The residue left after thoroughly extracting the violet salt, is reddish-brown to black. When treated with a warm aqueous solution of *pyridine*, a dull-red solution is obtained, which is filtered off from silver oxide and other insoluble substances and fractionated in vacuo, in the presence of potassium hydroxide and of P_4O_{10}. The most soluble fraction is the pure $[AgPy_2]$-salt of the isomeric β-*L*-$[Co(d\text{-}glut)_3]$complex. The less soluble fractions always contain too much *silver* (about 30 % *Ag*). Analysis yielded: 25.43 and 24.88 % *Ag*; 4.86 % Co (from oxide); calculated for $(AgPy_2)_3[Co(d\text{-}glut)_3]$: 25.06 % *Ag*, 4.56 % *Co*.

When heated, the salt loses *pyridine* at about 100° C. and becomes black; at this temperature only about 3 mol of *pyridine* are set free. It is impossible to dry the substance at any higher temperature. The *lead*-precipitate is violet and is insoluble even in boiling water. It can easily be obtained in a pure state by removing its impurities by boiling with water. After drying at 105° C., for instance, analysis yielded: 38.83 % *Pb*; calculated 38.62 % *Pb*: Perhaps the *lead*-salts might be obtained separately from the corresponding *silver*-salts if the latter could in a sufficiently pure state be prepared in greater quantities.

It must finally be remarked that, in preparing solutions of the *sodium*-salts from the described *silver*- and *lead*-salts, a careful control is necessary whether the interaction has been completed, — especially in the case of the insoluble *lead*-salt. Although the solutions necessary for the polarimetrical measurements, because of their absorption, have to be very dilute, the general form of the curves can notwithstanding this very satisfactorily be reproduced, so that the deviations of the rotatory values for any wavelength do not surpass a few percentages.

Groningen, Laboratory of Inorganic and Physical Chemistry of the University.

Geology. — *The Granites of the Malayan Tin-Belt compared with Tin-Granites from Other Regions.* By J. WESTERVELD. (Communicated by Prof. H. A. BROUWER.)

(Communicated at the meeting of November 28, 1936).

In a previous paper [1]) a petrographic description has been given of the porphyritic biotite-granite from N. Banka (Djeboes). The following lines will serve to show the great petrographic uniformity of stanniferous and related granitic rocks of the Inner Malayan Arc (the Malayan Peninsula, the Dutch Tin Islands, etc.). A comparison with tin-granites from other

1) J. WESTERVELD, On the Geology of North Banka (Djeboes). These Proc. **39**, 1122—1132 (1936).

parts of the world (Cornwall, Saxony, Pitkäranta in Finland, Bolivia, Bushveld in the Transvaal), both petrographically and chemically, tends to make clear the limited range of composition of parent-magmas connected with cassiterite-deposits.

The association of cassiterite with acid granitic rocks is a long-known fact and has been emphasized by many authors. FERGUSON and BATEMAN [2]) mentioned the occurrence of acid intrusive rocks as parent-magmas of tin-ores for 40 out of 41 cases considered by them. The only exception would be the Satsuma-province in Japan, where the ore is reported to occur with dikes of augite-andesite in mesozoic (or tertiary) sandstones. This supposition has afterwards proved to be erroneous; the Suzuyama-veins in Satsuma on closer examination appeared to be connected genetically with a granite-porphyry [3]). For the copper-tin veins in the Akénobé District (Prov. Tajima) a relation with rocks of intermediate composition (diorites) has still been maintained by KATO [4]), although this author does not deny a genetic relation of at least part of the veins with a local small boss of quartz-monzonite-pegmatite (akenobeite). The diorites, which are intrusive into palaeozoic and mesozoic slates and older than the veins, are sometimes strongly mylonitized, whereas the smaller intrusives near the tin-veins are only slightly dynamometamorphic. The intrusion of the dioritic magma and the Cu-Sn-mineralization therefore seem to be separated by some diastrophism, in which time the deeper magma underwent further differentiation, accompanied by concentration of volatiles. It is reasonable to suppose that in this case also all vein-stuff was derived from one source, i.c. a still buried acid magma, of which the akenobeite represents an offshoot and the diorite an earlier and less acid differentiate.

The last chapter to this paper gives a number of chemical analyses of granitic rocks connected with tin-deposits. Most of them are of rather recent date and care has been taken to discard untrustworthy figures, hitherto cited in some publications.

PETROGRAPHY OF GRANITES FROM THE DUTCH TIN-ISLANDS AND THE MALAYAN PENINSULA. *Banka*. For a description of the granite of N. Banka the reader is referred to a previous paper [1]). Granites from other parts of the island according to VERBEEK [5]) are nearly all "granitites" or biotite-granites, in which amphibole is a less common mineral. In the smaller

---

[2]) H. G. FERGUSON and A. M. BATEMAN, Geologic Features of Tin Deposits. Econ. Geol. **7**, 209—262 (1912).

[3]) TAKEO KATO, A microscopic study of the tin veins of the Suzuyama mine. Province of Satsuma, Japan. Journ. Geol. Soc. Tôkyô, **23**, 145—164 (1916). Cited from [4]), foot-note on p. 37.

[4]) Idem, A study of the Copper-Tin Veins of the Akénobé District in the province of Tajima, Japan. Journ. of the College of Science, Tokyo Imperial Univ. **43**, art. 5 (1919—1921).

[5]) R. D. M. VERBEEK, Geologische Beschrijving van Banka en Billiton. Jaarboek v. h. Mijnwezen in N.O.I., p. 98—109 (1897).

intrusive bodies of southern Banka (Toboali district) the latter mineral seems to be of more regular occurrence.

Billiton. The larger granite of Tandjoengpandan is a porphyritic biotite-granite of the Banka type. It contains orthoclase, perthite, acid plagioclase (between andesine and albite), fluor-bearing biotite and quartz. The smaller granite-bosses from the eastern part of the island in some cases are reported to consist of amphibole-granite, e.g. the Boeroeng-Mandi granite. A coarsely porphyritic structure is described from the Batoe-Besi biotite-granite [5, 6, 7]). The amphibole-granites are probably earlier marginal facies of the acid magma, of which the more leucocratic final differentiates are found in the core of the masses.

Singkep. The granite of this smallest of productive Malayan tin-islands is very similar to the granites of Banka and Billiton. It is a grayish-white, medium or coarse-grained and often porphyritic rock with phenocrysts of feldspar. The minerals are quartz (often with undulous extinction and with inclusions of gas and fluids), orthoclase (as Karlsbad-twins and often perthitic or as micrographic intergrowths), microcline (in smaller pieces with irregular boundaries), plagioclase (larger, sometimes idiomorphic crystals with zonal arrangement of rims with different extinction-angles and albite-twinning), biotite (strongly pleochroitic, with inclusions of zircon and apatite), muscovite (subordinate), and accessory blue tourmaline, sphene, fluorspar (in feldspar) [8]).

The islands of the Riouw Archipelago outside Singkep (Koendoer, Karimon, Lingga, Bintan, Batam). Granitic rocks from these islands are all more or less stanniferous [9]). Koendoer and Karimon have biotite- or biotite-muscovite-granites of medium or coarse grain, only occasionally fine-grained and sometimes porphyritic. They consist of mica and sometimes hornblende, orthoclase, microcline, orthoclase- and microline-microperthite, subordinate oligoclase-albite, and quartz. Micrographic intergrowths of quartz and orthoclase are abundant. Tourmaline has also been detected. The intrusive granite from S.W.-Lingga is accompanied by micropegmatites and granite-porphyries with a micrographic matrix. The rock from Pasir Pandjang on this island is an aplitic granite containing quartz (main constituent), oligoclase-albite (with inclosed biotite), microcline, amphibole, biotite, some zircon and apatite (inclosed in biotite). The island Bintan has biotite-granites, locally accompanied by

---

6) CH. TH. GROOTHOFF, Eenige merkwaardige gesteenten van Billiton. Verh. v/h Geol. Mijnbouwk. Genootsch. voor Nederl. en Kolon.; Geol. Serie, **3**, 90—92 (1916).

7) CH. TH. GROOTHOFF, De greisenvorming in het Batoe-Besie graniet-massief (Billiton). Verh. v/h Geol. Mijnb. Genootsch. voor Nederl. en Kol.; Geol. Serie, **1**, 319—336 (1912—1915).

8) CH. H. J. WILHELM, De Tinertsafzettingen van het Eiland Singkep en de Genese der Alluviale Afzettingen. Diss. Delft, p. 15—16 (1928).

9) Summary descriptions by GISOLF in: A. CHR. D. BOTHÉ, Geologische verkenningen in den Riouw-Lingga Archipel, etc. Jaarb. v/h Mijnwezen in N.O.I. **54**, Verh. II, p. 101—152 (1925).

quartz-amphibole-diorite (east-side of G. Bintan Besar), and quartz-porphyries (G. Bintan Ketjil). The dioritic rock probably represents a marginal facies. Granitic rocks from N.E.-Batam are biotite-quartz-porphyries with phenocrysts of orthoclase, biotite and quartz in a matrix of feldspar and quartz (acc. magnetite and apatite). Blocks of a somewhat earlier granite have been found inclosed by the quartz-porphyry.

The Malayan Peninsula. The granites of the Malayan Peninsula, which belong to the same post-triassic and probably late mesozoic intrusive period as the stanniferous granites of the Dutch tin-islands, do not differ petrographically from the latter. The commonest kind of granite is a grey porphyritic rock with large crystals of orthoclase, often reaching about 4 cm. in length and generally twinned. The other minerals are quartz, microcline, soda-plagioclase, biotite, muscovite, hornblende (in small amounts), pyroxene (rare), and tourmaline. Accessory minerals are sphene (sometimes abundant), zircon, apatite, anatase, topaz, fluorspar, cassiterite (sometimes a trace of this mineral), ilmenite, magnetite, locally cordierite (Kuala Selangor) and sillimanite (hills near Trolak) [10]). The presence of the latter two minerals may however be ascribed to the presence of a slate-contact. Structural varieties between Kuala Kubu and The Gap (Selangor) comprise coarse-grained porphyritic granite with much biotite; coarse-grained non-porphyritic granite; dark porphyritic granite with much biotite; coarse-grained non-porphyritic granite with tourmaline, biotite, muscovite, and fluorspar; microgranite with tourmaline-veins, biotite, muscovite and fluorspar, etc. [10]). LACROIX [11]) calls the main type of Main Range granite a "granite monzonitique à biotite" with phenocrysts of "microcline" in Karlsbad-twins, homogeneous or with strings of albite. Fine-grained marginal facies, often tourmalinized and with cassiterite, have been named microgranite (LACROIX) or "masses of aplite" (SCRIVENOR [12]). Alcaline granite, consisting essentially of orthoclase with albite-strings, quartz, and some biotite and fluorspar, from Gunung Blumut (Johore), is considered a less frequent type (LACROIX). Monazite, an abundant mineral in some alluvial deposits, is suggested to be an original constituent of granite by the latter author, who thinks many small crystals of zircon to be mistaken for the Ce-phosphate [13]). Veins of aplite and pegmatite occur at many localities along the granite-contacts and, if in a weathered state, may be a source of tin-ore [14]). Aplite-veins bordered by pegmatite-pockets,

---

[10]) J. B. SCRIVENOR, The Geology of Malaya, p. 23—33 (1931).

[11]) A. LACROIX, Contribution à la connaissance de la composition chimique et minéralogique des roches éruptives de l'Indochine. Bull. du Service Géol. de l'Indochine, **20**, Fasc 3, 154—155 (1933).

[12]) J. B. SCRIVENOR, l.c., p. 31 (1931).

[13]) Compare the occurrence of monazite as inclusions in biotite in granitic rocks from P. Berhala in the Strait of Malacca, described by J. H. DRUIF (These Proc. **38**, 643 (1935).

[14]) For descriptions of stanniferous deposits on the Peninsula the reader is referred to: J. B. SCRIVENOR, The Geology of Malayan Ore-Deposits (1928).

observed by the writer in N. Banka [1]), have also been noticed in Malaya [15]).

Hornblende-granites, with some syenitic and dioritic varieties, are principally found in the eastern ranges in Trengganu, Pahang and Johore. Their distrubution with regard to the biotite-granites (compare the 1930 Geological Map of Malaya by SCRIVENOR) seems to indicate that they occur as cap-rocks and marginal facies of the more acid differentiates. The hornblende-granites and intermediate rocks have been considered by SCRIVENOR [16]) as "the result of imperfect mixing of the constituent minerals that crystallized from the magma, one rock passing gradually into another." In the writer's opinion it seems much more probable that the hornblende-varieties are the first products of congealing against the upper- and side-contacts of the intrusions, whereas the biotite-granites are the result of continued differentiation. Vestiges of this phenomenon have been observed in the granite of N. Banka, where hornblende-granite and mica-diorite are inclosed as xenoliths in biotite-granite [1]). The interesting rocks of Pulau Ubin in the Strait of Johore N.E. of Singapore evidently illustrate the same course of events. According to SCRIVENOR [17]) hornblende-granite on P. Sekudu near the eastern extremity of P. Ubin contains dark inclusions, while the hornblende-granite itself is again cut by fine-grained acid granite at Tg. Jawa not far from the former locality. N. of Tg. Jawa (near Tg. Balai) the same acid granite can be observed intruding a dark fine-grained rock, called "lamprophyre" (enstatite-spessartite) and according to LACROIX [18]) consisting of green hornblende, bronzite and biotite, the latter mineral moulding together plagioclase-crystals. On the north-side of P. Ubin and near Changi on Singapore are other examples of a dark intrusive cut by later hornblende-granite. The sequence of intrusion evidently is: "lamprophyre" → hornblende-granite → acid granite. Chemical analyses of biotite-hornblende-granite and dark inclusions from P. Ubin, amongst which a "lamprophyre" from Tg. Jawa [19]), reveal the consanguinity of the rock-types by the analogy of normative feldspar-proportions.

The greater abundance of less acid granites in the eastern ranges of Malaya may be explained by a less advanced stage of differentiation at the beginning of crystallization, *which possibly is also the reason why the Eastern Belt is less important as a tin-producer than the Western.*

TIN-GRANITES FROM OTHER PARTS OF THE WORLD. The *Cornish* granites are very similar in their structural and petrographical habit to the granites of the Malayan Tin-Belt. The Land's End granite, which may be regarded as the type-rock, is a coarsely porphyritic biotite-muscovite-granite with phenocrysts of orthoclase in Karlsbad-twins. The mineral is perthitic and

---

15) A. LACROIX, l.c., p. 158. J. B. SCRIVENOR, l.c., p. 33 (1931).
16) J. B. SCRIVENOR, l.c., p. 24 (1931).
17) J. B. SCRIVENOR, l.c., p. 39—48 (1931).
18) A. LACROIX, l.c., p. 155—156.
19) A. LACROIX, l.c., p. 157, analyses nos. 150—152.

partly shows inclusions of albite-oligoclase, biotite, zircon, apatite and quartz. Quartz occurs as coarse grains and in the matrix orthoclase is more abundant than oligoclase, which often has a zonal arrangement of rims with different extinction-angles. Microcline is rare and small flakes of muscovite sometimes inclose small zircons, surrounded by pleochroitic halos (altered biotite!). The dark mica is Li-bearing (lithionite) and alters into chlorite and rutile (Ti-content!). Some tourmaline may be primary. Coarse crystals of pinite (and andalusite) are due to the contaminating effect of the neighbouring slate-contact. Pockets of pegmatite with large perthite-crystals, muscovite, quartz, tourmaline, fluorspar and gilbertite, rarely topaz (Newquay), cut the granite and the slates near the contacts [20]).

The *Saxonian* tin-granites of Altenberg-Schellerhau, Geyer and the Eibenstock [21]) are evenly coarse-grained, sometimes porphyritic, and consist of quartz, orthoclase (partly perthitic), some microcline, oligoclase-albite, biotite, Li-Fe-mica (lithionite, characteristic mineral), and some accessory tourmaline, zircon, apatite, topaz, sericite, fluorspar, magnetite, hematite. The feldspar contains traces of Zn and Ba (Wilzschhaus), and the Fe-Li-mica traces of Sn, Bi, Cu, Co and U. It may be recalled to the mind that WINKLER [22]) showed the presence of chemically combined Sn in mica- and feldspar + quartz-concentrates from granites of Banka and Billiton (between 0.0071 % and 0.0173 % SnO_2).

The parent-rock of the *Pitkäranta* tin-deposits in Finland is the Rapakivi-granite near Lake Ladoga, which essentially consists of orthoclase, biotite and quartz (often in micrographic intergrowths with the potash-feldspar), with only very local development of the typical rapakivi-structure (orthoclase-crystals surrounded by covers of plagioclase). The rock is partly a quartz-porphyry, partly a granite-porphyry [23]).

The *Bolivian* tin-deposits are principally allied with bosses of quartz-porphyry (Oruro, Uncia, Colquechaca, Potosi, etc.), for a minor part also with granodioritic granites (N.W. section of the tin-belt N. and E. of La Paz). The "granodiorites" of Bolivia according to AHLFELD [24]) are medium- and coarse-grained rocks with local pronouncedly porphyritic structure (size of orthoclase-crystals up to 3 cm.), and consisting of orthoclase, plagioclase (with zonal structure), occasional microcline, quartz

---

[20]) CLEMENT REID and J. S. FLETT, The Geology of the Land's End District. Expl. of sheets 351 and 358, Geol. Map of England and Wales, p. 40—60 (1907).

[21]) Data gathered from: K. DALMER, Die westerzgebirgischen Granitmassive. Zeitschr. für prakt. Geol. 8, 297—312 (1900); E. FRITZSCHE, Beitrag zur petrochemischen Kenntnis der erzgebirgischen Granitmassive. Neues Jahrb. für Miner., Geol. und Paläont. **58**, Beil. — Bd. A, p. 253—301 (1928).

[22]) R. D. M. VERBEEK, l.c., p. 117—129.

[23]) O. TRÜSTEDT, Die Erzlagerstätten von Pitkäranta am Ladoga-See. Bull. de la Comm. Géol. de Finlande, No. 19, p. 93—97 (1907).

[24]) FR. AHLFELD, Die Erzlagerstätten in der tertiären Magmaprovinz der bolivianischen Zentralanden. Neues Jahrb. für Min., Geol. und Paläont. **65**, Beil. — Bd. A, p. 298—319 (1932).

(inclosing zircon, apatite), biotite (inclosing zircon and altering into muscovite, chlorite and rutile), and often hornblende. Dikes of aplite and pegmatite occur in the border-zones of the batholiths (Sorata-batholith). The latter consist of quartz, plagioclase, orthoclase, microcline, Li-bearing muscovite, often pyrrhotite and occasionally cassiterite. The porphyries, often badly altered by chloritization, sericitization, silicification and tourmalinization, are mineralogically very similar to the granites. They show phenocrysts of quartz, orthoclase, plagioclase and biotite, acid plagioclase being the predominating feldspar. The orthoclase is sanidine in Karlsbad-twins. Hornblende is less conspicious; zircon and apatite are accessory. AHLFELD's supposition that the porphyries are ore-bringers does not seem to be justified. The veins cut the porphyry-chimneys and very probably derive their metals from some buried and presumably more acid hypabyssal magma-chamber below, of which the porphyries are merely earlier offshoots.

The Red Granite of the *Bushveld (Transvaal)*, parent-magma of the Potgietersrust, Olifants river, and Elands river cassiterite-deposits, is a coarsely cristalline rock of very uniform appearance over large areas, and consisting, in the order of quantitative importance, of microperthitic soda-rich orthoclase, oligoclase-albite, quartz, hornblende, biotite, magnetite, apatite, zircon. Micrographic intergrowths of quartz-orthoclase are common. Porphyritic, miarolitic, fine-grained aplitic and pegmatitic developments of the granite are conspicious near some tin-deposits, e.g. the Potgietersrust tin-pipes [25]).

CHEMISTRY OF TIN-GRANITES. The very uniform petrographical and even structural properties of tin-granites all over the world are also clearly expressed by the restricted variability of chemical constituents. A number of analyses-bearing upon the regions hitherto referred to-have been put together in Table I. Table II gives molecular values and proportions of normative minerals, calculated according to NIGGLI's method [26]). Graphical representations of the values giving the relative proportions of norm. free quartz, SiO_2 in norm. feldspar and pyroxenes, and the composition of normative feldspar, are resp. given in figs. 1 and 2. In each fig. a boundary-line surrounds the field occupied by points representing type-rocks of batholitic intrusions connected with tin-deposits. For each country represented in the tables a choice has been made of available analyses. For the Malayan Peninsula we have a number of analyses published by LACROIX. Nrs 3 and 4 are representative for Malayan tin-granites, very probably also for the petrographically very similar Tin-Islands, of which unfortunately no granitic rocks have been analyzed as yet. N°. 1 is a

---

[25]) A. L. HALL, The Bushveld Igneous Complex of the Central Transvaal. Memoir No. 28, Geol. Surv. Union of S. Africa, p. 486—493, 373—377 (1932).

[26]) P. NIGGLI, Gesteins- und Mineralprovinzen, I, p. 51—60 (1923); Idem, Zur Deutung der Eruptivgesteinsanalysen auf Grund der Molekularwerte. Schweiz. Min.-Petrogr. Mitt. 7, 1, p. 116—133 (1927).

TABLE I: Chemical Analyses of Intrusive Rocks from various Tin-Provinces.

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SiO_2	77.64	74.16	71.58	71.64	66.70	75.63	75.45	71.57	70.17	73.53	73.22	74.06	70.98	63.99	75.50
Al_2O_3	11.34	13.90	12.96	14.09	14.50	13.93	12.44	14.65	15.07	13.84	13.32	12.62	12.69	15.65	12.15
Fe_2O_3	0.94	0.47	0.61	0.52	1.07	0.16	1.58	1.55	0.88	1.06	0.75	0.96	2.99	0.88	0.96
FeO	1.60	0.31	3.12	2.26	1.89	0.43	0.44	1.04	1.79	0.63	0.72	1.88	1.45	2.31	0.96
MnO	0.08	0.07	0.15	0.09	0.02	tr.	0.02	0.04	0.12			0.45	—	0.04	0.01
MgO	—	—	0.35	0.04	2.22	0.15	0.15	0.85	1.11	0.52	0.09	0.02	1.04	1.47	0.37
CaO	0.76	0.92	1.78	1.92	0.83	2.00	0.52	1.80	1.13	1.21	1.41	1.11	2.56	2.37	0.86
Na_2O	2.84	2.73	3.39	3.83	1.70	3.24	3.99	3.85	2.69	3.86	3.86	2.44	3.03	3.43	2.73
K_2O	4.52	6.48	5.03	4.68	9.37	4.27	4.99	3.95	5.73	4.04	4.12	5.36	4.59	5.52	5.22
Li_2O									0.11	tr.	tr.				
H_2O+	0.36	0.96	0.36	0.31	0.99	0.45	0.33	0.69	0.70	0.45	0.92	0.65	0.57	1.93	0.52
H_2O-	0.28	0.37	0.12	0.26	0.16	0.30	0.14	0.12	0.18	0.15	0.39	0.16	0.13	0.15	0.08
BaO					—					tr.	tr.			0.08	
r. earths					0.02									0.015	
CO_2					tr.	—	—	—						1.26	
TiO_2	tr.	—	0.66	0.42	0.24	tr.	0.20	0.22	0.41	0.06	0.08	0.24	0.19	0.44	0.50
P_2O_5	—	0.11	0.11	0.07	0.13	0.11	0.07	0.11	0.34	0.99	1.08	0.14		0.33	0.06
Cr_2O_3					—									0.01	
Cl									0.06					0.10	
F	0.10								0.15	0.04	0.08				
S					0.01				0.04					—	
B_2O_3									str.tr.						
ZrO_2					0.03									0.03	
SnO_2									—	0.09					
	100.46	100.48	100.22	100.13	99.88	100.67	100.32	100.44	100.68	100.38	100.04	100.09	100.22	99.98	99.92

Origin of specimens cited in Table I.

1. "*Granite alcalin*", Gunong Blumut, Johore. Analyst F. RAOULT; given in A. LACROIX, l.c., p. 156 (No. 142).
2. "*Aplite*" Kuala Selangor. Analyst F. RAOULT; given in A. LACROIX; l.c., p. 156 (No. 143).
3. "*Granite monzonitique à biotite*", Kuala Dipang. Analyst F. RAOULT; given in A. LACROIX, l.c., p. 156 (No. 147).
4. "*Granite monzonitique à biotite*", Selangor. Analyst F. RAOULT; given in A. LACROIX, l.c., p. 156 (No. 148).
5. "*Granite*", Poeloe Berhala. Analyst W. VAN TONGEREN; given in W. VAN TONGEREN, l.c., p. 636.
6. "*Aplite*", Poeloe Berhala. Analyst B. MENNEGA; given in W. VAN TONGEREN, l.c., p. 636.
7. "*Alkalireicher Aplitgranit*", mouth of Sei Banang, Karimata. Analyst P. ESENWEIN; given in P. ESENWEIN, l.c., p. 9
8. "*Rapakiwitischer Granosyenit*" T. Senna, N. Karimata. Analyst DEN HAAN; given in P. ESENWEIN, l.c., p. 17
9. "*Lamorna granite*", Lands End, Cornwall. Analyst W. POLLARD; given in CLEMENT REID and J. S. FLETT, l.c., p. 59.
10. "*Mittelkörnig-porphyrischer Granit*", Muldental, Erzgebirge (Saxony), Straszenbau 1925. Analyst E. FRITZSCHE; given in E. FRITZSCHE, l.c., p. 272.
11. "*Mittelkörniger Granit*", Kahleberg, near Schellerhau, Erzgebirge (Saxony). Analyst E. FRITZSCHE; given in E. FRITZSCHE, l.c., p. 273.
12. "*Coarse Red Granite*", Zoutpanslaagte no. 120, Pienaars River (Bushveld, S. Africa). Analyst E. A. RADLEY; given in R. A. DALY, l.c., p. 717.
13. "*Granodiorit*", from Mt. Illampu, Sorata-Batholith, Bolivia. Analyst BRENDLER; given in Fr. AHLFELD, l.c., p. 350
14. "*Quarzporphyr*", Colquechaca, Bolivia. Analyst Frl. BENDING, given in Fr. AHLFELD, l.c., p. 316.
15. "*Rapakivi*", Tschasonkallio, Salmi. Analyst LAURI LOKKA; given in LAURI LOKKA, l.c., p. 40—41.

TABLE II. NIGGLI's molecular values for chemical analyses of granitic rocks cited in table I.

No.	si	al	fm	c	alk	qz	k	mg	Ls	Fs	Qs	k	Vsp
1	510	43.8	13.8	5.3	37	+262	0.51	0.00	0.46	0.02	0.51	0.51	0.93
2	447	49.3	4	5.9	40.8	+184	0.61	0.00	0.59	0.003	0.41	0.61	0.93
3	363	38.6	18.8	9.7	32.9	+132	0.49	0.14	0.58	0.06	0.36	0.49	0.92
4	368	42.6	12.4	10.6	34.4	+131	0.45	0.03	0.60	0.04	0.35	0.45	0.89
5	293	37.5	25	4	33.5	+ 59	0.78	0.58	0.71	0.09	0.20	0.78	0.95
6	447	48.5	4	12.5	35	+209	0.47	0.32	0.52	0.01	0.47	0.47	0.83
7	451	43.5	11	3.5	42	+183	0.45	0.13	0.57	0.03	0.41	0.45	0.98
8	370	41	17	10	32	+142	0.40	0.38	0.57	0.05	0.38	0.40	0.88
9	343	43.3	19.1	5.9	31.7	+116	0.56	0.43	0.62	0.04	0.34	0.56	0.91
10	410	45.5	12	7.5	35	+170	0.41	0.37	0.56	0.02	0.41	0.41	0.87
11	430	46	8	9	37	+182	0.41	0.10	0.56	0.02	0.42	0.41	0.89
12	433	43.4	15.8	7	33.8	+198	0 59	0.01	0.51	0.03	0.46	0.59	0.90
13	335	35	24	13	28	+123	0.50	0.31	0.54	0.09	0.37	0.50	0.89
14	284	41	17	11	30.5	+ 62	0.51	0.32	0.72	0.06	0.22	0.51	0.85
15	469	44	13	5.5	37.5	+219	0.56	0.26	0.50	0.03	0.47	0.56	0.93

$$Vsp = \frac{2\,alk}{al + alk}, \text{ resp. } \frac{2\,alk}{2\,alk + c} \text{ (if } c < al - alk).$$

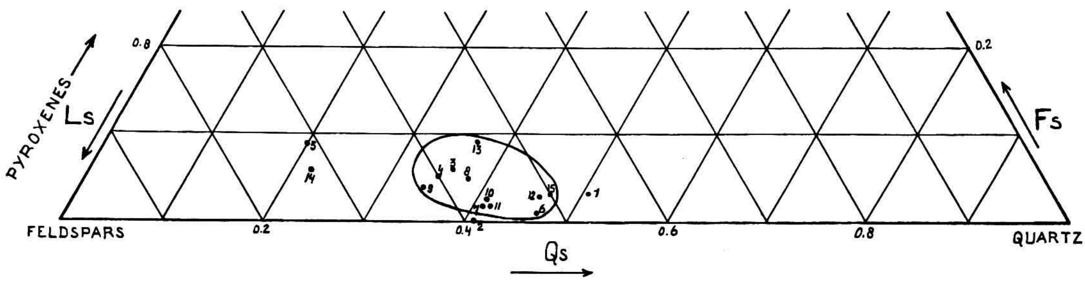

Fig. 1.

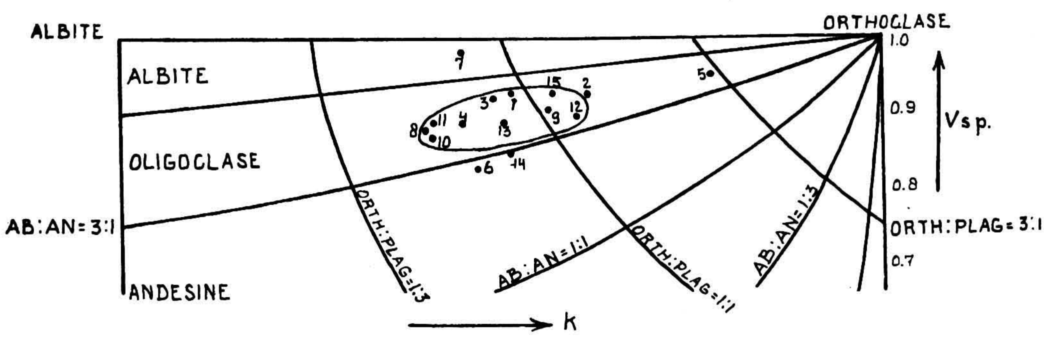

Fig. 2.

silica-rich variety of Malayan granite, which contains somewhat less normative albite. Nrs 2 and 5, resp. an aplite from Selangor and a granitic rock from P. Berhala in the Strait of Malacca (analyzed by VAN TONGEREN [27]), show the tendency of Malayan granites to split off differentiates rich in K-feldspar. The main types are however characterized by a slight excess of normative albite. Nrs 7 and 8, granitic rocks from the island Karimata (N.E. of Billiton), which belong to the same intrusive period as the Malayan tin-granites, are petrographically analogous [28]). ESENWEIN's chemical analyses of Karimata-rocks showed their differentiation-series to be very conformable to that of the Lausitz granite-area in Saxony (l.c., p. 62—81). The Lausitz-area in a wider sense also comprises the Erzgebirge stanniferous granites, of which two new analyses by FRITZSCHE have been cited in the tables (Nrs 10, 11). According to this author the Erzgebirge granites are of the pacific type [29]).

The best analysis of Cornish granite is perhaps that by POLLARD (N⁰. 9), given by REID and FLETT. For the Bushveld granite an analysis by RADLEY, published by DALY [30]), and representing the common type of Red Granite, has been given (N⁰. 12). Other available figures for granites of this area, gathered by HALL [31]), resulted to be of insufficient accuracy for this purpose. For Bolivia two analyses given by AHLFELD, one of a granodiorite from Mt. Illampu (N⁰. 13), and another of a quartz-porphyry (Colquechaca, N⁰. 14), have been chosen. The porphyry is however reported to be rather badly altered by hydrothermal metamorphism. The number of reliable analyses from this important province is very restricted. The rapakivi-granite near the Pitkäranta tin-deposits has recently been analyzed by LAURI LOKKA [32]).

Figs. 1 and 2 clearly show that Fs remains below 0.1 for all rock-types considered; Ls varies between $\pm$ 0.5 and $\pm$ 0.65 in typical tin-granites (Nrs. 3, 4, 9, 10, 11, 12, 13, 15). The Bolivian quartz-porphyry and the "granite" from P. Berhala are much poorer in normative free quartz than the common types of batholitic rocks. The composition of the normative feldspar in the Colquechaca porphyry is however not very different from that in the Mt. Illampu granite, which therefore appears to be intimately related to the former rock.

The average normative feldspar of tin-granites considered is neither pronouncedly towards the albite-side, nor towards the orthoclase-side,

[27]) W. VAN TONGEREN, Chemische analyses van gesteenten van Poeloe Berhala. These Proc. **38**, 634—638 (1935).

[28]) P. ESENWEIN, Die Eruptiv-, Sediment- und Kontaktgesteine der Karimata-Inseln. Wetensch. Meded. No. 24, Dienst v/d Mijnb. in N.O.I., p. 4—19 (1933).

[29]) E. FRITZSCHE, l.c., p. 299—300.

[30]) R. A. DALY, Bushveld Igneous Complex of the Transvaal. Bull. Geol. Soc. of Amer. **39**, 717 (1928).

[31]) A. L. HALL, l.c., p. 375.

[32]) LAURI LOKKA, Neuere Chemische Analysen von Finnischen Gesteinen. Bull. de la Comm. Géol. de Finlande, No. 105, p. 40—41 (1934).

while the proportion of alkali-feldspar to total feldspar (Vsp) varies only between 0.87 (Erzgebirge) and 0.93 (rapakivi). *The tin-granites are evidently more or less end-stages of differentiation of acid magmas, which in the proportions of main constituents do not differ essentially from non-stanniferous common biotite-granites. There are however indications that a higher content of rarer elements, which tend to be concentrated in granite-pegmatites, distinguish them from common granites:* e.g. the unusual content of rare earths in Malayan granites; small quantities of Sn in dark mica, quartz and feldspars from Banka-granites [22]); traces of Li, Sn, Bi, Cu, Co and U in lithionite-mica from Saxonian tin-granites [34]), and of Ga, Sn and W in biotite from granite in the East Pool-Mine near Redruth, Cornwall [33]). It should be remarked in this connection that the stanniferous Eibenstock-granite (Saxony) is a lithionite-albite-granite, whereas the neighbouring and presumably somewhat older Kirchberg biotite-granite is non-stanniferous [34]). The question of minor constituents deserves further consideration for tin-granites all over the world.

[33]) J. CH. BROWN, Lagerstätten und erzmikroskopische Untersuchung der Zinnerzgänge der East Pool-Mine bei Redruth in Cornwall. Neues Jahrb. für Miner., Geol., und Paläont. **68**, Beil. — Bd. A, p. 331—332 (1934).

[34]) K. DALMER, l.c.

Geologisch Instituut der Universiteit van Amsterdam.

Histology. — *The branching of the dendrites in the cerebral cortex.* By Prof. Dr. S. T. BOK. (Communicated by Prof. M. W. WOERDEMAN).

(Communicated at the meeting of November 28, 1936).

The theory of the neurone pattern, published in my paper "A quantitative analysis of the structure of the cerebral cortex" [1]), included two provisional conclusions about the way in which the dendrites of the cortical ganglion cells split up into branches: in neurones of different sizes the radius of the dendrite field was assumed to be proportional to the volume of the nucleus, and, secondly, the total length of the dendrites and its branches was assumed to be proportional to the square of that radius. These two proportionalities had to remain hypothetical untill the dendrites themselves were measured, the theory being based upon the measurements of the nuclei and cell bodies only and upon some peculiarities of the dendrites suggested by drawings made by CAJAL.

After this theory was published, measurements of the dendrites and their

[1]) Verhandelingen Koninklijke Akademie v. Wetenschappen te Amsterdam, Afdeeling Natuurkunde, 2e Sectie, deel XXXV, No. 2, 1936.