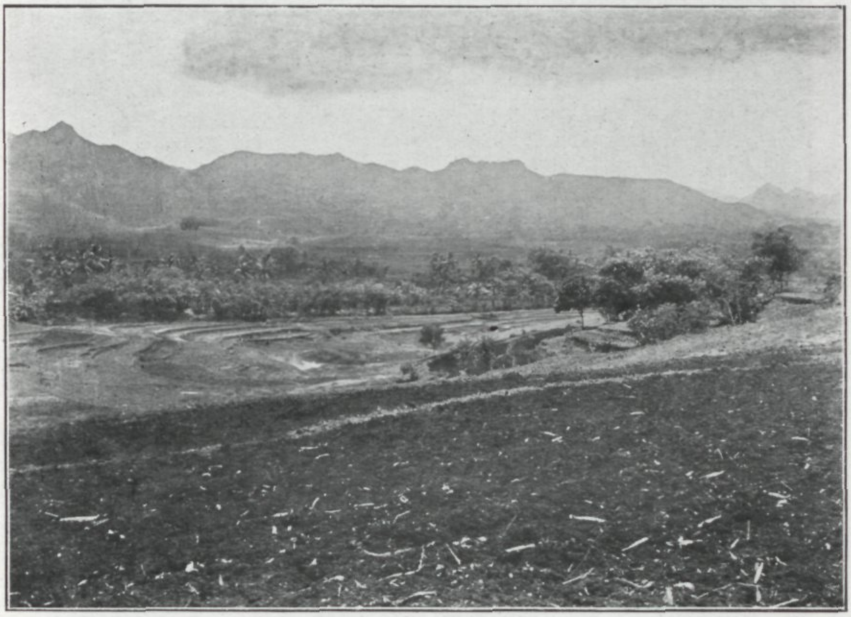


Fragment of limestone with eroded surface of the G. Sewu, fallen down by the influence of marine erosion. At the right the Indian Ocean. Photographed: October 1916.

PLATE IV.

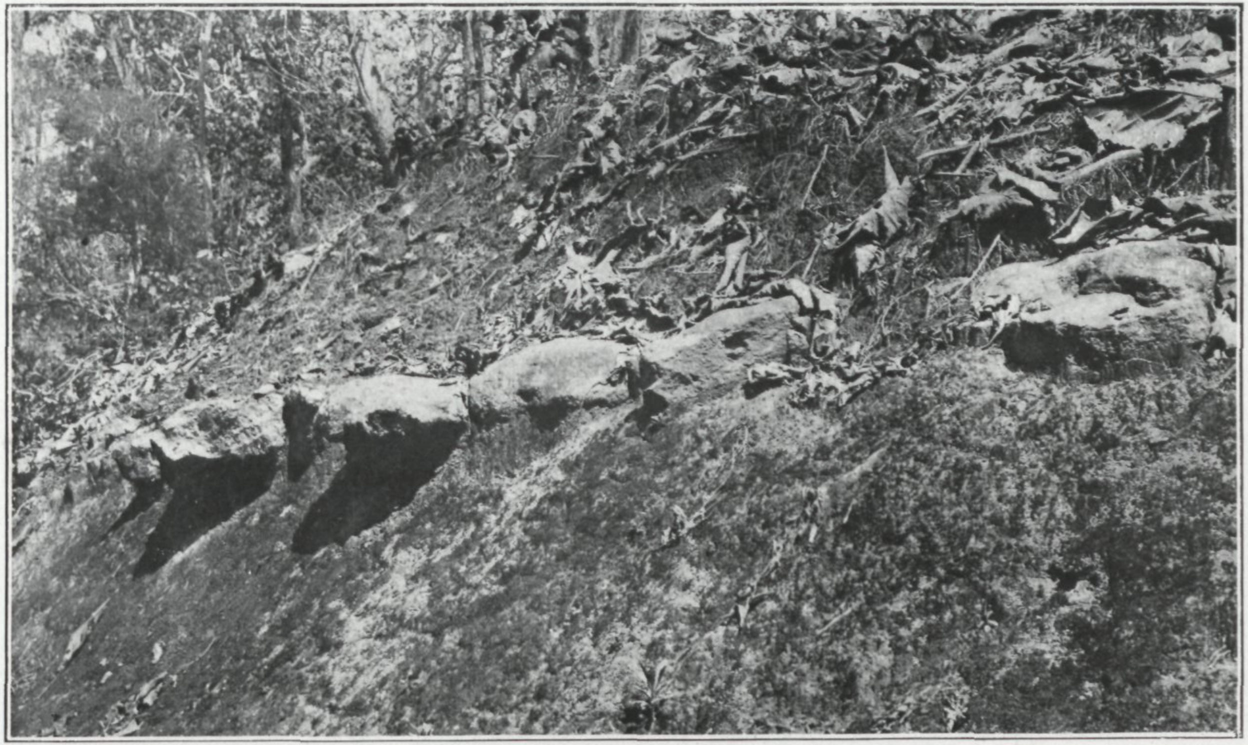


The Gunung Sewu near Rongkop. In the foreground a dolina. Photographed: October 1917, by L. Kalshoven, Buitenzorg (Java).



Landscape near Bunder. Here was collected N°. 535, see p. 69.
Photographed: October 1916.

PLATE VI.



Teak-forest on limestone-soil; the hard layer of limestone builts a bank. Here was collected N°. 551, see p. 90.
Photographed: October 1916.

Soft limestone with pot-holes in the Forest-division Sulur, Residency Semarang. In such a location was collected N°. 548, see p. 94. Photographed: Sept. 1916, by Dr. J. BEUMÉE, Chief-botanist at Buitenzorg (Java).

Teak-forest on loamy-soil, Forest-division Tjabak. In such a location was collected N°. 546, see p. 104. Photographed: October 1916.

PLATE IX*a*.

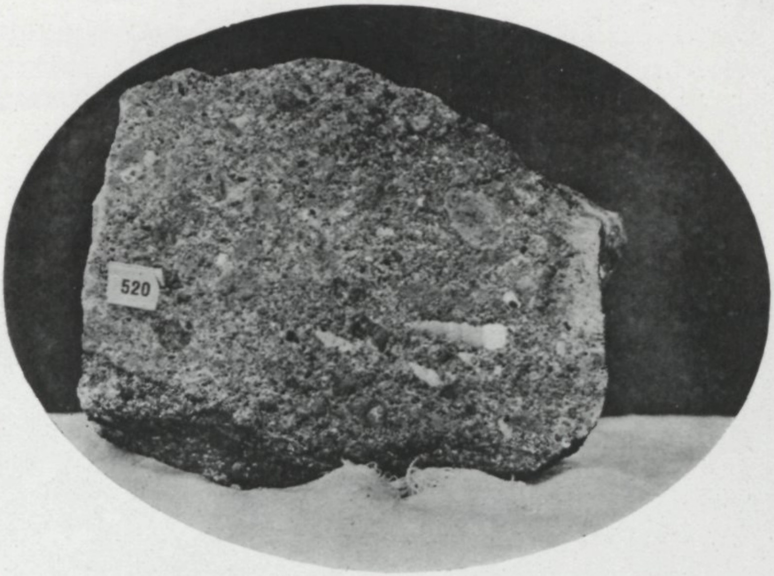
Photograph of N°. 570, see p. 78.

PLATE IX*b*.

Micro-photograph of N°. 570; enlargement 12 ×.

Micro-photograph of N°. 502, see p. 111;
enlargement 11 ×.

PLATE XI.



Photograph of N°. 520, see p. 111.

PLATE XII.

Photograph of N°. 521, see p. 111.

Rain-erosion on limestone, N. of Purwodadi, Res. Semarang.
Collected: October 1916.

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TIMOR.

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CHRISTMAS-ISLAND.

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RECAPITULATION.

CONCLUSIONS.

APPENDIX.

NOTES.

MICRO-PHOTOGRAPHS.

1. amphibole.
2. amphibole or augite.
3. andalusite.
4. pseudo-chiastolite.
5. apatite.
6. apatite.
7. augite.
8. baryte.
9. biotite.
10. calcite.
11. corundum.
12. fluorite.
13. garnet.
14. globulites of ironbisulfide.
15. hypersthene.
16. kyanite.
17. plagioclase
18. plagioclase.
19. plagioclase.
20. quartz.
21. quartz.
22. siderite.
23. sillimanite.
24. sillimanite.
25. staurolite.
26. tourmaline.
27. zircon.
28. zircon.
29. zircon.
30. zircon.
31. zircon.
32. fourth fraction.
33. third fraction.

PLATES.

I. Landscape in the neighbourhood of Tagok Apu. Here was collected N°. 91. Photographed: Aug. 1916.

II. Karst-landscape, East of the river Opak (on the foreground). Here was collected N°. 566, 567 and 568. Photographed: Oct. 1926.

III. Fragment of limestone with eroded surface of the G. Sewu, fallen down by the influence of marine erosion. At the right the Indian Ocean. Photographed: October 1916.

IV. The Gunung Sewu near Rongkop. On the foreground a dolina. Photographed: October 1927 by L. KALSHOVEN, Buitenzorg (Java).

V. Landscape near Bunder. Here was collected N°. 535. Photographed: October 1916.

VI. Teak-forest on limestone-soil; the hard layer of limestone builts a bank. Here was collected N°. 551. Photographed: October 1916.

VII. Soft limestone with pot-holes in the Forest-division Sulur, Residency Semarang. In such a location was collected N°. 548. Photographed: Sept. 1916, by Dr. J. BEUMÉE, Chief-botanist at Buitenzorg (Java).

VIII. Teak-forest on loamy-soil, Forest-division Tjabak. In such a location was collected N°. 546. Photographed: October 1916.

IX*a*. Photograph of N°. 570, see p. 78.

IX*b*. Micro-photograph of N°. 570; enlargement 12 ×.

X. Micro-photograph of N°. 502, see p. 111; enlargement 11 ×.

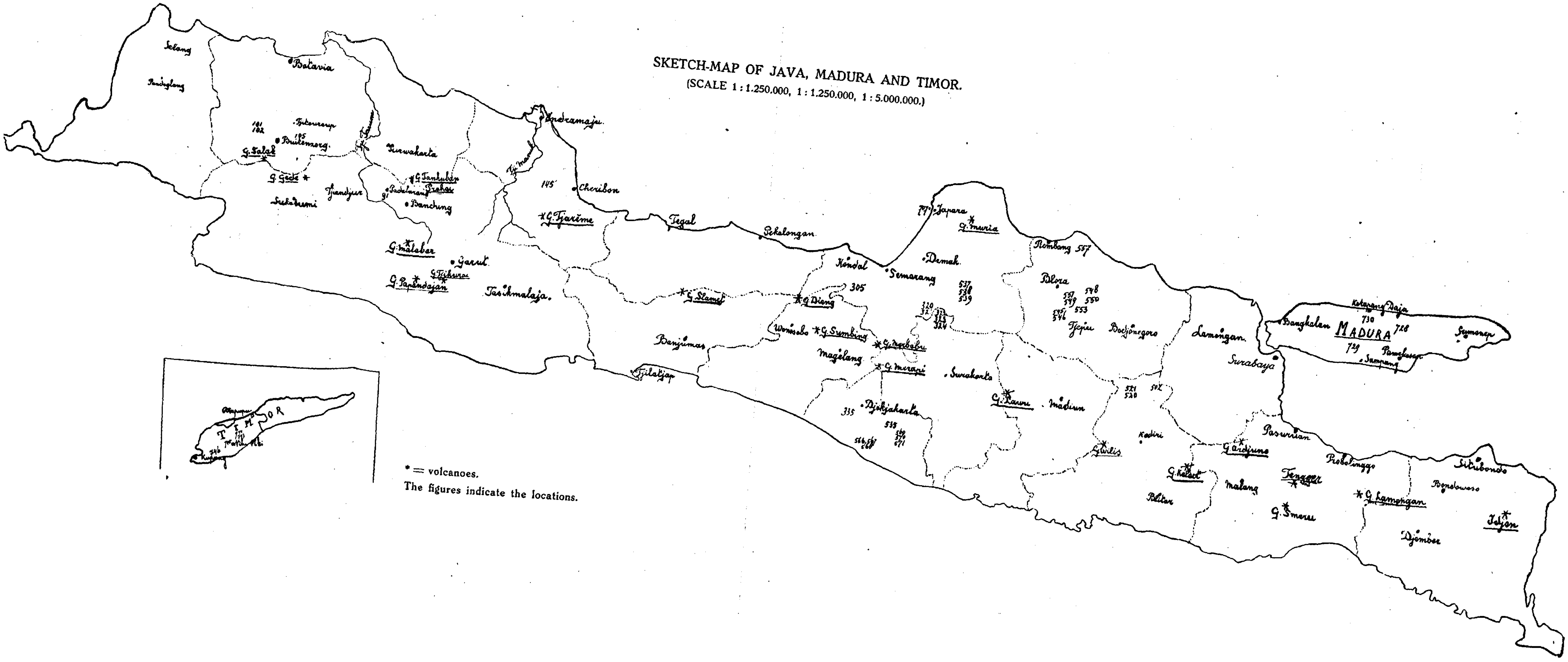
XI. Photograph of N°. 520, see p. 111.

XII. Photograph of N°. 521, see p. 111.

XIII. Rain-erosion on limestone, N. of Purwodadi, Res. Semarang. Collected October 1916.

SKETCH-MAP OF JAVA, MADURA AND TIMOR.

(SCALE 1 : 1.250.000, 1 : 1.250.000, 1 : 5.000.000.)



* = volcanoes.

The figures indicate the locations.