19. COMMISSION DE LA VARIATION DES LATITUDES

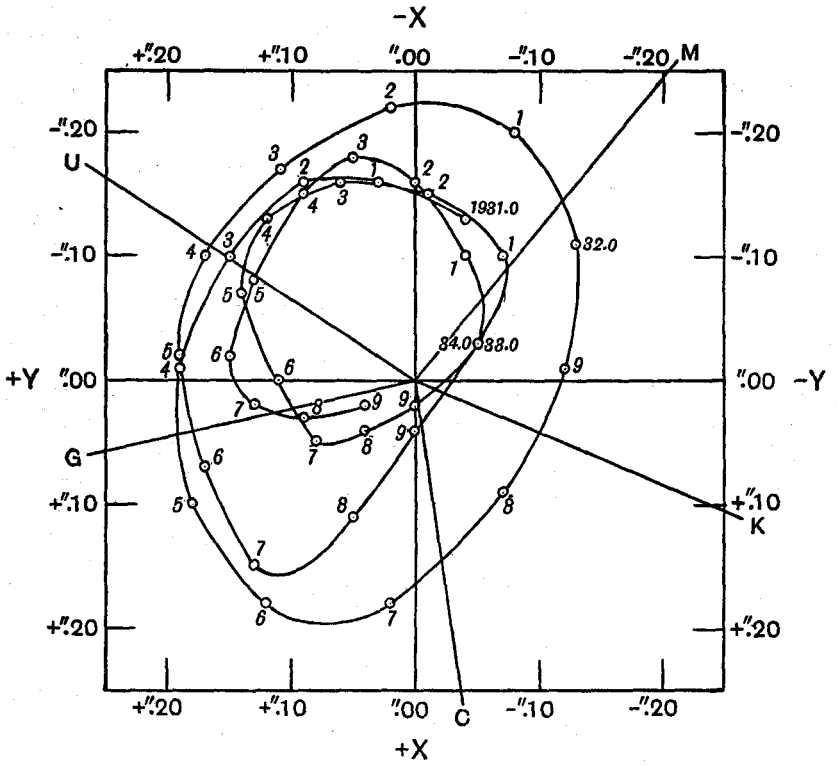
PRÉSIDENT: M. KIMURA, *Director of the International Latitude Observatory.*

MEMBRES: MM. Aguilar, G. Bemporad, Beneš, Bianchi, Burton, Carnera, de Gama, Dodwell, Esclangon, Hartmann, Hashimoto, J. Jackson, Jones, W. D. Lambert, Littell, Muller, Nijland, Perez, Schlesinger, Schumann, Stetson, Subbotin, Voûte, Williams.

A. PROVISIONAL RESULTS OF THE OBSERVATIONS OF THE LATITUDE VARIATION DURING THE PAST THREE YEARS

1. *International Latitude Service in the North Parallel.*

The values given below are those published in each annual report of the international latitude work. They were calculated from the observations at five stations, except the last part of 1934 which was made without Kitab, because the observation books from Kitab since November 1934 have arrived too late at the Central Bureau.



Path of the Polar Motion, 1931.0–34.9.

https://doi.org/10.1017/S0251107X00017223 Published online by Cambridge University Press

Fraction of year	Year 1932 X	1932 Y	1933 X	1933 Y	1934 X	1934 Y
	"	"	"	"	"	"
·0	−·11	−·13	−·03	−·05	−·03	−·05
·1	−·20	−·08	−·10	−·07	−·10	−·04
·2	−·22	+·02	−·15	−·01	−·16	·00
·3	−·17	+·11	−·16	+·06	−·18	+·05
·4	−·10	+·17	−·13	+·12	−·15	+·09
·5	−·02	+·19	−·07	+·14	−·08	+·13
·6	+·07	+·17	·00	+·11	−·02	+·15
·7	+·15	+·13	+·05	+·08	+·02	+·13
·8	+·11	+·05	+·04	+·04	+·03	+·09
·9	+·04	·00	+·02	·00	+·02	+·04

2. *Royal Observatory, Greenwich.*

The following values were taken directly from *M.N.* No. 5, March of each year.

Fraction of year	Year 1931	1932	1933
	"	"	"
·0	−·16	−·12	−·05
·1	−·22	−·19	−·12
·2	−·20	−·21	−·18
·3	−·14	−·19	−·20
·4	−·06	−·15	−·18
·5	+·03	−·05	−·08
·6	+·12	+·12	+·03
·7	+·17	+·13	+·10
·8	+·04	+·08	+·09
·9	−·05	+·02	+·03

3. *Naval Observatory, Washington.*

The following values were taken from *A.J.* Nos. 973, 1000, 1019.

Fraction of year	Year 1931	1932	1933
	"	"	"
·0	−·14	−·17	−·20
·1	−·10	−·15	−·19
·2	−·03	−·12	−·13
·3	+·02	−·04	−·11
·4	+·05	+·01	−·06
·5	+·01	+·04	−·01
·6	−·03	+·04	+·01
·7	−·09	+·01	+·04
·8	−·16	−·08	+·01
·9	−·18	−·15	−·05

https://doi.org/10.1017/S0251107X00017223 Published online by Cambridge University Press

4. *Z for Greenwich and Washington.*

The following z for each observatory is obtained by taking the simple annual means of residuals in the sense Greenwich or Washington minus International for each tenth of the year, during the period of three years 1931–33.

Fraction of year	1931–33 z_g	1931–33 z_w
	"	"
·0	−·020	−·077
·1	−·023	−·073
·2	−·020	−·087
·3	−·033	−·113
·4	−·050	−·137
·5	−·037	−·153
·6	+·007	−·143
·7	+·007	−·117
·8	−·010	−·100
·9	−·017	−·090

The above values of z except the constant parts have very similar runs with the corresponding ones reported in *Transactions of I.A.U.* **4**, 1932. Such facts can be seen very clearly by looking at the following results of the harmonic analysis according to the annual and semi-annual parts.

Period	z_g
1923–30	$-''\cdot005+''\cdot006\sin(t+70°)+''\cdot013\sin(2t+335°)$;
1931–33	$-''\cdot020+''\cdot009\sin(t+125°)+''\cdot015\sin(2t+331°)$.
	z_w
1923–30	$-''\cdot046+''\cdot034\sin(t+82°)+''\cdot013\sin(2t+253°)$;
1931–33	$-''\cdot109+''\cdot037\sin(t+81°)+''\cdot006\sin(2t+298°)$.

It is very interesting to note that the peculiarities for both observatories, viz. the constancy of the semi-annual part at Greenwich and that of the annual one at Washington, hold continuously through the whole of their own series; but that their constant parts are increasing numerically pretty considerably in both observatories while their signs remain unchanged.

5. *South International Station at Adelaide.*

The following values of the variation of latitude at this station were directly taken from the annual reports.

Fraction of year	Year 1931	1932	1933
	"	"	"
·06	—	+·30	+·10
·14	—	+·30	+·13
·22	—	+·27	+·12
·30	—	+·13	+·08
·39	—	+·07	+·02
·47	—	−·25	−·02
·56	—	−·20	−·06
·64	−·24	−·29	−·09
·72	−·25	−·31	−·10
·80	−·13	−·19	−·07
·89	−·02	−·05	−·02
·97	+·22	+·15	+·03

From the residuals substracted by the latitude variation of the polar motion, we got the following z_a for the two different periods:

$$1932.06\text{–}32.97 \quad z = +''\cdot012 + ''\cdot09 \sin(2\odot - \alpha - 46°);$$
$$1933.06\text{–}33.97 \quad z = +''\cdot025 + ''\cdot07 \sin(2\odot - \alpha + 48°).$$

6. *South International Station at La Plata.*

At this station the observations complete in all respects, as in the other international stations, were begun in August 1934 under the direction of the new Director, Mr Aguilar. Thus there is no material to report here, until one complete year passes.

7. *Batavia International Latitude Station.*

The detailed report with minute and interesting discussions on the results of observations during the period 1931.73–33.97 was published by the Topographic Service at Batavia in *Jaarverslag van den Topografischen Dienst in Nederlandsch-Indië over* 1933.

The following observed values of the variation of latitude were taken directly from those given on p. 10 of the above cited report.

Group	Date	$[\Delta\phi_m]$	Date	$[\Delta\phi_m]$	Date	$[\Delta\phi_m]$
		"		"		"
IV	—		1932.08	+·321	1933.03	+·525
V	—		.15	+·309	.12	+·515
VI	—		.23	+·225	.21	+·488
VII	—		.31	+·097	.31	+·384
VIII	—		.39	+·065	.39	+·291
IX	—		.47	−·021	.48	+·312
X	—		.56	+·019	.55	+·325
XI	—		.65	+·106	.63	+·385
XII	—		.74	+·250	.72	+·484
I	1931.80	+·081	.81	+·378	.80	+·564
II	.89	+·133	.88	+·450	.87	+·701
III	.96	+·229	.96	+·539	.97	+·856

The above series was formed by the successive summation of the difference between two consecutive values of the same group obtained by its evening and morning observations. Therefore, as seen in the table, the constant part of z which may be due to the local diurnal variation of latitude is becoming larger and larger with the time. It is noteworthy that the sense of this variation is opposite to those of the same kind in the north international stations. This change of sign may, however, be easily explained by an appropriate choice of the phase angle of a diurnal form $-a_1 \cos(\odot - \alpha + A_1)$; assuming $a_1 = ''\cdot10$, as I have done usually, A_1 will be $-27°$.

In addition the Batavia report has given the interesting results of an investigation into the residuals of observations after subtracting the pure polar motion deduced from the provisional international results and also by the linear variation above quoted. The residuals were solved in two ways, firstly as only a function of the Chandler Period and secondly as that of an annual period, with better results for the assumption of an annual period than for the other. Thus the existence of the local annual term of z being affirmed, I have tried to find the amplitude and the phase of the second term of z, namely $+a_2 \sin(2\odot - \alpha + A_2)$, not from the residuals

given in the Batavian report but from the direct value of $\Delta\phi_m$ (see p. 10 of the report) corrected by the variation of latitude of the pure polar motion. Thus I have obtained $+''\cdot039 \sin(2\odot - \alpha - 16°)$.

Here it ought to be noted that the three observations in the year 1931 have been omitted in my calculation. As a matter of fact, the observations for the first three or four groups are in wide disagreement with any computed ones, while the whole remainder of the series agrees very closely with them. In my experience, however, such discrepancies might take place pretty often especially in the case of the start of new observations. They may probably be due to the unsettled state of the foundation and of the instrument, and moreover the observer himself is not familiarized with every thing regarding the observations even though he is skilful and experienced. According to the circumstances, such an unstable state may even continue for about half a year.

8. *R. Osservatorio di Milano (Italy).*

Latitude observations during the years 1929, 1930, 1931, 1932.

	Year							
	1929		1930		1931		1932	
Fraction of year	+45°41′	O–C	+45°41′	O–C	+45°41′	O–C	+45°41′	O–C
	″	″	″	″	″	″	″	″
·0	54·98	−·11	55·13	+·06	55·21	+·14	55·20	+·09
·1	54·89	−·19	54·95	−·08	55·12	+·10	55·07	+·06
·2	55·02	−·08	54·89	−·17	54·99	−·03	54·96	−·03
·3	55·16	−·01	55·05	−·06	54·93	−·14	54·88	−·16
·4	55·25	+·01	55·23	+·05	55·10	−·06		
·5	55·30	+·02	55·31	+·04	55·29	+·01		
·6	55·34	+·04	55·35	·00	55·38	+·01		
·7	55·34	+·06	55·36	+·04	55·40	+·04		
·8	55·30	+·11	55·34	+·08	55·38	+·09		
·9	55·23	+·11	55·29	+·11	55·31	+·11		

This result was kindly reported by Prof. Bianchi, the Director. This series of latitude observations was made at the observatory of Merate with the Bamberg transit instrument (55/570). The residuals subtracted by the computed ones based upon the international latitude service are local z which is given under the heading O–C in the above table.

In the report the director adds the following words:

"The residuals are in good agreement with the ones obtained in 1912–13 at Rome and 1912–17 at Greenwich. The causes that determine their systematic character seem to be rather complex. However, a comparison with the temperature variations makes it probable that the thermal gradient near the instrument is the main cause of the observed residuals. This is shown in the observations of α Aurigae, including those made in the day-time."

9. *Preliminary Results of Observations made with Pulkovo Zenith Telescope during the Four Years* 1929–32.

The following values of the variation of latitude and z at Pulkovo were taken

directly from those given in Tables 3 and 4 on p. 6, *Poulkovo Observatory Circular*, No. 12.

$$\phi = +59^\circ\ 46'\ 17''{\cdot}00$$

Fraction of year	Year 1929	1930	1931	1932
	"	"	"	"
·0	−·08	−·11	−·08	·00
·1	−·05	−·16	−·18	−·09
·2	·00	−·11	−·21	−·18
·3	·00	−·09	−·18	−·18
·4	·00	−·09	−·14	−·15
·5	+·02	−·03	−·07	−·10
·6	+·05	+·06	+·02	−·02
·7	+·10	+·14	+·12	+·03
·8	+·07	+·13	+·14	+·08
·9	−·01	+·02	+·07	(+·11)

z_p

	1929	1930	1931	1932	Mean
	"	"	"	"	"
·0	+·02	−·03	+·01	+·02	+·005
·1	+·06	·00	−·02	+·05	+·022
·2	+·11	+·05	−·03	+·02	+·038
·3	+·07	+·05	−·01	+·01	+·030
·4	+·02	−·02	−·04	·00	−·010
·5	−·03	−·04	−·07	·00	−·035
·6	−·05	−·04	−·08	·00	−·042
·7	·00	+·02	−·01	−·03	−·005
·8	+·03	+·05	+·04	+·01	+·032
·9	+·01	·00	+·03	(+·03)	+·018

The star programme consists of twelve groups, each of them covering about 2 hours in Right Ascension and containing from seven to ten pairs. The observing programme is similar to that of the International Latitude Service in summer; but in winter the time of observations has been shifted toward the evening, because sometimes more than two groups were observed simultaneously when the weather conditions allowed. It is noteworthy that the general run of the mean z is very similar to those in most stations in the northern hemisphere.

10. *Variation of Latitude at Dehra Dun (India).*

$$\phi = +30^\circ\ 19',\ \lambda = -78^\circ\ 3'$$

This series of observations was made by the Geodetic Branch, Survey of India, in the years 1930–33. The work has now been discontinued. The star programme consists of six groups, each of which extends over about 2 hours of R.A., the intervals between two consecutive groups lying from 1^h to 3^h. The detailed reports were given in the *Annual Geodetic Report*. The results given below for each tenth of a year were read from the smoothed curve on the plotted observed points drawn by the Geodetic Branch. The plate giving these observing points was

kindly sent to the Central Bureau by Colonel R. H. Philimore, Director, Geodetic Branch.

$$\phi = +30^\circ\ 18'\ 51''{\cdot}00$$

Fraction of year	Year 1930	1931	1932	1933
	"	"	"	"
·0	—	·71	1·06	1·11
·1	—	·56	1·00	1·06
·2	·46	·41	·86	·94
·3	·34	·26	·66	
·4	·30	·19	·50	
·5	·28	·19	·44	
·6	·30	·30	·55	
·7	·42	·53	·82	
·8	·74	·96	·00	
·9	·78	1·07	1·10	

Taking the mean latitude as 51″·69, and subtracting the variation of latitude computed by X and Y of the International Latitude Service from the above tabulated values we got the following local z:

Fraction of year	z_a 1930	1931	1932	1933	Mean
	"	"	"	"	"
·0	—	+·01	+·26	+·38	+·217
·1	—	−·07	+·27	+·32	+·173
·2	−·08	−·16	+·24	+·27	+·068
·3	−·18	−·26	+·12	—	−·107
·4	−·23	−·31	·00	—	−· 80
·5	−·31	−·34	−·06	—	−·237
·6	−·37	−·31	+·02	—	−·220
·7	−·33	−·18	+·23	—	−·093
·8	−·04	+·18	+·34	—	+·160
·9	+·01	+·26	+·40	—	+·223

It is interesting that the general run of z is very similar to that of Washington or Pulkovo given before. Only the peculiarity in this station is the largeness of the amplitude. This may be caused by, not only the abnormal variations of refraction, but also the real change of the plumb-line due to the special topographical condition to be expected under the Himalayan influence. Moreover, it is noted that an abrupt change of the mean latitude has happened in an epoch about 1931·8.

11. Besides the above-mentioned stations, there is still another one, namely the observatory at Rio de Janeiro, in which the observations of the variation of latitude have been carried out for many years.

B. Recommendations from Members of the Commission

(*a*) *From* Dr R. Schumann, *Bemerkungen über Berechnung und Beobachtung der Schwankungen von Stationspolhöhen nebst Vorschlägen*

I. Bekanntlich zeigen sich von Anfang an in dem Beobachtungsmaterial zur Breitenvariation, reduciert nach dem seit 40 Jahren bei der Internationalen Erdmessung üblichen Verfahren, ausser der 12- und der 14-monatigen Periodicität

noch andere "Fluktuationen." Die dafür verwendeten Ausdrücke: systematische Abweichungen, Missstimmigkeiten u.s.w. besagen zu wenig; nach meiner Meinung sind als äquivalente oder koordinierte Naturerscheinungen zu werten:

(1) die Schwankung der Stationspolhöhen, die üblicherweise in eine 12- und eine 14-monatige sinusartige Schwankung aufgelöst wird;

(2) die ständigen, stetigen Schwankungen in den Schlussfehlern;

(3) die ständigen, stetigen Ab-, seltener Anstiege in den Grössen $\Sigma\Delta\Phi$ nebst ihren übergelagerten, eigenen Schwankungen.

Die unter (2), namentlich aber *die unter* (3) *genannten Erscheinungen verdienen, ebenso ausführlich zur Kenntnis der Geophysiker und Astronomen gebracht zu werden, wie die unter* (1) *genannten*, und dies umsomehr, als sie sich in Strenge frei von den Deklinationsverbesserungen $\Delta\delta$ berechnen lassen. Es ist seit langem bekannt und aus den Bänden I bis VI der *Ergebnisse des Internationalen Breitendienstes* ersichtlich, welche Schwierigkeiten bei der Berechnung dieser an und für sich nebensächlichen Grössen $\Delta\delta$ von Anfang an entstanden sind.

II. Ein ständiges Ansteigen einer $\Sigma\Delta\Phi$ Kurve ergab sich bereits 1901 aus der Schnauder-Hecker'schen Polhöhenreihe in Potsdam für die Jahre 1894–1900, danach fortlaufend bei sämtlichen Stationen des internationalen Parallels*, aber auch die zehnjährige, im I. Vertikal beobachtete Hill'sche Reihe zeigte† einen ständigen Anstieg unter Schwankungen. Im Jahre 1931 fand Herr Ingenieur Gsöllpointner dieselbe Eigenschaft aus den Breitenbeobachtungen von Weltevreden‡; die Grössen $\Sigma\Delta\Phi$ werden von ihm mit $[\Delta\phi]$ bezeichnet.

Der wesentliche Vorzug jeder dieser Polhöhen-Aenderungen $\Delta\Phi$ (oder $[\Delta\phi]$ nach Gsöllpointner) liegt darin, dass sie, als Differenz zwischen den beiden Mitteln aus den beiden Abschnitten einer und derselben Gruppe, in Strenge frei ist von den $\Delta\delta$. Die Zwischenzeit zwischen den mittleren Epochen jener beiden Abschnitte ist durchschnittlich 4 Wochen; bei den Schlussfehlern dagegen wird Unabhängigkeit von den $\Delta\delta$ erst erreicht nach Summation von je 12 Unterschieden der Mittel zweier benachbarten Gruppen eines Tages.

In den *Astronomischen Nachrichten*, Nr. 5813, S. 67 u.f. setzt Herr Dr Lederstegер eine $\Delta\delta$-freie Methode zur Ableitung einer "Polbahn" auseinander, wobei eine bei dieser Summation unvermeidliche Anfangskonstante ausser Betracht bleiben darf. Das Lederstegersche Verfahren habe ich in Nr. 5960, S. 125 analytisch begründet und sodann die Lederstegersche Abstiegsfunktion J in Nr. 6022, S. 339 durch eine zweite Methode kontrolliert, siehe Figur. Diese Methode erlaubte nebenbei jene Anfangskonstante zu bestimmen, und führte zu einer Bestimmung der Polhöhenschwankung einer einzelnen Station, frei von den $\Delta\delta$. Die Vergleiche zwischen den 3 auf verschiedenen Wegen gefundenen Schwankungsreihen der Polhöhenstationen des internationalen Parallels findet man in Nr. 6023, S. 359–382, weitere numerische Untersuchungen darüber in Nr. 6027. Die Ableitung einer "Polbahn" habe ich unterlassen, da mir die dazu erforderliche Voraussetzung einer "Rotationsachse eines starren Erdkörpers" nicht gesichert zu sein scheint.

III. Als Ursache der Polhöhenschwankungen wird zwar allgemein eine kleine Bewegung einer Rotationsachse der Erde angenommen; es ist aber zweifelhaft, ob

* Ergänzungsheft Nr. 11 der *A.N.* Kiel, 1906. Eine numerische Untersuchung über die den zukommende Genauigkeit wird demnächst an anderer Stelle erscheinen.

† *A.N.* 229.

‡ *Jaarverslag von den Topografischen Dienst in Nederlandsch-Indië*, 1932, siehe auch *A.N.* Nr. 6023, S. 383, Zusatz.

für die in sich bewegliche Erde eine Rotationsachse besteht, und ob die Erde so starr ist, dass die Beobachtungen von Polhöhenschwankungen auf dem 39. Parallel um viele tausende von Kilometern, bis zu den Polen, übertragen werden dürfen. Nach meiner Ansicht bleiben diese Messungen an die jeweilige Beobachtungs-Station gebunden.

Sowohl die Ursache der Schlussfehler steht noch nicht fest, als wie jene für die Ab- oder Anstiege der $\Sigma\Delta\Phi$ $[\Delta\phi]$; jedenfalls aber ist bemerkenswert, dass diese bei den verschiedenen Erscheinungen in verschiedener Weise mit den Tagesepochen der Gruppenmittel zusammenhängen. Vielleicht genügt eine Ursache.

Deshalb ist es von grossen Wert, *dass die Beobachtungen zur Polhöhenschwankung über die Nacht ausgedehnt werden* und *in allen Jahreszeiten zu gleichen, aequidistanten Tageszeiten stattfinden.*

IV. Die in den Bänden I bis VI der "Ergebnisse..." wiedergegebene Reduktion der Beobachtungen auf dem 39. Parallel blieb bisher die gleiche im allgemeinen; allerdings wurden, wegen neuerlich hervortretender "Missstimmigkeiten in Bd. VI, S. 218 u.f. die Grössen Δ_N eingeführt": "Es wurden also keine Deklinationskorrektionen durch Mittelbilden über den ganzen Zeitraum abgeleitet, sondern es wurde von Fall zu Fall mit einer individuellen, mit der Zeit auch für die einzelnen Gruppen N veränderlichen Korrektion Δ_N gearbeitet."

Die Tabelle der Δ_N für 1912 bis 1922 (S. 219) lässt erkennen, dass sie sowohl mit den Jahreszeiten, als auch mit den Jahren veränderlich sind. Eine Folge dieser Abweichung vom früheren Verfahren ist eine Verzerrung* der Periodicität in den Schwankungen der Stationspolhöhen, beginnend mit dem Zeitpunkte der Einführung, hier 1912. Dies wird ersichtlich bei einem Vergleich zwischen den Schwankungskurven aus den internationalen Polhöhenmessungen mit denen nach den beiden oben unter II genannten $\Delta\delta$-freien Methoden. Den Verlauf ihrer Unterschiede zeigt beifolgende Figur; der Einfachheit wegen wurden die Epochen gleichabständig genommen, 1 mm. entspricht 1/12 Jahr.

Die bevorzugte Station Carloforte eignet sich am besten zu solchen Untersuchungen, da bei ihr infolge der grösseren Anzahl von Sternpaaren und Abenden der Einfluss der reinen Beobachtungs-Unsicherheit zurücktritt.

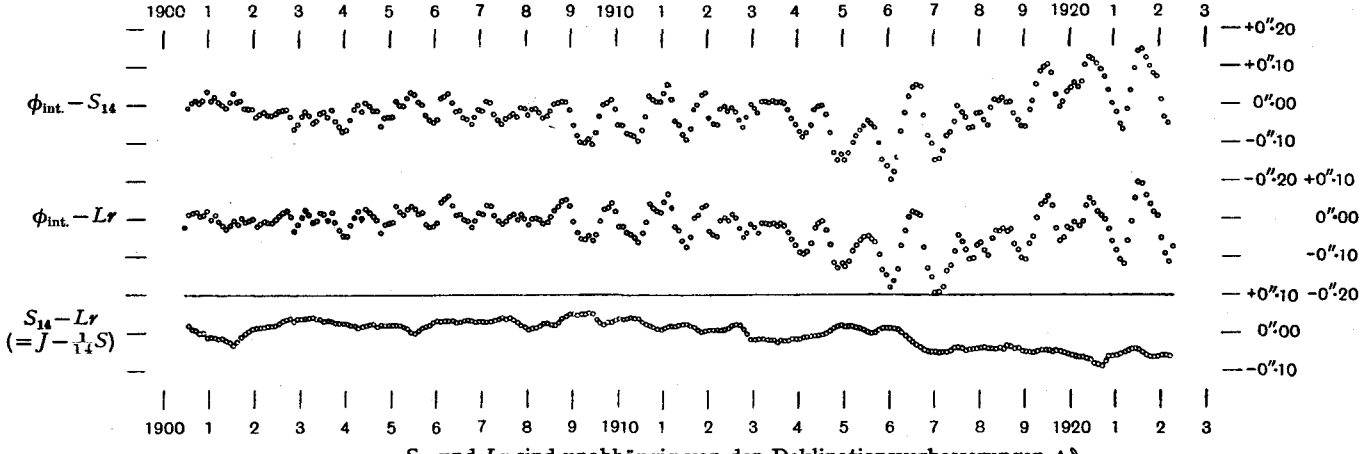
Die *unterste* Kurve zeigt den Verlauf der Differenzen der Polhöhenschwankungen zwischen den beiden $\Delta\delta$-freien Methoden und zwar im Sinne: zweite minus dritte Methode, mit der Bezeichnung nach *A.N.* Nr. 6022, S. 337 u.f. also:

$$S_{14} - Lr = (\Sigma\Delta\Phi - \tfrac{1}{14}S) - (\Sigma\Delta\Phi - J) = J - \tfrac{1}{14}S;$$

da beide Methoden auf den $\Delta\delta$-freien $\Sigma\Delta\Phi$ beruhen, gibt mithin die unterste Kurve zugleich die Unterschiede zwischen den beiden, ebenfalls $\Delta\delta$-freien, von einander unabhängig berechneten Abstiegsfunktionen J und $\frac{1}{14}S$; die hier nicht interessierenden, oben erwähnten Summations-Konstanten sind dabei berücksichtigt. Der ruhige Verlauf dieser Kurve rührt übrigens davon her, dass bei $\frac{1}{14}S$ die Gruppenmittel-Differenzen über 14 Monate, bei den J solche über 12 Monate successive summiert und gemittelt werden. Wesentlich ist, dass die Aenderungen im Deklinations-System zwischen 1900 und 1922 ohne Einfluss bleiben.

Die *oberste* Kurve stellt dar die Schwankungs-Differenzen im Sinne: erste minus zweite Methode, oder: $\phi_{\text{int}} - (\Sigma\Delta\Phi - \frac{1}{14}S)$, die *mittlere* Kurve: erste minus dritte Methode, oder: $\phi_{\text{int}} - (\Sigma\Delta\Phi - J)$; beide Kurven werden unmittelbar durch Aenderungen in der Behandlung der Deklinationen und ihrer Verbesserungen betroffen,

* Siehe *A.N.* Nr. 5961, Tab. 10, 11, Fig. 2, Tab. 13.



S_{14} und Lr sind unabhängig von den Deklinationsverbesserungen $\Delta\delta$.

Verlauf der Differenzen zwischen drei verschiedenen Darstellungen der Polhöhenschwankung in Carloforte.

deren Bestimmung bekanntlich von Anfang an in das übliche Reductions-Verfahren mit eingeschlossen worden ist.

Aenderungen im Deklinations-System fallen bekanntlich wenig ins Gewicht, wenn man es vorzieht, aus Messungen auf dem 39. Parallel eine Bahn für den fast 6000 km. entfernten Nordpol zu berechnen. Im Interesse der Schwankungen der auf dem 39. Parallel unmittelbar beobachteten Stations-Polhöhen dagegen entsteht der Wunsch: *die Beobachtungen möchten von* 1900 *an wenigstens nach gleichen Verfahren bezüglich der Deklinationen durchgerechnet werden.*

V. Im Laufe der letzten Jahre wurde von verschiedenen Seiten auf Veränderlichkeiten in geographischen Längen bei Gelegenheit schärfster neuerer Zeitvergleiche hingewiesen; die Beträge der Aenderungen sind von der gleichen Grössenordnung, wie die der in nordsüdlichen Richtungen erfolgenden Polhöhenschwankungen. Wichtiger als ein selbstständiges Stations-Netz für die Ostwest-Komponenten allein erscheint es, *die internationalen Stationen für Polhöhenschwankung zugleich in Länge fortlaufend auf das schärfste zu vergleichen.* Dann würde wenigstens für diese Stationen die Beweglichkeit in den beiden Hauptrichtungen erkannt werden; jedenfalls war der Vorschlag sehr zu begrüssen, diese Stationen auch mit Instrumenten für seismische Beobachtungen auszustatten.

Wenn die Konstanz der Rotationsdauer der Erde geprüft werden soll, so ist es wichtig, die Beweglichkeit oder Unbeweglichkeit der dazu ausersehenen Beobachtungsstationen zu verfolgen.

Wien, 1934 *Oktober*

(*b*) *From* Dr H. S. JONES, *Astronomer Royal*

Latitude Variation observations at Greenwich with the Cookson Floating Telescope have continued regularly on the same lines as previously. I propose to bring this programme to a termination about the end of 1935, after 25 years' observations. The telescope will then be rehoused, on a site about 300 yards from the present site and adjacent to the new transit circle.

There is a marked dependance of the latitude variation observed at Greenwich upon the wind direction. In its new position, the telescope will not be so near the brow of a steep hill and the ground will fall away to the north more gradually. It will be of interest to find out whether the z-term is appreciably changed by the change in location of the instrument.

At the same time, the present programme, designed to determine the aberration constant as well as the variation of latitude, will be modified.

The new programme will be more similar to the present International programme; three groups of stars, centred near midnight, will be observed nightly. A full discussion of the results of the present programme will be made in due course.

(*c*) *From* Prof. E. ESCLANGON, *Director of the Paris Observatory*

1. Il est important d'avoir les résultats détaillés du Service International des Latitudes depuis 1922, le plus tôt possible, ainsi que les coordonnées du pôle instantané dès le début du Service International des Latitudes réduites au même pôle moyen.

2. Il est important que les coordonnées provisoires du pôle soient déterminées en tenant compte non seulement des stations du nord, mais aussi de celles du sud.

3. Il est désirable d'avoir la troisième station dans l'hémisphère sud (en Afrique du Sud), en plus d'Adélaide et de La Plata. Mesures pour que les stations existantes travaillent régulièrement.

(*d*) *From* Dr H. KIMURA

To obtain z in any isolated station, the value of one division of the micrometer is of the first importance. Nevertheless, its accurate determination is the most difficult one. As is well known, there are two methods for its determination, namely, one by the observations of the greatest elongations of circumpolar stars and the other by the measurements of the declination-differences of two stars having nearly the same right ascensions. Of these two methods the latter one only may be used universally in any place in the world, and the necessary and important thing for this method is the exactness of the angular value of the declination-difference. It is, however, generally exceedingly uncertain except for some which were specially determined for the purpose. But those special scale-stars are mostly of high northern declinations, so they can hardly be used in southern stations.

The present distribution of the international latitude stations over the world is within the limit of latitude $+39°$ to $-35°$, and the best manner of finding relative values of the micrometers for all these stations is to observe the same scale-stars at these places. Moreover, such stars must be chosen in the equatorial zones. Now as the constants referred to the micrometers at all stations in the north parallel may be well determined, the angular value of the declination-difference for any scale-stars will also be well found from the observations made on them. Thence the values of one division of the micrometer for other stations on the equator and in the southern hemisphere may be determined. And at the same time, such universal co-operation might be of some service for the examination of the results of the greatest elongations in both hemispheres.

On my request, Mr Goto, observer in Midusawa Observatory, has chosen plenty of such scale-stars after having examined for double and variable stars. Their catalogue is annexed to this report.

I hope all observers who are engaged on the latitude observations in the international stations will agree on this plan and will put it into practice.

(*e*) *From* Dr W. BOWIE, *Head of the Geodetic Section of the Coast and Geodetic Survey, U.S.A.*

Of general recommendations in compliance with your request of September 22, 1934, I have only one and it is a suggestion rather than a recommendation. You need not be told of the current tendency to have photographic observations replace visual ones. This is likely to affect the programme of the International Latitude Service and I suggest that the Committee consider the subject of photographic observations.

One of the primary reasons for the organization of the International Latitude Service was homogeneity and uniformity, not only of stars used but also in instruments, observatories and methods. Under financial conditions even less unfavourable than those of the present it would probably be impracticable to procure an

adequate supply of photographic instruments of the same type and to place them in operation simultaneously at all observatories. This would mean that any change from visual to photographic methods would have to be made gradually, the photographic observations being first added to the programme, perhaps one observatory at a time until all observatories were equipped with photographic apparatus and it would be possible to abandon visual work entirely, if that seemed desirable.

The Talcott visual method of observation has remained unchanged in substance through many decades, but there is no guarantee that the approved type of photographic observation will be equally stable. The gradual installation of photographic equipment with a view to the final displacement of visual observations might involve a choice between:

(*a*) a possibly outmoded type of photographic apparatus at all observatories of the International Latitude Service;

(*b*) a lack of homogeneity in the photographic apparatus used.

I have no suggestions as to the type of photographic apparatus to recommend at this time and merely lay the whole problem before the members of the Committee, to whom doubtless similar ideas have occurred.

(*f*) *On the Instrumental Adjustment of a Zenith Telescope.* *By* EARL L. WILLIAMS

In the instruments used in the International Variation of Latitude Observatories the telescope is fixed at the end of a long horizontal axis supported at two points near its centre. This form of mounting, with the heavy telescope on one end and a counterweight on the other, gives rise to bending of the axis, with an attendant extra instrumental constant known as "side flexure."

Without offsetting adjustments, which adjustments are the subject of this paper, the effect of this flexure will be to make the middle thread of the telescope fail to coincide with the meridian at the zenith, but it will do so at the horizon. The customary method* of offsetting this effect has been to adjust the collimation to the negative of the flexure, thus bringing the middle thread to the meridian at the zenith, *but causing an increasing departure from the meridian as zenith distance increases*. This arises from the fact that the coefficients of flexure and collimation are numerically alike in the zenith but nowhere else. Since great accuracy in this particular is not required for the variation of latitude programme, where all the stars used transit within 25° of the zenith, this lack of conformity to the meridian at all zenith distances is not important, but there is an appreciable error when the telescope is close to the horizon as when sighting on the meridian mark. The error in the meridian mark resulting may be of importance, as when it is being used as an azimuth mark, as has recently been the case at Gaithersburg.

Proposed below is a more perfect method of offsetting the effect of flexure, which avoids completely any disadvantages of the method just reviewed, since in this the middle thread can be made to follow the meridian perfectly at all zenith distances.

In addition, it is possible to save considerable time in keeping the instrument in sufficiently good adjustment since *computation of instrumental constants is unnecessary*.

In the method instituted at Gaithersburg, instead of having the horizontal axis level and at right angles with the vertical axis, *the horizontal axis is raised at the*

* Method discussed by Ross, *Astr. Nach.*, 4538, Nov. 1911.

telescope end by an amount equal to the flexure, the vertical axis remaining undisturbed. Because the coefficient of the inclination (of the horizontal axis) is identically the same coefficient as that for flexure, perfect coincidence with the meridian is obtained at *all* zenith-distances, the meridian mark included. Other constants, such as collimation, are now made zero.

C. Activities of the Central Bureau at Mizusawa

The present work in the Central Bureau is just the same as reported in *Transactions of the I.A.U.* **4**, 114, 1932, except for the last one (6).

The evaluations of each individual value of latitude observed at the three old stations, namely, Midusawa, Carloforte and Ukiah during about 8 years 1922.7–1931.0, and the definitive values of the co-ordinates of the polar curve and local z for each station; in addition, the determination of the errors for the adopted values of the declinations and the proper motions of all pairs from the latitude observations themselves were entirely finished, and their results are now in the press.

D. Report on the Financial Position

During the past three years, the Central Bureau of the International Latitude Service at Mizusawa has received the following grants from the International Astronomical Union and the Geodetic Section of the International Geodetic and Geophysical Union:

From I.A.U.		From Geodetic Section		From Reduced Geodetic Association	
Swiss francs	For the year	Francs	For the year	Pounds £ s. d.	In the year
2,500	1933	7,000	1932	34 17 3	1933
2,500	1934	7,000	1933		
2,500	1935	7,000	1934		
Total 7,500		7,000	1935		
		28,000			

H. Kimura
President of the Commission

March 8, 1935

ERRATA

The two following errata in the recently published "Results of the International Latitude Service from 1922·7 to 1931·0" are to be noted:

Page 20, l. 2 and l. 4, *for* "division" *read* "revolution".

CATALOGUE OF SCALE-PAIRS WHOSE DECLINATIONS ARE VERY NEAR TO ZERO.

The star-places, precession and secular variation were taken directly from the Albany Catalogue. The proper motions were taken from the Catalogues of Boss and Yale. Under the heading "remarks" the magnitude and distance of the double star are given; these are taken from the Catalogue of Aitken.

https://doi.org/10.1017/S0251107X00017223 Published online by Cambridge University Press

Albany Number	BD or Cordova Number	Mag.	R.A. 1910	Prec.	Sec. Var.	μ	Decl. 1910	Prec.	Sec. Var.	μ'	Epoch	Remarks
			h m s	s	s	s	° ′ ″	″	″	″		m ″
16	*4752*	6·9	0 0 45·664	+3·0728	+·0035	—	+3 6 18·44	+20·046	−·010	—	13·9	—
220	*32*	7·1	0 13 30·919	+3·0771	+·0043	—	+3 17 48·61	+20·011	−·035	—	11·8	—
53	*3*	6·3	0 3 35·584	+3·0714	+·0005	+·0003	−2 56 55·07	+20·043	−·016	−·005	14·3	—
301	*49*	6·3	0 19 53·727	+3·0670	+·0016	−·0030	−2 43 0·53	+19·970	−·047	−·037	13·6	—
167	20	7·0	0 10 19·831	+3·0688	+·0006	—	−3 31 37·61	+20·026	−·029	—	12·3	—
363	57	7·0	0 25 2·636	+3·0640	+·0015	—	−3 20 13·05	+19·926	−·057	—	12·1	—
211	*28*	6·4	0 13 10·313	+3·0741	+·0032	+·0049	+1 11 18·27	+20·013	−·034	+·009	14·8	—
314	57	6·0	0 20 47·301	+3·0756	+·0038	−·0013	+1 26 29·31	+19·964	−·049	−·016	13·8	—
244	*36*	7·0	0 15 14·744	+3·0679	+·0012	—	−2 58 45·70	+20·002	−·038	—	13·8	—
301	*49*	6·3	0 19 53·727	+3·0670	+·0016	−·0030	−2 43 0·53	+19·970	−·047	−·037	13·6	—
459	*68*	5·9	0 30 55·578	+3·0694	+·0031	+·0086	−0 59 59·79	+19·864	−·069	−·061	12·1	—
655	*104*	6·8	0 45 18·370	+3·0692	+·0040	—	−0 42 51·34	+19·656	−·096	—	10·8	—
488	80	6·6	0 32 52·404	+3·0813	+·0050	+·0069	+2 38 29·82	+19·840	−·073	−·063	12·2	—
678	118	6·5	0 46 40·148	+3·0862	+·0059	+·0007	+2 53 49·60	+19·632	−·099	−·086	12·8	—
494	*75*	6·9	0 33 28·408	+3·0691	+·0032	−·0036	−0 59 54·14	+19·833	−·074	−·006	12·1	11·5 30
655	*104*	6·8	0 45 18·370	+3·0692	+·0040	—	−0 42 51·34	+19·656	−·096	—	10·8	—
526	*101*	6·1	0 36 7·463	+3·0547	+·0014	−·0014	−4 50 44·46	+19·798	−·078	−·010	13·3	—
590	120	6·4	0 40 49·214	+3·0513	+·0015	+·0020	−5 7 19·78	+19·729	−·087	+·031	13·6	—
923	212	6·7	1 3 21·181	+3·0822	+·0060	+·0089	+1 31 21·68	+19·285	−·131	−·425	13·4	—
1128	*223*	6·5	1 17 58·859	+3·0823	+·0066	+·0034	+1 15 24·14	+18·897	−·158	−·047	12·9	—
975	*161*	6·2	1 7 8·798	+3·0541	+·0041	−·0038	−2 43 43·90	+19·192	−·137	−·026	13·6	—
1044	*172*	5·5	1 12 2·049	+3·0511	+·0042	−·0074	−2 58 26·02	+19·064	−·146	−·061	14·8	—
1050	*174*	6·8	1 12 22·618	+3·0526	+·0044	+·0178	−2 45 1·83	+19·054	−·146	−·129	14·3	—
1209	221	6·9	1 23 26·202	+3·0517	+·0050	—	−2 30 3·66	+18·732	−·166	—	8·3	—

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			h m s	s	s	s	° ′ ″	″	″	″		m ″
1343	*249*	6·8	1 33 18·394	+3·0365	+·0048	—	−3 53 54·80	+18·408	−·183	—	10·4	—
1432	260	5·3	1 38 10·420	+3·0323	+·0049	+·0012	−4 8 35·84	+18·235	−·191	−·022	14·8	—
1655	311	5·8	1 55 28·217	+3·1026	+·0086	+·0155	+2 40 0·22	+17·555	−·226	−·244	13·3	—
1694	321	7·1	1 58 20·513	+3·1062	+·0088	—	+2 55 18·64	+17·432	−·231	—	12·2	—
1708	324	5·9	1 59 8·440	+3·0199	+·0055	—	−4 32 3·94	+17·398	−·226	—	13·9	—
1924	*438*	6·6	2 15 9·387	+3·0106	+·0059	+·0053	−4 45 33·38	+16·660	−·251	+·02	13·4	—
1898	410	5·8	2 13 20·930	+3·0896	+·0084	+·0245	+1 19 59·29	+16·747	−·255	+·377	14·8	—
2029	431	6·5	2 23 21·146	+3·0938	+·0087	−·0013	+1 33 28·55	+16·251	−·271	−·02	14·9	—
2128	*426*	6·8	2 30 49·102	+3·0162	+·0066	−·0101	−3 56 36·75	+15·860	−·276	−·426	14·4	—
2157	*437*	5·8	2 33 9·688	+3·0177	+·0067	+·0029	−3 47 7·22	+15·733	−·279	−·042	13·1	—
2817	552	6·5	3 24 22·084	+3·1259	+·0092	—	+2 56 16·32	+12·590	−·360	—	12·5	—
2967	581	5·8	3 35 9·746	+3·1246	+·0089	−·0023	+2 45 53·62	+11·842	−·372	+·006	15·0	—
2861	560	6·6	3 26 28·490	+3·0581	+·0079	—	−0 47 16·20	+12·446	−·355	—	14·5	—
3044	593	5·8	3 40 20·300	+3·0614	+·0078	+·0036	−0 34 44·88	+11·474	−·371	−·001	14·9	—
3286	640	7·0	3 58 37·042	+3·1295	+·0083	—	+2 49 43·27	+10·128	−·398	—	13·9	—
3376	*655*	6·5	4 5 0·755	+3·1357	+·0081	—	+3 5 15·68	+ 9·641	−·405	—	13·3	—
3443	600	6·3	4 9 3·876	+3·0441	+·0069	+·0020	−1 22 41·78	+ 9·329	−·397	−·02	16·4	—
3538	619	6·7	4 15 55·075	+3·0404	+·0066	—	−1 31 50·90	+ 8·794	−·402	—	15·0	—
3913	773	6·7	4 43 45·754	+3·1289	+·0063	—	+2 33 16·70	+ 6·546	−·434	—	12·8	—
3979	800	5·7	4 48 41·078	+3·1250	+·0060	+·0019	+2 21 36·38	+ 6·137	−·436	−·020	14·9	—
4262	1165	5·9	5 6 47·317	+3·0134	+·0045	—	−2 36 4·00	+ 4·613	−·429	—	14·9	—
4513	1250	6·6	5 22 27·520	+3·0164	+·0038	—	−2 26 14·40	+ 3·269	−·435	—	13·1	—
4402	924	6·7	5 16 1·815	+3·1287	+·0045	—	+2 27 14·11	+ 3·822	−·449	—	16·1	—
4471	947	6·3	5 19 54·718	+3·1247	+·0043	·0000	+2 16 15·56	+ 3·488	−·450	·00	17·0	—

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4422	929	5·6	5 16 56·188	+3·0609	+·0042	−·0007	−0 30 18·72	+ 3·744	−·440	+·003	14·0{	13·0 32 12·0 36
4455	936	5·6	5 19 6·131	+3·0669	+·0041	−·0010	−0 14 37·44	+ 3·558	−·441	−·001	15·9	—
4429	1075	7·0	5 17 27·910	+3·0025	+·0040	—	−3 3 5·26	+ 3·699	−·432	—	13·0	—
4691	1146	6·3	5 31 6·145	+2·9958	+·0033	—	−3 18 39·10	+ 2·521	−·434	—	14·0	—
4455	936	5·6	5 19 6·131	+3·0669	+·0041	−·0010	−0 14 37·44	+ 3·558	−·441	−·001	15·9	—
4538	960	6·6	5 23 49·170	+3·0713	+·0039	—	−0 3 10·96	+ 3·151	−·443	—	16·5	—
4524	1021	6·4	5 23 22·297	+3·1007	+·0040	+·0013	+1 13 24·87	+ 3·190	−·448	+·07	11·7	—
4825	1105	5·2	5 37 49·302	+3·1058	+·0032	−·0035	+1 25 54·39	+ 1·937	−·451	−·018	15·0	—
4563	1116	6·1	5 24 54·440	+2·9913	+·0036	—	−3 31 3·47	+ 3·057	−·432	—	16·0	—
4603	1126	6·8	5 27 13·821	+2·9966	+·0035	—	−3 16 58·26	+ 2·856	−·434	—	15·0	—
4603	1126	6·8	5 27 13·821	+2·9966	+·0035	—	−3 16 58·26	+ 2·856	−·434	—	15·0	—
4641	1136	7·0	5 29 8·437	+2·9909	+·0034	—	−3 31 31·30	+ 2·691	−·433	—	11·3	—
4890	1126	6·1	5 41 56·400	+3·0990	+·0029	−·0056	+1 8 14·30	+ 1·578	−·451	−·145	13·1	—
5017	1208	6·2	5 50 5·422	+3·0947	+·0024	+·0007	+0 57 7·66	+ 0·866	−·451	+·04	16·4	—
4955	1148	6·3	5 45 49·185	+3·1191	+·0027	·0000	+1 59 56·21	+ 1·240	−·454	·00	15·8	—
5087	1171	6·1	5 53 43·950	+3·1152	+·0022	+·0003	+1 49 43·28	+ 0·548	−·454	−·012	16·6	9·7 36
5123	1256	4·7	5 55 33·131	+3·0007	+·0021	+·0011	−3 4 37·70	+ 0·389	−·437	−·082	15·0	—
5239	1297	6·8	6 2 26·704	+2·9947	+·0018	—	−3 19 51·07	− 0·214	−·436	—	14·6	—
5394	1234	5·7	6 10 59·540	+3·0614	+·0013	−·0110	−0 28 40·16	− 0·961	−·445	−·204	15·1	—
5636	1299	5·8	6 22 39·505	+3·0674	+·0006	+·0004	−0 13 17·00	− 1·979	−·444	−·010	17·0	—
5422	1278	6·4	6 11 42·190	+3·0984	+·0012	+·0027	+1 6 39·94	− 1·023	−·451	+·01	13·5	—
5601	1414	6·8	6 21 13·118	+3·0926	+·0006	—	+0 51 51·53	− 1·853	−·448	—	11·4	—

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			h m s	s	s	s	° ′ ″	s	″	″		m ″
5446	1445	6·8	6 13 25·882	+2·9711	+·0013	—	−4 20 51·05	− 1·174	−·432	—	12·5	—
5617	1510	6·1	6 22 7·422	+2·9668	+·0009	—	−4 32 38·26	− 1·932	−·430	—	11·1	—
5546	1413	6·6	6 18 31·696	+2·9973	+·0010	—	−3 13 53·58	− 1·619	−·435	—	14·7	—
5599	1601	6·7	6 21 4·441	+3·0042	+·0008	—	−2 56 25·24	− 1·841	−·435	—	12·8	—
5635	1237	5·8	6 22 37·946	+3·1413	+·0004	−·0030	+2 57 45·15	− 1·976	−·455	−·010	15·1	—
5821	1315	6·4	6 32 58·238	+3·1368	−·0002	−·0040	+2 46 56·64	− 2·874	−·451	−·06	11·1	—
5656	*1244*	6·3	6 23 36·170	+3·1182	+·0004	−·0013	+1 58 10·69	− 2·061	−·451	+·01	12·6	—
5834	1443	6·1	6 33 58·144	+3·1116	−·0002	·0000	+1 41 34·01	− 2·960	−·447	·00	15·2	—
5761	*1303*	6·8	6 29 25·748	+3·1412	·0000	—	+2 58 1·07	− 2·567	−·453	—	13·1	—
5821	1315	6·4	6 32 58·238	+3·1368	−·0002	−·0040	+2 46 56·64	− 2·874	−·451	−·06	11·1	—
6056	*1487*	5·3	6 49 50·177	+3·0494	−·0008	+·0006	−1 0 49·26	− 4·325	−·432	−·008	16·2	—
6185	1509	6·2	6 57 18·830	+3·0450	−·0011	+·0027	−1 12 57·68	− 4·961	−·428	−·03	13·6	—
6361	1646	6·7	7 8 42·143	+3·0701	−·0018	—	−0 6 23·88	− 5·920	−·425	—	12·9	—
6580	1721	6·9	7 21 58·414	+3·0662	−·0023	—	−0 17 20·58	− 7·018	−·416	—	13·1	—
6648	1685	7·0	7 25 47·902	+3·1258	−·0031	—	+2 27 1·06	− 7·330	−·421	—	11·2	—
6853	1761	6·3	7 39 26·289	+3·1280	−·0037	·0000	+2 37 15·70	− 8·427	−·410	·00	13·6	—
6700	1719	5·8	7 29 32·592	+3·1496	−·0035	−·0006	+3 34 2·86	− 7·634	−·421	−·013	15·0	—
6817	1758	5·9	7 36 51·448	+3·1542	−·0039	·0000	+3 50 7·87	− 8·222	−·416	·00	14·5	—
6901	1826	6·5	7 44 14·122	+3·1682	−·0044	−·0013	+4 33 30·32	− 8·806	−·411	−·02	13·1	—
7006	1860	6·3	7 51 38·810	+3·1701	−·0048	·0000	+4 43 30·00	− 9·384	−·404	·00	12·4	—
7241	1938	6·5	8 8 47·149	+3·0549	−·0037	—	−0 53 40·83	−10·681	−·372	—	12·6	—
7336	1966	6·3	8 15 37·525	+3·0604	−·0040	+·0020	−0 37 24·67	−11·182	−·365	−·09	13·7	—
7336	1966	6·3	8 15 37·525	+3·0604	−·0040	+·0020	−0 37 24·67	−11·182	−·365	−·09	13·7	—
7389	1987	6·8	8 19 57·904	+3·0562	−·0040	—	−0 51 8·88	−11·495	−·360	—	13·2	—

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7389	1987	6·8	8 19 57·904	+3·0562	−·0040	—	−0 51 8·88	−11·495	−·360	—	13·2	—
7468	2000	6·9	8 24 55·322	+3·0601	−·0041	—	−0 39 33·85	−11·848	−·355	—	12·8	—
7530	2074	5·6	8 29 28·476	+3·0383	−·0038	−·0022	−1 50 37·50	−12·167	−·347	+·021	15·1	—
7722	2130	5·2	8 42 41·297	+3·0448	−·0040	−·0031	−1 34 0·31	−13·064	−·331	−·006	13·9	—
7654	*2445*	7·0	8 38 7·189	+2·9989	−·0032	—	−4 5 12·54	−12·759	−·332	—	13·7	—
7756	2486	7·0	8 45 54·022	+3·0050	−·0033	—	−3 51 32·08	−13·276	−·322	—	13·7	11·2 26
7756	2486	7·0	8 45 54·022	+3·0050	−·0033	—	−3 51 32·08	−13·276	−·322	—	13·7	11·2 26
7922	*2535*	6·8	8 57 1·378	+3·0039	−·0032	—	−4 6 10·75	−13·989	−·308	—	15·7	—
8598	*2276*	6·6	9 55 2·983	+3·1187	−·0057	−·0050	+3 48 55·00	−17·140	−·228	+·011	12·9	—
8640	2311	6·4	9 59 28·700	+3·1152	−·0055	−·0052	+3 38 21·72	−17·338	−·221	−·100	14·0	—
8858	2332	6·6	10 18 51·976	+3·0681	−·0030	+·0031	−0 26 46·18	−18·126	−·183	−·045	16·2	—
8950	*2663*	5·0	10 25 41·437	+3·0709	−·0028	−·0031	−0 10 30·33	−18·372	−·171	−·028	13·3	—
8863	*3132*	6·7	10 18 59·136	+3·0408	−·0017	—	−3 11 15·20	−18·130	−·181	—	14·3	—
8996	2950	6·6	10 30 16·460	+3·0420	−·0011	—	−3 25 49·96	−18·529	−·161	—	13·7	—
9060	*2364*	6·4	10 36 49·440	+3·0620	−·0018	−·0094	−1 16 5·95	−18·740	−·150	−·129	14·4	—
9147	2446	6·2	10 44 5·185	+3·0613	−·0014	−·0013	−1 29 0·53	−18·956	−·137	+·03	14·2	—
9195	2710	6·6	10 47 59·490	+3·0745	−·0021	−·0027	+0 16 37·64	−19·065	−·130	−·02	14·6	—
9336	2729	6·2	10 59 0·176	+3·0755	−·0017	−·0044	+0 29 1·94	−19·340	−·110	·000	13·3	—
9204	2459	6·2	10 48 50·303	+3·0599	−·0010	−·0092	−1 46 27·90	−19·087	−·128	−·082	14·6	10·0 34
9311	*2471*	5·0	10 57 14·194	+3·0599	−·0005	+·0012	−1 59 59·52	−19·299	−·112	−·037	14·6	—
9208	2460	5·7	10 49 8·744	+3·0608	−·0011	−·0063	−1 39 1·91	−19·096	−·128	+·004	15·3	—
9393	2488	6·9	11 3 41·125	+3·0645	−·0006	—	−1 24 56·03	−19·444	−·100	—	11·5	—
9456	2761	5·4	11 9 9·092	+3·0747	−·0011	−·0025	+0 25 13·29	−19·555	−·090	−·011	15·9	—
9565	2782	6·3	1 18 41·421	+3·0751	−·0008	−·0027	+0 37 34·25	−19·721	−·072	·00	13·3	—
9520	2411	6·0	1 14 17·790	+3·0824	−·0018	−·0034	+2 8 38·60	−19·649	−·081	−·056	15·8	—
9575	*2418*	5·5	11 19 25·200	+3·0803	−·0014	−·0021	+1 54 7·52	−19·733	−·071	+·002	13·3	—

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9592	*2461*	6·7	11 21 1·850	+3·0875	−·0023	−·0009	+3 47 49·38	−19·757	−·068	−·054	15·3	—
9699	2521	5·8	11 29 45·545	+3·0835	−·0018	−·0123	+3 33 36·45	−19·872	−·051	−·111	13·6	—
10327	*3298*	6·0	12 23 14·409	+3·0823	+·0053	−·0054	−4 7 1·94	−19·943	+·054	−·009	14·3	—
10467	2929	6·9	12 34 5·583	+3·0860	+·0058	−·0034	−3 52 43·08	−19·825	+·075	−·013	14·1	—
10637	*3593*	6·2	12 48 34·490	+3·0876	+·0061	−·0175	−3 3 50·82	−19·598	+·103	−·013	14·6	—
10726	3384	5·9	12 55 1·241	+3·0910	+·0066	−·0019	−3 19 35·22	−19·471	+·115	−·004	15·1	11·2 21
10917	2674	6·5	13 11 48·216	+3·0791	+·0061	−·0007	−0 54 52·60	−19·070	+·146	+·01	14·4	—
11033	2686	6·0	13 21 34·679	+3·0784	+·0064	−·0081	−0 43 28·52	−18·789	+·164	+·007	14·0	—
11033	2686	6·0	13 21 34·679	+3·0784	+·0064	−·0081	−0 43 28·52	−18·789	+·164	+·007	14·0	—
11159	2710	7·0	13 31 38·691	+3·0768	+·0067	—	−0 28 11·61	−18·464	+·182	—	14·3	—
11409	2834	6·9	13 52 7·238	+3·0349	+·0057	• —	+3 25 36·51	−17·694	+·215	—	13·6	—
11551	2859	6·9	14 4 55·044	+3·0335	+·0062	—	+3 13 24·50	−17·141	+·236	—	13·0	—
11729	2920	6·3	14 18 39·132	+3·0504	+·0072	+·0134	+1 39 44·64	−16·488	+·260	−·485	13·7	—
11767	2927	7·0	14 21 20·903	+3·0536	+·0074	—	+1 23 57·35	−16·353	+·264	—	13·0	—
12191	2905	4·6	14 58 21·098	+3·0325	+·0075	−·0033	+2 26 39·50	−14·276	+·316	−·002	14·0	—
12238	2915	6·8	15 2 34·028	+3·0273	+·0074	—	+2 42 35·48	−14·015	+·322	—	12·4	—
13017	3168	6·8	16 5 6·552	+3·0509	+·0071	—	+1 3 24·22	− 9·634	+·394	—	10·5	—
13175	3215	4·8	16 17 30·748	+3·0464	+·0066	−·0111	+1 14 24·84	− 8·668	+·404	+·043	14·0	—
13416	3286	6·6	16 36 42·770	+3·0416	+·0059	—	+1 25 9·23	− 7·126	+·418	—	12·2	—
13464	3298	6·0	16 40 55·222	+3·0465	+·0058	+·0002	+1 11 5·24	− 6·780	+·421	·000	15·5	—
14331	3501	6·9	17 41 50·465	+3·0474	+·0029	—	+1 4 44·30	− 1·587	+·444	—	13·5	—
14423	3528	6·2	17 48 1·752	+3·0416	+·0025	−·0033	+1 19 35·53	− 1·046	+·443	−·01	12·2	—
14471	3427	6·7	17 51 5·191	+3·0238	+·0024	—	+2 5 21·76	− 0·780	+·441	—	12·8	—
14505	3436	6·7	17 53 19·074	+3·0197	+·0022	—	+2 15 47·67	− 0·584	+·440	—	13·5	—
14670	4237	6·9	18 2 12·130	+3·1483	+·0017	—	−3 14 42·32	+ 0·192	+·459	—	11·5	—
14815	4263	6·1	18 12 10·010	+3·1432	+·0011	+·0009	−3 1 56·85	+ 1·064	+·457	−·274	13·1	—

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14876	3680	4·9	18 16 22·450	+2·9948	+·0011	−·0010	+3 20 10·33	+ 1·431	+·435	−·003	13·6	11·6 28
15030	3737	6·3	18 27 37·756	+2·9892	+·0006	—	+3 35 40·17	+ 2·411	+·432	—	12·9	—
15193	4354	6·9	18 36 50·879	+3·1464	−·0005	—	−3 12 14·50	+ 3·209	+·451	—	13·9	—
15391	4392	6·0	18 46 38·583	+3·1508	−·0011	+·0001	−3 25 25·56	+ 4·052	+·448	−·037	14·1	—
15626	3765	7·0	18 59 3·770	+3·0181	−·0010	—	+2 24 47·90	+ 5·109	+·423	—	11·6	—
15831	3824	5·1	19 9 10·428	+3·0248	−·0015	−·0002	+2 8 24·31	+ 5·959	+·419	−·006	14·1	12·3 36
15831	3824	5·1	19 9 10·428	+3·0248	−·0015	−·0002	+2 8 24·31	+ 5·959	+·419	−·006	14·1	12·3 36
15912	3960	6·1	19 13 15·436	+3·0311	−·0017	·0000	+1 52 12·64	+ 6·299	+·417	−·04	14·7	—
15925	4166	6·7	19 13 55·146	+3·0668	−·0020	—	+0 15 31·68	+ 6·354	+·421	—	15·1	—
16149	*3760*	6·5	19 24 41·620	+3·0712	−·0025	+·0027	+0 3 38·08	+ 7·240	+·414	−·000	11·0	—
15965	4071	6·9	19 15 52·300	+2·9706	−·0014	—	+4 36 46·20	+ 6·516	+·407	—	14·6	—
16215	4152	6·8	19 28 40·728	+2·9678	−·0017	—	+4 50 8·95	+ 7·564	+·398	—	13·2	—
16888	4341	6·7	20 1 27·622	+2·9814	−·0026	—	+4 31 5·19	+10·133	+·371	—	12·6	—
17105	4395	6·6	20 11 37·401	+2·9880	−·0029	—	+4 18 20·76	+10·890	+·361	—	13·6	—
17292	4888	6·1	20 21 0·876	+3·1315	−·0052	−·0067	−3 5 34·12	+11·570	+·368	−·12	13·1	—
17491	*4961*	5·2	20 32 2·461	+3·1252	−·0054	+·0005	−2 51 43·56	+12·344	+·354	−·008	14·6	—
17579	*4220*	6·9	20 35 46·099	+3·0158	−·0035	—	+3 7 20·34	+12·600	+·337	—	13·2	10·3 17
17717	4430	6·6	20 43 53·405	+3·0140	−·0035	—	+3 19 0·12	+13·144	+·326	—	13·7	—
17674	4089	6·9	20 41 23·737	+3·0844	−·0048	—	−0 40 6·43	+12·978	+·337	—	11·7	—
17736	*4057*	6·5	20 44 39·637	+3·0883	−·0049	—	−0 53 47·33	+13·195	+·333	—	11·3	—
17836	4075	6·6	20 50 29·126	+3·1020	−·0052	·0000	−1 43 0·53	+13·574	+·327	−·03	10·8	—
17993	*5434*	6·8	20 58 50·147	+3·1046	−·0054	—	−1 56 8·47	+14·102	+·316	—	14·2	—
18076	4163	6·8	21 2 55·711	+3·0811	−·0048	—	−0 31 33·87	+14·355	+·307	—	14·6	10·3 24
18196	4186	6·6	21 10 0·084	+3·0769	−·0047	+·0020	−0 16 49·17	+14·780	+·297	−·06	14·3	—
18171	4319	7·0	21 8 12·334	+3·0364	−·0038	—	+2 16 22·91	+14·673	+·296	—	8·3	—
18366	4348	6·6	21 18 2·816	+3·0341	−·0036	—	+2 32 3·96	+15·246	+·281	—	10·7	—

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18319	*5524*	6·0	21 16 21·256	+3·1482	−·0066	−·0017	−4 56 32·64	+15·149	+·294	+·008	14·7	—
18561	*5584*	6·8	21 29 24·919	+3·1406	−·0065	—	−4 46 5·64	+15·872	+·273	—	14·0	13·0 18
18351	4714	6·8	21 17 15·106	+3·0576	−·0042	—	+0 58 43·51	+15·200	+·284	—	15·0	—
18437	4726	6·4	21 21 51·980	+3·0619	−·0042	+·0056	+0 43 3·96	+15·460	+·277	−·166	10·8	—
18360	5188	6·6	21 17 45·884	+3·1259	−·0060	—	−3 30 48·92	+15·230	+·290	—	9·8	—
18465	5217	6·9	21 23 40·923	+3·1208	−·0059	—	−3 16 37·87	+15·561	+·280	—	13·0	—
18853	4787	6·9	21 46 57·753	+3·0681	−·0040	—	+0 20 57·01	+16·762	+·238	—	12·3	—
18992	*4296*	5·8	21 56 28·766	+3·0705	−·0038	+·0001	+0 10 20·38	+17·204	+·222	−·006	13·7	—
19816	4939	6·0	22 50 23·241	+3·0684	−·0016	+·0014	+0 35 6·40	+19·128	+·126	+·007	15·1	—
19956	4963	6·4	23 0 41·335	+3·0676	−·0009	+·0013	+0 49 18·58	+19·378	+·106	+·01	15·3	—
20122	4982	6·8	23 11 2·886	+3·0685	−·0004	—	+0 49 6·78	+19·590	+·086	—	8·8	—
20302	4999	6·4	23 22 38·168	+3·0701	+·0001	+·0029	+0 37 41·16	+19·780	+·064	−·033	14·7	—
20201	5868	6·6	23 15 35·883	+3·0924	−·0029	—	−4 24 32·68	+19·671	+·078	—	8·3	—
20360	5896	6·5	23 26 52·635	+3·0879	−·0024	+·0114	−4 34 45·49	+19·837	+·056	−·179	13·3	—
20302	4999	6·4	23 22 38·168	+3·0701	+·0001	+·0029	+0 37 41·16	+19·780	+·064	−·033	14·7	—
20421	5018	6·6	23 30 52·486	+3·0701	+·0006	−·0031	+0 48 57·67	+19·884	+·048	−·022	15·8	—
20386	5655	7·0	23 28 17·820	+3·0838	−·0017	—	−3 30 47·65	+19·855	+·054	—	8·3	—
20576	5707	5·6	23 43 18·954	+3·0781	−·0008	+·0063	−3 15 42·91	+19·993	+·024	+·006	13·2	—
20421	5018	6·6	23 30 52·486	+3·0701	+·0006	−·0031	+0 48 57·67	+19·884	+·048	−·022	15·8	—
20598	5054	5·8	23 44 50·979	+3·0716	+·0013	−·0004	+0 34 35·31	+20·002	+·021	−·026	13·3	—
20576	5707	5·6	23 43 18·954	+3·0781	−·0008	+·0063	−3 15 42·91	+19·993	+·024	+·006	13·2	—
20768	5749	5·2	23 57 12·687	+3·0735	−·0001	+·0008	−3 31 41·88	+20·044	−·003	−·011	13·8	—
20773	5750	6·8	23 57 25·670	+3·0734	·0000	—	−3 16 1·82	+20·045	−·004	—	8·2	—
48	2	6·3	0 3 7·447	+3·0716	+·0004	+·0018	−3 2 58·90	+20·044	−·015	+·004	12·8	—