laria perhaps it is permitted to think of a later inversion of aragonite into calcite but for the very new specimina of Buccinum undatum and Littorina littorea this explanation seems excluded. Possibly the form in which the lime carbonate is separated depends on external influences and a species which builds as a rule an aragonite shell may be able to separate calcite under abnormal circumstances (temperature, composition of the water). This appears to me the more probable as we can precipitate artificially calcite or aragonite according to the circumstances of temperature and composition of the solution. If this should be true the composition of the shell is no specific property.

Geophysica. — "*Earthcurrent-Registration at Batavia.*" (3d communication). By Dr. W. VAN BEMMELEN.

In the preceding communication about my earthcurrent registration in Java, I expected to be able before long to throw more light on the question of the abnormal intensity of the current between Batavia and Anjer (a place in the neighbouring residency of Bantam)

The kind co-operation of the Superintendent of Government Railways, who allowed me the use of the railway telegraph lines during night time, enabled me to realise my intention of measuring the currents flowing between Batavia and some other places situated in the residencies of Batavia and Bantam.

In order to obtain an exact control over the new results, I registered next to the currents flowing through these wires, those between Anjer and Batavia flowing through the direct telegraph line between these towns, i.e. by means of the line formerly used by me. Moreover the N—S component of the magnetic force was recorded.

By means of the railway telegraph-wires I obtained connection with the following places:

Laboean on the Westcoast of Java, 32 K.M. to the S.S.W. of Anjer.

Serang 28 K.M. to the East of Anjer.

Rangkas Betoeng 40 K.M. to the East of Laboean.

Between Anjer, Serang, Rangkas Betoeng and Laboean there rises a volcanic chain, the volcano Karang (1780 M.) being the culminating summit.

Tangerang 21 K.M. to the West of Batavia.
Bekassi 20 „ „ „ E.S.E. „ „
Krawang 54 „ „ „ E.S.E. „ „

The directions and distances from Batavia are:

Batavia—	Anjer	W 5°N.
,,	Laboean	W 12 S.
,,	Serang	W 4 N.
,,	Rangkas Betoeng	W 17 S.
,,	Tangerang	W 1 S.
,,	Bekassi	E 17 S.
,,	Krawang	E 14 S.

I think it necessary for a better understanding of the results to be mentioned hereafter, to summarise the results obtained before.

In my former work on earthcurrents I always compared the oscillations shown in the intensity of the current, with those occurring simultaneously in the magnetic component, always taking into account the horizontal component directed perpendicularly on the straight line connecting the two stations.

I measured the variations of the magnetic component in absolute measure, and determined those of the earthcurrent by means of the differences of potential per Kilometer, which, if existing, should give the same variation of the current through the wire as was shown by the recording galvanometer.

Thus I did not decide whether such a difference of potential really existed at the two stations.

The records obtained brought to view the fact, that especially for places one of which lies to the East of the other, each oscillation of the earthcurrent corresponded with a simultaneous one of the component. But if one station lies to the North of the other the correspondence with the E.-W. component of magnetic force was much less than in the former case.

The connection between corresponding oscillations of earthcurrent and magnetic force may be described thus. Those of the earthcurrent precede those of force with a certain difference of phase; their amplitude increases compared with those of force, when the duration decreases.

As to the amount of this difference of phase and of this increase of amplitude I found them to be quite different for the coast-plains of North-Java and the volcanic regions in the southern part of the island.

In the South especially the increase of amplitude, which accompanies decreasing duration, was much more rapid, than in the northern regions. The following figures will make this divergence evident.

Mean half duration of the oscillation	Amplitude of earthcurrent in volts. per K.M. / Amplitude of magnetic force	
	Northern-Java Batavia-Cheribon	Southern-Java Buitenzorg-Tasik Melaja
0.5 min.	21.2	59 0
1.2 „	20 5	55.0
9 0 „	16.5	15.0

I recorded the current between Semarang and Cheribon and between Semarang and Soerabaja during a stay at the former place and found it to be of the same type and strength as the current between Batavia and Cheribon. The current between Batavia and Anjer however, though bearing also this same type, I found to be more than four times stronger. Experiments made specially for that purpose giving evidence of the realty of this phenomenon, the next step to be done was to examine the current between Batavia and other places situated between Anjer and Cheribon. In the months of March and April of this year I made these measurements, having recorded during some nights the current for each station in connection with Batavia, together with the Batavia—Anjer current and the N—S component of magnetic force.

I measured on the diagram obtained the amplitudes for a certain number of oscillations of short and of longer duration; the average values are given below. For each case I have added the proportion of the strength of the currents (per K.M.) to that of the Anjer-current. (See table p. 245).

When we examine the numbers of the last column, which give the proportion of the strength of the currents between Batavia and Anjer we at once see that for each case this proportion is nearly the same for shorter and longer oscillations (only for Batavia-Bekassi we find an exception, the numbers being 1.9 and 1.3 resp.).

Now this means that also for different regions between Anjer and Cheribon the currents bear the type of the coast-plains of northern Java, as was mentioned above.

But the numbers also point to a gradual increase of strength, when we connect successively Batavia with places of an increasing westerly position.

Supposing the current between Batavia and Cheribon to be 1.0,

Earth-magnetical E-W component		Earth-current				
Half duration of the oscillation	Amplitude	Amplitude of the Earthcurrent in V.p. KM. / Ampl. of the magn. force in abs. meas.				Ampl. Btv.-Anjer / Ampl. Btv.-Station
1.3 min.	1.2	Batavia—Laboean	71	Batavia—Anjer	83	1 2
7.3	2.8	„ „	60	„ „	62	1.1
0.5	1 6	Batavia—Serang	86	„ „	97	1.1
2 0	0.9	„ „	66	„ „	75	1.1
9 6	3 3	„ „	57	„ „	68	1.2
0 9	0.5	Batavia—Rangkas Betoeng	80	„ „	82	1 0
10.0	1.2	„ „ „	52	„ „	47	0 9
0.5	1.0	Batavia—Tangerang	49	„ „	97	2.1
6 2	0 8	„ „	39	„ „	82	2.0
0.5	0 9	Batavia—Bekassi	47	„ „	89	1.9
13.7	7.5	„ „	43	„ „	57	1 3
0 7	0 4	Batavia—Krawang	25	„ „	93	3.7
13 7	2 8	„ „	20	„ „	72	3.6
		Batavia—Cheribon				4.2

we have, taken into account the variations of the current during short oscillations only :

	Amplitude Earthcurrent
Batavia—Cheribon	1.0
„ Krawang	1.1
„ Bekassi	2.2
„ Tangerang	2.0
„ Rangkas Betoeng	4.2
„ Serang	3.8
„ Anjer	4.2
„ Laboean	3.5

If we suppose, that a difference of potential rises between Cheribon and Batavia, when a certain variation of the magnetic force occurs, and supposing the gradient of potential to be 1 Volt per K.M., we are able to calculate the potentials rising at the different stations.

For convenience, sake we may assume the potential at Cheribon to be zero. We find:

Laboean	595	volt
Anjer	645	,,
Serang	496	,,
Rangkas Betoeng	481	,,
Tangerang	242	,,
Batavia	200	,,
Bekassi	156	,,
Krawang	141	,,
Cheribon	0	,,

From these and formerly found values we deduce the following gradients.

Between	Potent. gradient	Geological formation.
Anjer and Serang	5.3	Neo-volcanic
Serang and Tangerang.	4.5	Quaternary
Rangkas Betoeng and Tangerang	4.1	Quaternary
Tangerang and Bekassi	2.1	Quaternary and alluvium
Bekassi and Krawang	0.4	Alluvium
Krawang and Cheribon	1.0	Quaternary and alluvium
Cheribon and Semarang	0.9	Quaternary and cretaceous
Semarang and Soerabaja	1.1	Quartenary, cretaceous a. alluvium.

The geological formations encountered on the different passages, have been borrowed from the geological atlas of VERBEEK and FENNEMA.

It is not to be denied, that a certain connection seems to exist between gradient and formation, such that the gradient is least in alluvium, greater in quaternary and greatest in the volcanic layers; and neither may it be said, that this succession is improbable.

Also for the volcanic province of the Preanger in southern Java I found a high value, viz. 3, but here the proportion of amplitudes for current and force bears the other type, which involves the gradient to be small, viz. 1, for oscillations of longer duration.

The formations given by the geological atlas are those met with at the surface of the earth, and the outlines of the deeper layers, no doubt, will differ much from those of the superficial ones.

Thus when we find a connection between the strength of the current and the outlines of the superficial layers, this points out that the currents measured are the superficial ones too.

Accordingly it is no wonder that the currents bear a different type in the mountainous Preanger compared with those of the coast-plains; but I utterly fail to explain this difference, just as it has been found.

All that has become known till now points to the next step, which should be taken in this research, viz. that the earth-connections should be brought to a depth of, say one or more kilometers under the surface of the earth, but, alas this is impossible.

It is true I had the intention to make use of two artesian wells to be bored recently at Serang and Batavia, but the considerations, that first the mantle of these holes consisted of iron, the depth was only 0,2 à 0,3 K.M., and besides the wire connecting the two did not possess the necessary isolation, frightened me out of this burdensome experiment.

I think it advisable to continue the registration in the old way, but to take into account the geological formation in the first place.

Dr. L. STEINER of Budapest has directed my attention to the fact, that I have erroneously applied the formula $A = 0.8 \sqrt[4]{\frac{1}{TM}}$ (c.f. 1st Comm. Proc. Jan. 25, 1908. p. 515) on the harmonic terms of the daily variation for the earthcurrent between Batavia and Cheribon.

Indeed a calculating error has curiously given rise to an apparent agreement between the observed values and those computed by means of the formula.

Dr. STEINER deduced the following expression

$$\frac{A}{M} = 3.9 \frac{1}{T^{0.8}} \text{ or } \frac{A}{M} = 3.9 \frac{T^{0.2}}{T}.$$

This formula gives the following values

	Amplitude				
	Earth-current volt. p. KM. $\times 10^{-5}$	Magn. Comp. c. g. s. $\times 10^{-5}$	Earth-current / Magn. comp.		Δ C—O
			Observ.	Calc.	
A_1	74.6	18 62	4.0	3.9	— 0.1
A_2	43.8	7 63	5.7	6.6	0.9
A_3	27.7	2.96	9.4	8 9	— 0 5
A_4	8.9	0.90	9.9	10.8	0.9
A_5	6.9	0 53	13.0	13.0	0.0
A_6	6.6	0.42	15.7	15.0	— 0.7

He also remarks that this formula agrees in character with my theoretical one, viz.

$$\frac{A}{M} = C\,\frac{\varrho}{1+c'}\cdot\frac{1}{T}$$

because $1+c'$ slowly increases with decreasing T.

This, indeed is the case. For instance when we assume $\varrho = 3.70\times10^{13}$ or $\sigma = 10$, and consider the spherical function of order 2 we find after SCHUSTER (Phil. Tr. Vol. 180 p. 496):

σ	$1+c'$	$\frac{1+c'}{1.172}$
1	1.019	$0.869 = 0.1^{0.061}$
5	1.093	$0.933 = 0.5^{0.100}$
10	1.172	1.000 —
20	1.278	$1.091 = 2^{0.126}$
30	1.337	$1.141 = 3^{0.120}$
40	1.374	$1.173 = 4^{0.115}$
50	1.399	$1.194 = 5^{0.110}$
100	1.466	$1.251 = 10^{0.097}$

The exponent accordingly changes slowly, and reaches as a maximum 0.126, a value, which approaches the value 0.2 required by the empirical formula.

I think this points to a possibility to bring agreement between the theoretical assumptions and the observed facts for the daily variation of earth-current and magnetic component. However this is not the case for the short oscillations.

I regret that my near return to Europe prevents me from entering now on those questions, or making new experiments.

Batavia, Aug. 1908.

Chemistry. — "*The nitration of toluene*", by Prof. A. F. HOLLEMAN.

(Communicated in the meeting, of September 26 1908).

On account of its great technical importance the nitration of toluene has been studied repeatedly; the determination of the quantity of *o*- and *p*-nitrotoluene contained in the product of the reaction has also been carried out a few times. RAOUL PICTET, (C.r. **116**, 815) states that when toluene is nitrated at — 55° 5.5 times as much *p*-nitrotoluene is formed as when the nitration is carried out at 0°. HOLDERMANN, (B. **39**, 1250) tried to modify the proportions in which