Astronomy. — Prof. J. A. C. OUDEMANS presents as a first communication on his journey to Réunion for observing the transit of Venus: "*A short account of the determination of the longitude of St. Denis, (Island of Réunion), executed in* 1874."

In our ordinary meeting of October 30, 1875 I communicated a few details on the state of the computation of the observations at St. Denis on the transit of Venus of December 9, 1874. The purport substantially was, that the computations had been carried out as far as was possible at that moment.

Several circumstances, independent of my will, were the cause that this state of things remained the same till the middle of last year, and that the computations could not earlier be taken in hand again.

What I communicated then has been inserted in the Proceedings of that meeting. Passing by all that refers to the heliometer measures, which I hope to take up at some later time, I will only mention the fact that the necessity was pointed out of determining with precision the longitude of the place of observation.

For this purpose we, viz. Mr. ERNST VAN DE SANDE BAKHUYZEN, Mr. SOETERS and myself, have observed a number of occultations, not so much of the brighter stars, announced in the Nautical Almanac, as rather of fainter stars, of the 8th or 9th magnitude, the positions of which were not yet known with precision at that time. These had to be determined therefore by meridian observations; our honoured president readily undertook the task of having these determinations made at the observatory under his direction.

As a rule at least four determinations have been made of each star. Though the added epochs show that this was done between the years 1879 and 1884, it lasted a considerable time, till November 1901, before the reductions of those determinations had proceeded so far that the results could be communicated to me.

At the same time my attention was called to the fact that most of these stars had been since also observed at other observatories.

It thus became necessary, in my opinion, to look for all these determinations in the several Annals and to reduce them to the same epoch, (of course 1874), in order to make allowance for proper motion, wherever necessary. In many cases it proved sufficient to retain the Leiden determination unchanged.

But besides, the errors of the lunar tables, that is to say of the positions published in the Nautical Almanac, had to be derived from observations. For this purpose the observations at the meridian-

circles of Paris, Greenwich and Washington and those at the Altazimuth of Greenwich have been used.

It is true that, in a remarkable paper, *Investigation of corrections to* HANSEN's *Tables of the moon, with tables for their application,* NEWCOMB brought together the corrections to be applied to the formulae by means of which HANSEN calculated his tables of the moon. The paper contains the terms which had to be added according to the state of science in that year, and also an empirical correction determined by the most recent observations.

Moreover a table of corrections for 1874 was given, founded on these data. But after having made a diagram representing, both the corrections found by direct observation and those furnished by NEWCOMB's table, I came to the conclusion that the former was to be preferred [1]).

As for the longitude of St. Denis, I will remark, that it has been determined by the French naval officer GERMAIN in 1867 and 1868 by means of 13 culminations of the first and 12 of the second limb. In the *Connaissance des Temps* of 1871 a short report of that determination is to be found. Though the 25 results there given, agree tolerably well, this kind of determinations is always liable to the drawback that the difference in the constant error, made in observing the culmination of the moon's limb and of the comparison stars, enters into the result, about thirty times magnified. There is no fear of such an injurious influence in a determination of longitude by occultations [2]). If the voyage to reach the isle of Réunion did not last so long, and if the Indian Ocean were not so wild and bois-

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[1]) The present state of science requires a correction of one of the tables of NEWCOMB. He points out (page 9) that the parallactic equation of HANSEN is founded on the value 8".916 of the solar parallax, whereas the value which he derived in 1867 from all the available materials is but 8" 848, which is less by 0".068. Further that later determinations require rather a diminution than an increase of that number. At present 8".800 is generally adopted as being the most probable value of the solar parallax, which is less than NEWCOMB's value by 0".048. The parallactic correction of NEWCOMB must therefore be increased 1,7 fold; in other words: three terms have to be added, viz.:

$$+ 0''.67 \sin D + 0''.05 \sin (D-g) - 0''.09 \sin (D + g'),$$

where D represents the mean elongation of the moon from the sun, g the mean anomaly of the moon and g' that of the sun.

[2]) NEWCOMB says at the beginning of his paper above mentioned: "Determi-"nations of longitude from moon occultations are found by experience to be "subject to constant errors which it is difficult to determine and allow for. It "was therefore a part of the policy of the American Commission to depend on "occultations rather than upon culminations for the determinations of longitudes, etc."

terous, these voyage would also present an occasion of determining the longitude by transport of chronometers. Unfortunately the results given by the different chronometers were so diverging as to be of no value whatsoever.

The report above mentioned of GERMAIN's determination is accompanied by a plan showing his place of observation. We see from this plan that west of the town the river St. Denis runs nearly in a north-north-westerly direction towards the sea and that the place of observation of GERMAIN was still on the west of the river.

A brick pillar, on which stood his transit instrument in 1867 and 1868, was still extant during our stay in 1874.

The result of GERMAIN's determination of longitude and latitude was given by him as follows:

Longitude of the place of observation east of Paris	$3^h32^m25^s,7$
Reduction to the flag-staff, east of the Barachois (*i. e.* of the little creek which protects the sloops in landing)	+ 1 ,07
Longitude of the flag-staff east of Paris, (*sic.*:) . .	$3^h32^m26^s,8$
Southern latitude of the place of observation determined by 4 northern and 3 southern stars	20°52′ 2″,0
Reduction to the flag-staff	— 23 ,7
Southern latitude of the flag-staff	20°51′38″,3

Our observations of occultations took place at different points, the relative position of which was accurately determined by Mr. SOETERS.

Taking the difference of longitude of Paris and Greenwich $= 9^m20^s63$ from the Nautical Almanac of 1874, (as given at that time both in the C. d. T. and in the N. A.), we got from the numbers just mentioned, for the flag-staff $3^h41^m47,43$ east of Greenwich.

Corresponding therewith:

Place of observation:	Long. E. of Gr.	Latitude
1st on the ground of the harbour office	$3^h41^m47^s,32$	— 20°51′40″,6
2nd „ „ „ „ our dwelling house, N°. 51 Rue du Conseil	48 ,11	46 ,1
3rd Near or in the pavilion of the heliometer on the battery	47 ,81	35 ,3

The calculation of the longitude from the occultations has been carried out on printed forms, arranged according to the method which I developed in the *Astronomische Nachrichten* N°. 1763.

In this method the declination of the moon is taken from the

astronomical almanac, using an adopted longitude; the parallax is then computed for that point of the moon's limb, where the star has disappeared and which therefore has the same right ascension and declination as the star. We then have to add or to subtract two terms to or from the right ascension of the star, to get that of the moon's centre, and finally we find from the almanac the Greenwich time corresponding with that right ascension.

The longitude of the place of observation, then found, is the right one, if it agrees with the adopted longitude. If it does not agree, we have only to repeat a small part of the calculation with a modified longitude of the place, to derive the true longitude from the two differences.

This method corresponds with the method, which was customary in the 18th century (which we find inter alia explained in the well known treatise of BOHNENBERGER: *Anleitung zur geografischen Ortsbestimmung*) with this distinction that then the whole computation was carried out in longitude and latitude, whereas we use the right ascension and declination. Further, that for BOHNENBERGER c. s. there is no question of any second hypothesis.

I will readily grant that BESSEL's method of computing ecliptic phenomena and thus also for the prediction of occultations and for the calculation of the longitude from an observed occultation, is justly considered to be the classic method. It is also the only one explained in most of the textbooks. But it seemed to me that the method indicated by myself is more expeditive and only in a few cases inferior to that of BESSEL in point of accuracy. The drawback of this last method consists in the troublesome preparatory calculations, which it requires. Any one may convince himself of the truth of this statement by consulting the wellknown textbook of CHAUVENET: *A manual of spherical and practical Astronomy*, Philadelphia 1874, vol I, p. 550 [1]).

The horizontal equatorial parallax of the moon could be derived from the Nautical Almanac, without any correction. As for the apparent semidiameter of the moon, I myself made a determination of this quantity, based on an elaborate investigation in 1859, (vid. *Verslagen en Mededeelingen der Natuurkundige Afdeeling*, Vol. VI, p. 25 seqq.)

[1]) I have calculated a single example by this method; the result differed only by $0^s,1$ from that obtained by the other method; in the first however 57 logarithms had to be taken out, against 37 in the latter. Thinking the matter over, however, I believe that the method of BESSEL will probably admit of a modification by which this difference will be materially diminished. I hope shortly to investigate this more thoroughly.

which furnished 0.27264 for the proportion of the mean moon's semidiameter and that of the earth's equator (at least this is the result of the occultations discussed). After mature consideration, however, I now adopted the value 0.2725 $\times$ hor. equ. parallax $+$ 0″04. This leads approximately to the same value as when we take the sine of the moon's apparent semidiameter $=$0.272525 of the sine of the equatorial horizontal parallax.

This factor is the mean of those which were derived from occultations during total eclipses of the moon by LUDWIG STRUVE in 1888 and by J. PETERS in 1895 (0.272535 and 0.272518). The Nautical Almanac, which used both the semidiameter and the parallax as given in the Tables of HANSEN, gave a value larger by 1″4 to 1″6. This difference has remained the same up to the present time.

About the observed occultations we may communicate the following particulars. They were mostly observed by myself, partly with the Fraunhofer telescope, (aperture 11 cm.) mounted on a stand, which Mr. STOOP of Amsterdam had kindly lent to the commission for the observation of the transit of Venus, partly with the telescope of the heliometer (aperture $7^1/_2$ cm.). At a later epoch, when the assistance of Mr. ERNST BAKHUYZEN was not so constantly required, as in the beginning, for the experiments of Dr. KAISER with the photoheliograph, he also took part in the observation of the occultations, as also did Mr. SOETERS in one case.

Altogether 35 disappearances and 4 reappearances were observed; but 12 disappearances and 1 reappearance had to be rejected. There thus remained 23 disappearances and 3 reappearances, that is altogether 26 observations, which furnished useful results.

The reason of the rejection lay partly in the fact that, already in recording the observation, the remark "uncertain" had been added, an addition due to the faintness of the star as it approached the moon's limb, or to passing clouds.

For another part the correction of the longitude determined by GERMAIN and adopted by myself, came out so extravagantly large that some mistake or other seemed probable. There seemed to be reason to suspect that a wrong star had been taken for the occulted one. In five of the cases I succeeded to find out the right star by means of star catalogues, but in four other cases all my endeavours proved in vain. Ultimately there remained five cases in which the correction to the adopted longitude was found so considerable ($-$ 21^s, $-$ 20^s, $-$28^s, $-$ 24^s and $+$ 33^s), that there was no escape from the conclusion that either a mistake, however improbable in itself, had been committed in writing down the time, or that the

Results for the longitude of St. Denis-Réunion, (flag-staff), obtained by occultations, without making a difference between disappearances and reappearances.

1874	Observer	Star, Name or apparent place.	Disapp. or reapp.	Limb	ΔL = Corr. Germain	G	$G\Delta L$	ε	$G\varepsilon^2$
Sept. 19	O.	Arg. Z. 223, No. 75	D	D	+2.26	0 70	+1.58	+3.18	7.08
» »	O.	Cordoba III.1589	D	D	+6.64	0.74	+4.91	+7 56	37.29
» »	O.	» XVIII.124	D	D	+8.21	0.60	+4.93	+9.12	49.90
» 22	O.	33 Capricorni	D	D	+1.00	0.29	+0.29	+1.92	1.07
» »	O.	Arg. Z. 255, No. 27	D	D	−6 10	0.50	−3.15	−5.18	13 42
» »	O.	» » » » 32	D	D	−1 54	0 63	−0.97	−0.62	0.24
» »	O.	» » » » 34	D	D	−1.51	0.89	−1.34	−0.59	0 31
» »	O.	» » » » 35	D	D	−5.75	0.97	−5.57	−4.83	22.63
» 26	O.	73 Piscium	R	D	+3.11	0.91	+2 83	+4.03	14.78
October 2	O.	53 Geminorum	R	D	+1.27	0.28	+0.36	+2.19	1 34
» 4	O.	$\alpha = 9^h0^m39^s,60$, $\delta = +22°57'38'',7$	R	D	+4 39	1.00	+4.39	+5.31	28.20
» 16	B.	Arg. Z. 223, No. 47	D	D	−3 91	1.00	−3 91	−2.99	8.94
» »	B.	»	D	D	+9.67	0.40	+3.87	+10.59	44.86
» »	O.B.	» » » 49	D	D	−5.99	0.95	−5.69	−5.07	24.42
» »	O.B.	» » » 52	D	D	+3.84	0.515	+1 98	+4.76	11.67
» »	O.B.	» » » 51	D	D	+4.65	0.49	+2.28	+5 57	15.20
» »	S. B.	$\alpha = 18^h6^m41^s,75$, $\delta = -28°0'56'',8$	D	D	−4.26	0.99	−4.22	−3.34	11.05
» »	B.	Gould 24851	D	D	+5.84	0.87	+5.08	+6.76	39.76
» 17	O.	$\alpha = 19^h2^m35^s,76$, $\delta = -27°54'17''75$	D	D	+5.39	0.19	+1.03	+6.31	7.57
» »	O.	Arg. Z. 241, No. 9	D	D	−5.10	0.58	−2.96	−4.18	10.13
» »	O.	» » 231, » 12	D	D	+1.15	0.35	+0.40	+2.07	1.50
» »	O.	» » » » 11	D	D	−4.73	0.62	−2.93	−3.81	9.00
» 18	B.	» » 239, »103	D	D	−5.10	0.95	−5.07	−4.18	16.60
» 19	B.	» » 247, » 99	D	D	−2.62	0.98	−2.57	−1.70	2.83
» »	B.	χ Capricorni	D	D	−4.22	0.97	−4.09	−3.30	10.56
» »	B.	$\alpha = 21^h2^m24^s,71$, $\delta = -21°33'15'',1$	D	D	−8.95	0.94	−8.41	−8.03	60.61
						18.305	+33.93	$25\,m^2 = 450.96$	
							−50.78	$m^2 = 18.04$	
							−16.85	$m = \pm 4^s25$	

$$\Delta L = -\frac{16.85}{18.305} = -0^s,92 \pm 0^s,99,$$

Results for the longitude of St. Denis-Réunion, reappearances and disappearances separately.

The 3 reappearances give: $\Sigma G = 2.19$ $\Sigma G \Delta L = +7.58$ therefore $\Delta L = +3^s.462$
The total sum was: 18.30^5 -16.85
Therefore the disappearances separately give: 16.11^5 -24.43 „ $\Delta L = -1.516$
Mean: $+0^s.97$

ε	ε^2	G	G^2	
Disapp.				
$+3^s.78$	14.29	0.70	10.00	N.B. As there is no reason to suppose that a reappearance at the dark limb should be so much more accurate than a disappearance at the dark limb, I have combined them.
+8.16	66.59	0.74	49.28	
+9.73	94.67	0.60	56.80	
+2.52	6.35	0.29	1.84	
−4.58	20.98	0.50	10.49	
−0.02	0	0.63	0	
+0.01	0	0.89	0	
−4.23	17.89	0.97	17.35	
−2.39	5.71	1 00	5.71	
+11.19	125.22	0.40	50.09	
−4.47	19.98	0.95	18 98	$22\,m^2 = 406.16$
+5.36	28.73	0.51^5	14 80	
+6.17	38.07	0.49	18.65	$m^2 = 18.06$
−2.74	7.51	0.99	7.43	$m = \pm 4^s.34$
+7.36	54 17	0.87	47.13	(not used)
+6 91	47.75	0.19	9.07	
−3.58	12.82	0.58	7.32	
+2.67	7.13	0.35	2.50	
−3.21	10.30	0.62	6.39	Together:
−3.58	12.82	0.95	12.18	$24m^2 = 408.47$
−1.10	1.21	0.98	1.19	$m^2 = 17.02$
−2.70	7.29	0.97	7.07	$m = \pm 4^s.13$
−7.43	55.20	0.94	51.89	
Reapp.				$\frac{m^2}{16.115} = 1.056$ $\nu = \pm 1^s.03$,
$-0^s.35$	0.12	0.91	0.11	
−2.19	4.80	0.27	1.34	$2\,m^2 = 2.31$ $\frac{m^2}{2.19} = 7.78$ $\nu = \pm 2.79$.
+0.93	0.86	1.00	0.86	$m^2 = 1.155$ $4 - \frac{8\ 84}{2.21}$ $\nu = \pm 1.49$.
				$m = \pm 1^s.08$ (not used)

occultation had taken place at a point considerably elevated above the rest of the limb. In the following lines we will only communicate the results of those observations which have been retained.

We remark that the weights G, which have been added, were taken equal to $sin^2 \psi$, 2ψ being the arc, of which the star would describe the chord behind the disk of the moon, were this disk at rest; (according to the notation of CHAUVENET this would become $cos^2 \psi$). This quantity could be easily derived from the numbers occurring in the computation.

The calculations have been all made in duplicate; the first by myself, the other by Mr. KRESS, amanuensis at the observatory of Utrecht.

We thus find:

Taking disappearances and reappearances together:

Correction to GERMAIN's longitude: $-0^s,92 \pm 0^s,99$ (m. err.)

Treating them separately: $+0,97 \pm 1,49$ „ „)

We thus come to the conclusion that the occultations observed by us leave undecided whether the longitude of St. Denis, according to the determination of GERMAIN in 1867 and 1868, must be increased or diminished; in other words they confirm his result.

Only one of these days I noticed, that since 1886 the *Connaissance des Temps* gives a longitude for that place, which is larger by 1^s2 or $18''$; in the last column of the table of the geographical positions

M. T. Greenwich	From meridian observations.		Newcomb.		N. — Merid.	
	s	"	s	"	s	"
Sept. $19^1/_8$	−0.52	−4.3	−0.39	+0.3	+0.13	+4.6
$22^1/_6$	−0.51	−1.9	−0.49	−2.4	+0.02	−0.5
$22^5/_{12}$	−0.51	−2.1	−0.49	−2.6	+0.02	−0.5
$26^1/_6$	−0.73	−5.9	−0.70	−5.8	+0.03	+0.1
Oct. $2^1/_2$	−0.79	+1.7	−0.95	+0.6	−0.16	−1.1
$4^1/_2$	−0.75	0.0	−0.77	+2.9	−0.02	+2.9
$16^1/_5$	−0.35	−4.1	−0.47	+0.4	−0.12	+4.5
$17^1/_4$	−0.43	−2.0	−0.46	−0.4	−0.03	+2.4
$18^1/_3$	−0.35	−1.2	−0 45	−1.3	−0.10	−0.1
$19^1/_3$	−0.34	−2.5	−0.44	−2.0	−0.10	+0.5
				Mean:	s −0.03	" +1.3

we find: GERMAIN corr. 86; the reason for the correction is however not stated. I have therefore written to Paris asking for information.

Moreover I will observe that the difference of longitude Paris—Greenwich above used, must be increased according to the determination executed by French and English observers in 1902. The result obtained by the English observers was $9^m20^s,932 \pm 0^s006$; by the French observers $9^m20^s,974 \pm 0^s008$. Mean 9^m20^s953. (Monthly Notices of the R. A. S. Jan. 1905).

Finally we subjoin a comparison of the corrections to the moon's ephemeris of the Naut. Alm. of 1874, furnished by the meridian observations on the one hand, and by NEWCOMB's formulae on the other.

It might be worth while to ascertain, whether the agreement of the results is improved, if we adopt the corrections according to NEWCOMB.

As for the meridian observations, some have been made at other observatories (Leiden, Pulkowa etc.). I hope to investigate this more closely; it is not probable however that the result will be greatly altered.

A last remark in conclusion. According to the "*Post en Telegraafgids*" the isle of Mauritius is already connected telegraphically with Europe. There is reason therefore to expect that the same will shortly be the case for Réunion also. In that case the "Bureau des Longitudes" will no doubt endeavour to obtain a telegraphically determined longitude of St. Denis.

Utrecht: 1905 March 24.

Physiology. — "*On the presence of fibringlobulin in fibrinogen solutions.*" By Dr. W. HUISKAMP. (Communicated by Prof. C. A. PEKELHARING).

After HAMMARSTEN had proved that in fibrinogensolutions, which had been coagulated either by heat to 55° or by means of fibrinferment, a proteid, afterwards called fibringlobulin, appears which coagulates at 64°, there existed several possibilities with regard to the formation or appearance of this proteid.

Firstly the original fibrinogensolution might already have contained the fibringlobulin as an admixture; in the second place it was possible that at the heat-coagulation or by means of fibrinferment, the fibrin-molecule was disintegrated, and that in such a way that an insoluble substance, fibrin, is formed, along with a soluble one, fibringlobulin; and lastly the fibringlobulin might perhaps be an altered fibrinogen, which has remained in solution, a sort of soluble fibrin.