are much greater than is generally accepted, also as to the nitrogen, although in a less degree. When comparing the accumulation of the elements it thus seems, that during the metabolism this accumulation is greatest for those, which form a small permanent percentage of the constituents of the organism. So we see, that in the course of an experiment the same quantity of an element may be many times active in the metabolism, one cell taking up the products excreted by another cell.

Starting from this view the study of elements, such as manganese, which are already active in very dilute solutions, are interesting.

Meteorology. — *"A long range weather forecast for the East-monsoon in Java."* By Dr. C. BRAAK.. (Communicated by Dr. J. P. VAN DER STOK.)

(Communicated in the meeting of November 30, 1912).

In a preceding communication [1]) it was deduced from a study of factors of correlation that in the Indian Archipelago, with the exception of the western part north of the equator, a connection is clearly perceptible between barometric pressure and rainfall. The nature of this connection appeared to depend upon the geographical position as well as upon the different seasons.

In the following an attempt will be made to show that by means of this connection it is possible to make a long range weather forecast.

For this purpose Java has been chosen, because a forecast is of greater value for this island than for any other part of the Archipelago on account of its intense cultivation. Moreover this research will be limited to the east monsoon, as the connection is less distinct in the west monsoon, and because a forecast for this season of abundant rainfall is of secondary importance.

It will be necessary to prove, that the changes of the barometer-readings from year to year succeed each other according to definite rules, so that they may be determined in advance. Further we must also prove that it is possible to ascertain with sufficient accuracy how the rainfall depends upon the barometric deviations.

With regard to the deviations of airpressure Java has an advantage over any other part of the world, because the variations of climate are determined by the variations of the barometric pressure in North Australia, which are characterised by an extraordinary regularity. No station outside North Australia can vie with it in this respect, not even Bombay of Cordova (Argentina) which stations

[1]) These Proceedings 1912 p. 454.

were selected by LOCKYER as the representatives of both types of the barometric periodical oscillation of 3.5 years [1]) Moreover the amplitude in Australia is much greater than elsewhere.

The variations of the airpressure in North Australia from the normal value are shown in curve I of the plate, by means of the six-monthly deviations of the barometric pressure at Port-Darwin, marked monthly on the plate in such a way that, for instance, the deviation in the period January-June (in relation to the normal value in the same months) is drawn on the 1st of April. Beginning with 1899 the base value has changed, apparently because something has been altered in the barometer or its position.

The curve shows some very regular series of waves, namely from 1878 till 1881, from 1885 till 1891, from 1896 till 1904, whereas in 1911 a new series seems to have begun. *The maxima and minima are characteristic of fixed seasons, they develop themselves namely in the first and last months of the year.*

Minima.	Maxima.
1 Dec. 1878	1 Febr. 1881
1 Oct. 1886	1 Sept. 1885
1 Febr. 1890	1 Jan. 1889
1 Febr. 1898	1 Oct. 1891
1 Sept. 1900	1 Nov. 1896
1 Febr. 1904	1 Febr. 1900
	1 Dec. 1902
	1 March 1912

It is further evident, that the time which elapses from minimum to maximum is one year, from maximum to minimum two years. The period is exactly 3 *years.*

The curve so closely resembles this schematic interpretation, that it may be represented by the schematic broken line IV of the plate. From 1878 it has been traced backward by means of the barometric observations made at Adelaïde. For simplicity's sake the maxima and minima have been drawn on the 1st of January.

These regular periods are particularly adapted to forecast the airpressure a considerable time in advance. Disturbed periods are lying between them however, in which the curve makes the impression that there has been no development of the maximum for some years. The certainty with which the barometric variations may be predicted would decrease greatly, if the epochs at which these disturbed

[1]) Solar Physics Committee. Monthly mean values of barometric pressure.

periods appear could not be predicted and one would always be uncertain whether the end of a regular series is near. Fortunately however these disturbances seem to be anything but irregular in their appearance, so that there exists a possibility of announcing them in advance. This may be seen from the comparison of the barometercurve I with the curve II, which represents WOLF's relative numbers of sunspots. *It is remarkable that the disturbances in the barometercurve coincide with the maxima of the sunspotcurve, whereas during the periods with small sunspot intensity the regular barometric wave is developed undisturbedly.*

It cannot be denied that the number of sunspot periods over which this comparison is possible, is but small, however there seems to be every reason to suppose that we have here to do with a real and not with an accidental connection. Indeed it is a matter of fact known already since long that there exists a connection between the number of sunspots and different meteorological phenomena, and the above mentioned result agrees with what has been found in earlier researches. At the close of this communication this connection will be still further considered.

One would be inclined to go back, beginning with the year 1876 and examine still more closely the connection between sunspots and disturbed barometerperiods by means of the observations made at other stations with longer records. For this purpose i.a. the stations Batavia, Adelaïde, Bombay, and Madras would be adapted. As however at these stations the oscillation itself is less regular, it is very difficult to distinguish what is disturbed by the sunspots and what is not, and the results would not be very convincing.

Now the question arises how the rainfall is affected with regard to the barometer oscillations. In answering this question the disturbed periods in which the connection is less distinct will be left out of account and only the regular waves will be considered. In curve V the rainfall deviations in West-Java (6 monthly means, calculated in the same manner as the deviations of curve I, accordingly reduced to one month) have been represented monthly; for the years 1875—1878 the curve is based on the Batavia observations only.

The curve shows clearly that the connection between rainfall and airpressure is different in the West- and the Eastmonsoon, it may serve to illustrate the numbers which are given below.

The investigation may be divided into three parts according to the schematic barometer curve.

1. The Eastmonsoons of the years in which the barometer is moving from maximum to minimum; these are years of transition.

2. The Eastmonsoons following the barometric minimum. The pressure remains below normal during the whole year.

3. The Eastmonsoons preceding the barometric maximum. The pressure is above normal during the whole year.

The first case is apparent in the years 1878, 1886, 1889, 1897, 1900, 1903, and 1912. The departures of the rainfall from its normal condition from June till November (the latter included) [1]), were in these years, averaged monthly, in millimeters.

	West-Java	East-Java
1878	—24 (*Batavia*)	*Not observed.*
1886	+ 1	+20
1889	+67	+50
1897	—29	-30
1900	+34	+43
1903	+24	—15
1912	+ 2 (June-September)	—21 (June-September).

The second case is apparent in the years 1876, 1879, 1887, 1890, 1898, 1901, and 1904. The rainfall departures are in the same months as above averaged monthly:

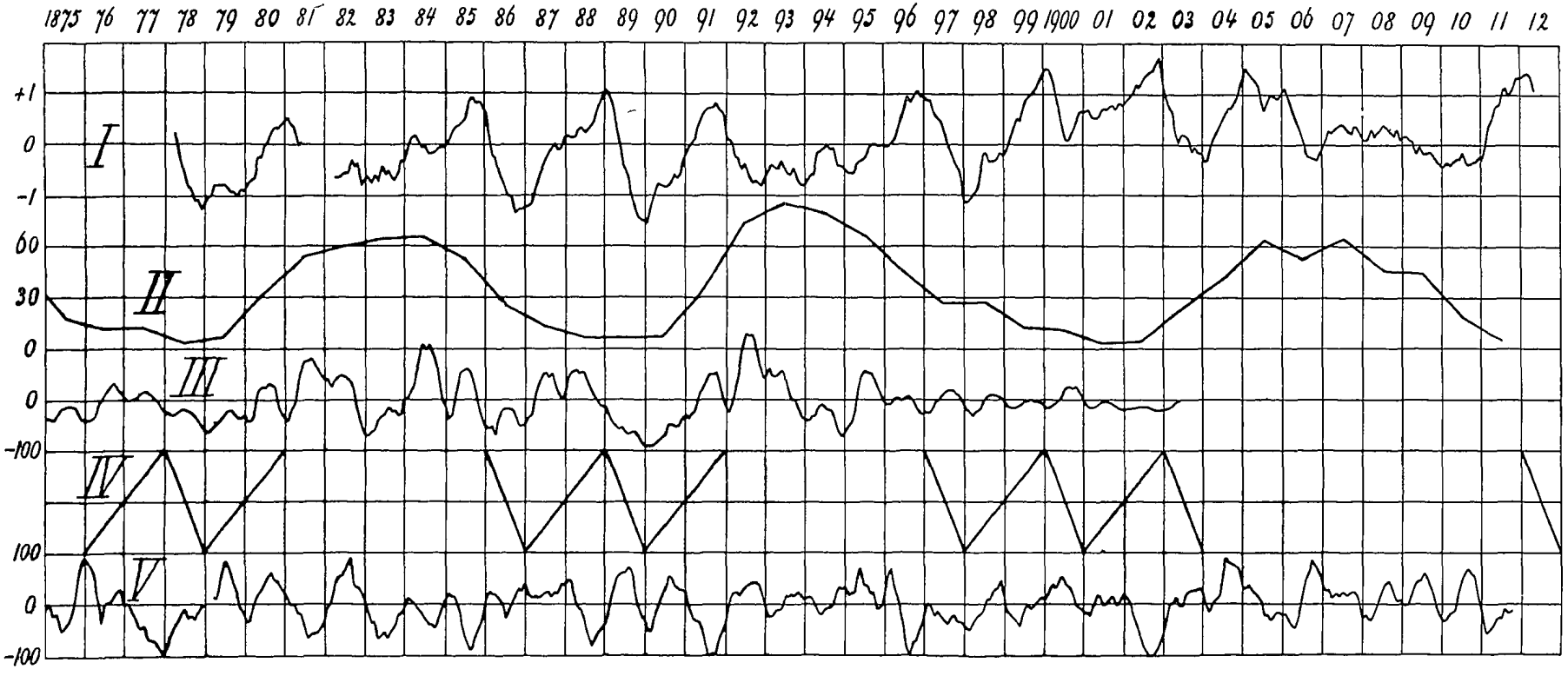
	West-Java	East-Java
1876	+ 4 (*Batavia*)	*Not observed.*
1879	69	+79
1887	29	7
1890	52	44
1898	8	18
1901	15	18
1904	81	17

In the last case are the Eastmonsoons of 1877, 1880, 1885, 1888, 1891, 1896, 1899, 1902, and 1911.

The rainfall departures in the months June-November are:

	West-Java	East-Java
1877	— 74 (*Batavia*)	*Not observed.*
1880	+ 62	—23
1885	— 88	—53
1888	— 86	+ 2
1891	— 99	—60
1896	—102	—51
1899	— 12	—41
1902	—104	—57
1911	— 18	+ 7

[1]) These are the months which have negative correlation between airpressure and rainfall as appears from the preceding communication.



I. Departures from normal of the airpressure in Port-Darwin in millimeters.
II. WOLFS' relative sunspotnumbers.
III. Departures of the number of prominences from 5 yearly means.
IV. Schematic barometercurve of Port-Darwin.
V. Departures from normal of the rainfall in West-Java in millimeters.

In the years of transition mentioned sub 1°, evidently the rainfall is also in a state of transition; the signs of the departures are changing and have no fixed character.

On the contrary all Eastmonsoons mentioned sub 2° *without exception have been too wet in West- as well as in East-Java, whereas of the Eastmonsoons mentioned sub* 3°, *out of* 9 *cases* 8 *have been too dry in West-Java and out of* 8 *cases* 6 *too dry in East-Java.*

It cannot be denied that among the favourable cases there are some in which the departure is but small, but on the other hand it is a matter of fact that with 2 of the 3 unfavourable cases the departure also remains small. In these years the character of the monsoon has been indefinitely developed, or has been different in different parts of Java or, as occurred in 1911, the character was different during the different months. Certainly 1911 must be reckoned among the dry years, even though the heavy rainfall in June caused a positive departure in East-Java.

It must be remarked that to the numbers given for 1876—1878, as taken from the observations of only one station, but little value can be attached. It is however a well known fact that 1877 was a dry year over the whole of Java and that therefore the strong negative departure observed in Batavia has a general validity.

Above has been given a scheme of barometric changes and corresponding fluctuations of rainfall which may be applied to 23 years out of the 37 of the period 1876—1912. If we exclude the year 1876 for the above mentioned reason, this scheme gives for 15 years (mentioned sub 2 and 3) a definite answer to the question what was the sign of the rainfall departure in the Eastmonsoon in Java. With one exception in West-Java and two exceptions in East-Java this sign corresponds with reality.

On the principle upon which the scheme has been based it also would have been possible to forecast for these 15 *years the sign of the rainfall departure in West-Java* 14 *times, in East-Java* 13 *times, if we had considered that the term should be taken somewhat shorter at the beginning and at the end of a regular wave series e.g. half a year, whereas it might be taken longer between them, even* 1 *or* 2 *years.*

What may be concluded from the scheme for the near future about the rainfall in Java? The circumstances for a forecast may presently be called really favourable, because a new regular series of barometer waves has already made its appearance during the present sunspot minimum.

We have already passed the barometer maximum and the pressure

is changing exactly in the direction indicated by the scheme, so that there is every reason to believe that the next minimum will appear at the expected time (namely about the 1st of January 1913), while there is no indication in the course of the sunspot number that points to an early disturbance. Therefore also the appearance of the next barometric maximum about the 1st of January 1915 is rather certain.

From this already now may be concluded, with certain reservations that must be admitted with every forecast, that most probably the Eastmonsoon in Java of 1913 *will deviate in the wet, and that of* 1914 *probably in the dry direction.*

Finally a remark may be made about the barometercurve itself. In the preceding communication the question was raised as to whether the barometerperiod of 3.5 years has a terrestrial or an extraterrestrial cause, as for the Port Darwin curve, (and to this one a considerable weight should be attached, because it is not only the most regular one, but it has also the greatest amplitude), I should like to call attention to the fact, that *the epoch of the maxima and minima seems to be entirely controlled by the terrestrial seasons.* This seems to me a new proof for its terrestrial origin. The cosmical influences instead of causing the barometric oscillations, seem to disturb them (namely during the sunspot maximum).

If the variations of climate (departures of airpressure, temperature and rainfall) of short period (BRUCKNER's period and the longer ones excepted) are described as a combination of waves of terrestrial origin with a period of about 3 years, and a cosmical disturbance, which is acting during the sunspot maximum, it seems to me that a satisfactory explanation may be given of the influence, that (as a result of different researches) is attributed to the sunspots. By a combination such as described above the fact may be especially explained, that although in many cases a connection is found, it manifests itself at different epochs in a different way, as e.g. KÖPPEN has established for the temperature in the tropics.

The idea here given about the origin of barometric variation of 3 years is contrary, it is true, to the opinion of LOCKYER and BIGELOW, whose ideas are that it is controlled by the number of prominences. However the data on which this opinion is based are by no means convincing as a comparison between curves I and III may teach. In curve III we have put down the observations made at Rome and Catania about the number of prominences, which data have also been used by the two above mentioned investigators. Again the 6 monthly means of departure have been represented monthly in such a manner however that, following the

example of BIGELOW, for the elimination of the 11 year period the departures from the nearest 60 months (5 years) have been calculated and not those from the normal of the whole period

Comparison teaches that in the beginning till 1891 the barometercurve shows indeed much conformity with the prominence curve; afterwards however every similarity has vanished and in the later years in which the prominences hardly show any variation, the barometeroscillation goes on with the same regularity as before. Therefore very likely the connection during the first years has been only accidental.

Weltevreden, 10 October 1912.

Chemistry. — "*Dynamic researches concerning the reaction of* FRIEDEL and CRAFTS." By S. C. J. OLIVIER and Prof. J. BÖESEKEN. (Communicated by Prof. A. F. HOLLEMAN).

(Communicated in the meeting of December 28, 1912).

Dynamic researches have already been carried out with $AlCl_3$ or analogous substances as catalyst.

The first are those of A. SLATOR [1]), who investigated the action of chlorine on benzene in the presence of $SnCl_4$ and $FeCl_3$.

The absorption of the halogen dissolved in an excess of benzene was measured, and it was found that this proceeded according to the reaction scheme of the first order the constant being proportional to the amount of the catalyst.

We may conclude therefrom that the catalyst is constantly active; that its action is not sensibly altered by any of the reaction products.

Further we mention the research of B. D. STEELE [2]), who has studied the ketone synthesis and the formation of phenyltolylmethane under the influence of $AlCl_3$ and FCl_3 where the progressive change of the reaction was determined from the amount of hydrogen chloride evolved.

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[1]) Proc. **19**, 135 (1903); Journ. Chem. Soc. **83**, 729 (1903): Zeits. phys. Ch. **45**, 513 (1903).

L. BRUNER had carried out measurements as to the bromination of benzene, but as a catalyst iodine was used which is not directly comparable with $AlCl_3$; moreover it was not sufficiently taken into consideration that the bromine unites with the catalyst (see Dissertation S. C. J. OLIVIER).

SLATOR has also used iodine as catalyst. Although this research is very interesting as regards the benzene substitution, this part may be passed over for the reason stated.

[2]) Journ Chem. Soc. **83**, 1470 (1903).