Geology. — *The joint systems in the vicinity of the Salida Mine (West Coast of Sumatra)*. By H. TERPSTRA. Communicated by Prof. H. A. BROUWER.

(Communicated at the meeting of June 25, 1932).

Between the rivers A. Tambang and A. Doeri in the vicinity of the Salida mine reddish brown silicious slates occur in two places, with an inclination varying from 40° to 60°. Further, S.W. of the Bukit Karang, in a conspicuously low and flat stretch of ground, we see clay- and coal slates, with from ½ to 2 meters thick coal- and sandstone banks and from 5 to 10 centimeters thick layers of pyrite.

The inclination of these rocks is of 5° to 10°, rising sometimes in the vicinity of the eruptive dykes to 50°. The sandstone banks we saw at various altitudes, both flat and with northerly and westerly inclinations of 30°, in the rivers A. Galagah, A. Serassa, and A. Sarik.

On the Bukit Tambang we found only loose blocks of these sediments. Fossils were not found here. They are well known in such sediments in the more northerly situated Loempo. According to Professor GERTH, however, the Gastropods and Lamellibranchiates found here do not permit an exact determination of age. ZWIERZYCKI (3) [1]) considers these as Tertiary rocks.

The eruptive rocks occur as andesite bodies, and dacite and basalt dykes. The following dykes, among others, were found :

In the Sungei Beramas Simpangkiri, 2 basalt dykes in dacite, 3 and 5 meters wide, strike N. 320° E., inclination 70° W., and Str. N. 40° E., incl. 40° W. ;

Numerous dacite dykes in andesite or bordering upon andesite with sediments (Bukit Karang), as a rule having a strike approximately from East to West. (Only a dyke near the Bukit Kapas Katjik seems to have a more northerly strike) ;

Further another andesite vein was found in coal slate, Str. N. 80° E., incl. 50° N., in the A. Kajoe Menang.

Propylitization, kaolinization (which sometimes turned out to be a product of weathering), and silicification, which are

[1]) WING EASTON (1), AERNOUT (2), and ZWIERZYCKI (3) have already given some particulars concerning this region, where in 1929 I was engaged for six weeks in geological investigations into the nature of ore deposits on behalf of the BARISAN Mining Company. The management of this company was so kind as to grant its permission for this publication.

not always connected with visible quartz veins, have altered the rocks considerably.

In consequence of the first of the above-mentioned processes, the eruptive rocks have been transformed into a blue clayey mass, with much pyrites, which sometimes turned out to contain gold.

Further the silicification is often so considerable that it is no longer macroscopically ascertainable whether we are concerned with an original vein or with silicified country rocks.

The Tertiary quartz veins, whether mineralized or not, always occur along the west coast of Sumatra in "vein regions", which may be arranged in a definite way; (I hope to deal with this subject again in a publication on the geology of Mocco-Mocco (N. Benkoelen)).

In such a vein region the veins are again accumulated in groups, lying in certain zones or lines.

The main vein of a group (i.e., the thickest) will as a rule have the same strike as the zone or line, while the strikes of the offshoot veins will be in accordance with those of the other zones.

As the veins are markedly lenticular and sometimes have no outcrop, because they are covered with detritus or do not break through to the surface, the arrangement often becomes a difficult matter to carry out.

We divided up the Salida vein group as follows:

I.	5 zones with an approx. strike	of N. 30° E.,	with 16	groups & veins.
II.	2 zones ,, ,, ,, ,,	of N. 40° W.,	,, 3	,, ,,
III.	2 zones ,, ,, ,, ,,	of N. 10° E.,	,, 4	,, ,,
IV.	1 zone ,, ,, ,, ,,	of N. 90° E.,	,, 2	,, ,,

I. Zones with an approx. strike of N. 30° E.

*a*1.	Sarik vein with the continuation in the A. Pinang.	Up to some meters wide.	Str. N. 27° E.	Incl. 80° E.
*a*2.	Serassa vein.	Up to some meters wide.	Str. N. 27° E.	Incl. 70° E.
*a*3.	Ilalang Roentjing vein.	Up to some meters wide.	Str. N. 40° E.	Incl. 70° E.
*b*4.	Doeri vein.	Up to some meters wide.	Str. N. 20° E.	Incl. 80°—90° E.
*b*5.	School vein.	veinlet, up to 40 cM.	Str. N. 40° E.	Incl. 80°—90° E.
*b*6.	Olo, Teleng, Katjai veins.	Up to 4 M. wide.	Str. N. 35° E.	Incl. 80° E.
*b*7.	Djambak vein.	?	?	
*b*8.	Kambang vein.	2 M. wide.	Str. N. 20° E.	Incl. 75° W.
*c*9.	Perakvein.	Some meters.	Str. N. 27° E.	

c10.	A. Doeri vein. 140 M. above sea level.	Up to 1 M. wide.	Str. N. 50° E.	Incl. 50° NW.
*d*11.	A. Goedang Arang vein, 140 M. above sea level.	1 sq. meter.	Str. N. 40° E.	Incl. ?
*d*12.	A. Doeri vein.	Wider than 3 M.	Str. N. 30° E.	Incl. 70° W.
*d*13.	Main vein of the Salida mine.	Up to 20 M. wide.	Str. N. 30° E.	Incl. 75° E.
*d*14.	A. Pisang vein.	0.15 M. wide.	Str. N. 45° E.	Incl. 90°
*d*15.	*a*. Bukit Beramas veins	Some meters.	Str. N. 30° E.	?
	b. Beramas Kanan vein.	1 M. wide.	Str. N. 40° E.	Incl. 60° E.
e16.	A. Solokketjil vein.	Approx. 0.15 M.	Str. N. 27° E.	Incl. 85° W.

II. Zones with an approximate strike of N. 40° W.

*a*17.	Painan vein.	Some meters	Str. N. 30°—40° W.	
*a*18.	Beramas Kiri vein.	veinlet.	Str. N. 40° W. ?	
*b*19.	Kambang vein.	?	?	

III. Zones with an approximate strike of N. 10° E.

*a*20.	A. Solokketjil vein.	0.05 M. wide.	Str. N. 0—10° E.	Incl. 85° E.
*b*21.	Leader vein in the Salida mine, N. and S. offshoot.	Some meters. wide.	Str. N. 12° E.	Incl. 80°—90° E.
*b*22.	S. Bank A. Doeri vein, 160 M. above sea level	Up to 4 M. wide.	Str. N. 0° E.	Incl. 80°—90° E.
*b*23.	veinlets in dacite near A. Goedang Arang.	Some centimeters wide.	Str. N. 10° E.	Incl. 40° W.

IV. Zones with an approximate strike of N. 90° E.

*a*24.	A. Goedang Arang vein, 110 M. above sea level.	2 M. wide.	Str. N. 70° E.	Incl. 40° N.
*a*25.	veinlet in the A. Sarik (near vein *a*1).	Some centimeters wide.	Str. N. 90° E.	Incl. 82° N.

The quartz veins, which cut both the sediments and the eruptive rocks, are very variously mineralized.

Some contain only gold or gold-bearing pyrites, while the Main and Leader veins of the Salida mine, and also the Sarik, Perak, Serassa, and Doeri veins, also contain, besides the above, silver-, lead-, sinc- and iron minerals.

The great differences in the mineralization of veins in the same place, as for instance the Leader vein with hessite and the Main vein without this mineral, in the Salida mine, indicate that mineralization has taken place in various ways and at different times.

That the quartz veins of various strikes originated at different times is quite certainly not always to be assumed (see fig. 1).

The displacement of a vein by another, even the bending of a vein towards another, can also be explained in various ways.

For we can assume that vein *a* (see fig. 2) is younger than vein *b*, and only follows it for some distance (called by HÖVIG (4) "pairing"), or that vein *a* is older than vein *b*, and that the latter was first a fault fissure which was later filled up.

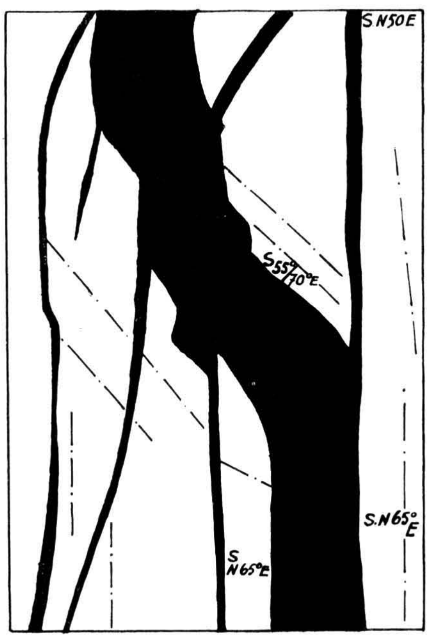


Fig. 1.

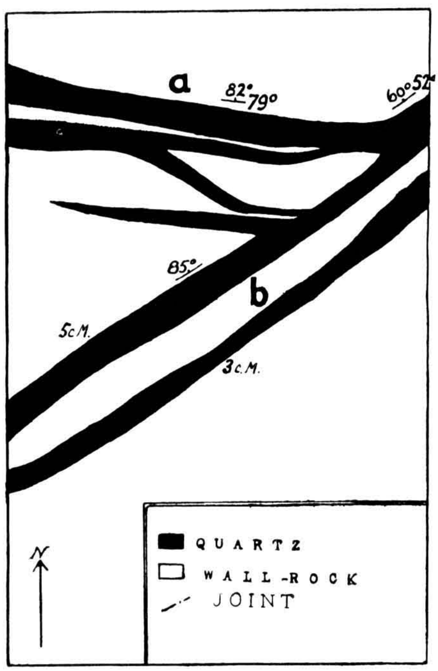


Fig. 2.

QUARTZ VEINS in the A. SARIK, Scale : 1 : 10.

Surface Exposure, vertical seen to N. 65° E.

Surface Exposure, horizontal

Only precise examination of the country rock on typical joints parallel to the fault, and of the ore at the point where the veins meet, would throw light on the subject.

AERNOUT (2), for instance, is of opinion that, in the Salida mine, the Leader is older than the Main vein, on the grounds of the observations that:

1. The wedges of the then-known Leader bend towards the Main vein.
2. Leader ore occurs in the Main vein between N. and S. Leader.

It has appeared however from the surface investigation that the N. Leader vein could be followed as far as 600 M. N. 10° E. from the junction. So the offshoot which at a point 150 M. distant from this junction bends towards the Main vein (which like the S. Leader has not been found on the surface), is only a diagonal bifurcation of the N. leader.

Nor does the mere fact thât Leader ore occurs between the two junctions prove that this ore is younger, since we do not know which ore envelops the other.

In this region the best ore columns have been formed at the point where the country rock is andesite, the quartz veins are the widest, and two veins, differing in strike only to the extent of 20°, meet each another.

Moreover it is striking that the courses of the rivers are approximately identical to those of the veins, and that often parts of the various rivers lie on the same line.

It is a familar occurrence along the west coast of Sumatra (see: HÖVIG (5), p. 138, AERNOUT (6), p. 165, HARTING (8), p. 248, PHILIPPI and VAN TUYN (9), p. 28).

In our region, the courses of the rivers are controlled by:

1. Varying resistance to the river erosion of the various rocks, on account of which the rivers will flow parallel to the eruptive dykes.
2. If there are only one sort of rocks the rivers will follow by preference the strikes and dips of the joint-planes of the rocks (see: CLOOS (11) p. 137), and in sedimentary rocks also the strikes and dips of the bedding planes.

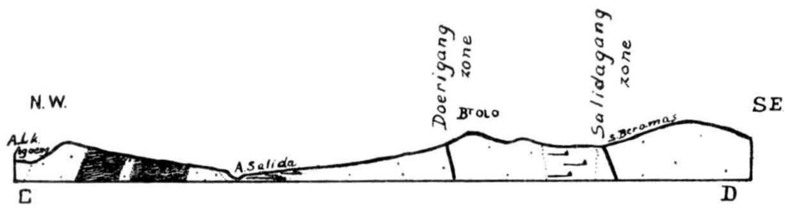
Thus the plan of drainage has been regulated in conformity with the structure of the underlying rock basement, and the repeating rectangles of the master-joints appeared in the lines of drainage. Such a type of relief has been described as "checkerboard topography" (see: HOBBS (7), p. 226).

It was noticeable that we found no faults here. But also in the vicinity of the Mangani mine, where we could follow a lot of faults, we saw that the courses of the rivers were determined by them only in a few cases.

The origin of the joint systems can be explained (as ZWIERZYCKI (10), p. 53, has already done for larger regions) according to the method of CLOOS, and thus by assuming a pressure perpendicular to the Sumatra direction, which would give rise to two pairs of joint systems, viz.:

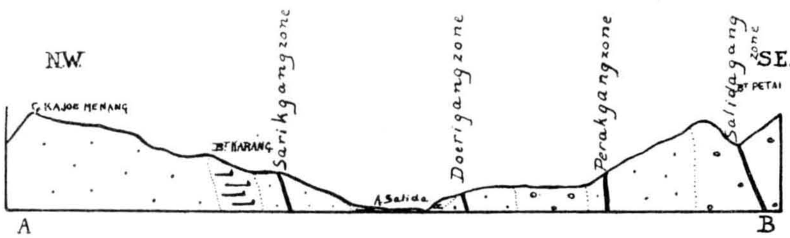
a. One more or less perpendicular to the pressure (N. 40° W.).
b. Two diagonal to it (N. 10° E. and N. 90° E.).
c. One in the direction of the pressure (N. 30° E.).

But we must emphasize the fact that these joints have been opened not once, but several times.



Section: N. 310° E.: A. L. AGOENG — Sei BERAMAS.

Scale : 1 : 40.000.



Section: N. 310° E.: G. KAJOE MENANG — Bt. PETAI.

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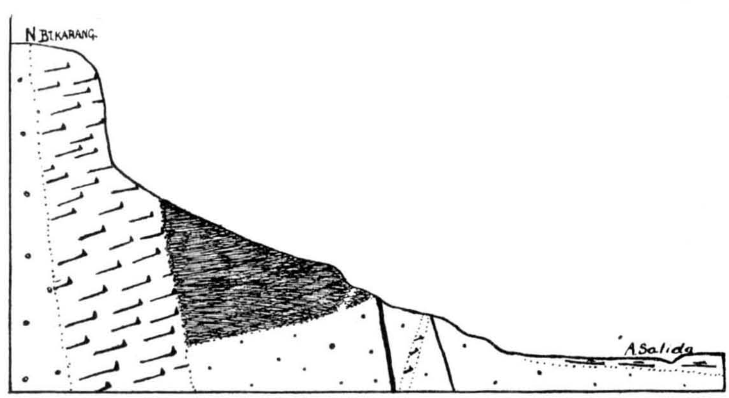
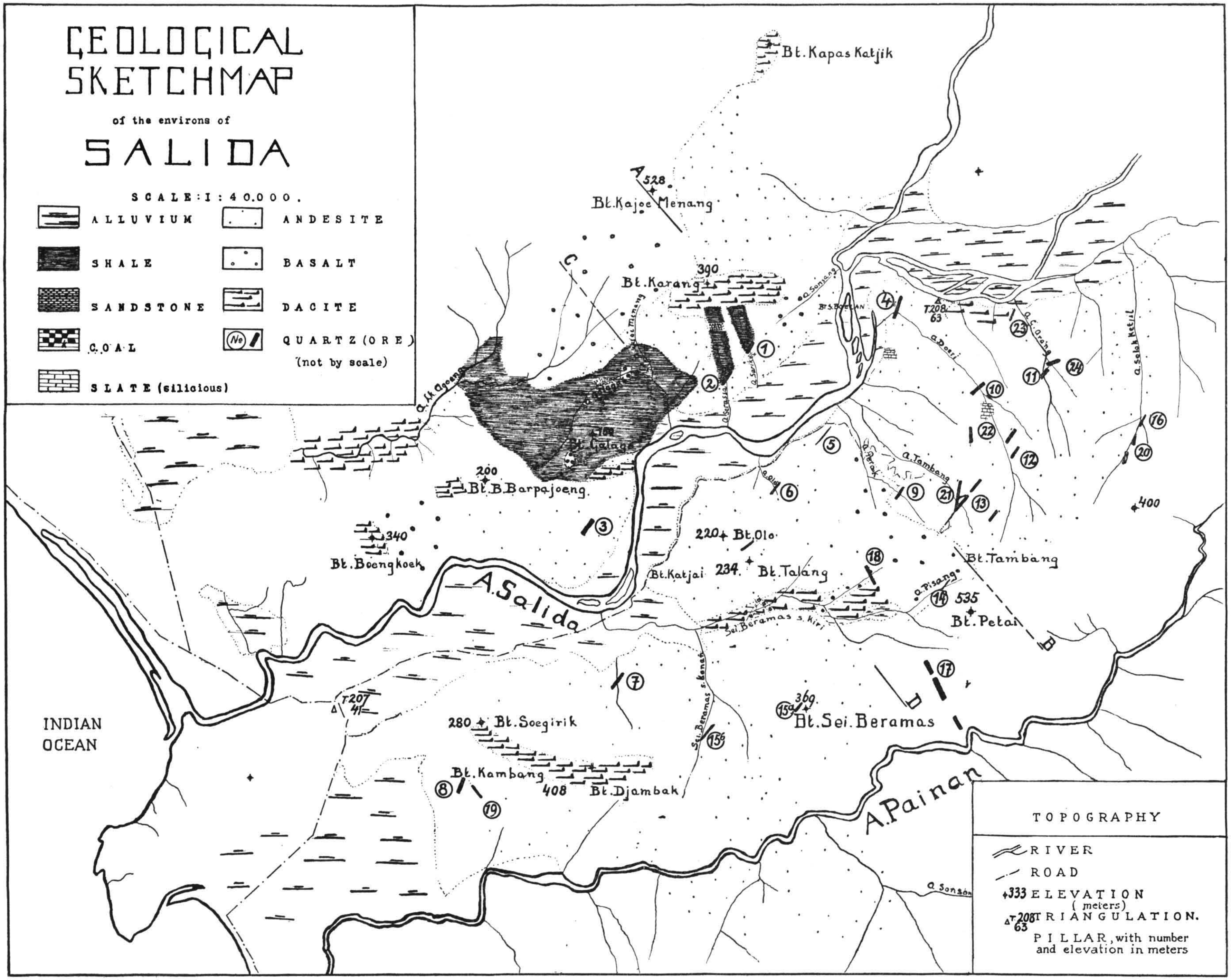


N—S Section along the A. SARIK.

Approx. vertical Scale : 1 : 6.600.

Approx. horizontal Scale : 1 : 10.000.


GEOLOGICAL SKETCHMAP
of the environs of
SALIDA
SCALE: 1 : 40.000.
ALLUVIUM
SHALE
SANDSTONE
COAL
SLATE (silicious)
ANDESITE
BASALT
DACITE
QUARTZ (ORE) (not by scale)
TOPOGRAPHY
RIVER
ROAD
ELEVATION (meters)
TRIANGULATION PILLAR, with number and elevation in meters
INDIAN OCEAN
A. Salida
A. Painan
Bt. Kapas Katjik
528 Bt. Kajoe Menang
390 Bt. Karang
Bt. Galang
200 Bt. B. Barpajoeng
340 Bt. Boengkoek
220 Bt. Olo
234 Bt. Talang
Bt. Katjai
Bt. Tambang
535 Bt. Petai
369 Bt. Sei. Beramas
280 Bt. Soegirik
Bt. Kambang
408 Bt. Djambak
400
T 207 41
T 208 63
Sei. Beramas s. Kiri
Sei. Beramas s. Kanan
A. Sonsan

LITERATURE.

In the Geological Mining Bibliography of the Dutch East Indies, closed in February, 1932, the following numbers mention something about Salida: 1040—1173—1186—1213—1238—1318—1332—1344—1415—1417—1449—1450—1982—2792—3008—3011—4369.

In the text reference has been made to:

1. Dr. N. WING EASTON. Die wichtigsten Edelmetall-Lagerstätten Sumatras. Archiv für Lagerstättenforschung Heft. 35. Berlin, 1926. pp. 42—44.

2. Ir. W. A. J. AERNOUT. Enkele nieuwere gegevens over de ertsafzettingen van Salida „De Mijningenieur", 8e Jaargang, 1927. pp. 73—76.

3. Dr. J. ZWIERZYCKI. Toelichting bij blad VII van de geol. overzichtskaart (Schaal 1 : 1.000.000) van den N.O. Indischen Archipel. Weltevreden 1922. pp. 21—34—50.

4. Ir. P. HÖVIG. Afzettingen van nuttige Delfstoffen (Vademecum voor het personeel van het mijnwezen). 2de verb. druk Batavia 1925. pp. 49—56.

5. Ir. P. HÖVIG. De goudertsen van de Lebongstreek. Jaarboek Mijnwezen, 41 Jg. 1912. Verhand. Batavia 1914. pp. 138—143.

6. Ir. W. A. J. AERNOUT. De ertsmijn Lebong Donok. „De Mijningenieur", 8e Jg., 1927. pp. 165—167.

7. Prof. W. H. HOBBS. Earth features and their meaning. N. York 1926.

8. Ir. A. HARTING. Verslag van een Mijnb. geol. onderzoek in de omstreken van Tampang Sawah. J. b. M. w. 1929. Verh. 1930.

9. Dr. H. PHILIPPI en Dr. J. VAN TUYN. De Westkust van Kroei (Benkoelen). „De Mijningenieur", 13de Jg., No. 2. 1932.

10. Dr. J. ZWIERZYCKI. Toelichting bij Bl. VIII van de geol. Overzichtskaart van den Ned. O.I. Archipel. Weltevreden, 1930.

11. H. CLOOS. Tektonische Behandlung magmatischer Erscheinungen. Teil I. Berlin 1925.

An interesting survey of the history of the mine is given by:

J. E. DE MEYIER. De Goud- en Zilvermijn Salida, in „De Indische Gids", XXXII, 1911. pp. 28—67.

The following book has just appeared:

ELIAS HESSE. Goldbergwerke in Sumatra, 1680—1683, 1931, p. 195. N^{0}. X, of „Reisebeschreibungen von Deutschen Beamten im Dienst der W.I. und O.I. Kompagnie 1602—1797", herausgegeben v. S. P. L'HONORÉ NABER (Den Haag).