Simultaneous Observations of Latitude Variation with Special Arrangements for the Investigation of the Atmospheric Refraction Effects at Mizusawa.

By

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§ 1. Introduction.

In a memoir[1] „Über die Physikalische Bedeutung des z-Gliedes in der Polhöhenschwankung", Prof. S. Shinjô fully discussed the effects of anomalies in atmospheric refraction from a theoretical stand-point. He there found a possible sort of anomalies in the temperature distribution of the atmosphere in the close neighbourhood of a typical observation-room of the zenith-telescope: which condition should make a seasonal and a daily variations, and to which the origin of the complicated phenomena relating to the z-term, the aberration constant, and the " closing sum " in the reduction of the Talcott observations should be attributed. To prove this theory in the most efficient manner, the Talcott observations in a specially constructed room is necessary, which is so built that a perfect uniformity of the atmospheric condition about the slit in the meridional direction is kept throughout the day as well as through the whole year. And if these arrangements and observations be made in close proximity to an international latitude observatory, using

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[1] Mem. Col. Sc. & Eng., Kyoto, **4**, 2 (1912).

the same star-pairs and programme—moreover, with a similar instrument —the results must be most effective. Fortunately, these circumstances were wholly granted in 1914: a Wanschaff zenith-telescope, previously used for the latitude variation at Tokyo, was put at my disposal since the winter of 1913, with which I was allowed to go to the Mizusawa International Latitude Observatory, where an ideal hut was to be built for observation by friendly negotiations between Prof. Shinjo and Director H. Kimura. The programme was at first intended for one year, but the result led naturally to one more cycle immediately continuing the preceding one, so that actual work lasted for two years, from May 1914 to May 1916, during which Director Kimura and Dr. M. Hashimoto aided me constantly with invaluable suggestions and advice, bisides making check examinations all through my course, for which I offer them grateful thanks as for their never-failing patience and kindness. A considerable part of the actual observations was done by Dr. Hashimoto through his kind-hearted sympathy for my bodily fatigue caused by constant daily work; he also took charge of the most part of determining the micrometer inequalities of my instrument by observations and computations—for all of which my hearty thanks are due.

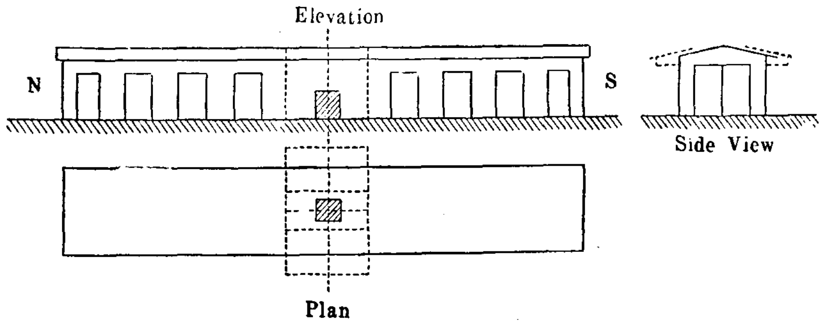
§ 2. Preparatory Observations in Kyoto.

The Wanschaff instrument was received in Kyoto on Christmas-day, 1913, and was immediately set up on a play-ground of the University to do some preparatory work there in examinations and observations. This course was continued till April, 1914, and a specially selected list of star-pairs were observed. The observing-room was so constructed, by Prof. Shinjô's plan that the main part of it could be removed to a distance by rail and the floor with the pillar and the instrument remained on the lawn, and that in this way open-air observations could be made at pleasure. On this ground the daily observations proceeded, one night in the room and the next night out of it, repeating these alternating sequences. It is, however, very much to be regretted that I had never sufficient experience in the use of this instrument before, and my daily manipulations had, naturally, to be done more or less by experiment and moreover the star-list was not well selected: these conditions led me to postpone their reductions indefinitely, at least until the instrumental constants and behaviors should be known. However, as said before, the above circumstances of the observations was of special kind, so that their final reduction will contribute something noteworthy to our original problem —the reductions are now in progress.

§ 3. Instrument.

The instrument here used is a zenith-telescope, made by Wanschaff of Berlin, No. 800, belonging to the Geodetic Committee of Japan, and was used for latitude-variation work at Tokyo Astronomical Observatory since 1895 by Drs. H. Kimura, K. Hirayama, K. Sotome, and others, up to 1913, when it was transferred to the present author. It had, therefore, already done good and long service, and naturally there were found several points which hardly stood a critical examination. The screw of the micrometer was exceedingly worn, and showed a considerable amount of progressive inequality as well as the periodic one. The striding level had been broken and a Talcott level for reserve substituted instead.

Fig. 1.



§ 4. Observing Room.

The observing room was planned mainly by Dr. Hashimoto, and built under his direction on the eastern part of the Observatory-yard, some 70 meters north-east of the international instrument. It was 20 meters long to the north-south direction, and 4 meters wide, with a general height of about 3 meters, so that the base-plan was a long rectangle. The slope of the upper roof was relatively very flat. The exact central square of the long room was occupied by the instrument, where a brick pillar stood for it ; the slit was opened over one meter wide above the telescope, the each halves of the roof being separately displaced to east and west sides by means of pulleys. The other parts of the building had many sliding doors in their outer sides : the extreme ends on both north and south sides had each two doors standing side by side, and the east and west sides (of the lengths of 20 meters) had each eight such doors—again equally divided into four each on both sides, north and south of the central square, which scuare, however, was excepted from supplying doors. These doors were shut for the day-time, and soon after sun-set they were all opened, so that the atmospheric conditions should be fully equalized all about the rooms. In winter, snow to a depth of more than half a meter collected on the roof, but was always thrown down and the surfaces smoothed.

§ 5. Programme of Observations.

The chief aim of our observations was to know the behavior of atmospheric circumstances affected differentially in latitudes of the international series and of my own ones of observations. Therefore the observing programme of the latter was necessarily made in quite the same manner as the former : the same star-pairs were observed at the same time, and the reductions were also made in the same mode. The orders of clamp-changes in east-west or west-east were parallel too, except during a few days at the beginning in which we were thoughtless to a degree.

§ 6. Instrumental Constants.

i) *Level Constants.*

Two Talcott levels were tested and their constants observed several times by Dr. Hashimoto and the writer before the commencement of the latitude observations with the following results :

	Level I	Level II
	R R	R R
Hashimoto	0·02275±0·00023	0·02301±0·00024
Yamamoto	0·02340±0·00025	0·02277±0·00026
Mean:	0·0231	0·0229

For the striding level, which was substituted from a reserved Talcott one as mentioned above, Dr. Hashimoto obtained the value from his investigation :

$$1^p = 0^s{\cdot}069$$

In December, 1915, the tube of the striding-level was found to be somewhat loosened, and consequently was examined and re-fixed. Then the constant of the division was re-determined by the writer with the result :

$$1^p = 0^s{\cdot}072$$

which was adopted after December 26, 1915.

ii) *Micrometer Constants.*

In the beginning a most probable value for the mean constant of the micrometer was adopted as

$$1^R = 51''{\cdot}640$$

and was used for preliminary computations. More definite and reasonable values, however, were obtained in the temperature adjustments of the final reductions, which is found on page

For the investigations of progressive and periodic inequalities of the micrometer, Dr. Hashimoto began a series of transit observations of polar stars in their greatest elongations, and obtained about 50 observations by June 1915, to which a few additions were contributed from the writer's own observations. Following are the final results :

Table I. Progressive Inequalities.

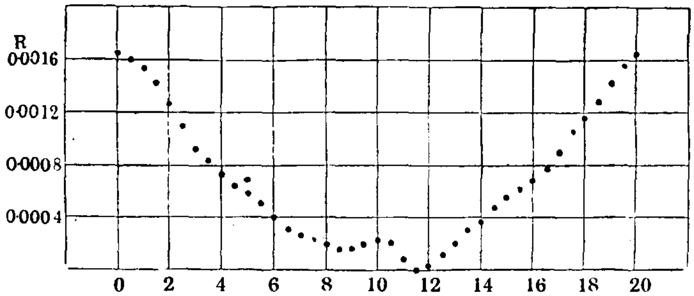
R	R	R	R	R	R	R	R	R	R
0·0	0·0164	4·5	0·0064	9.0	0·0016	13·5	0·0030	18·0	0·0116
0·5	160	5·0	68	9·5	20	14·0	38	18·5	128
1·0	153	5·5	49	10·0	23	14·5	48	19·0	143
1·5	142	6·0	40	10·5	20	15·0	56	19·5	156
2·0	126	6·5	30	11·0	8	15·5	63	20·0	165
2·5	109	7·0	26	11·5	0	16·0	69		
3·0	93	7·5	23	12·0	3	16·5	78		
3·5	82	8·0	19	12·5	11	17·0	90		
4·0	72	8·5	16	13·0	20	17·5	105		

Table II. Periodic Inequalities.

R	*R*	*R*	*R*
0·0	0·0001	0·5	0·0047
0·1	4	0·6	41
0·2	19	0·7	33
0·3	37	0·8	22
0·4	48	0·9	10

All are relative values, and throughout to be *added* to actual readings. The amounts are considerable, and surprising indeed. In Fig. 2, the progressive inequalities are plotted, which shows the general form of a parabola. This from is probably the consequence of long services of the preceding periods, except a peculiar second meximum near the vertex —what is the meaning of this ?

Fig. 2.



iii) *The Wire Intervals of the Transit Wires and the Corrections to the Meridian.*

Five wires are fixed parallel to the meridian in the visual field, the wire-intervals of each of which from the mean position are, for an equatorial star, as follows :

In the position of Telescope West :

1st. wire	$20^s \cdot 089$	earlier
2nd. ,, ...	9·730	,,
3rd. ,, ...	0·088	,,
4th. ,, ...	10·007	later
5th. ,, ...	19·895	,,

The micrometric bisections were made, four times for a star, in each middle space of the neighboring transit wires, said above,—the four positions are almost symmetrically placed about the center of view, the equatorial intervals of both outer and inner points being assumed as

outer points :	$14^{s}\!\cdot\!93$,
inner points :	$4\cdot98$.

These were applied to the general formula of the correction to the meridian, thus :

$$\frac{15^2}{2}\cdot\sin\,1''\cdot\tan\delta\cdot(F)^2\cdot\frac{1}{R}$$

where δ is the declination of the star, F the equatorial-interval of the observation points, and R the micrometer value$=51''\cdot64$.

iv) *Adjustments of Settings of the Zenith-telescope.*

The meridian transit observations for determining the constants of the setting of the instrument were made very often during our period of work, and the reductions were carried out to test the adjustments at that time. Moreover, the striding-level was read every night of observation to see the inclination of the horizontal axis. The results of the above are given in detail in the Table below. All the circumstances are within the limits which affect the observed latitudes in the hundredth parts of a second of arc, except a few cases of azimuth deviations. According to Albrecht, the limiting azimuth is about 50″ from the meridian, and we find in the table that this limit was nearly surpassed in the following determinations :

Azimuth-deviations.			*Preceding Observations.*		
1914 Sept. 18.	$A_W=12^s\cdot82$	$A_E=12^s\cdot4$	Aug. 18.	$A_W=0^s\cdot7$	$A_E=1^s\cdot0$
Oct. 11.	——	$=3\cdot9$	Oc. 2.	——	$=2\cdot1$
1915 May 25.	——	$=3\cdot7$ }	May 13.	——	$=2\cdot0$
29.	——	$=5\cdot4$ }			
June 20.	$=5\cdot0$	$=5\cdot5$	June 10.	$=0\cdot9$	$=1\cdot4$
1916 Apr. 18.	$=7\cdot7$	——	Apr. 11.	$=0\cdot6$	——

And moreover, the writer gave a small mechanical shock during the observation on June 9, 1914, by the handling of the telescope-change from west to east in the bisection of the star-pair No. 77 ; the amount of the azimuth change was found the next day to be about 3′ of arc by means of the horizontal circle—this was corrected just after the completion of the bisection of Pair No. 72 on June 11. Hence a series of observations from Pair No. 77 on June 9 to Pair No. 71 on June 11 was affected by this disturbance. Of the above, the results of September 18, 1914, became known to us two days later, on which the deviations were corrected to the meridian by the circle, and a new time-determination was made. The probable cause and the date of the disturbance are unknown, but at least a series of results from Pair No. 81 on both 18 and 19, September, is evidently affected by it. These two data are our only cases in which the azimuth deviations actually affected the observed latitudes, and these were then corrected by a formula:

$$d\varphi = -\frac{1}{2} \cdot k^2 \cdot \sin 1'' \cdot K \cos \varphi$$

In all other cases, the probable dates of disturbances are quite unknown, since we knew the facts only by the transit observations following them, and we can only limit them by the preceding dates of the transit observations. The observed values of latitudes are, therefore, not corrected. Fortuanately, the affected amounts would possibly never be greater than 0·02″. In order to make many times the transit observations of polar stars in their greatest eastern or western elongations for the investigations of the micrometer-inequality, the azimuth-clamps had very often to be removed. In each case, therefore, at first the horizontal circle was read just before the elongation, and this datum was made use of in the resetting to the meridian afterwards. But, as it became evident this was very inconvenient and inaccurate, often leading to errors and mistakes, Dr. Hashimoto set early in 1915 two collimaters side by side at about 40 meters south of the zenith-telescope, each in the meridians of Telescope-West and Telescope-East, which thenceforward served conveniently as the *Miré*.

§ 7. Changes in Programme and Arrangements.

i) *Changes in Observers.*

The observations are, so to speak, a private work of research in a sense. Hence the writer was to be the sole observer for the whole period, and of course expected no one to help him. But, happily he met Dr. Hashimoto on arriving at Mizusawa who kindly supported the writer in every point, and proposed to take a part in the actual observations as far as he himself found time besides the regular service of the International work. The writer received him very gratefully, and they came to an agreement that on about one night from a consecutive four the writer could take a rest, unless some particular circumstance prevented him.

Moreover, the valuable help of Director Kimura in the field work was accepted with many thanks, when all various circumstances prevented the co-workers from attending to their important duties.

These changes of observers in daily observations are given in detail in the Table III below.

ii) *Changes in Arrangements of the International Instrument.*

(1) *Cross-wires of the Micrometer renewed.* In the interval from December 12 to 14, 1914, all wire were renewed by Messrs. Kimura and Hashimoto, and applied to the field-work since December 15.

(2) *Door for entrance re-constructed.* Since the beginning of the international service, the door was in the north side of the observing room. This position was always problematical to them who found a disturbance and asymmetrical conditions in north-south distributions of the atmospheric states every time this door had to be opened and closed by individual receptions of stars. Therefore a plan for re-construction was adopted and carried out during October 25 to 28, 1915, with the result that a new door was constructed in the east side of the room and at the same time former one was abolished. Observations under this new arrangement began on October 29.

(3) *Up-right standing of the Telescope.* Again, since the beginning of the International Series, the room was so limited that the Zenith-telescope tube could not stand up-right when it was out of use, but was obliged to make an inclination—sometimes nearly horizontal. Here arose a problem, and Prof. K. Hirayama[1] attributed an error to the after-effect of this position in a sort of flexure. At least a remedy was planned, and finally a new dewcap was realised by Professor A. Tanakadate of the National Geodetic Association, which could be applied to the instrument making it stand up-right. This new position was taken since February 9, 1916.

iii) *Changes in the Research Instruments.*

(1) *Cross-wire renewed.* A set of somewhat thick wires were replaced by a new one of beautifully fine wires on June 6, 19.4.

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1 Astr. Nachr. **181**, Nr. 4332, pp. 183-190 (1909).

(2) *Striding-level re-arranged.* The level was, by a mistake, dropped on the floor in the readings of the axial inclination on December 27, 1915, by which the bubble tube received a shock, and was displaced a little from its former position of stability. This was repaired the next day, and a new constant of division was determined by the writer the same evening, with this result:

$$1^p = 0^s{\cdot}072$$

This value has been used since then.

§ 8. Weather Conditions.

In the beginning of the period, the weather was generally good, and the proportion of cloudiness was normal. But, along with the revival of the solar activity, more or less abnormal phases often appeared. The winter of 1914–1915 was a severe one, especially in January, 1915. The minimum temperature of the air during the night-work showed -16° C., which was the temperature on January 23, of that year. The snow began to fall as early as November 22, 1914, continued to cover the ground until the next May; its maximum depth reached about four feet on the free ground, which is said to be a rare occurrence. Clouds predominated, too, at the same time, and mercilessly attacked the observations, which are clearly shown in the summary tables of daily observations below.

The second summer of our period was, again, an happy one. Instead of the mild aerial temperatures, generally speaking, which were frankly very favourable to observers, the invincible clouds prevailed over the sky, and notwithstandiug the observers' daily attendance on the instruments, the results were very meagre as may be seen in the tables of July–August of that year. The second winter, 1915–1916, was contrary to the preceding one, a remarkably mild. The temperature did not fall below -7°C even on the severest day, and also the snow-fall scarcely accumulated as much as one foot of depth.

Generally speaking, the weather was never normal, which is to be regretted to some extent for this work, which is really an atmospheric investigation in astronomy.

§ 9. Observed Data.

Here the observed values of the latitudes of the two series, made by both the International and the Research Instruments, are given, besides, with their individual differences, all in parallel in the tabular form. The individual values are provisional in so far as the direct observations are corrected only in level, curvature, micrometric inequalities, and the differential refraction. The declinations of the stars are as given provisionally by the Central Bureau of Potsdam, sent annually to the International Station. The star-list contains many pairs which had since 1912 been newly selected, and therefore their places are very uncertain—these pairs are indicated with brackets in the following table. The mean constants of the micrometers are also provisionally taken as,

for International Instr.: $R = 39''{\cdot}775$,
,, Research Instr.: $= 51{\cdot}640$

The temperature-effects of these micrometers are not adjusted.

In the table, all the materials are arranged in the natural order of actual observations, arranged in columns of each star-group and each pair. For each day, indicated in the left, three rows of figures are placed, of which the first row gives the data of the Research Instrument, while the lowest one gives simply the subtracted values of the above materials corresponding to each pair. For convenience' sake, the figures :

$39° \; 8'$

are omitted in both of the directly-observed latitude series.

The capital letters standing to the right of each rows of the observed data signifies the observers, and that under the following conventions of abbreviations :

K . . . Director H. Kimura,
H . . . Dr. M. Hashimoto,
Y . . . I. Yamamoto, *the writer*.

Table III.

Date 1914	Pair: Group VIII. 57	58	59	60	61	62	(63)	64	Group IX. 65	(66)	67	68	69	70	71	72	
May 12	5.62	5.11	4.67	5.19	5.06[1]	4.96	5.49	4.60	4.67	4.48	4.93	5.28	5.18	5.29	4.52	5.50	Y
	3.24	3.37	3.49	3.35	3.47	3.41	3.46	3.14	3.42	3.03	3.24	3.22	3.56	3.40	3.12	3.44	H
	2.38	1.74	1.18	1.84	1.59	1.55	2.03	1.46	1.25	1.45	1.69	2.06	1.62	1.89	1.40	2.15	
17	5.07	5.46	5.04	5.03	5.23	5.61	—	—	—	—	—	—	—	—	—	—	Y
	3.69	3.60	3.40	3.58	3.41	3.45	3.28	—	—	—	—	—	—	—	—	—	K
	1.38	1.86	1.64	1.47	1.82	2.16	—	—	—	—	—	—	—	—	—	—	
18	4.90	5.00	4.79	5.10	5.04	4.94	4.99	5.00	4.91	4.62	5.40	4.65	5.14	4.61	4.87	4.75	Y
	3.70	3.26	3.46	3.23	3.38	3.30	3.30	3.45	3.14	3.19	3.83	3.48	3.54	3.29	2.93	3.58	H
	1.20	1.74	1.33	1.87	1.66	1.64	1.69	1.55	1.77	1.43	1.57	1.12	1.60	1.32	1.94	1.17	
21	5.05	5.23	5.22	4.67	4.78	4.49	4.92	5.06	4.87	4.91	5.57	5.12	—	5.25	4.96	5.04	Y
	3.25	3.35	3.54	3.05	2.28	3.37	3.39	2.99	3.12	3.28	3.74	3.49	3.27	3.36	3.38	3 28	K
	1.80	1.88	1.68	1.62	1.50	1.12	1.53	2.07	1.75	1.63	1.83	1.63	—	1.89	1.58	1.77	
22	5.11	4.83	4.69	4.63	4.62	4.86	4.93	4.84	4.31	4.86	4.63	4.72	5.29	4.87	4.83	4.72	Y
	3.42	3.35	3.76	3.43	3.27	3.36	3.32	3.30	3.38	3.30	3.25	3.69	3.67	3.38	3.21	3.53	K
	1.69	1.48	0.93	1.20	1.35	1.50	1.61	1.54	0.93	1.56	1.38	1.03	1.61	1.49	1.62	1.19	
24	4.83	5.01	4.21	5.30	5.04	4.94	5.54	5.21	5.46	4.67	4.57	5.09	5.17	5.00	4.54	5.64	Y
	3.77	3.51	3.23	3.03	3.68	3.38	3.49	3.42	3.46	3.09	3.19	3.38	3.50	3.25	3.34	3.59	K
	1.06	1.50	0.98	2.27	1.36	1.56	2.05	1.79	2.00	1.58	1.38	1.71	1.67	1.75	1.20	2.05	
25	5.44	4.97	5.24	5.37	—	—	5.64	4.73	4.84	5.38	5.22	5.28	5.21	4.67	4.09	5.15	Y
	3.82	3.34	3.34	3.20	3.63	—	3.11	3.62	—	2.58	3.36	3.65	3.47	2.31	3.19	3.48	K
	1.62	1.63	1.90	2.17	—	—	2.53	1.11	—	2.80	1.63	1.86	1.73	1.36	0.90	1.67	
26	5.11	4.86	5.05	4.98	5.35	4.62	5.20	4.70	4.79	4.91	5.20	4.76	5.22	5.12	4.86	5.23	Y
	3.53	3.33	3.44	3.21	3.50	3.22	3.00	3.33	3.29	3.25	3.52	3.56	3.38	3.22	3.01	3.28	H
	1.58	1.53	1.61	1.77	1.85	1.40	2.20	1.37	1.50	1.66	1.68	1.10	1.84	1.90	1.85	1.95	
27	4.83	5.14	4,99	5.04	4.65	5.35	4.96	4.97	4.73	5.07	5.17	5.15	4.83	5.46	4.24	5.17	Y
	3.55	3.38	3.53	3.25	3.41	3.38	2.96	3.38	3.20	3.33	3.52	3.41	3.19	3.22	2.92	3.34	H
	1.28	1.76	1.46	1.79	1.24	1.97	2.00	1.59	1.53	1.74	1.65	1.74	1.64	2.24	1.32	1.83	

	57	58	59	60	61	62	(63)	64	65	(66)	67	68	69	70	71	72	
28	4.84	5.07	5.14	4.84	4.84	4.75	4.83	4.43	4.43	4.69	4.97	4.92	4.71	4.86	4.49	—	Y
	3.65	3.27	3.44	3.13	3.35	3.38	3.24	3.21	3.08	3.17	3.26	3.52	3.53	3.32	3.02	3.84	H
	1.19	1.80	1.70	1.71	1.49	1.37	1.62	1.22	1.35	1.52	1.71	1.40	1.18	1.54	1.47	—	
31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	—	—	—	—	3.08	—	—	—	—	—	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
June 1	—	—	—	—	—	—	4.68	4.82	4.68	4.88	5.03	4.59	4.95	4.87	4.83	4.80	H
	3.89	—	—	—	2.91	4.59	3.31	3.32	3.16	3.26	3.51	3.60	3.33	3.52	3.08	3.54	K
	—	—	—	—	—	—	1.37	1.50	1.52	1.62	1.52	0.99	1.62	1.35	1.75	1.26	
4	4.94	5.34	5.30	5.12	5.15	5.11	4.94	5.00	4.73	4.59	5.20	4.95	4.70	—	—	—	Y
	3.82	3.36	3.68	3.45	3.41	3.21	3.32	3.27	3.19	3.37	3.56	3.54	3.58	—	—	—	H
	1.12	1.98	1.62	1.67	1.74	1.90	1.62	1.73	1.54	1.22	1.64	1.41	1.12	—	—	—	
5	5.06	4.82	4.72	4.72	5.11	—	4.86	4.73	5.08	4.26	5.21	5.18	5.24	5.02	4.77	4.71	Y
	3.55	3.53	3.60	3.35	3.46	3.41	3.04	3.75	2.97	2.92	2.28	1.23	1.19	1.41	1.44	1.43	H
	1.51	1.29	1.12	1.37	1.65	—	1.82	0.98	2.11	1.34	1.93	1.95	2.05	1.61	1.33	1.28	
6	—	—	—	—	—	—	5.43	4.61	5.09	4.82	4.96	5.15	5.00	5.11	4.66	4.93	Y
	—	—	—	—	—	—	3.02	3.12	3.13	3.35	3.58	3.42	3.42	3.09	2.84	3.47	H
	—	—	—	—	—	—	2.41	1.49	1.96	1.47	1.38	1.73	1.58	2.02	1.82	1.46	
7	—	5.01	4.74	4.79	4.82	4.73	4.36	4.19	4.19	4.85	5.03	4.98	4.90	5.16	4.62	5.16	H
	3.66	3.38	3.56	3.02	3.42	3.42	3.33	3.27	3.11	2.92	3.19	3.09	3.70	3.58	2.86	3.21	K
	—	1.63	1.18	1.77	1.40	1.31	1.03	0.92	1.08	1.93	1.84	1.89	1.20	1.58	1.76	1.95	

Group IX. Group X.

Date 1914	Pair :	65	(66)	67	68	69	70	71	72	73	74	75	76	77	78	(79)	80	
June 9		4.52	4.93	5.54	5.00	4.78	4.78	4.99	4.87	--	5.02	5.63	4.84	5.22	5.03	5.00	4.68	Y
		3.04	3.37	3.96	3.87	3.69	2.90	—	3.55	3.73	3 66	3.61	3.51	3.12	3.36	3.27	3.15	K
		1.48	1.56	1.58	1.13	1.09	1.88	—	1.32	—	1.36	2.02	1.33	2.10	1.67	1.73	1.53	

Date 1914	Pair: 65	66	67	68	69	70	71	72	73	74	75	76	77	78	(79)	80	
Nov. 10	4.55	4.43	5.07	5.10	4.79	4.88	4.82	5.18	4.79	4.82	4.64	4.86	5.32	4.50	—	—	H
	3.31	3.39	3.56	3.61	3.38	3.24	3.18	3.48	3.71	3.63	3.45	3.48	3.20	3.20	—	—	K
	1.24	1.04	1.51	1.49	1.41	1.64	1.64	1.70	1.08	1.19	1.19	1.38	2.12	1.30	—	—	
11	—	4.61	5.27	5.20	5.19	5.32	5.74	4.94	4.58	4.87	5.19	—	—	—	—	—	Y
	3.40	3.33	3.49	3.42	3.32	3.32	3.13	3.28	3.64	3.58	3.46	—	—	—	—	—	H
	—	1.28	1.78	1.78	1.87	2.00	1.61	1.66	0.94	1.29	1.73	—	—	—	—	—	
13	5.12	5.20	5.02	4.98	—	—	—	4.66	—	—	—	—	—	—	—	—	Y
	3.04	3.60	3.79	3.51	—	—	—	3.51	—	—	—	—	—	—	—	—	H
	2.08	1.60	1.23	1.47	—	—	—	1.15	—	—	—	—	—	—	—	—	
14	5.35	5.13	4.86	3.72	5.02	4.84	4.80	5.29	5.44	5.19	5.54	—	4.71	4.97	4.87	4.74	Y
	3.16	3.32	3.56	3.53	3.25	3.56	2.98	3.56	3.68	3.69	3.84	3.64	3.58	3.59	3.44	3.09	H
	2.19	1.81	1.30	1.19	1.77	1.28	1.82	1.73	1.76	1.50	1.70	—	1.13	1.38	1.43	1.65	
19	4.96	—	—	—	—	—	—	4.91	5.47	—	4.73	5.02	5.09	5.06	5.38	4.41	Y
	3.16	—	3.70	—	—	—	—	3.44	3.77	—	4.43	3.50	3.64	3.67	3.71	3.28	H
	1.80	—	—	—	—	—	—	1.47	1.70	—	1.30	1.52	1.45	1.39	1.67	1.13	
23	4.33	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
	2.74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	1.62	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
24	4.73	5.02	4.89	4.94	4.72	4.85	4.44	4.89	5.23	4.78	5.43	4.95	5.11	4.98	5.11	5.00	H
	3.12	3.37	3.43	3.44	3.23	3.30	2.95	3.22	3.65	3.41	3.17	3.65	3.58	3.35	3.61	3.49	K
	1.61	1.65	1.46	1.50	1.62	1.42	1.49	1.67	1.58	1.37	2.26	2.30	1.53	1.63	1.50	1.51	
25	4.79	4.71	5.06	4.98	4.94	—	—	—	5.28	5.02	—	—	—	—	5.12	4.83	Y
	3.13	3.12	3.38	3.45	3.46	—	—	—	3.84	3.50	—	—	—	—	3.44	3.40	K
	1.66	1.59	1.68	1.53	1.48	—	—	—	1.44	1.52	—	—	—	—	1.68	1.43	
29	4.98	—	5.49	4.85	4.77	4.90	4.31	—	4.95	4.74	4.87	5.14	—	5.03	4.65	—	Y
	3.23	3.51	3.54	3.49	3.25	3.25	2.96	—	3.67	3.49	3.55	3.44	3.51	3.40	3.33	—	K
	1.75	—	1.95	1.36	1.52	1.65	1.35	—	1.28	1.25	1.32	1.70	—	1.63	1.32	—	
30	—	—	—	—	—	—	—	—	—	—	5.25	5.33	5.30	—	—	4.92	Y
	—	—	—	—	—	—	—	—	—	—	3.78	3.63	3.69	4.02	3.79	3.21	H
	—	—	—	—	—	—	—	—	—	—	1.47	1.70	1.61	—	—	1.71	

Date		65	66	67	68	69	70	71	72	73	74	75	76	77	78	(79)	80	
July	1	4.95	—	—	—	—	4.77	5.25	4.98	5.04	4.69	5.58	5.50	4.65	5.02	4.43	—	H
		3.37	—	—	—	—	3.28	—	3.26	3.73	3.55	3.86	3.58	3.34	3.25	—	3.58	K
		1.58	—	—	—	—	1.19	—	1.72	1.31	1.14	1.72	1.92	1.31	1.67	—	—	
	6	—	—	—	—	—	—	—	5.18	5.36	5.13	—	—	4.48	5.61	4.86	4.57	Y
		—	—	—	—	—	—	3.08	3.75	3.78	3.59	—	—	3.67	3.42	3.53	2.98	H
		—	—	—	—	—	—	—	1.43	1.58	1.54	—	—	0.81	2.19	1.33	1.59	
	7	—	—	—	—	—	4.82	5.15	4.16	—	4.77	4.78	4.95	5.17	4.40	4.46	3.69	Y
		—	—	—	—	—	2.84	—	2.74	—	3.02	3.34	3.43	3.52	3.23	2.95	3.10	H
		—	—	—	—	—	1.98	—	1.42	—	1.75	1.44	1.52	1.65	1.17	1.51	0.59	

Group X. Group XI.

Date 1914	Pair:	73	74	75	76	77	78	(79)	80	(81)	82	83	84	85	86	87	88	
July	14	—	—	—	—	—	—	5.04	4.91	4.28	—	—	—	—	—	—	—	Y
		—	—	—	—	3.16	3.52	3.56	3.31	2.66	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	1.48	1.60	1.62	—	—	—	—	—	—	—	
	16	5.47	—	—	—	—	—	—	4.47	4.20	5.12	4.94	5.04	4.75	5.36	5.35	4.78	Y
		3.83	—	—	—	—	—	—	3.33	2.84	3.72	3.52	3.63	3.49	3.60	3.68	3.53	K
		1.64	—	—	—	—	—	—	1.41	1.36	1.40	1.42	1.41	1.26	1.76	1.67	1.25	
	19	—	4.58	—	4.90	—	—	—	—	—	—	5.48	—	—	—	—	—	Y
		—	3.61	—	3.39	—	—	—	—	—	—	3.68	—	—	—	—	—	K
		—	0.97	—	1.51	—	—	—	—	—	—	1.80	—	—	—	—	—	
	20	—	—	—	4.85	4.96	5.08	4.92	4.96	—	—	5.04	4.93	5.02	5.35	5.26	5.23	K
		—	—	—	3.69	3.25	3.64	3.39	3.17	3.00	3.72	3.60	3.60	3.43	3.68	3.35	3.46	H
		—	—	—	1.16	1.71	1.44	1.53	1.79	—	—	1.44	1.33	1.59	1.67	1.91	1.77	
	21	—	—	5.30	4.81	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.73	—	3.57	3.43	3.46	—	—	—	—	—	—	—	—	—	—	—	H
		—	—	1.73	1.34	—	—	—	—	—	—	—	—	—	—	—	—	

Date 1914		Pair: 73	74	75	76	77	78	(79)	80	(81)	82	83	84	85	86	87	88	
July	22	5.38	5.60	5.11	5.10	4.90	5.01	5.20	4.75	4.30	5.36	5.09	5.97	5.18	—	—	5.09	Y
		3.38	3.73	3.42	3.55	3.45	3.36	3.30	3.22	2.82	3.70	3.51	3.53	3.25	—	3.61	3.40	H
		2.00	1.87	1.69	1.55	1.45	1.65	1.90	1.53	1.48	1.66	1.58	2.44	1.93	—	—	1.69	
	23	5.28	5.13	5.08	4.94	4.67	5.09	4.88	4.69	4.25	4.60	5.07	5.08	5.25	5.30	5.25	5.21	Y
		4.01	3.43	3.43	3.61	3.20	3.33	3.53	3.16	2.69	3.35	3.97	3.65	3.33	3.76	3.22	3.50	H
		1.27	1.70	1.65	1.33	1.47	1.76	1.35	1.53	1.56	1.24	1.10	1.43	1.92	1.54	2.03	1.71	
	24	—	—	4.92	—	5.01	4.99	5.04	5.13	4.23	—	5.11	—	—	—	—	—	H
		—	—	3.77	—	3.27	3.56	3.58	3.22	2.86	—	3.47	—	—	—	—	—	K
		—	—	1.15	—	1.74	1.43	1.46	1.91	1.37	—	1.64	—	—	—	—	—	
	26	6.03	5.03	5.23	5.12	5.05	4.61	5.30	4.73	4.35	4.44	5.15	5.14	4.89	5.23	4.80	4.80	Y
		3.79	3.64	3.86	3.43	3.52	3.08	3.33	3.19	2.74	3.54	3.58	3.50	3.50	3.48	3.64	2.50	K
		2.24	1.39	1.37	1.69	1.53	1.53	1.97	1.54	1.61	1.90	1.57	1.64	1.39	1.75	1.16	1.30	
	29	—	—	—	—	4.88	—	5.13	—	—	5.46	5.01	—	4.57	—	—	—	Y
		—	—	—	—	3.17	3.69	3.44	—	—	3.69	3.84	—	3.47	—	—	—	H
		—	—	—	—	1.71	—	1.69	—	—	1.77	1.17	—	1.10	—	—	—	
	30	5.31	5.10	5.24	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.52	3.35	3.55	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.79	1.75	1.69	—	—	—	—	—	—	—	—	—	—	—	—	—	
	31	5.50	5.23	—	4.72	—	5.60	—	5.54	—	—	—	—	5.85	—	—	—	Y
		3.88	3.23	4.09	3.71	3.10	3.26	—	3.41	—	—	—	—	3.20	—	—	—	H
		1.62	2.00	—	1.01	—	2.34	—	2.13	—	—	—	—	2.65	—	—	—	
Aug.	5	5.74	5.22	5.21	—	4.89	4.70	4.89	4.52	4.62	5.32	5.30	—	—	5.50	—	—	Y
		3.95	4.00	3.55	—	3.34	3.36	3.57	3.38	2.83	1.68	1.75	—	—	—	—	—	H
		1.79	1.22	1.66	—	1.55	1.34	1.32	1.14	1.79	1.64	1.55	—	—	—	—	—	
	6	5.22	5.17	5.17	5.39	5.20	4.88	5.17	4.94	4.34	5.00	5.14	5.19	4.94	5.22	—	—	Y
		3.94	3.61	3.50	3.86	3.53	3.49	3.51	3.46	2.84	3.83	3.55	3.29	3.34	3.66	—	3.10	H
		1.28	1.56	1.67	1.53	1.67	1.39	1.66	1.48	1.50	1.17	1.59	1.90	1.60	1.56	—	—	
	7	5.22	5.20	5.35	5.20	5.36	5.07	4.70	4.98	4.55	5.37	5.23	5.18	5.16	5.51	4.87	4.91	Y
		3.90	3.64	3.46	3.60	3.82	3.43	3.55	3.20	2.76	3.69	3.63	3.66	3.62	3.91	3.57	3.60	H
		1.32	1.56	1.89	1.60	1.54	1.64	1.15	1.78	1.79	1.68	1.60	1.52	1.54	1.60	1.30	1.31	

	73	74	75	76	77	78	(79)	80	(81)	82	83	84	85	86	87	88	
8	5.21	5.28	5.17	5.05	4.94	4.90	4.94	4.84	4.35	5.33	5.11	5.51	5.40	5.16	4.85	4.96	Y
	3.84	3.59	3.62	3.67	3.39	3.64	3.30	3.40	2.47	3.80	3.65	3.64	3.60	3.72	3.61	3.41	H
	1.37	1.69	1.55	1.38	1.55	1.26	1.64	1.44	1.88	1.53	1.46	1.87	1.80	1.44	1.24	1.55	
9	5.40	5.03	4.87	4.81	5.07	5.11	4.96	4.56	—	—	—	—	—	5.10	5.40	4.39	H
	3.82	3.58	3.44	3.77	3.46	3.75	3.62	3.26	2.95	—	—	—	—	—	3.73	3.61	K
	1.58	1.45	1.43	1.04	1.61	1.36	1.34	1.30	—	—	—	—	—	—	1.67	1.78	
10	5.44	5.05	5.17	5.26	5.23	5.17	5.13	4.94	4.25	5.27	5.03	5.21	5.00	5.50	—	—	Y
	4.06	3.71	3.70	3.66	3.45	3.50	3.60	3.48	2.77	3.65	3.58	3.69	3.66	3.58	—	—	K
	1.38	1.34	1.47	1.60	1.78	1.67	1.53	1.46	1.48	1.62	1.45	1.52	1.34	1.92	—	—	
11	5.34	5.14	5.07	5.17	5.13	5.19	5.38	4.91	4.15	5.28	5.31	5.16	5.09	5.51	5.28	5.17	Y
	3.92	3.43	3.71	3.72	3.43	3.64	2.72	3.57	2.92	3.86	3.65	3.55	3.46	3.63	3.59	3.65	K
	1.42	1.71	1.36	1.45	1.70	1.55	1.66	1.34	1.23	1.42	1.66	1.61	1.63	1.88	1.69	1.52	
12	5.32	5.11	5.17	4.99	4.99	4.96	—	5.13	4.22	5.49	5.07	—	—	—	5.35	—	H
	3.80	3.84	3.61	3.68	3.49	3.51	3.77	3.35	2.74	2,69	2.71	—	—	—	3.52	—	K
	1.52	1.27	1.56	1.31	1.50	1.45	—	1.78	1.68	1.80	1.36	—	—	—	1.83	—	

Group XI. Group XII.

Date 1914	Pair :	(81)	82	83	84	85	86	87	88	89	90	91	92	93	(94)	(95)	96	
Aug.	14	—	5.29	5.03	5.26	4.89	—	5.35	5.59	—	—	—	5.22	5.19	4.41	—	—	Y
		2.86	4.14	3.47	3.60	3.24	3.93	4.06	—	3.48	—	—	3.90	3.66	2.88	—	—	H
		—	1.15	1.56	1.66	1.65	—	1.29	—	—	—	—	1.32	1.53	1.53	—	—	
	15	—	—	—	—	3.92	—	—	—	—	5.07	5.16	5.26	5.11	—	—	5.05	Y
		3.17	3.73	3.56	—	3.58	—	—	—	—	3.54	3.58	3.67	3.76	—	3.30	—	H
		—	—	—	—	0.34	—	—	—	—	1.53	1.58	1.59	1.35	—	—	—	

Date		Pair : (81)	82	83	84	85	86	87	88	89	90	91	92	93	(94)	(85)	96	
Aug.	18	4.32	5.29	5.23	5.20	5.12	5.48	5.10	4.95	—	—	—	—	—	—	—	—	Y
		3.00	3.68	3.37	3.66	3.41	3.57	3.58	3.66	—	—	—	—	—	—	—	—	H
		1.32	1.61	1.86	1.54	1.71	1.91	1.52	1.29	—	—	—	—	—	—	—	—	
	21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.33	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	22	4.40	5.17	4.91	5.23	5.25	5.29	5.07	5.01	4.92	4.93	4.83	—	—	—	—	—	Y
		3.00	3.70	3.53	3.69	3.42	3.85	3.52	3.44	3.47	3.53	3.34	—	—	—	—	—	H
		1.40	1.47	1.38	1.54	1.83	1.44	1.55	1.57	1.45	1.40	1.49	—	—	—	—	—	
	27	4.07	5.01	5.14	5.04	5.16	5.00	5.10	5.28	4.93	5.23	5.29	5.00	4.98	4.50	4.55	4.95	H
		2.69	3.60	3.54	3.62	3.72	3.50	3.69	3.70	3.53	3.63	3.56	3.86	3.34	2.94	3.19	3.51	K
		1.38	1.41	1.60	1.42	1.44	1.50	1.41	1.58	1.40	1.60	1.73	1.14	1.64	1.56	1.36	1.44	
	28	—	—	5.11	5.30	—	—	5.61	4.90	—	—	—	5.03	4.94	4.75	—	—	Y
		—	3.79	3.87	3.50	—	—	3.83	3.63	—	—	—	3.72	3.73	3.21	—	—	K
		—	—	1.24	1.80	—	—	1.78	1.27	—	—	—	1.31	1.21	1.54	—	—	
	31	4.37	5.09	5.02	4.97	5.19	5.28	5.07	5.23	5.21	5.18	5.30	5.28	5.03	4.78	4.62	4.96	Y
		2.70	3.75	3.43	3.50	3.32	3.71	3.56	3.72	3.59	3.82	3.30	3.85	3.49	3.09	3.52	3.42	H
		1.67	1.34	1.59	1.47	1.87	1.57	1.51	1.51	1.62	1.36	2.00	1.43	1.54	1.69	1.10	1.54	
Sept.	1	—	5.23	4.97	5.02	5.07	—	5.09	5.17	5.22	5.24	—	—	—	—	—	—	Y
		2.71	3.65	3.60	3.46	3.61	3.87	3.52	3.47	3.67	3.79	3.60	—	—	—	—	—	H
		—	1.58	1.37	1.56	1.46	—	1.57	1.70	1.55	1.45	—	—	—	—	—	—	
	2	4.52	5.10	4.78	5.12	5.18	5.32	5.27	5.13	4.97	5.36	5.14	5.36	5.12	4.74	—	—	Y
		2.90	3.54	3.72	3.84	3.21	3.80	3.64	3.64	3.55	3.73	3.50	4.16	3.70	2.85	—	—	H
		1.62	1.56	1.06	1.28	1.97	1.52	1.63	1.49	1.42	1.63	1.64	1.20	1.42	1.89	—	—	
	3	—	—	—	—	—	—	5.40	—	—	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	3.68	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	1.72	—	—	—	—	—	—	—	—	—	
	6	—	—	5.05	5.25	5.17	5.17	5.01	5.23	5.11	5.68	—	—	—	—	—	—	
		2.90	3.86	3.53	3.69	—	3.74	3.50	3.72	3.45	3.87	—	—	—	—	—	—	
		—	—	1.52	1.56	—	1.43	1.51	1.51	1.66	1.81	—	—	—	—	—	—	

	(81)	82	83	84	85	86	87	88	89	90	91	92	93	(94)	(95)	96	
7	—	5.49	4.91	5.18	5.25	5.27	5.01	—	—	—	—	—	—	—	—	—	Y
	2.85	3.66	3.70	3.77	3.55	3.66	3.85	—	—	—	—	—	—	—	—	—	K
	—	1.83	1.21	1.41	1.70	1.61	1.16	—	—	—	—	—	—	—	—	—	
8	4.31	5.33	4.70	—	5.15	5.37	5.28	—	5.14	5.64	5.46	5.73	5.74	4.54	—	5.22	Y
	2.59	3.77	3.41	4.00	3.81	3.78	3.61	—	3.92	3.82	3.48	3.64	3.63	3.01	3.43	3.70	K
	1.72	1.56	1.29	—	1.34	1.59	1.67	—	1.22	1.82	1.98	2.09	2.11	1.53	—	1.52	
9	4.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
	2.69	—	—	—	—	—	—	—	—	—	—	—	—	3.17	—	—	K
	1.43	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
12	—	—	—	—	—	—	—	—	—	—	—	—	5·66	4.72	5.18	—	H
	—	—	—	—	—	—	—	—	—	—	—	—	4.16	3.60	—	—	K
	—	—	—	—	—	—	—	—	—	—	—	—	1.50	1.12	—	—	
15	4.61	5.11	5.12	5.22	5.11	5.29	4.94	5.08	5.10	5.15	5.00	4.97	4.95	4.34	4.68	5.14	Y
	2.67	3.88	3.52	3.77	3.56	3.69	3.62	3.67	3.51	3.65	3.60	3.71	3.45	3.28	3.20	3.59	H
	1.94	1.23	1.60	1.45	1.55	1.60	1.32	1.41	1.59	1.50	1.40	1.26	1.50	1.06	1.48	1.55	
16	4.47	5.23	5.02	5.05	5.27	5.80	5.45	5.19	4.85	5.34	4.71	5.16	5.17	4.80	4.95	4.78	Y
	2.70	3.79	3.59	3. 9	2.46	3.75	3 79	3.53	3.53	3.93	3.77	3.81	3.73	3.22	3.55	3.70	H
	1.77	1.44	1.43	1.36	1.81	2.05	1.66	1.66	1.32	1.41	0.94	1.35	1.44	1.58	1.40	1.08	
17	—	—	—	—	—	—	5.49	5.31	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	3.80	3.45	—	3.79	—	3.63	—	—	—	3.56	H
	—	—	—	—	—	—	1.69	1.86	—	—	—	—	—	—	—	—	
18	4.27	5.26	5.24	5.40	4.99	5.22	4.95	5.26	5.30	5.11	5.39	5.13	5.43	4.45	5.33	5.51	Y
	2.93	3.71	3.41	3.73	3.51	4.00	3.52	3.55	3.75	3.81	3.74	3.70	3.75	2.99	3.34	3.63	H
	1.34	1.55	1.83	1.67	1.48	1.22	1.43	1.71	1.55	1.30	1.65	1.43	1.68	1.46	1.99	1.88	
19	4.42	5.37	4.93	—	—	5.59	4.92	—	4.98	5.28	—	—	—	—	—	—	Y
	2.77	3.77	3.54	—	3.49	3.75	3.63	3.52	3.67	3.68	—	—	—	—	—	—	K
	1.65	1.60	1.39	—	—	1.84	1.29	—	1.31	1.60	—	—	—	—	—	—	
20	4.73	5.48	5.54	5.43	5.20	5.57	5.89	5.96	5.33	6.00	—	—	—	—	—	6.33	Y
	3.09	3.88	3.72	4.00	3.74	3.91	4.08	3.93	3.71	3.68	3.68	—	—	—	—	3.71	K
	1.64	1.60	1.82	1.43	1.46	1.66	1.81	2.03	1.62	2.32	—	—	—	—	—	2.62	

Date		Group XII.								Group I.								
Date 1914	Pair :	89	90	91	92	93	(94)	(95)	96	1	2	3	4	5	6	(7)	8	
Sept.	23	5.14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		3.87	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
		1.27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	24	5.10	5.35	—	—	—	—	—	—	—	—	—	—	5.21	—	—	—	Y
		3.52	3.62	—	—	—	—	—	—	—	—	—	3.93	3.93	—	—	4.40	H
		1.58	1.73	—	—	—	—	—	—	—	—	—	—	1.28	—	—	—	
	26	—	—	—	—	5.06	4.41	—	5.36	5.03	6.10	5.33	5.45	5.10	4.91	5.10	5.25	Y
		—	—	—	—	3.69	2.94	—	3.66	3.89	3.38	3.91	3.57	3.84	3.31	3.66	3.54	H
		—	—	—	—	1.37	1.47	—	1.70	1.14	1.72	1.42	1.88	1.26	1.60	1.44	1.71	
	27	—	—	—	—	—	4.81	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	2.95	—	—	—	—	—	—	—	—	—	—	H
		—	—	—	—	—	1.86	—	—	—	—	—	—	—	—	—	—	
	28	5.36	5.20	5.17	5.25	5.64	4.50	4.89	5.51	—	—	—	—	5.48	—	5.94	—	Y
		3.70	3.87	3.88	3.73	3.68	3.16	3.30	3.95	—	—	—	—	3.62	—	4.47	3.36	K
		1.66	1.33	1.29	1.52	1.96	1.34	1.59	1.56	—	—	—	—	1.86	—	1.87	—	
	29	5.40	5.21	—	5.39	5.40	4.24	4.83	5.51	5.39	—	—	—	—	—	—	—	Y
		3.74	3.84	—	3.74	3.79	3.02	3.07	3.60	3.89	—	—	—	—	—	—	—	H
		1.66	1.37	—	1.65	1.61	1.22	1.76	1.91	1.50	—	—	—	—	—	—	—	
Oct.	2	—	—	—	5.56	—	—	—	—	5.61	5.50	—	5.46	5.09	5.33	—	5.30	Y
		—	—	—	3.77	—	—	—	—	3.94	3.55	—	3.98	3.75	3.75	—	4.16	H
		—	—	—	1.79	—	—	—	—	1.67	1.95	—	1.48	1.34	1.58	—	1.14	
	3	—	5.23	5.32	5.70	5.63	5.02	5.06	5.57	—	—	4.62	5.17	5.00	5.11	5.49	5.13	Y
		—	3.69	3.57	4.01	3.89	3.37	3.52	3.88	—	—	3.86	—	3.61	4.16	4.54	5.71	K
		—	1.54	1.75	1.69	1.74	0.65	1.54	1.69	—	—	0.76	—	1.39	0.95	0.95	1.42	
	4	—	—	—	—	—	—	—	—	—	—	—	—	5.35	5.28	5.44	5.32	Y
		—	—	—	—	—	—	—	—	—	—	—	—	3.82	3.83	4.49	4.04	K
		—	—	—	—	—	—	—	—	—	—	—	—	1.53	1.45	0.95	1.28	

	89	90	91	92	93	(94)	(95)	96	1	2	3	4	5	6	(7)	8	
5	5.68	5.26	4.87	5.88	—	—	—	5.37	—	—	5.39	5.43	5.30	5.17	5.36	5.17	H
	3.61	3.83	3.64	3.79	—	—	—	3.64	—	4.08	3.84	3.78	3.67	3.67	4.63	3.60	K
	2.07	1.43	1.23	2.09	—	—	—	1.73	—	—	1.55	1.65	1.63	1.50	0.73	1.57	
6	5.40	5.24	4.87	5.80	5.14	4.88	5.03	5.29	5.10	5.31	5.35	5.97	4.98	4.83	5.60	5.42	H
	3.40	4.01	3.99	3.83	3.94	3.53	3.27	3.62	3.83	3.69	3.63	3.68	3.79	3.61	4.23	3.72	K
	2.00	1.23	0.88	1.97	1.20	1.35	1.76	1.67	1.27	1.62	1.72	1.39	1.19	1.22	1.37	1.70	
8	5.42	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.22	Y
	3.76	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.50	K
	1.66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.72	
9	—	4.95	5.74	5.19	5.37	4.70	4.87	4.98	—	—	—	—	—	—	—	—	Y
	—	—	—	3.96	4.02	3.17	3.25	3.63	—	—	—	—	—	—	—	—	H
	—	—	—	1.23	1.35	1.53	1.62	1.35	—	—	—	—	—	—	—	—	
10	—	—	—	—	—	4.52	4.90	5.40	6.65	5.39	5.39	—	5.37	—	—	—	Y
	—	1.67	—	—	—	3.12	3.31	3.78	3.69	3.88	3.84	—	3.90	4.06	—	—	H
	—	—	—	—	—	1.40	1.59	1.62	2.96	1.51	1.55	—	1.47	—	—	—	
11	—	—	5.07	5.38	5.43	—	4.97	5.11	5.49	5.52	5.0[illegible]	5.59	5.26	5.72	5.58	5.49	Y
	—	—	3.56	3.70	3.72	—	3.33	3.70	3.89	3.46	3.90	4.05	3.83	3.70	4.23	3.65	H
	—	—	1.51	1.68	1.71	—	1.64	1.41	1.60	2.06	1.12	1.54	1.43	2.02	1.35	1.84	
12	5.28	5.29	5.51	5.58	5.38	4.68	—	5.15	5.35	5.23	5.21	5.61	5.31	5.30	5.84	5.61	Y
	3.54	4.09	3.86	3.83	3.65	3.38	3.19	3.72	3.70	3.84	3.77	3.80	3.81	4.14	4.32	3.85	H
	1.74	1.20	1.65	1.75	1.73	1.30	—	1.43	1.65	1.39	1.44	1.81	1.50	1.16	1.52	1.76	
13	5.15	5.32	5.16	5.51	5.01	4.86	4.60	5.22	5.39	5.45	5.58	5.55	5.30	5.31	5.71	5.09	Y
	3.44	3.79	2.67	4.06	3.91	3.08	3.37	3.75	3.85	3.75	3.98	3.77	3.80	3.70	4.59	3.89	H
	1.71	1.53	1.49	1.45	1.10	1.78	1.23	1.47	1.54	1.70	1.60	1.78	1.50	1.61	1.12	1.20	
15	—	—	—	—	—	—	—	—	—	5.58	5.48	5.47	5.14	5.30	5.69	5.18	Y
	—	—	—	—	—	—	—	—	—	3.66	4.00	3.89	3.57	3.96	4.23	3.76	H
	—	—	—	—	—	—	—	—	—	1.92	1.48	1.58	1.57	1.34	1.46	1.42	
16	—	5.09	5.13	4.24	5.79	4.84	4.91	5.14	5.53	5.06	5.31	5.61	5.02	5.44	5.94	5.29	Y
	3.90	3.82	4.07	3.77	3.94	3.19	3.31	3.47	4.07	3.62	3.92	4.25	3.99	3.87	4.51	3.68	H
	—	1.27	1.06	1.47	1.85	1.65	1.60	1.67	1.46	1.44	1.39	1.36	1.03	1.57	1.43	1.61	

Date	Pair: 89	90	91	92	93	(94)	(95)	96	1	2	3	4	5	6	(7)	8	
17	5.43	5.62	5.22	5.30	5.15	—	—	—	—	—	—	—	—	—	—	—	Y
	3.86	4.05	3.71	3.64	3.89	—	—	—	—	—	—	—	—	—	—	—	H
	1.57	1.57	1.51	1.66	1.26	—	—	—	—	—	—	—	—	—	—	—	
20	—	—	—	—	—	—	—	—	—	—	—	—	—	5.89	—	5.49	Y
	—	—	—	3.91	—	—	—	—	—	—	—	—	—	3 44	—	4.10	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	1.45	—	1.39	
21	5.81	5.53	—	—	—	4.98	—	—	—	—	5.39	5.69	5.40	—	—	—	H
	3.84	3.77	4.03	—	—	3.14	—	—	—	3.83	3.43	4.24	4.01	—	—	—	K
	1.97	1.76	—	—	—	1.84	—	—	—	—	1.96	1.45	1.39	—	—	—	
22	5.33	5.46	5.54	5.57	5.29	4.66	—	—	—	—	—	—	—	—	—	—	Y
	3.83	3.60	3.52	4.10	4.00	2.97	—	—	—	—	—	—	3.69	—	—	—	K
	1.50	1.86	2.02	1.47	1.29	1.69	—	—	—	—	—	—	—	—	—	—	
23	—	—	—	—	—	4.58	—	—	—	—	—	—	5.27	5.32	5.75	5.40	H
	—	—	—	—	—	3.07	—	—	—	—	—	—	4.12	3.63	4.17	3.61	K
	—	—	—	—	—	1.51	—	—	—	—	—	—	1.15	1.69	1.68	1.79	
24	5.25	5.39	5.52	4.98	5.50	4.69	4.78	5.47	5.08	4.77	5.48	5.35	5.44	5.34	5.85	5.16	Y
	3.79	3.93	3.51	3.30	4.16	3.31	3.42	3.75	3.49	3.65	3.76	3.87	4.18	3.46	4.38	3.81	H
	1.46	1.46	2.01	1.68	1.34	1.38	1.36	1.72	1.59	1.12	1.72	1.48	1.26	1.38	1.47	1.35	
25	5.14	5.49	5.30	5.63	5.20	4.63	4.91	5.29	5.04	5.34	5.12	5.62	5.39	5.11	5.60	5.28	Y
	3.91	3.82	3.75	3.77	4.11	3.16	2.97	3.89	3.80	3.81	3.97	3.86	3.85	4.15	4.33	3.63	H
	1.23	1.67	1.55	1.86	1.09	1.47	1.94	1.40	1.24	1.53	1.15	1.76	1.54	0.96	1.27	1.65	
26	5.45	5.28	5.09	5.32	5.55	4.69	4.94	5.18	5.57	—	5.25	—	—	—	—	—	Y
	—	3.68	3.78	4.00	3.94	3.06	3.23	3.93	3.93	—	3.74	—	—	—	—	—	H
	—	1.60	1.31	1.32	1.61	1.63	1.71	1.25	1.64	—	1.51	—	—	—	—	—	
27	5.41	5.41	5.07	5.68	5.33	4.78	5.13	5.37	5.14	5.03	5.30	—	5.43	5.16	5.26	5.25	Y
	3.89	3.95	4.07	3.80	3.78	3.37	3.63	3.73	3.87	3.56	3.74	3.73	4.05	3.99	4.00	3.78	H
	1.52	1.46	1.00	1.88	1.55	1.41	1.50	1.64	1.27	1.47	1.56	—	1.38	1.17	1.26	1.47	
29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	4.01	3.87	3.99	—	3.68	3.49	3.82	4.16	—	—	—	—	3.81	—	—	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

	89	90	91	92	93	(94)	(95)	96	1	2	3	4	5	6	(7)	8	
Nov. 1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	3.89	—	—	—	3.99	3.20	3.35	4.12	3.92	3.94	3.66	3.91	3.80	3.87	—	—	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Date 1914	Pair:	Group I.								Group II.								
		1	2	3	4	5	6	(7)	8	9	10	11	(12)	13	14	15	16	
Nov. 2		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		3.94	3.75	4.16	3.59	4.15	3.76	4.01	3.52	3.88	4.03	4.12	4.67	4.18	4.01	4.09	3.97	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
3		5.25	—	5.20	—	—	—	—	—	3.59	—	5.69	—	—	—	—	—	Y
		4.12	—	—	—	—	—	—	3.98	4.05	—	3.88	—	—	—	—	—	H
		1.13	—	—	—	—	—	—	—	1.54	—	1.81	—	—	—	—	—	
4		5.65	5.51	5.39	5.34	5.50	5.56	5.54	—	—	—	5.12	—	—	—	5.72	—	Y
		4.02	3.81	3.75	3.69	3.74	3.75	4.11	3.77	4.20	4.26	3.58	—	—	—	3.82	—	H
		1.63	1.70	1.64	1.65	1.76	1.81	1.43	—	—	—	1.54	—	—	—	1.90	—	
6		5.58	5.30	5.23	4.46	5.19	5.30	5.69	5.01	5.67	5.75	—	—	—	—	—	—	Y
		3.90	3.89	3.84	4.13	3.85	4.19	4.32	3.81	4.20	4.26	—	—	—	—	—	—	H
		1.68	1.41	1.39	0.33	1.34	1.11	1.37	1.20	1.47	1.49	—	—	—	—	—	—	
7		5.40	5.06	5.12	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
8		5.09	—	5.50	—	5.55	5.09	5.50	5.10	5.26	5.32	—	—	—	—	—	—	Y
		4.02	—	3.70	—	3.81	3.80	4.39	3.86	3.58	4.04	—	—	—	—	—	—	H
		1.07	—	1.80	—	1.74	1.29	1.11	1.24	1.68	1.28	—	—	—	—	—	—	
10		5.36	5.34	5.23	5.55	5.46	—	—	—	—	—	—	—	—	—	—	—	Y
		4.03	3.55	3.61	4.00	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.33	1.79	1.62	1.55	—	—	—	—	—	—	—	—	—	—	—	—	

Date 1914		Pair: 1	2	3	4	5	6	(7)	8	9	10	11	(12)	13	14	15	16	
Nov.	11	—	5.03	5.38	5.90	5.26	5.02	5.94	—	5.18	5.34	5.47	5.25	5.56	5.55	5.40	5.28	Y
		—	3.86	3.83	4.40	3.91	3.95	4.11	4.00	3.67	4.10	3.95	4.07	3.89	3.70	3.77	3.83	H
		—	1.17	1.55	1.50	1.36	1.07	1.83	—	1.51	1.24	1.52	1.18	1.67	1.85	1.63	1.45	
	12	5.57	5.31	5.60	5.28	5.59	5.30	5.79	5.03	5.41	5.12	5.27	5.05	5.57	5.08	5.39	5.27	Y
		3.86	3.59	4.14	3.88	3.94	3.82	4.42	3 85	3.94	3.65	3.90	3.74	4.31	3.75	3.87	3.81	H
		1.71	1.72	1.46	1.40	1.65	1.48	1.37	1.18	1.47	1.47	1.37	1.31	1.26	1.33	1.52	1.46	
	13	5.58	5.40	5.37	5.42	5.43	5 45	5.78	5.22	5.69	5.47	5.22	5.21	5.71	5.18	5.32	5.28	Y
		3.94	3.89	2.76	4.06	3.82	3.79	4.18	3.72	3.85	4.01	3.82	3.93	4.24	3.53	3.85	3.78	H
		1.64	1.51	1.61	1.36	1.61	1.66	1.60	1.50	1.84	1.46	1.40	1.28	1.47	1.65	1.47	1.50	
	15	—	—	—	—	—	—	—	—	—	—	5.17	—	—	5.20	5.59	5.56	Y
		—	—	—	—	—	—	—	—	—	—	3.75	—	—	3.72	3.69	3.63	
		—	—	—	—	—	—	—	—	—	—	1.42	—	—	1.48	1.90	1.43	
	17	5.43	5.41	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.68	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.75	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	18	—	—	—	—	5.34	5.74	—	5.04	—	—	—	—	—	—		—	Y
		—	—	—	3.96	3.77	3.70	4.54	3.87	—	—	—	—	—	—	—	—	H
		—	—	—	—	1.57	2.04	—	1.17	—	—	—	—	—	—	—	—	
	19	—	5.45	5.22	5.22	5.65	—	—	—	—	—	—	—	—	5.23	5.10	5.44	Y
		—	3.66	3.80	3 97	4.06	3.96	—	—	—	—	—	3.74	4.07	3.74	3.82	4.34	K
		—	1.79	1.42	1.25	1.59	—	—	—	—	—	—	—	—	1.49	1.28	1.10	
	21	—	—	—	—	—	—	—	—	5.84	—	—	—	—	5.42	5.51	5.30	Y
		—	—	—	—	—	—	—	—	4.03	—	—	—	—	3.81	3.94	3.59	H
		—	—	—	—	—	—	—	—	1.81	—	—	—	—	1.61	1.57	1.71	
	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	—	—	—	—	4.29	—	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	23	5.61	5.19	5.32	5.28	—	—	—	—	—	5.49	5.56	5.39	5.69	5.07	5.21	—	Y
		3.91	3.61	3.89	3.81	3.94	—	—	—	—	3.82	3.75	3.60	4.09	3.55	4.17	—	K
		1.70	1.58	1.43	1.47	—	—	—	—	—	1.67	1.81	1.70	1.60	1.52	1.04	—	

		1	2	3	4	5	6	(7)	8	9	10	11	(12)	13	14	15	16	
	24	5.24	5.37	5.26	5.31	5.79	5.60	—	5.55	5.47	5.26	5.01	5.43	5.64	5.56	5.76	5.72	H
		3.70	3.76	3.62	4.21	3.86	3.80	—	3.77	3.85	3.87	3.78	3.72	4.21	3.78	3.84	3.99	K
		1.54	1.61	1.64	1.10	1.93	1.80	—	1.78	1.62	1.39	1.23	1.71	1.43	1.78	1.92	1.73	
	25	5.41	5.35	5.35	5.37	5.55	5.46	5.76	5.17	5.56	5.29	5.39	5.23	5.64	5.69	5.49	5.25	Y
		3.83	3.65	3.81	3.76	3.86	3.43	4.16	3.65	3.76	3.97	3.58	3.84	4.11	3.83	3.81	3.53	H
		1.58	1.70	1.54	1.61	1.69	2.03	1.57	1.52	1.80	1.32	1.81	1.39	1.53	1.86	1.68	1.72	
	26	—	—	—	—	—	—	—	—	5.57	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	—	3.92	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	—	—	1.65	—	—	—	—	—	—	—	
	28	5.65	—	—	5.58	5.11	5.86	—	—	—	—	—	—	—	—	—	—	Y
		3.61	—	—	3.99	4.02	3.62	4.41	—	—	—	—	—	—	—	—	—	K
		2.04	—	—	1.59	1.09	2.24	—	—	—	—	—	—	—	—	—	—	
	29	5.38	5.52	5.78	—	5.32	5.21	5.59	5.64	5.44	5.85	5.07	5.18	5.95	5.13	5.04	5.20	Y
		4.02	3.62	3.81	—	3.89	3.88	3.99	3.88	3.97	3.92	4.26	3.72	4.58	3.79	3.81	3.76	H
		1.36	1.90	1.97	—	1.43	1.33	1.60	1.76	1.47	1.93	1.81	1.46	1.37	1.34	1.23	1.44	
Dec.	2	5.44	4.93	5.43	5.91	5.16	5.67	5.76	5.14	5.61	5.49	5.54	5.69	5.62	5.79	5.62	5.16	Y
		3.94	3.50	3.72	3.94	3.64	3.79	—	3.43	3.72	3.81	3.86	4.32	4.25	3.74	3.49	3.77	K
		1.50	1.43	1.71	1.97	1.52	1.88	—	1.71	1.89	1.68	1.68	1.37	1.37	2.05	2.13	1.39	
	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	—	—	3.56	—	4.14	—	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	4	—	—	5.54	—	—	—	—	—	—	—	5.51	5.04	6.10	—	—	5.45	Y
		3.85	—	3 83	—	—	—	—	—	—	—	3.27	4.07	4.12	—	—	3.98	H
		—	—	1.71	—	—	—	—	—	—	—	2.24	0.97	1.98	—	—	1.47	
	5	—	—	—	—	—	—	—	—	—	—	—	—	5.97	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	6	4.93	4.97	5.29	5.05	5.58	5.27	5.86	5.37	5.56	5.76	5.78	5.56	5.97	5.54	5.83	5.20	Y
		3.65	3.26	3.48	3.70	3.73	3.88	4.39	3.85	3.81	4.04	3.89	4.18	4.00	3.87	3.79	3.80	K
		1.28	1.71	1.81	1.35	1.85	1.39	1.47	1.52	1.75	1.74	1.89	1.38	1.97	1.67	2.04	1.40	

Date 1914		Group II.								Group III.								
	Pair :	9	10	11	(12)	13	14	15	16	17	18	19	20	21	22	23	24	
Dec.	7	5.47	—	5.40	5.04	5.83	5.67	5.47	5.48	5.55	5.33	5.58	5.16	5.59	5.90	—	—	Y
		3.95	3.64	3.75	4 29	4.03	3.77	2.67	3.97	3.74	3.85	3.92	3.78	3.97	3.79	—	—	H
		1.52	—	1.65	0.75	1.80	1.90	2.83	1.51	1.81	1.48	1.66	1.38	1.62	2.11	—	—	
	8	—	—	—	—	—	—	—	—	5.39	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	—	3.73	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	—	—	1.66	—	—	—	—	—	—	—	
	11	—	—	—	—	—	—	—	—	—	—	—	—	5.37	—	—	—	Y
		—	—	—	—	—	—	—	—	—	—	3.28	—	3.57	3.97	3.53	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	1.80	—	—	—	
	15	5.63	5.59	5.26	5.28	5.99	—	5.34	—	—	—	—	—	—	—	—	—	Y
		4.05	3.96	3.86	3.41	3.70	—	3.72	—	—	—	—	—	—	—	—	—	H
		1.58	1.63	1.40	1.87	2.29	—	1.62	—	—	—	—	—	—	—	—	—	
	16	—	—	—	—	—	5.49	5.50	5.52	5.37	3.27	5.15	4.85	5.34	5.53	5.45	5.62	Y
		—	—	—	—	4.05	3.88	3.98	3.96	4.02	3.77	3.80	3.66	3.79	3.74	3.49	3.81	H
		—	—	—	—	—	1.61	1.52	1.56	1.35	1.50	1.35	1.19	1.55	1.79	1.96	1.81	
	17	—	—	—	—	—	—	5.27	5.26	—	—	5.73	5.26	5.12	4.93	4.93	—	Y
		—	—	—	—	—	—	3.90	3.49	3.94	—	3.92	3.48	3.67	3.86	3.77	—	K
		—	—	—	—	—	—	1.37	1.77	—	—	1.81	1.78	1.45	1.07	1.16	—	
	19	5.70	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.97	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	23	—	—	—	—	—	—	—	—	—	—	—	5.32	—	—	—	—	Y
		3.68	3.74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	24	6.33	5.42	5.23	4.94	4.70	—	5.33	5.00	5.03	5.06	—	6.02	5.84	—	—	—	Y
		4.03	3.99	3.96	3.34	3.87	—	3.77	3.77	3.85	3.70	—	—	3.07	—	—	3.70	K
		2.30	1.43	1.27	1.60	0.83	—	1.56	1.23	1.18	1.36	—	—	2.77	—	—	—	

		9	10	11	(12)	13	14	15	16	17	18	19	20	21	22	23	24	
	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.14	5.26	Y
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.67	3.73	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.47	1.53	
	28	5.44	5.43	5.00	5.33	5.47	5.23	5.81	—	6.07	—	—	5.19	—	—	—	—	Y
		3.92	4.12	3.81	3.92	4.52	3.61	—	—	4.02	—	—	3.72	—	—	—	—	H
		1.52	1.31	1.19	1.41	0.95	1.62	—	—	2.05	—	—	1.47	—	—	—	—	
	30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		4.24	3.86	3.82	3.44	3.94	6.63	—	—	—	—	—	—	3.76	4.04	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		4.08	3.73	3.39	3.41	3.85	3.81	3.97	3.93	3.94	4.04	3.96	3.70	3.54	3.82	3.94	3.51	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Jan.	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		—		—	—	—	—	—	—	3.75	—	—	3.47	—	—	—	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		—	3.97	3.71	3.61	4.00	—	—	—	4.28	3.85	3.92	3.63	4.09	3.98	3.91	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		—	—	—	—	—	—	—	—	—	—	—	3.68	3.71	4.06	3.74	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		—	—	3.98	3.27	4.39	3.75	4.04	3.48	3.68	3.17	3.79	—	—	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Date 1915			Group III.								Group IV.								
		Pair :	17	18	19	20	21	22	23	24	25	26	27	28	29	30	(31)	32	
Jan.	5		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
			—	—	—	—	3.74	3.85	3.81	—	—	—	3.76	3.77	—	—	—	—	H
			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Date 1915	Pair: 17	18	19	20	21	22	23	24	25	26	27	28	29	30	(31)	32	
Jan. 6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	3.37	4.47	4.05	4.09	3.71	4.10	3.60	4.17	3.69	3.10	4.06	3.63	3.89	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	4.02	3.80	—	3.74	—	—	—	—	—	—	—	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
9	5.32	5.56	4.86	5.56	5.28	5.50	5.25	—	—	5.68	5.34	5.25	—	—	—	—	Y
	3.51	3.92	3.88	3.95	3.93	3.72	3.61	—	—	3.82	3.82	—	—	—	—	—	H
	1.81	1.64	0.98	1.61	1.35	1.78	1.64	—	—	1.86	1.52	—	—	—	—	—	
10	—	—	—	—	—	—	5.41	—	5.38	5.49	5.06	—	—	5.33	5.55	5.55	Y
	—	—	—	—	—	—	4.04	3.36	3.75	3.78	4.00	3.66	3.80	4.12	3.96	4.11	H
	—	—	—	—	—	—	1.37	—	1.63	1.71	1.06	—	—	1.21	1.59	1.44	
14	—	—	—	—	—	—	—	—	5.13	—	—	—	—	—	—	—	Y
	—	—	—	—	4.00	3.94	—	3.91	4.33	—	—	—	—	—	—	—	H
	—	—	—	—	—	—	—	—	0.80	—	—	—	—	—	—	—	
15	—	—	—	—	5.81	4.92	5.71	—	5.01	—	—	—	—	—	5.90	5.68	H
	—	—	—	—	3.74	3.78	4.00	3.45	4.01	—	—	—	—	—	4.01	4.07	K
	—	—	—	—	2.07	1.14	1.71	—	1.00	—	—	—	—	—	1.89	1.61	
16	—	—	—	—	5.14	5.66	5.20	5.33	5.35	5.52	5.54	—	—	—	—	—	Y
	—	—	—	—	—	—	3.53	3.56	3.94	3.83	3.79	—	—	—	—	—	K
	—	—	—	—	—	—	1.67	1.77	1.41	1.69	1.75	—	—	—	—	—	
18	5.64	4.95	—	4.90	—	5.69	5.64	5.16	5.36	—	—	—	—	5.76	—	—	Y
	3.55	3.68	3.83	3.66	3.59	4.06	3.54	3.63	3.74	3.98	3.96	3.92	2.73	4.17	—	—	H
	2.09	1.27	—	1.24	—	1.63	2.11	1.53	1.62	—	—	—	—	1.59	—	—	
19	5.36	5.06	5.20	5.15	5.34	5.08	5.20	—	5.11	—	—	—	—	—	—	—	Y
	3.70	3.80	3.37	3.71	3.95	3.90	3.53	—	4.07	—	—	—	—	—	—	—	K
	1.66	1.26	1.83	1.44	1.39	1.18	1.67	—	1.04	—	—	—	—	—	—	—	
21	5.64	4.95	—	4.57	—	—	—	—	—	—	—	—	—	—	—	—	Y
	4.09	3.65	—	3.41	—	—	—	—	—	—	—	—	—	—	—	—	H
	1.55	1.30	—	1.16	—	—	—	—	—	—	—	—	—	—	—	—	

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	(31)	32	
22	5.21	5.42	5.52	5.33	5.00	5.79	4.62	5.19	5.75	4.94	4.90	5.00	4.99	5.12	5.05	5.83	Y
	3.72	3.74	3.75	3.38	4.09	3.96	3.82	3.52	3.87	3.94	4.08	3.75	3.64	3.78	4.09	4.17	H
	1.49	1.68	1.77	1.95	0.91	1.83	0.80	1.67	1.88	1.00	0.82	1.25	1.35	1.34	0.96	1.66	
23	5.04	4.75	—	5.28	—	—	—	—	—	—	—	—	—	—	—	—	Y
	3.91	3.19	3.31	3.81	—	—	—	—	—	—	—	—	—	—	—	—	K
	1.13	1.56	—	1.47	—	—	—	—	—	—	—	—	—	—	—	—	
25	5.76	5.67	5.12	5.07	4.99	5.78	5.77	4.88	5.35	4.94	4.93	5.37	5.04	5.41	5.58	5.60	Y
	3.87	4.03	3.69	3.90	3.94	4.05	3.79	3.88	3.91	3.74	3.81	3.86	3.84	4.16	3.87	4.38	H
	1.89	1.64	1.43	1.17	1.05	1.73	1.98	1.00	1.44	1.20	1.12	1.51	1.20	1.25	1.71	1.22	
26	5.47	5.76	5.64	5.27	4.91	5.19	5.58	4.89	5.37	3.26	5.32	5.11	5.47	5.63	5.37	5.87	Y
	4.20	3.96	4.13	3.74	3.91	3.77	3.93	3.35	3.98	3.72	3.88	3.56	3.50	4.09	4.19	4.20	H
	1.27	1.80	1.51	1.53	1.00	1.42	1.65	1.54	1.39	1.54	1.44	1.55	1.97	1.54	1.18	1.67	
27	—	5.18	5.65	5.25	5.78	5.36	5.29	5.16	5.40	5.83	5.58	5.97	5.41	5.73	—	—	K
	4.06	3.88	3.66	3.65	3.83	4.11	3.36	3.63	4.06	3.47	3.61	3.98	3.87	3.92	3.50	—	H
	—	1.30	1.99	1.60	1.95	1.25	1.93	1.53	1.34	1.36	1.97	1.99	1.54	1.81	—	—	
30	—	—	—	—	—	—	5.20	5.16	5.40	4.91	5.15	5.01	5.65	5.52	5.69	6.07	Y
	—	—	—	—	—	—	3.92	3.63	3.75	3.66	2.85	4.06	3.09	4.09	4.10	4.12	H
	—	—	—	—	—	—	1.28	1.53	1.65	1.25	1.30	0.95	1.66	1.43	1.59	1.95	

Group IV. Group V.

Date 1915	Pair:	25	26	27	28	29	30	(31)	32	(33)	34	35	36	37	38	39	40	
Feb.	7	5.01	5.12	5.92	5.37	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.81	3.74	3.89	3.48	3.90	—	—	—	—	—	—	—	—	—	—	—	H
		1.21	1.38	2.03	1.89	—	—	—	—	—	—	—	—	—	—	—	—	
	8	—	—	—	—	4.42	5.47	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	3.83	3.89	4.12	3.73	—	—	—	—	—	—	—	—	K
		—	—	—	—	0.59	1.58	—	—	—	—	—	—	—	—	—	—	

Date 1915	Pair :	25	26	27	28	29	30	(31)	32	(33)	34	35	36	37	38	39	40	
Feb.	13	5.53	—	—	—	—	5.06	5.54	—	—	—	—	—	—	—	—	—	H
		3.90	3.82	—	—	—	3.98	3.96	—	—	4.02	—	3.11	—	3.81	—	—	K
		1.93	—	—	—	—	1.08	1.58	—	—	—	—	—	—	—	—	—	
	14	—	—	—	5.41	—	—	—	4.81	5.44	—	—	5.30	—	—	4.99	—	Y
		—	—	3.99	3.88	3.49	3.92	—	3.81	3.39	—	—	3.61	3.80	3.58	3.51	3.61	H
		—	—	—	1.53	—	—	—	1.00	2.05	—	—	1.69	—	—	1.48	—	
	15	5.25	—	—	—	—	—	5.13	5.57	4.90	—	—	—	—	—	—	—	Y
		3.56	3.35	—	—	—	—	3.43	3.75	3.37	—	—	—	—	—	—	—	H
		1.69	—	—	—	—	—	1.70	1.82	1.53	—	—	—	—	—	—	—	
	16	—	—	—	—	—	—	—	5.35	5.25	5.21	5.03	—	5.17	5.18	5.33	5.21	H
		—	—	—	—	—	—	—	3.39	3.44	3.43	3.37	3.83	3.65	3.77	3.40	3.98	K
		—	—	—	—	—	—	—	1.96	1.81	1.78	1.66	—	1.52	1.41	1.93	1.23	
	17	5.44	5.11	5.23	—	5.02	5.64	5.45	3.93	4.88	5.38	5.00	5.39	5.43	5.47	5.20	5.09	Y
		3.72	3.64	3.49	—	3.51	3.80	3.70	2.73	3.64	3.48	3.62	3.70	3.91	3.91	3.70	3.61	H
		1.72	1.47	1.74	—	1.51	1.84	1.75	1·20	1.24	1.90	1.38	1.69	1.52	1.56	1.50	1.48	
	19	—	—	—	—	5.27	5.37	5.38	5.29	5.09	—	4.97	5.05	5.37	5.42	5.07	5.37	Y
		—	—	—	—	3.64	3.86	3.93	3.86	3.19	—	3.27	3.54	3.84	3.86	3.72	3.84	K
		—	—	—	—	1.63	1.51	1.45	1.43	1.90	—	1.70	1.51	1.53	1.56	1.35	1.53	
	20	5.66	5.13	4.69	5.19	4.98	—	5.24	—	—	—	—	—	—	—	—	—	Y
		4.11	3.60	3.43	3.76	3.40	3.93	3.95	3.74	3.43	—	—	—	—	—	—	—	H
		1.55	1.53	1.26	1.43	1.58	—	1.29	—	—	—	—	—	—	—	—	—	
	21	—	—	5.27	4.20	5.52	5.49	—	5.27	—	4.96	4.80	4.94	—	—	5.41	5.44	H
		—	—	3.59	3.64	3.81	3.73	—	—	—	3.63	3.22	3.71	—	4.10	3.74	3.77	K
		—	—	1.68	1.56	1.71	1.76	—	—	—	1.33	1.58	1.23	—	—	1.67	1.67	
	22	—	—	—	—	4.73	—	5.31	—	4.93	5.58	4.61	4.93	5.42	5.78	5.31	4.74	Y
		—	—	—	—	—	—	3.35	—	5.42	4.04	3.18	3.30	4.19	3.44	3.46	3.51	H
		—	—	—	—	—	—	1.96	—	1.51	1.54	1.43	1.63	1.23	1.34	1.85	1.13	
	24	—	—	—	—	—	—	5.07	5.14	5.03	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	3.47	3.46	3.42	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	1.60	1.68	1.61	—	—	—	—	—	—	—	

		Group V.								**Group VI.**								
Date 1915	Pair:	(33)	34	35	36	37	38	39	40	41	42	(43)	44	(45)	46	47	48	
Feb.	25	4.51	4.97	4.85	5.06	4.83	5.74	5.26	—	5.50	—	—	5.26	4.29	5.47	—	—	Y
		3.34	3.41	3.24	3.58	3.78	—	3.70	3.50	3.75	3.48	—	3.86	2.67	3.60	—	3.97	K
		1.17	1.56	1.61	1.48	1.05	—	1.56	—	1.75	—	—	1.40	1.62	1.87	—	—	
Mar.	2	—	—	—	—	—	—	—	—	5.79	—	—	—	—	5.10	—	—	Y
		—	—	—	3.28	—	—	—	3.67	3.77	—	—	—	—	3.75	—	—	K
		—	—	—	—	—	—	—	—	2.02	—	—	—	—	1.35	—	—	
	3	4.78	5.17	4.87	5.56	5.17	5.69	4.45	5.06	5.14	—	3.94	5.17	4.26	5.26	5.16	4.99	Y
		3.10	3.35	3.57	3.66	3.87	4.15	3.85	4.04	3.99	3.30	1.73	3.82	2.93	3.59	3.56	3.74	K
		1.68	1.82	1.30	1.90	1.30	1.54	1.60	1.02	1.15	—	2.21	1.35	1.33	1.67	1.60	1.25	
	5	—	—	—	—	—	—	—	—	—	—	—	—	4.48	—	—	—	Y
		—	—	—	—	—	—	—	—	—	—	—	—	5.52	2.89	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	1.96	—	—	—	
	6	6.34	—	4.07	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	3.59	—	—	—	—	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	8	—	—	—	—	—	—	—	—	5.38	—	—	—	—	—	—	—	Y
		—	3.66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	9	5.15	4.93	4.99	5.39	5.04	5.66	4.95	5.11	5.15	5.07	3.40	5.49	4.16	5.22	5.47	5.69	H
		3.54	3.59	3.37	3.67	3.75	3.90	3.72	3.72	3.69	3.53	1.79	3.52	2.87	3.89	3.79	4.12	K
		1.61	1.34	1.62	1.72	1.29	1.76	1.23	1.39	1.46	1.54	1.61	1.97	1.29	1.33	1.70	1.57	
	10	—	5.15	4.80	5.01	—	5.22	5.47	—	5.40	4.92	3.29	5.44	4.40	—	—	—	Y
		—	3.62	2.93	3.74	—	3.69	3.71	3.42	3.86	3.29	1.74	3.65	2.81	—	—	—	H
		—	1.53	1.87	1.27	—	1.53	1.76	—	1.54	1.63	1.55	1.79	1.59	—	—	—	
	11	—	—	—	—	—	—	—	—	—	—	—	—	4.23	5.24	5.11	4.98	Y
		—	—	—	—	—	—	—	—	—	—	2.17	—	2.76	1.65	4.09	3.62	H
		—	—	—	—	—	—	—	—	—	—	—	—	1.47	1.59	1.02	1.34	

Date 1915	Pair: (33)	34	35	36	37	38	39	40	41	42	(43)	44	(45)	46	47	48	
Mar. 14	4.85	5.06	4.83	4.20	5.17	5.10	5.69	5.04	5.09	5.29	3.24	5.27	—	4.99	4.94	—	Y
	3.64	3.49	3.05	3.47	3.49	3.68	3.84	3.85	3.79	3.50	1.74	3.58	—	3.84	3.78	4.09	H
	1.21	1.57	1.78	1.73	1.68	1.42	1.85	1.19	1.30	1.79	1.50	1.69	—	1.15	1.16	—	
15	—	—	—	—	—	—	5.28	4.95	5.09	5.19	—	—	4.30	—	—	5.20	Y
	—	—	—	—	—	—	3.83	3.41	3.63	3.59	2.11	—	2.92	—	—	3.83	H
	—	—	—	—	—	—	1.45	1.54	1.46	1.60	—	—	1.38	—	—	1.37	
17	—	—	—	—	—	—	—	—	—	—	2.81	5.09	—	5.23	5.09	—	H
	—	—	—	—	—	—	—	—	—	—	1.50	3.58	2.40	3.66	3.53	3.52	K
	—	—	—	—	—	—	—	—	—	—	1.31	1.51	—	1.57	1.56	—	
21	—	—	—	—	—	—	—	—	5.40	5.01	3.28	—	—	5.30	4.98	—	Y
	—	—	—	—	—	—	—	—	3.97	3.42	1.79	3.87	—	3.76	3.62	3.77	K
	—	—	—	—	—	—	—	—	1.43	1.59	1.49	—	—	1.54	1.36	—	

Group VI. Group VII.

Date 15	Pair: 41	42	(43)	44	45	46	47	48	(49)	50	51	(52)	(53)	(54)	(55)	56	
Mar. 22	5.04	5.06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	3.43	3.47	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
	1.61	1.59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
23	—	—	—	—	—	—	—	4.46	4.30	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	—	3.75	2.72	—	—	—	—	—	—	—	H
	—	—	—	—	—	—	—	0.71	1.58	—	—	—	—	—	—	—	
24	—	—	—	5.71	—	4.81	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	3.45	—	—	—	—	—	—	—	—	—	—	H
	—	—	—	—	—	1.36	—	—	—	—	—	—	—	—	—	—	
25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	1.91	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

	41	42	(43)	44	(45)	46	47	48	(49)	50	51	(52)	(53)	(54)	(55)	56	
April 1	5.06	4.94	3.21	5.16	4.36	4.97	4.88	5.03	4.98	4.79	5.35	5.04	4.74	4.88	4.54	5.23	Y
	3.79	3.32	1.58	3.66	2.71	3.61	3.57	4.01	5.15	4.32	4.85	5.36	3.76	3.89	3.34	3.72	H
	1.27	1.62	1.63	1.50	1.65	1.36	1.31	1.02	1.83	1.47	1.50	1.65	0.98	0.99	1.20	1.51	
8	5.38	4.82	3.17	5.14	—	—	—	—	4.53	5.05	—	5.21	3.97	5.47	4.70	4.97	Y
	3.45	2.94	1.76	3.72	—	—	—	—	3.15	3.28	3.72	3.53	3.36	3.77	3.10	3.36	H
	1.93	1.88	1.41	1.42	—	—	—	—	1.38	1.77	—	1.68	1.61	1.70	1.60	1.61	
10	5.05	4.78	2.83	5.34	4.29	5.55	5.34	5.03	4.54	4.84	5.01	5.29	4.62	4.70	4.85	4.81	H
	3.32	3.39	1.86	3.84	2.79	3.80	3.76	3.78	2.44	3.58	3.57	3.58	3.07	3.59	3.34	3.53	K
	1.73	1.39	1.97	1.50	1.50	1.75	1.58	1.25	2.10	1.26	1.44	1.71	1.55	1.11	1.51	1.28	
14	5.31	4.87	3.29	5.36	4.53	5.34	5.46	5.45	5.40	5.18	5.63	5.17	4.53	4.77	4.45	—	Y
	3.66	3.42	1.40	3.82	2.70	3.89	3.78	3.55	3.76	3.52	4.04	4.40	3.50	3.32	—	—	K
	1.65	1.45	1.89	1.54	1.83	1.45	1.68	1.90	1.64	1.66	1.59	1.67	1.03	1.45	—	—	
15	4.94	4.84	3.13	5.39	4.18	5.09	5.23	5.03	4.92	4.59	5.19	5.15	4.77	4.88	4.77	4.92	Y
	3.43	3.22	1.43	3.41	2.74	3.74	3.50	3.78	3.13	3.28	3.53	3.58	3.12	3.64	3.37	3.55	H
	1.51	1.62	1.70	1.98	1.44	1.35	1.73	1.25	1.79	1.31	1.66	1.57	1.65	1.24	1.40	1.37	

Group VII. Group VIII.

Date 1915	Pair: (49)	50	51	52	(53)	(54)	(55)	56	57	58	59	60	61	62	(63)	64	
April 18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	3.73	—	—	—	3.41	3.25	3.09	2.85	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	3.21	3.23	3.51	3.20	3.33	3.96	2.75	—	—	—	—	3.21	3.37	3.48	3.41	3.47	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
22	4.83	4.96	5.65	2.26	4.99	4.82	—	—	5.06	5.21	5.24	4.71	4.87	5.15	5.08	4.74	H
	3.31	3.70	3.93	3.75	3.38	3.72	—	—	3.45	3.61	3.48	3.26	3.14	3.55	3.58	3.30	K
	1.52	1.26	1.72	1.51	1.61	1.10	—	—	1.61	1.60	1.76	1.45	1.73	1.60	1.50	1.44	

Date 1915	Pair: (49)	50	51	52	(53)	(54)	(55)	56	57	58	59	60	61	62	(63)	64	
April 23	—	—	4.70	4.95	4.37	4.98	4.59	5.26	4.86	5.06	4.89	4.54	4.87	4.83	5.25	—	K
	—	3.23	3.00	3.37	3.23	3.42	3.31	3.26	3.31	3.47	3.21	3.24	3.54	4.15	3.43	—	H
	—	—	1.70	1.58	1.14	1.56	1.28	2.00	1.55	1.59	1.68	1.30	1.33	1.68	1.82	—	
24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	3.16	3.49	3.69	3.61	—	—	—	—	—	—	—	3.34	3.57	3.37	3.28	3.14	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
25	4.78	4.71	4.90	—	—	—	—	—	—	—	—	5.08	5.18	5.17	5.11	5.08	H
	3.01	3.22	3.60	—	—	—	—	—	—	—	—	1.51	3.38	3.74	3.40	3.28	K
	1.77	1.49	1.30	—	—	—	—	—	—	—	—	1.57	1.80	1.43	1.71	1.80	
26	—	4.82	5.57	4.83	4.92	5.00	4.71	4.68	5.12	—	5.50	4.68	4.83	4.90	5.04	5.07	H
	3.08	3.27	3.23	3.51	2.79	3.58	3.09	3.63	3.48	3.42	3.65	3.22	3.47	3.25	3.30	3.37	K
	—	1.55	2.34	1.32	2.13	1.42	1.62	1.05	1.64	—	1.85	1.46	1.36	1.65	1.74	1.70	
29	—	—	—	—	—	4.88	4.34	4.92	5.04	4.62	5.12	5.33	5.06	4.71	5.32	4.69	H
	2.23	3.10	3.03	3.38	2.92	3.22	2.80	3.58	3.34	3.76	3.17	3.60	3.31	3.40	3.61	3.31	K
	—	—	—	—	—	1.66	1.54	1.34	1.70	0.86	1.95	1.73	1.75	1.31	1.71	1.38	
30	—	—	—	—	—	5.03	4.69	5.14	4.81	—	—	—	4.74	4.82	—	4.70	H
	—	—	—	—	—	3.27	2.76	3.64	3.50	—	—	—	4.14	2.94	3.23	3.13	K
	—	—	—	—	—	1.76	1.90	1.50	1.31	—	—	—	1.60	1.88	—	1.57	
May 1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	3.34	3.12	3.72	3.27	3.25	3.66	3.39	3.39	3.55	3.47	3.40	3.42	3.67	3.58	3.72	3.16	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4	5.01	4.66	5.27	4.86	5.06	4.78	4.31	5·22	5.20	4.79	4.73	4.82	4.61	4.85	5.11	4.93	Y
	3.54	3.22	3.87	3.52	4.03	3.42	2.89	3.70	3.72	3.31	3.27	3.39	3.24	3.54	3.46	3.61	K
	1.47	1.44	1.40	1.34	1.03	1.36	1.42	1.52	1.48	1.48	1.46	1.43	1.37	1.31	1.65	1.32	
5	5.17	4.64	4.93	4.76	4.71	4.86	4.62	4.94	5.37	5.12	5.03	5.08	5.09	5.05	4.79	4.80	Y
	3.51	3.50	3.62	3.52	3.21	3.35	3.10	3.36	3.76	3.77	3.49	3.26	3.55	3.63	3.33	3.06	H
	1.66	1.14	1.31	1.24	1.50	1.51	1.52	1.58	1.61	1.35	1.54	1.82	1.54	1.42	1.46	1.74	
6	4.88	4.84	4.81	4.86	4.82	5.03	4.89	4.92	5.39	4.91	4.93	5.15	4.74	4.52	4.67	4.91	Y
	3.02	3.19	3.47	3.05	3.31	3.42	3.15	3.44	3.62	3.43	3.70	3.02	3.47	3.55	3.07	3.53	K
	1.46	1.65	1.34	1.81	1.51	1.61	1.74	1.58	1.77	1.48	1.23	1.13	1.27	0.97	1.60	1.38	

	(49)	50	51	52	(53)	(54)	(55)	56	57	58	59	60	61	62	(63)	64	
7	4.37	—	—	4.56	5.08	—	—	—	5.10	4.71	5.38	4.86	4.99	5.30	5.22	4.50	Y
	3.25	3.57	3.23	3.04	3.22	—	—	—	3.69	3.30	3.67	3.29	3.66	3.51	3.35	3.45	K
	1.12	—	—	1.52	1.86	—	—	—	1.41	1.41	1.71	1.57	1.33	1.79	1.87	1.05	
8	—	—	—	—	—	—	—	4.89	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	3.17	3.70	—	—	—	—	—	—	—	—	K
	—	—	—	—	—	—	—	1.19	—	—	—	—	—	—	—	—	

		Group VIII.								Group IX.								
Date 1915	Pair :	57	58	59	60	61	62	(63)	64	65	(66)	67	68	69	70	71	72	
May 13		5.13	5.09	5.07	5.04	5.05	4.94	4.65	4.51	4.87	4.76	4.87	3.83	5.19	4.69	4.37	5.01	Y
		3.31	3.67	3.23	3.23	3.35	3.66	3.29	3.30	3.55	2.94	3.36	3.12	3.49	3.29	3.43	3.42	H
		1.82	1.41	1.84	1.81	1.70	1.28	1.36	1.21	1.32	1.82	1.51	1.71	1.70	1.41	0.94	1.59	
14		4.69	—	4.87	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.32	3.49	3.41	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.37	—	1.46	—	—	—	—	—	—	—	—	—	—	—	—	—	
18		4.33	4.85	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.40	3.23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		0.93	1.62	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
20		4.66	4.75	4.79	4.59	5.00	4.72	4.89	4.67	4.43	4.48	4.93	4.81	4.82	4.79	4.35	5.11	Y
		3.32	3.28	3.46	3.34	3.48	3.39	3.25	3.41	3.04	3.28	3.39	3.48	3.32	3.45	3.27	3.60	K
		1.34	1.47	1.33	1.25	1.52	1.33	1.64	1.26	1.39	1.20	1.54	1.33	1.50	1.34	1.18	1.51	
24		4.66	5.27	5.02	5.17	5.30	5.11	5.00	4.95	5.07	4.73	5.15	4.97	5.26	4.84	4.73	5.30	H
		3.60	3.86	3.41	3.21	4.00	3.51	3.29	3.78	2.98	3.72	3.58	3.46	3.40	3.42	3.53	3.63	K
		1.06	1.41	1.61	1.96	1.30	1.60	1.71	1.18	2.09	1.01	1.57	1.51	1.86	1.42	1.20	1.67	
25		—	4.54	4.61	4.88	4.97	5.31	4.86	4.66	4.74	4.80	4.74	5.06	4.97	4.94	4.65	4.81	Y
		3.85	3.36	3.50	3.01	3.57	3.85	3.31	3.59	3.50	3.43	3.47	3.63	3.41	3.13	3.04	3.11	H
		—	1.18	1.11	1.87	1.40	1.46	1.55	1.07	1.24	1.37	1.27	1.43	1.56	1.81	1.61	1.70	

Date 1919		Pair : 57	58	59	60	61	62	(63)	64	65	(66)	67	68	69	70	71	72	
	27	—	—	—	—	—	—	—	—	—	—	4.70	4.62	4.70	4.98	4.63	5.14	Y
		—	—	—	—	—	—	—	—	—	—	3.27	3.13	3.14	3.35	3.07	—	K
		—	—	—	—	—	—	—	—	—	—	1.43	1.49	1.56	1.63	1.56	—	
	29	5.07	4.74	4.83	4.55	5.19	4.97	4.66	4.94	4.36	4.62	4.86	5.06	4.68	4.75	4.50	4.99	Y
		3.60	3.11	3.33	3.14	3.60	3.19	2.99	3.38	3.44	3.36	3.63	3.46	3.51	3.27	3.21	3.20	H
		1.47	1.63	1.50	1.41	1.59	1.78	1.97	1.56	0.92	1.26	1.23	1.60	1.17	1.48	1.29	1.79	
	30	—	—	—	—	4.70	—	4.68	—	4.97	4.55	5.21	—	—	—	—	—	Y
		3.36	3.38	3.37	3.34	3.39	—	2.62	3.21	2.99	3.14	3.54	—	—	—	—	—	K
		—	—	—	—	1.31	—	2.06	2.77	1.98	1.41	1.67	—	—	—	—	—	
	31	—	—	—	—	—	—	—	—	—	—	4.97	4.65	4.85	—	4.67	4.88	Y
		—	—	—	—	—	—	—	—	—	—	3.50	3.21	1.10	—	2.90	3.08	K
		—	—	—	—	—	—	—	—	—	—	1.47	1.44	1.75	—	1.77	1.80	
June	2	4.91	4.99	4.97	4.92	5.04	4.98	4.84	4.82	4.43	4.97	5.16	4.76	4.92	4.62	4.28	5.05	Y
		3.50	3.44	3.59	3.04	3.58	3.52	3.56	4.24	3.32	3.21	3.39	3.55	3.55	3.12	3.24	3.28	K
		1.41	1.55	1.38	1.88	1.46	1.46	1.28	1.58	1.11	1.76	1.77	1.21	1.37	1.50	1.04	1.77	
	3	5.04	4.67	5.01	4.88	5.15	5.18	4.84	4.89	4.89	—	—	—	—	—	—	—	Y
		3.50	3.39	3.25	3.20	3.42	3.60	3.37	3.36	3.21	—	—	—	—	—	—	—	H
		1.54	1.28	1.76	1.68	1.73	1.58	1.47	1.53	1.48	—	—	—	—	—	—	—	
	7	5.02	4.59	4.98	4.61	4.97	4.83	4.58	4.80	4.65	4.64	4.85	4.89	5.00	4.73	4.44	4.88	Y
		3.68	3.30	•3.51	2.97	3.42	3.66	3.27	3.31	3.00	3.22	3.43	—	3.31	3.11	3.08	3.43	H
		1.34	1.29	1.47	1.64	1.55	1.17	1.31	1.49	1.65	1.42	1.42	—	1.69	1.62	1.36	1.45	

Group IX. Group X.

Date 1915		Pair : 65	(66)	67	68	69	70	71	72	73	74	75	76	77	78	(79)	80	
June	10	4.63	4.73	—	4.91	—	—	—	—	—	—	—	—	—	—	—	4.85	Y
		3.08	3.27	—	3.06	—	—	—	—	—	—	—	—	—	—	3.22	3.09	K
		1.55	1.46	—	1.85	—	—	—	—	—	—	—	—	—	—	—	1.76	

	65	(66)	67	68	69	70	71	72	73	74	75	76	77	78	(79)	80	
13	—	4.88	4.86	5.11	4.54	4.85	4.74	5.05	4.93	5.07	5.04	4.75	4.79	4.80	4.43	4.62	Y
	—	3.13	3.41	3.81	3.12	3.41	3.06	3.27	3.73	3.24	3.79	3.39	3.00	3.50	3.17	3.10	H
	—	1.75	1.45	1.30	1.42	1.44	1.68	1.78	1.20	1.83	1.25	1.36	1.79	1.30	1.26	1.52	
14	4.78	—	—	—	—	—	4.78	4.57	—	—	—	—	—	—	—	—	Y
	2.82	—	—	—	—	—	3.02	3.21	3.56	—	—	—	—	—	—	—	K
	1.96	—	—	—	—	—	1.75	1.36	—	—	—	—	—	—	—	—	
15	4.11	5.47	5.00	4.85	4.89	4.83	4.61	5.02	5.22	5.01	4.96	4.94	4.92	—	4.91	4.81	H
	2.75	3.47	3.21	3.30	3.16	3.34	2.78	3.34	3.64	—	3.53	3.35	2.98	—	3.44	2.84	K
	1.36	2.00	1.79	1.55	1.73	1.49	1.83	1.68	1.58	—	1.43	1.49	1.94	—	1.47	1.97	
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
	—	—	—	—	—	—	—	—	—	—	—	—	3.53	—	—	3.18	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
20	4.57	4.86	4.81	5.03	4.92	4.68	4.52	5.14	4.74	—	—	—	—	—	—	—	Y
	3.31	3.03	3.37	3.32	3.18	3.26	3.05	3.42	3.91	—	—	—	—	—	—	—	H
	1.26	1.83	1.44	1.71	1.74	1.42	1.47	1.72	0.83	—	—	—	—	—	—	—	
22	4.49	4.86	4.96	5.18	4.97	—	—	4.76	—	|	5.24	4.90	4.84	5.04	4.86	—	H
	3.00	3.25	3.46	3.42	3.16	3.23	—	2.99	—	—	3.40	3.37	3.31	3.46	3.25	—	K
	1.49	1.61	1.50	1.76	1.81	—	—	1.77	—	—	1.84	1.53	1.53	1.58	1.61	—	
23	—	—	4.96	5.33	4.62	4.54	4.61	4.94	5.21	5.14	5.45	5.32	4.68	4.68	4.93	5.11	Y
	3.07	3.31	3.68	3.36	3.64	3.18	3.35	3.03	3.87	4.06	3.53	3.83	3.37	3.33	—	3.23	H
	—	—	1.28	1.97	0.98	1.36	1.26	1.91	1.34	1.08	1.92	1.49	1.31	1.35	—	1.88	
26	4.93	4.43	4.94	4.65	4.60	4.54	4.64	4.96	5.04	4.43	4.79	4.87	4.61	4.36	4.87	4.56	Y
	3.26	2.82	3.22	3.25	3.24	3.22	2.77	3.03	3.51	3.44	3.20	3.72	3.05	3.54	3.36	3.09	H
	1.67	1.61	1.72	1.40	1.36	1.32	1.87	1.93	1.53	0.99	1.59	1.15	1.56	0.82	1.51	1.47	
27	4.50	4.66	5.02	4.91	4.97	4.66	4.63	4.81	5.00	4.77	5.16	—	4.68	4.78	4.97	4.29	Y
	3.13	3.26	3.10	2.86	3.08	3.12	3.14	3.26	3.44	3.53	3.47	3.63	3.47	3.40	3.48	2.93	H
	1.37	1.40	1.92	2.05	1.89	1.54	1.49	1.55	1.56	1.24	1.69	—	1.21	1.38	1.49	1.36	
29	—	—	—	—	—	—	—	4.66	—	—	—	—	4.75	4.66	4.96	—	Y
	—	—	—	—	—	—	—	3.44	—	—	—	4.00	3.17	3.43	3.51	3.14	H
	—	—	—	—	—	—	—	1.22	—	—	—	—	1.58	1.23	1.45	—	

Date 1915		Pair: 65	(66)	67	68	69	70	71	72	73	74	75	76	77	78	(79)	80	
June	30	4.41	4.75	4.59	4.97	4.76	4.66	4.78	4.83	5.30	5.08	5.22	4.60	5.04	4.97	5.20	4.60	Y
		2.94	4.14	3.24	3.09	3.12	3.29	3.03	3.62	3.38	3.50	3.65	3.33	3.23	3.66	3.48	3.08	H
		1.47	1.61	1.35	1.88	1.64	1.37	1.75	1.21	1.42	1.58	1.57	1.27	1.81	1.31	1.72	1.52	
July	1	4.63	4.78	4.74	4.62	4.83	4.70	4.73	5.07	4.93	5.05	5.28	5.40	4.75	—	4.76	4.82	Y
		3.35	2.99	2.98	3.42	3.18	3.34	3.09	3.06	3.64	3.54	3.54	3.75	3.38	3.53	3.50	3.23	H
		1.28	1.79	1.76	1.20	1.65	1.36	1.64	2.01	1.29	1.51	1.74	1.65	1.37	—	1.26	1.59	
	7	4.66	5.70	4.99	4.80	4.98	4.77	4.77	4.87	5.23	5.25	5.04	—	—	—	—	—	Y
		3.20	3.40	3.43	3.32	3.08	3.29	3.04	3.20	3.56	3.45	3.23	—	—	—	—	—	K
		1.46	1.30	1.56	1.43	1.90	1.48	1.73	1.67	1.67	1.80	1.81	—	—	—	—	—	
	8	—	—	—	4.78	—	—	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	3.05	—	—	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	1.73	—	—	—	—	—	—	—	—	—	—	—	—	
	9	4.62	4.65	4.67	4.82	4.87	4.92	4.39	4.47	5.29	4.92	—	5.00	—	—	4.73	—	Y
		3.06	3.30	3.27	3.11	3.16	4.05	2.80	3.25	—	3.53	—	3.27	—	—	3.43	—	K
		1.56	1.35	1.40	1.71	1.71	1.87	1.59	1.22	—	1.39	—	1.73	—	—	1.30	—	

		Group X.								Group XI.								
Date 1915		Pair: 73	74	75	76	77	78	(79)	80	(81)	82	83	84	85	86	87	88	
July	14	4·83	—	5.05	5.04	4·82	5.07	5.03	4·87	4.01	4.90	5.16	4.89	4.97	4.97	—	4.91	Y
		3.24	3.52	3.49	3.50	3.25	3.22	3.48	3.32	2.78	3.39	3.54	3.34	3.38	3.81	3.12	3.35	K
		1.59	—	1.56	1.54	1.57	1.85	1.55	1.55	1.23	1.51	1.62	1.55	1.59	1.16	—	1.56	
	15	4·88	5.02	4.97	5.16	4.61	4.95	—	—	—	—	—	—	—	—	—	—	Y
		3.56	3.25	3.59	3.48	3.28	3.47	—	—	—	—	—	—	—	—	—	—	K
		1.32	1.77	1.38	1.68	1.33	1.48	—	—	—	—	—	—	—	—	—	—	

	73	74	75	76	77	78	(79)	80	(81)	82	83	84	85	86	87	88	
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	3.67	3.42	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
19	—	4.81	5.35	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	3.65	3.21	3.70	—	3.55	—	—	—	—	—	—	—	—	—	—	—	K
	—	1.60	1.65	—	—	—	—	—	—	—	—	—	—	—	—	—	
20	—	—	—	—	4.86	—	—	4.78	4.27	5.26	5.11	—	5.08	4.89	5.34	5.34	Y
	—	—	—	—	3.47	—	—	3.36	2.39	2.97	3.27	—	3.53	3.55	3.24	3.50	K
	—	—	—	—	1.39	—	—	1.42	1.88	2.26	1.84	—	1.55	—	1.65	1.84	
21	5.26	4.47	5.03	4.53	4.87	4.35	—	—	—	—	5.10	4.36	5.20	5.06	4.81	4.84	Y
	3.77	3.50	3.45	3.27	3.37	3.03	3.27	3.01	—	—	3.55	3.36	3.23	3.51	3.44	3.29	K
	1.46	0.97	1.58	1.26	1.50	1.32	—	—	—	—	1.55	1.00	1.97	1.55	1.37	1.55	
25	5.14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	3.78	—	—	—	3.37	3.56	—	—	—	—	—	—	—	—	—	—	H
	1.36	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
26	5.12	5.16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	3.67	3.39	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	1.45	1.77	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
28	—	—	—	—	—	—	—	—	—	4.76	4.85	—	—	—	4.88	5.10	Y
	—	—	—	—	—	—	—	—	—	3.57	3.44	—	—	—	3.33	3.26	K
	—	—	—	—	—	—	—	—	—	1.22	1.41	—	—	—	1.55	1.84	
30	—	5.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	4.02	3.58	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	—	1.45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
31	5.34	5.07	—	—	—	—	—	4.87	4.01	4.92	—	—	4.81	5.12	5.06	5.01	Y
	3.91	3.34	—	—	—	—	—	3.09	2.68	3.45	—	—	3.51	3.45	3.45	3.34	K
	1.43	1.73	—	—	—	—	—	1.78	1.33	1.47	—	—	1.30	1.67	1.61	1.67	
Aug. 1	—	5.07	5.05	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	3.63	3.44	3.42	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	—	1.63	1.63	—	—	—	—	—	—	—	—	—	—	—	—	—	

Date 1915	Pair :	73	74	75	76	77	78	(79)	80	(81)	82	83	84	85	86	87	88	
Aug.	3	—	—	—	—	—	—	—	4.91	4.13	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	3.25	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	1.66	—	—	—	—	—	—	—	—	
	4	—	5.13	4.90	4.90	4.63	5.01	5.00	—	—	—	—	—	—	—	—	—	Y
		—	1.55	1.60	1.50	1.39	1.23	1.48	—	—	—	—	—	—	—	—	—	K
		—	1.58	1.30	1.40	1.24	1.78	1.52	—	—	—	—	—	—	—	—	—	
	7	—	—	—	—	—	—	—	—	—	—	—	—	4.77	5.03	4.84	—	Y
		—	—	—	—	—	—	—	—	—	—	—	3.63	3.14	3.33	3.36	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	1.33	1.70	1.48	—	
	8	—	—	—	—	—	—	—	4.92	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	—	—	3.[17	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	1.75	—	—	—	—	—	—	—	—	
	9	5.43	5.06	—	—	—	—	—	—	—	—	—	—	4.84	—	—	—	Y
		3.74	3.46	—	—	—	—	—	—	—	—	—	—	3.11	3.58	3.31	—	K
		1.69	1.60	—	—	—	—	—	—	—	—	—	—	1·73	—	—	—	
	11	5.08	4·68	4.98	4.82	4.78	—	—	4.95	4.01	4.98	4.74	—	4.89	5.33	4.93	5.75	Y
		3.81	3.38	3.55	3.14	3.12	—	—	3.27	2.38	3.80	3.40	—	3.66	3.27	3.32	—	K
		1.27	1.30	1.43	1.68	1.66	—	—	1.68	1.63	1.18	1.34	—	1.23	2.06	1.61	—	

Group XI.

Group XII.

Date 1915	Pair :	(81)	82	83	84	85	86	87	88	89	90	91	92	93	(94)	(95)	96	
Aug.	14	—	—	—	—	—	—	—	—	—	—	—	—	4.88	4.73	4.77	5.28	Y
		—	—	—	—	—	—	—	—	—	—	—	—	3.41	2.81	3.16	3.36	K
		—	—	—	—	—	—	—	—	—	—	—	—	1.47	1.92	1.61	1.92	

	(81)	82	83	84	85	86	87	88	89	90	91	92	93	(94)	(95)	96	
16	—	—	4.70	4.97	—	4.85	4.93	5.04	4.71	5.27	4.94	4.78	4.94	4.37	4.73	—	Y
	—	3.68	3.43	3.39	3.17	—	3.32	3.49	3.30	3.63	3.40	3.20	3.21	2.89	3.18	—	K
	—	—	1.27	1.58	—	—	1.61	1.55	1.41	1.64	1.54	1.58	1.73	1.48	1.55	—	
21	4.12	4.99	4.64	5.06	—	5.42	—	—	—	—	—	—	—	—	—	—	Y
	2.54	3.35	3.41	3.46	3.39	3.43	—	—	—	—	—	—	—	—	—	—	H
	1.58	1.64	1.23	1.60	—	1.99	—	—	—	—	—	—	—	—	—	—	
22	—	5.09	4.97	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	3.41	3.23	3.69	—	—	—	—	—	—	—	—	—	—	—	—	H
	—	1.68	1.74	—	—	—	—	—	—	—	—	—	—	—	—	—	
23	—	—	—	—	—	—	—	—	—	—	4.94	5.01	—	—	4.78	—	Y
	—	—	—	—	—	—	—	—	—	3.44	3.29	3.43	—	2.79	3.10	—	H
	—	—	—	—	—	—	—	—	—	—	1.65	1.58	—	—	1.68	—	
28	4.09	4.82	4.66	4.76	4.96	5.04	4.86	5.07	5.29	5.11	4.86	5.01	5.20	4.40	4.37	5.14	Y
	2.55	3.65	3.25	3.52	3.13	3.77	3.20	3.49	3.47	3.44	3.58	3.74	3.26	2.75	3.13	3.36	K
	1.54	1.17	1.41	1.24	1.83	1.27	1.66	1.58	1.82	1.67	1.28	1.27	1.94	1.65	1.24	1.78	
29	3.52	5.28	5.53	4.90	4.99	5.14	4.77	5.17	4.89	5.31	4.93	4.88	4.92	4.43	4.63	4.95	Y
	2.35	3.71	3.62	3.38	3.47	3.57	3.26	3.35	3.43	3.97	3.55	3.44	3.51	3.04	3.31	3.31	H
	1.17	1.57	1.91	1.61	1.43	1.57	1.51	1.82	1.46	1.34	1.38	1.44	1.41	1.39	1.32	1.64	
30	3.57	5.40	4.76	5.02	4.80	—	—	—	5.04	5.25	4.84	5.00	5.28	—	—	—	Y
	—	—	3.36	3.44	3.09	—	—	—	2.95	3.58	3.36	3.58	3.45	—	—	—	H
	—	—	1.40	1.58	1.71	—	—	—	2.09	1.67	1.48	1.42	1.83	—	—	—	
31	—	—	—	4.59	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	3·28	—	3.63	—	—	—	—	—	—	—	—	—	—	H
	—	—	—	1.31	—	—	—	—	—	—	—	—	—	—	—	—	
Sept. 1	—	4.95	5.01	5.34	4.67	—	—	—	—	—	—	—	—	—	—	—	Y
	—	3.54	3.16	3.67	3.08	—	—	—	—	—	—	—	—	—	—	—	H
	—	1.41	1.85	1.67	1.59	—	—	—	—	—	—	—	—	—	—	—	
6	—	—	—	—	—	—	4.72	—	—	—	—	5.31	5.08	—	4.40	—	Y
	—	—	—	—	—	—	—	—	—	3.72	—	3.74	3.41	3.01	3.02	—	K
	—	—	—	—	—	—	—	—	—	—	—	1.57	1.67	—	1.38	—	

Date 1915	Pair : (81)	82	83	84	85	86	87	88	89	90	91	92	93	(94)	(95)	96	
Sept. 8	4.24	4.93	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	3.01	3.81	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
	1.23	1.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
10	—	—	4.94	5.18	5.00	5.21	5.00	—	—	5.04	—	—	—	—	4.56	4.99	H
	—	—	3.42	3.57	3.38	3.87	3.57	3.64	—	3.46	—	—	—	—	3.04	3.56	K
	—	—	1.42	1.61	1.62	1.34	1.43	—	—	1.58	—	—	—	—	1.52	1.43	
11	—	—	5.00	4.89	—	5.09	5.12	—	—	—	—	—	—	—	—	—	Y
	—	—	3.48	3.59	3.45	3.69	3.39	—	—	—	—	—	—	—	—	—	H
	—	—	1.52	1.30	—	1.40	1.73	—	—	—	—	—	—	—	—	—	
12	—	4.82	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
13	—	4.95	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
15	4.08	5.00	4.79	5.15	4.91	5.15	4.98	4.94	4.61	4.73	4.91	5.08	4.99	4.54	4.51	4.87	Y
	2.28	3.46	3.42	3.46	3.58	3.67	3.73	3.56	3.46	3.52	—	3.57	4.06	5.08	5.03	3.76	H
	1.80	1.54	1.37	1.69	1.33	1.48	1.25	1.38	1.45	1.21	—	1.50	0.93	1.46	1.48	1.11	
16	4.06	4.83	4.64	4.91	4.72	5.00	—	—	4.99	4.51	4.87	5.14	5.21	—	—	—	Y
	2.61	3.45	3.12	3.49	3.36	3.50	—	—	3.72	3.58	3.39	3.57	3.59	—	—	—	H
	1.45	1.38	1.52	1.42	1.36	1.50	—	—	1.27	0.93	1.48	1.57	1.62	—	—	—	
17	—	—	4.86	5.33	4.69	5.06	5.22	5.28	4.73	—	—	—	—	—	4.69	—	H
	—	—	3.39	3.68	3.28	3.65	3.69	3.67	3.32	—	—	—	—	—	3.04	—	K
	—	—	1.47	1.65	1.41	1.41	1.53	1.61	1.41	—	—	—	—	—	1.65	—	
18	4.36	5.01	4.89	5.26	5.20	5.14	5.06	5.07	4.92	5.10	4.84	5.10	—	—	—	—	Y
	2.70	3.32	3.41	3.48	3.23	3.43	3.35	3.35	3.51	3.57	3.51	3.61	—	—	—	—	H
	1.66	1.69	1.48	1.78	1.97	1.71	1.71	1.72	1.41	1.53	1.33	1.49	—	—	—	—	
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5.30	Y
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.20	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2.10	

	(81)	82	83	84	85	86	87	88	89	90	91	92	93	(94)	(95)	96	
20	—	—	—	—	—	—	4.84	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	3.58	—	—	—	—	—	—	—	—	—	H
	—	—	—	—	—	—	1.26	—	—	—	—	—	—	—	—	—	
22	—	5.32	5.22	—	5.33	—	—	5.27	5.11	5.24	5.03	5.18	5.26	4.49	4.83	4.95	Y
	—	3.91	3.55	—	3.34	—	—	3.88	3.34	3.43	3.36	3.69	3.46	2.85	2.27	3.51	K
	—	1.41	1.67	—	1.99	—	—	1.39	1.77	1.81	1.67	1.49	1.80	1.64	1.56	1.44	

Group XII. Group I.

Date 1915	Pair:	89	90	91	92	93	(94)	(95)	96	1	2	3	4	5	6	(7)	8	
Sept.	23	5.17	—	—	—	—	—	—	5.02	5.22	5.08	4.97	—	—	5.16	—	—	Y
		3.37	3.51	—	—	—	3.29	—	3.40	3.81	3.66	3.58	—	—	3.34	—	—	H
		1.80	—	—	—	—	—	—	1.62	1.41	1.42	1.39	—	—	1.82	—	—	
	27	—	—	—	—	—	—	—	—	—	—	—	5.33	—	—	—	4.80	Y
		—	—	—	—	—	—	—	—	—	—	—	3.85	—	—	—	3.53	H
		—	—	—	—	—	—	—	—	—	—	—	1.48	—	—	—	1.27	
	28	—	—	—	—	—	—	—	5.08	5.30	—	—	—	—	—	—	—	Y
		—	3.55	—	—	—	3.14	—	3.27	3.49	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	—	1.81	1.81	—	—	—	—	—	—	—	
Oct.	1	5.11	5.27	5.16	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.55	3.70	3.51	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.56	1.57	1.65	—	—	—	—	—	—	—	—	—	—	—	—	—	
	3	4.72	5.02	5.42	4.92	5.18	4.42	4.77	5.07	5.27	5.21	5.23	5.19	5.47	5.30	5.80	5.19	H
		3.56	3.29	3.42	3.52	3.84	2.86	3.13	3.72	3.87	3·76	3.53	3.80	3.78	3.65	4.07	3.72	K
		1.16	1.73	2.00	1.40	1.34	1.56	1.64	1.35	1.40	1.45	1.70	1.39	1.69	1.65	1.73	1.47	
	4	—	—	—	—	—	4.11	4.85	4.77	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	2.98	3.27	3.54	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	1.13	1.58	1.23	—	—	—	—	—	—	—	—	

Date 1915	Pair: 89	90	91	92	93	(94)	(95)	96	1	2	3	4	5	6	(7)	8	
Oct. 5	5.07	5.44	5.20	5.09	5.27	4.64	4.96	4.99	5.15	4.95	5.27	5.36	5.09	5.25	5.38	5.32	Y
	3.57	3.67	3.33	3.66	3.71	3.12	3.43	3.42	3.87	3.50	3.61	3.66	3.53	3.70	3.97	3.48	H
	1.50	1.77	1.87	1.43	1.56	1.52	1.53	1.57	1.28	1.45	1.66	1.70	1.56	1.55	1.41	1.84	
6	—	—	—	—	5.21	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	3.62	—	—	—	—	—	—	—	—	—	—	—	H
	—	—	—	—	1.56	—	—	—	—	—	—	—	—	—	—	—	
9	—	—	—	4.75	5.45	4.60	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	4.02	—	—	—	—	—	—	—	—	—	—	—	H
	—	—	—	—	1.43	—	—	—	—	—	—	—	—	—	—	—	
14	5.23	5.03	5.12	4.87	5.11	4.71	4.83	—	—	5.17	4.91	—	—	—	—	—	Y
	3.34	3.62	3.59	3.34	3.85	3.24	3.46	—	—	3.57	3.65	—	—	—	—	—	H
	1.89	1.41	1.53	1.53	1.26	1.47	1.37	—	—	1.60	1.26	—	—	—	—	—	
15	—	—	—	5.17	5.17	4.16	5.28	4.66	5.32	5.28	5.14	5.14	5.21	5.35	5.50	5.20	H
	—	—	—	3.46	3.54	3.17	3.65	3.34	4.02	3.67	3.65	3.76	3.22	3.48	3.67	3.65	K
	—	—	—	1.71	1.63	0.99	1.63	1.32	1.30	1.61	1.49	1.38	1.99	1.87	1.83	1.55	
16	5.30	5.30	4.87	5.37	5.18	4.54	4.90	5.12	5.26	5.11	5.56	5.15	5.43	5.07	5.42	4.94	Y
	3.63	3.86	3.79	3.88	3.64	2.96	3.20	3.57	3.60	3.29	3.46	3.75	3.45	3.74	4.08	3.46	K
	1.67	1.44	1.08	1.49	1.54	1.58	1.70	1.55	1.66	1.82	2.10	1.40	1.98	1.33	1.34	1.48	
23	—	5.17	4.96	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	3.58	3.60	—	—	—	3.29	—	—	—	—	—	—	—	—	—	H
	—	1.59	1.36	—	—	—	—	—	—	—	—	—	—	—	—	—	
29	5.18	5.02	5.09	5.18	5.15	4.50	4.38	5.03	5.00	5.09	5.23	5.49	4.88	5.07	5.71	4.97	Y
	3.63	3.87	3.61	3.59	3.67	3.28	3.34	3.53	3.81	3.74	3.83	3.93	3.77	3.65	—	3.46	H
	1.55	1.15	1.48	1.59	1.48	1.22	1.04	1.50	1.19	1.35	1.40	1.56	1.11	1.42	—	1.51	
31	5.15	5.44	5.68	5.57	5.25	4.55	4.94	5.27	5.29	5.11	5.12	4.80	5.16	5.20	5.08	5.07	Y
	3.63	3.58	3.84	4.09	3.77	3.15	3.25	3.82	3.88	3.89	3.47	3.78	3.87	3.59	3.79	3.31	K
	1.52	1.86	1.84	1.48	1.48	1.40	1.69	1.45	1.41	1.22	1.65	1.02	1.29	1.61	1.29	1.76	

Date 1915	Pair:	1	2	3	4	5	6	(7)	8	9	10	11	(12)	13	14	15	16	
		Group I.								**Group II.**								
Nov. 3		5.18	4.99	5.36	5.22	5.31	5.26	5.84	5.36	5.54	5.34	5.31	5.08	5.26	5.30	5.56	4.46	Y
		3.80	3.40	3.73	3.63	4.64	3.83	4.17	3.68	3.82	3.92	4.00	3.77	4.02	3.73	3.70	3.87	H
		1.38	1.59	1.63	1.56	1.67	1.43	1.67	1.68	1.72	1.42	1.31	1.31	1.24	1.57	1.86	0.59	
5		5.61	5.35	5.37	5.73	5.82	5.80	5.92	5.07	5.81	4.91	5.34	5.37	5.02	5.57	5.81	5.26	H
		3.92	3.56	3.66	4.11	4.12	3.82	4.09	3.48	3.93	3·63	3.92	3.39	4.36	3.57	3.53	3.47	K
		1.69	1.79	1.71	1.62	1.70	1.98	1.83	1.59	1.88	1.28	1.42	1.98	0.66	2.00	2·28	1.79	
6		—	—	5.20	—	5.63	5.76	5.99	5.97	5.68	5.27	5.77	5.52	5.63	5.05	5.28	4.74	Y
		—	—	3.83	—	4.05	3.97	4·54	4.10	3.69	4.14	4.06	6.79	3.76	3.53	3.66	3.32	H
		—	—	1.37	—	1.58	1.82	1.45	1.87	1.99	1.13	1.71	1.73	1.87	1.52	1.62	1.42	
10		5.45	5.11	5.83	5.75	5.15	5.64	5.74	5.24	5.36	5.25	—	—	—	—	5.11	5.30	Y
		3.70	3.53	3.64	3.26	4.01	—	3.98	3.80	4.15	4.10	3.89	—	—	—	3.99	3.54	H
		1.75	1.58	2.19	2.49	1.14	—	1.76	1.44	1.21	1.15	—	—	—	—	1.12	1.76	
12		5.40	4.81	5.63	5.15	5.33	4.97	5.36	4.74	5.43	—	5.11	5.19	5.70	—	—	—	Y
		4.13	3.30	3.73	4.84	3.07	3.38	3.87	3.33	4.17	—	—	3.51	4.01	—	—	—	H
		1.27	1.51	1.90	1.31	2.26	1.59	1.49	1.41	1.26	—	—	1.68	1.78	—	—	—	
13		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		—	—	3.73	—	3.62	3.65	—	—	4.17	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
14		5.37	4.92	5.37	4.92	5.36	5.04	5.21	5.30	5.46	5.22	4.86	4.66	5.34	4.99	5.12	4.81	Y
		3.96	3.64	3.87	3.71	4.09	3.91	4.20	3.90	4.26	3.69	3.71	3.38	4.28	3.58	3.85	3.43	H
		1.41	1.28	1.50	1.21	1.27	1.13	1.01	1.40	1.20	1.53	1.15	1.28	1.06	1.41	1.27	1.38	
15		5.01	5.06	5.04	5.17	5.82	5.38	5.42	5.42	5.36	—	—	4.05	5.68	—	—	—	Y
		3.85	3.74	3.57	3.71	3.60	3.98	4.15	3.80	3.85	—	—	—	3·76	—	—	—	H
		1.16	1.32	1.47	1.46	2.22	1.40	1.27	1.62	1.51	—	—	—	1.92	—	—	—	
17		—	—	—	—	—	5.51	5.80	5.40	—	—	—	—	—	—	—	—	H
		—	—	—	—	—	3.80	4.19	3.82	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	1.71	1.61	1.58	—	—	—	—	—	—	—	—	

Date 1915	Pair: 1	2	3	4	5	6	(7)	8	9	10	11	(12)	13	14	15	16	
Nov. 21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	3.85	4.13	3.55	3.61	3.91	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
22	—	—	—	—	—	—	5.90	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	4.56	—	—	—	—	—	—	—	—	—	K
	—	—	—	—	—	—	1.34	—	—	—	—	—	—	—	—	—	
23	—	—	—	—	—	—	5.87	5.49	5.49	5.24	5.31	4.98	5.98	5.07	5.27	5.31	Y
	—	—	—	—	—	—	4.05	3.78	3.78	3.93	3.74	3.50	4.21	3.79	3.50	3.76	K
	—	—	—	—	—	—	1.82	1.71	1.71	1.31	1.57	1.48	1.77	1.28	1·68	1.55	
24	5.41	5.13	5.33	5.45	5.19	5.71	5.37	5.43	5.28	5.28	4.96	5.26	5.72	5.47	5.40	5.32	H
	3.95	3.60	3.80	3.91	3.89	3.85	4.18	3.84	3.85	3.82	3.81	3.84	4.09	4.56	4.73	3.64	K
	1.46	1.53	1.53	1.54	1.30	1.86	1.19	1.59	1.43	1.46	1.15	1.42	1.63	1.91	1.67	1.68	
26	4.82	—	—	—	—	—	5.99	5.51	5.48	—	—	—	—	5.60	5.59	5.72	Y
	3.26	—	—	—	—	3.83	4.05	—	3.74	—	—	—	—	4.00	3.47	4.31	K
	1.56	—	—	—	—	—	1.94	—	1.74	—	—	—	—	1.60	2.12	1.41	
27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	4.20	3.73	3.80	3.85	3.83	—	—	3.64	—	—	—	—	—	—	—	—	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
29	5.32	5.45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	3.77	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	—	1.68	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
30	5.10	5.64	—	—	4.82	5.06	5.14	5.54	4.58	5.21	5.01	5.00	5.39	5.34	4.77	5.40	H
	—	—	—	—	3.44	—	3.73	—	3.34	3.68	3.27	3.25	3.71	3.22	3.06	3.63	K
	—	—	—	—	1.38	—	1.41	—	1.24	1.53	1.74	1.74	1.68	1.12	1.71	1.77	
Dec. 1	—	5.16	5.59	5.63	5.96	5.67	5.75	5.34	5.79	—	—	—	—	—	—	—	Y
	—	3.74	3.56	4.09	4.13	4.06	4.22	3.75	4.17	3.81	3.48	—	—	—	—	—	H
	—	1.42	2.03	1.54	1.83	1.61	1.53	1.59	1.62	—	—	—	—	—	—	—	
	5.51	5.09	5.00	5.24	5.77	5.14	—	5.15	5.62	5.64	5.56	5.24	5.93	5.34	5.35	5.41	Y
	4.56	3.62	3.89	4.09	4.19	4.10	4.49	3.96	4.36	3.96	3.84	3.80	4.07	3.63	3.90	3.73	H
	0.95	1.47	1.11	1.15	1.58	1.04	—	1.19	1.26	1.68	1.72	1.44	1.86	1.71	1.44	1.68	

	1	2	3	4	5	6	(7)	8	9	10	11	(12)	13	14	15	16	
3	5.24	—	—	—	—	—	—	5·58	5.95	5.57	5.49	5.68	5.69	5.45	5.64	5.21	H
	3.91	—	—	—	—	—	—	3.69	3.85	3.97	3.73	3.71	4.29	3.81	4.03	3.37	K
	1.33	—	—	—	—	—	—	1.89	2.10	1.60	1.76	1.97	1.40	1.64	1.61	1.84	
4	5.53	—	—	—	5.95	5.40	—	5.15	—	—	—	—	—	—	—	—	Y
	3.83	—	4.54	—	4.12	4.12	—	3.65	—	—	—	—	—	—	—	—	H
	1.70	—	—	—	1.83	1.28	—	1.50	—	—	—	—	—	—	—	—	
5	5.37	5.07	5.13	5.27	5.52	5.32	5.65	5.26	5.14	5.26	5.33	4.80	5.47	—	—	5.36	Y
	4.08	3.41	4.17	3.73	4.20	3.92	3.98	3.96	3.95	3.72	3.63	3.48	4.27	—	—	3.90	H
	1.29	1.66	0.96	1.54	1.32	1.40	1.67	1.30	1.19	1.54	1.70	1.32	1.20	—	—	1.46	
6	—	5.06	5.19	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	3.74	3.77	—	—	—	—	—	—	—	—	—	—	—	—	—	K
	—	1.32	1.42	—	—	—	—	—	—	—	—	—	—	—	—	—	

Group II. Group III·

Date 1915	Pair: 9	10	11	(12)	13	14	15	16	17	18	19	20	21	22	23	24	
Dec. 7	—	—	5.25	4.58	5.72	5.73	6.05	5.44	5.82	5.17	—	—	—	5.68	5.43	—	H
	—	—	4.01	3.11	4.26	3.93	3.95	4.16	4.34	3.83	—	4.27	—	3.70	3.87	—	K
	—	—	1.24	1.47	1.46	1.80	2.10	1.28	1.48	1.34	—	—	—	1.98	1.56	—	
8	—	—	—	4.99	5.47	5.47	5.58	5.18	5.45	5.31	5.53	5.25	5.57	—	5.42	4:95	Y K
	3.89	—	—	3.45	3.65	3.94	3.83	3.72	3.71	4.10	3.95	3.79	3.94	3.84	3.89	3.41	Y
	—	—	—	1.54	1.82	1.53	1.75	1.46	1.74	1.21	1.58	1.46	1.63	—	1.53	1.54	
9	—	—	—	—	—	—	—	5.62	—	5.08	5.65	5.41	5.23	5.48	5.47	5.45	Y H
	—	—	—	—	—	—	3.85	3.87	3.83	3.82	4.18	3.82	3.68	4.08	3.79	3.80	
	—	—	—	—	—	—	—	1.75	—	1.26	1.47	1.79	1.55	1.40	1.68	1.65	
10	4.82	5.18	—	—	3.38	—	—	—	—	5.41	—	—	—	—	—	—	Y H
	3.80	3.56	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	1.02	1.62	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

Date 1915	Pair : 9	10	11	(12)	13	14	15	16	17	18	19	20	21	22	23	24	
Dec. 11	—	—	—	5.41	5.34	5.85	5.29	5.48	4.99	4.81	5.68	5.71	5.54	5.07	5.59	—	H
	—	—	—	3.57	—	—	—	3.94	3.70	3.31	3.99	3.90	—	3.98	3 81	—	K
	—	—	—	1.84	—	—	—	1.54	1.29	1.50	1.69	1.81	—	1.09	1.78	—	
12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	—	—	4.09	—	3.94	3.83	3.84	4.07	—	3.47	K
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
13	5.33	5.55	5.08	5.02	5.74	5.20	5.60	5.42	5.47	5.22	5.57	5.47	5.29	—	—	5.35	Y
	3.88	4.05	3.59	3.51	3.91	3.73	3.90	3.89	3.85	3.72	3.87	3.65	4.18	—	3.91	3.71	K
	1.45	1.50	1.49	1.51	1.83	1.47	1.70	1.53	1.62	1.50	1.70	1.82	1.11	—	—	1.64	
15	5.60	5.42	5.87	5.07	5.64	5.20	5.87	5.17	5.36	5.03	5.22	4.99	5.19	5.56	4.94	4.45	H
	4.13	4.09	4.01	3.68	4.22	3.27	4.17	3.48	3.93	3.47	3.62	3.35	3.69	4.12	3.68	3.20	K
	1.47	1.33	1.86	1.39	1.42	1.93	1.70	1.69	1.43	1.56	1.60	1.64	1.50	1.44	1.26	1.25	
18	5.77	5.67	5.04	5.29	5.79	5.49	5.66	5.45	5.48	5.53	—	—	—	—	—	—	Y
	3.91	3.88	3.92	3.78	3.89	4.15	3.69	3.98	3.90	3.96	—	—	—	—	—	—	H
	1.86	1.79	1.12	1.51	1.90	1.34	1.97	1.47	1.58	1.57	—	—	—	—	—	—	
20	5.73	5.30	5.27	—	—	—	5.25	5.29	5.36	5.17	5.40	5.54	5.56	5.29	5.59	5.44	Y
	4.18	3.90	3.70	—	4.00	—	3.71	3.77	4.00	3.62	3.70	3.63	4.09	3.93	4.13	3.75	K
	1.55	1.40	1.57	—	—	—	1.54	1.52	1.36	1.55	1.70	1.91	1.47	1.36	1.46	1.69	
23	5.82	—	5.23	5.15	—	—	—	—	—	—	—	—	5.36	—	4.86	5.21	Y
	4.08	—	3.59	3.65	4.25	—	—	—	—	—	—	—	3.53	—	—	3.72	K
	1.74	—	1.64	1.50	—	—	—	—	—	—	—	—	1.83	—	—	1.49	
27	5.17	5.02	5.22	5.07	5.70	5.31	5.43	5.43	5.41	5.05	5.75	5.51	5.64	5.41	5.23	5.32	Y
	3.96	3.76	3.94	3.67	4.00	3.86	3.96	3.77	4.05	3.71	3.94	3.94	4.08	3.90	3.92	3.83	K
	1.21	1.26	1.28	1.40	1.70	1.45	1.47	1.64	1.36	1.34	1.81	1.57	1.56	1.51	1.31	1.49	
28	—	—	—	5.00	5.44	—	—	—	—	—	5.56	5.31	5.49	5.25	5.36	5·24	H
	—	—	3.63	3.70	4.44	—	—	—	—	—	3.98	3.99	3.59	3.92	3.84	3.61	K
	—	—	—	1.30	1.00	—	—	—	—	—	1.58	1.32	1.90	1.33	1.52	1.63	
29	5.40	—	—	—	5.58	5.48	5.76	—	—	—	—	—	—	—	—	—	Y
	3.82	2.83	3.75	3.85	4.42	3.96	4.03	—	—	—	—	3.92	—	—	3.38	—	H
	1.58	—	—	—	1.16	1.52	1.73	—	—	—	—	—	—	—	—	—	

		9	10	11	(12)	13	14	15	16	17	18	19	20	21	22	23	24	
	30	5.36	5.29	5.31	5.27	5.50	5.14	5.69	5.08	5.45	5.16	5.38	5.20	5.44	5.46	5.25	5.08	Y
		3.95	3.83	3.76	3.71	4.13	3.88	3.93	3.61	4.15	3.71	4.06	3.68	3.79	3.90	3.92	3.71	H
		1.41	1.46	1.55	1.56	1.37	1.26	1.76	1.47	1.30	1.45	1.32	1.52	1.65	1.56	1.33	1.37	
	31	5.54	5.20	5.36	5.29	5.59	5.57	5.63	5.33	5.93	5.53	5.60	5.35	5.79	5.53	5.34	5.65	K
		3.91	4.11	3.85	2.51	4.02	3.68	3.86	3.99	3.78	4.16	3.78	3.67	3.92	3.12	3.74	3.94	H
		1.63	1.09	1.51	1.78	1.57	1.89	1.77	1.34	2.15	1.37	1.82	1.68	1.87	1.41	1.60	1.67	
1916 Jan.	4	5.79	5.08	5.56	5.19	5.55	5.43	5.69	5.47	5.70	5.53	5.25	5.22	—	—	5.08	5.29	Y
		4.00	3.82	3.72	3.61	4.15	3.72	3.95	3.81	4.02	3.79	3.89	3.83	—	—	3.71	3.79	K
		1.79	1.26	1.84	1.58	1.40	1.71	1.74	1.66	1.68	1.74	1.36	1.39	—	—	1.37	1.50	

Group III.   Group IV.

Pair 1916	Group:	17	18	19	20	21	22	23	24	25	26	27	28	29	30	(31)	32	
Jan.	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		4.09	4.14	3.80	—	—	4.02	3.86	3.71	4.08	3.80	3.76	3.81	4.05	4.18	3.96	4.05	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		—	—	—	—	4.04	—	3.83	3.53	4.16	3.93	4.05	—	—	—	—	—	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		3.57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	10	—	—	5.29	5.10	4.79	5.26	5.52	—	—	—	—	—	—	5.47	5.42	5.32	Y
		—	—	4.14	3.60	3.81	3.77	3.97	—	—	—	—	—	—	3.92	3.79	3.56	H
		—	—	1.15	1.50	1.98	1.49	1.55	—	—	—	—	—	—	1.55	1.63	1.76	
	11	5.30	5.96	5.56	5.75	5.54	5.83	—	—	—	—	—	—	—	—	—	—	Y
		4.09	4.61	4.29	3.91	4.49	—	—	—	—	—	—	—	—	—	—	—	H
		1.21	1.35	1.27	1.84	1.05	—	—	—	—	—	—	—	—	—	—	—	

Pair 1916	Group: 17	18	19	20	21	22	23	21	25	26	27	28	29	30	(31)	32	
12	5.21	4.48	5.79	5.83	5.39	5.22	5.42	5.49	5.33	5.58	5.17	5.60	5.35	5.51	5.50	5.28	H
	4.12	4.00	4.01	3.97	3.88	3.74	3.98	3.79	4.07	3.96	3.90	3.98	4.00	3.98	4.19	3.65	K
	1.09	1.48	1.78	1.86	1.51	1.48	1.44	1.70	1.26	1.62	1.27	1.62	1.35	1.53	1.31	1.63	
13	5.39	5.36	5.36	5.22	5·47	—	—	5.69	—	—	—	—	—	—	—	—	Y
	4.03	3.69	3.99	3.81	3.96	—	—	3.75	—	—	—	—	—	—	—	—	K
	1.36	1.67	1.37	1.41	1.51	—	—	1.94	—	—	—	—	—	—	—	—	
16	5.41	5.31	5.42	5.51	5.55	5.70	5.23	—	—	—	5.36	5.58	5.47	5.74	5.25	5.09	H
	4.18	4.28	3.76	3.89	4.10	4.12	—	—	—	—	3.81	3.95	3.89	4.36	3.88	4.01	K
	1.23	1.03	1.66	1.62	1.45	1.58	—	—	—	—	1.55	1.63	1.58	1.38	1.37	1.08	
18	—	—	—	—	—	—	5.31	—	—	—	—	—	—	5.34	5.35	5.16	Y
	—	—	—	—	—	—	3.77	—	—	—	—	3.82	4.49	3.96	4.01	3.63	H
	—	—	—	—	—	—	1.54	—	—	—	—	—	—	1.38	1.34	1.53	
20	5.83	—	—	4.62	—	—	—	—	—	—	—	—	—	5.88	5.63	5.37	Y
	3.74	—	—	—	—	—	—	—	—	—	—	—	—	—	3.74	4.06	K
	2.09	—	—	—	—	—	—	—	—	—	—	—	—	—	1.89	1.31	
21	5.36	5.26	—	—	—	—	5.32	—	5.55	—	—	—	—	—	—	—	H
	3.90	3.76	—	3.58	—	—	3.75	3.49	4.38	—	—	—	—	—	—	—	K
	1.46	1.50	—	—	—	—	1.57	—	1.17	—	—	—	—	—	—	—	
24	5.77	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
26	5.34	—	—	—	—	5.90	—	—	—	—	—	—	—	—	—	—	Y
	3.71	—	—	3.71	—	3.87	—	—	—	4.05	—	—	—	—	—	—	H
	1.63	—	—	—	—	2.03	—	—	—	—	—	—	—	—	—	—	
27	4.37	3.84	—	4.15	5.39	5.40	—	—	—	—	—	—	—	—	—	—	Y
	3.20	2.93	—	3.02	4.15	—	—	—	—	—	—	—	—	—	—	—	H
	1.17	0.91	—	1.13	1.24	—	—	—	—	—	—	—	—	—	—	—	
30	—	—	—	5.16	5.23	5.48	4.87	—	5.45	—	—	—	—	—	—	—	Y
	4.07	3.90	4.02	3.53	3.97	3.91	3.74	—	4.17	3.69	—	—	—	—	—	—	H
	—	—	—	1.63	1.26	1.57	1.13	—	1.28	—	—	—	—	—	—	—	

Date 1916		Pair:	Group IV. 25	26	27	28	29	30	(31)	32	Group V. (33)	34	35	36	37	38	39	40	
Jan.	31		5.31	5.05	5.37	5.18	—	—	—	—	—	—	—	—	—	—	—	—	Y
			3.94	3.85	3.91	3.59	—	—	—	—	—	—	—	—	—	—	—	—	H
			1.37	1.20	1.46	1.59	—	—	—	—	—	—	—	—	—	—	—	—	
Feb.	1		5.66	5.51	5.68	5.56	5.57	5.86	5.41	5.40	5.38	5.49	5.02	5.44	5.61	5.75	5.48	—	H
			4.28	3.77	4.20	4.12	4.07	4.32	3.93	3.47	3.69	3.91	3.67	3.84	3.81	4.06	3.82	—	K
			1.38	1.74	1.48	1.44	1.50	1.54	1.48	1.93	1.69	1.58	1.35	1.60	1.80	1.69	1.66	—	
	2		5.64	5.07	5.36	5.95	5.39	5.52	5.66	5.52	5.17	5.46	4.84	5.54	5.70	5.82	5.74	4.87	Y
			3.71	3.90	3.84	3.99	8.87	4.20	3.92	3.95	3.77	3.98	3.69	4.17	3.99	4.00	4.04	3.80	K
			1.93	1.17	1.52	1.96	1.52	1.32	1.74	1.57	1.40	1.50	1.15	1.37	1.71	1.83	1.70	1.07	
	4		—	—	—	—	5.79	5.82	5.75	—	—	—	—	—	—	—	5.25	—	H
			—	—	—	—	4.21	4.15	4.11	—	—	—	—	—	4.20	4.02	3.73	—	K
			—	—	—	—	1.58	1.67	1.64	—	—	—	—	—	—	—	1.52	—	
	9		5.63	—	5.61	5.34	5.50	5.72	5.43	5.21	—	5.24	4.96	5.33	5.40	5.62	5.26	5.20	H
			3.99	—	3.95	3.42	4.08	4.03	3.77	3.52	—	3.67	3.77	4.18	4.00	3.91	3.82	3.45	K
			1.64	—	1.66	1.92	1.42	1.69	1.66	1.69	—	1.57	1.19	1.15	1.40	1.71	1.44	1.75	
	10		—	—	5.32	5.31	5.54	5.31	5.27	—	—	—	—	5.14	—	—	—	—	Y
			—	—	3.64	3.76	3.89	3.94	3.70	—	—	—	—	3.97	—	3.83	3.96	—	K
			—	—	1.68	1.55	1.65	1.37	1.57	—	—	—	—	1.17	—	—	—	—	
	12		—	—	—	—	5.14	5.45	5.44	4.99	4.84	—	4.73	—	—	—	—	5.18	Y
			—	—	—	4.04	4.03	4.07	3.80	3.64	3.83	3.51	3.50	4.04	4.09	—	—	3.94	H
			—	—	—	—	1.11	1.38	1.64	1.35	1.01	—	1.23	—	—	—	—	1.24	
	13		5.72	—	—	—	—	5.65	5.30	5.83	5.00	5.09	4.84	5.46	—	—	5.37	5.28	Y
			3.61	—	—	—	3.86	4.03	3.79	3.66	3.34	3.76	3.33	3.92	—	—	3.88	3.92	K
			2.11	—	—	—	—	1.62	1.51	2.17	1.66	1.33	1.51	1.54	—	—	1.49	1.36	
	14		5.16	5.15	5.52	5.42	5.60	5.62	5.44	5.28	5.05	5.37	4.93	5.38	5.53	5.21	4.95	4.76	Y
			3.71	3.68	3.83	3.76	3.83	3.92	3.86	3.78	3.41	3.71	3.67	3.77	3.86	3.92	3.98	3.87	K
			1.45	1.47	1.69	1.66	1.72	1.70	1.58	1.50	1.64	1.66	1.28	1.61	1.67	1.29	0.97	0.89	

Date 1916		Pair: 25	26	27	28	29	30	(31)	32	(33)	34	35	36	37	38	39	40	
Feb.	18	5.44	5.55	5.59	5.38	5.73	5.85	5.46	5.43	5.40	5.43	5.97	5.52	5.93	5.51	5.51	5.22	H
		3.77	3.99	3.68	3.77	4.02	4.23	3.83	3.68	3.61	3.98	3.67	3.72	3.90	4.09	4.28	4.14	K
		1.67	1.56	1.91	1.61	1.71	1.62	1.63	1.75	1.79	1.45	1.30	1.80	2.03	1.42	1.23	1.08	
	19	5.06	5.13	—	—	—	—	—	—	5.17	5.14	—	—	—	—	4.85	5.11	Y
		3.80	3.67	—	—	—	—	—	3.72	3.75	3.89	—	—	—	—	3.72	3.80	H
		1.26	1.46	—	—	—	—	—	—	1.42	1.25	—	—	—	—	1.13	1.31	
	20	5.56	5.49	5.54	5.52	5·10	5.89	5.56	5.30	5.08	5.75	5.20	4.91	5.79	4.96	5.39	—	Y
		4.19	3.96	3.92	3.99	3.95	4.29	4.10	3.91	3.52	4.08	3.70	3.79	4.23	—	—	—	H
		1.37	1.53	1.62	1.53	1.15	1.60	1.46	1.39	1.56	1.67	1.50	1.12	1.56	—	—	—	
	21	—	5.31	—	—	—	5.31	—	—	—	—	—	—	—	—	—	—	Y
		3.95	4.06	3.89	4.03	—	4.17	—	—	—	—	3.39	3.63	—	—	3.77	—	K
		—	1.25	—	—	—	1.14	—	—	—	—	—	—	—	—	—	—	
	22	5.41	5.28	5.31	5.42	5.28	6.02	5.18	5.21	5.51	5.51	5.15	4.95	—	—	5.26	—	H
		3.84	3.79	3.88	3.48	3.82	4.23	3.86	3.57	3.64	3.90	3.70	3.64	—	—	—	—	Y
		1.57	1.49	1.43	1.94	1.46	1.79	1.32	1.64	1.87	1.61	1.45	1.31	—	—	—	—	
	23	—	—	—	—	—	5.35	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	3.71	4.05	—	—	—	—	—	—	—	—	—	—	H
		—	—	—	—	—	1.30	—	—	—	—	—	—	—	—	—	—	
	24	—	—	—	—	—	—	—	—	5.14	—	4.87	5.30	5.22	5.51	5.57	5.56	Y
		—	—	—	—	—	—	—	—	3.46	4.23	3.45	3.84	3.72	3.73	3.71	3.80	H
		—	—	—	—	—	—	—	—	1.68	—	1.42	1.46	1.50	1.78	1.86	1.76	

Group V. / Group VI.

Date 1916		Pair: (33)	34	35	36	37	38	39	40	41	42	(43)	44	(45)	46	47	48	
Feb.	26	5.10	5.28	5.11	—	5.07	5.39	—	—	—	5.09	3.20	5.62	4.67	5.14	4.93	5.63	Y
		3.80	3.62	3.73	—	3.72	3.91	—	—	—	3.61	1.71	3.96	2.93	3.72	3.74	4.09	K
		1.30	1.66	1.38	—	1.35	1.48	—	—	—	1.48	1.49	1.66	1.74	1.42	1.19	1.54	
	27	4.83	4.91	4.84	4.82	5.36	—	—	5.67	5.28	5.18	3.39	5.33	4.07	5.63	4.69	4.60	Y
		3.10	3.98	3.83	3.28	3.67	5.22	—	4.01	3.50	3.44	1.21	3.64	2.83	3.76	3.92	3.70	H
		1.73	0.93	1.01	1.54	1.69	—	—	1.66	1.78	1.74	2.18	1.69	1.24	1.87	0.77	0.90	

		(33)	34	35	36	37	38	39	40	41	42	(43)	44	(45)	46	47	48	
Mar.	2	5.28	—	—	—	—	—	—	5.57	5.24	5.16	3.19	5.34	4.33	5.10	5.24	5.44	Y
		3.79	3.92	—	—	—	—	—	3.75	3.99	3.85	1.52	3.87	3.18	3.76	3.82	3.97	H
		1.49	—	—	—	—	—	—	1.82	1.25	1.31	1.67	1.47	1.15	1.34	1.42	1.47	
	3	4.94	5.44	4.68	4.67	—	6.24	5.55	5.23	4.53	—	—	—	—	—	—	—	Y
		3.50	3.99	3.71	3.52	—	3.96	4.05	3.97	3.74	3.21	—	—	—	—	—	—	H
		1.44	1.45	0.97	1.15	—	2.28	1.50	1.26	0.79	—	—	—	—	—	—	—	
	5	5.15	—	5.06	—	—	5.72	5.33	5.39	4.90	—	—	—	4.49	5.16	5.20	5.20	H
		3.78	—	3.41	—	—	3.77	3.95	3.71	3.60	—	—	—	2.93	3.82	3.43	3.85	K
		1.37	—	1.65	—	—	1.95	1.38	1.68	1.30	—	—	—	1.56	1.34	1.62	1.35	
	6	5.05	5.43	4.68	4.88	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.89	3.75	3.27	3.91	3.73	—	—	—	—	—	—	—	—	—	—	—	H
		1.16	1.68	1.41	0.97	—	—	—	—	—	—	—	—	—	—	—	—	
	7	5.16	5.25	4.75	5.62	5.36	—	—	—	—	—	—	—	—	—	—	—	Y
		3.57	3.92	3.38	3.57	3.73	—	3.88	—	—	—	—	—	—	—	—	—	H
		1.59	1.33	1.37	2.05	1.63	—	—	—	—	—	—	—	—	—	—	—	
	8	4.96	—	—	—	—	5.58	5.40	—	—	—	—	—	—	—	—	—	H
		3.96	—	3.68	—	—	3.97	3.48	—	—	—	—	—	—	—	—	—	K
		1.00	—	—	—	—	1.61	1.92	—	—	—	—	—	—	—	—	—	
	10	5.28	5.20	5.03	5.36	5.42	5.51	5.28	5.33	5.32	5.01	3.05	5.59	4.40	5.33	5.43	5.45	Y
		3.18	3.78	3.60	3.77	3.80	3.88	3.64	3.70	3.64	3.51	1.83	3.97	2.93	3.96	3.85	3.90	H
		2.10	1.42	1.43	1.59	1.62	1.63	1.64	1.63	1.68	1.50	1.22	1.62	1.47	1.37	1.58	1.55	
	11	5.16	5.54	5.01	5.24	5.57	5.35	—	5.64	—	—	3.09	5.38	4.58	3.61	3.16	5.34	Y
		3.67	3.82	3.51	4.00	4.16	4.03	—	3.67	—	—	1.86	4.02	3.10	3.67	3.56	3.53	H
		1.49	1.72	1.50	1.24	1.41	1.32	—	1.97	—	—	1.23	1.36	1.48	1.94	1.60	1.81	
	14	—	5.40	—	—	5.38	5.45	5.38	—	5.49	—	3.19	5.56	4.42	4.45	4.28	5.55	Y
		—	3.90	—	—	3.81	4.02	3.59	4.06	3.84	—	1.68	4.06	2.57	3.94	3.85	4.06	H
		—	1.50	—	—	1.57	1.43	1.79	—	1.65	—	1.51	1.50	1.85	1.51	1.43	1.49	
	15	—	—	—	—	—	—	5.40	5.15	5.11	—	—	—	—	5.30	—	—	Y
		3.56	—	—	—	—	—	3.76	3.98	3.99	—	—	—	—	3.83	—	—	H
		—	—	—	—	—	—	1.64	1.17	1.12	—	—	—	—	1.47	—	—	

Date 1916	Pair: (33)	34	35	36	37	38	39	40	41	42	(43)	44	(45)	46	47	48	
Mar. 16	—	—	4.70	4.88	4.81	5.06	5.30	5.19	—	—	—	5.30	4.91	5.59	5.02	5.29	Y
	3.05	—	3.43	3.21	3.60	3.78	3.76	3.64	—	—	—	—	2.65	3.54	3.63	3.65	K
	—	—	1.27	1.67	1.21	1.28	1.54	1.55	—	—	—	—	2.26	2.05	1.39	1.64	
17	5.07	5.26	4.93	5.41	5.54	5.09	4.63	5.37	5.26	4.98	3.37	5.55	4.42	5.56	—	—	H
	3.63	3.90	3.49	3.67	3.88	3.67	3.70	4.01	4.05	3.62	1.66	4.05	3.17	3.92	—	—	K
	1.44	1.26	1.44	1.74	1.66	1.42	0.93	1.36	1.21	1.34	1.71	1.50	1.25	1.14	—	—	
18	5.23	5.52	4.99	5.26	5.28	5.19	—	5.34	5.42	5.08	3.65	5.50	4.42	—	5.28	5.59	Y
	3.68	3.50	3.59	3.74	3.83	3.79	3.58	3.72	3.79	3.47	1.87	4.14	2.71	—	4.30	3.30	H
	1.55	2.02	1.40	1.52	1.45	1.40	—	1.62	1.63	1.61	1.78	1.36	1.71	—	0.98	2.29	
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	3.67	3.67	—	4.01	2.72	3.86	3.73	3.92	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
20	5.23	5.14	4.76	4.62	5.19	5.43	5.36	5.14	—	4.90	3.23	5.62	4.62	5.14	5.34	5.74	Y
	3.36	3.49	3.10	3.66	3.56	3.70	3.72	3.71	3.85	3.48	1.69	3.92	2.80	3.87	3.81	3.87	K
	1.87	1.65	1.66	0.96	1.63	1.73	1.64	1.43	—	1.42	1.54	1.70	1.82	1.27	1.53	1.87	

Group VI. Group VII.

Date 1916	Pair: 41	42	(43)	44	(45)	46	47	48	(49)	50	51	52	(53)	(54)	(55)	56	
Mar. 22	—	—	2.94	5.59	3.99	5.44	5.25	—	—	—	—	—	—	—	—	—	Y
	—	—	1.80	3.81	2.47	3.88	3.94	—	—	—	—	—	—	—	—	—	H
	—	—	1.14	1.78	1.52	1.56	1.31	—	—	—	—	—	—	—	—	—	
23	5.24	5.24	2.93	5.34	4.81	5.07	5.40	5.38	5.06	—	—	5.10	5.18	—	—	—	Y
	3.38	3.45	1.74	3.76	2.96	3.76	3.87	3.89	3.45	—	—	3.84	3.47	—	—	—	H
	1.36	1.79	1.19	1.58	1.85	1.31	1.53	1.49	1.61	—	—	1.26	1.71	—	—	—	
25	—	5.71	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
	—	3.53	1.35	—	—	4.32	—	—	—	—	—	—	—	—	—	—	K
	—	2.18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
26	5.23	4.89	2.82	5.31	4.65	—	5.12	5.43	5.14	4.81	5.51	5.23	4.99	5.11	4.95	5.96	Y
	3.89	3.23	1.50	3.84	2.83	3.66	3.73	3.87	3.61	3.56	3.86	3.67	3.15	3.83	3.42	3.95	H
	1.34	1.66	1.32	1.47	1.82	—	1.39	1.56	1.53	1.25	1.65	1.56	1.84	1.28	1.53	2.01	

		41	42	(43)	44	(45)	46	47	48	(49)	50	51	52	(53)	(54)	(55)	56	
	28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
		3.53	3.31	1.34	3.91	2.34	3.60	—	3.19	—	—	4.09	3.76	3.29	3.90	3.95	4.05	H
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	30	—	—	—	—	—	—	—	—	5.05	—	—	—	—	—	—	—	Y
		—	—	—	4.24	—	—	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	31	4.97	5.02	3.30	3.56	4.26	5.43	—	—	—	—	—	—	—	—	—	—	Y
		3.70	3.44	1.70	3.89	2.76	3.68	—	—	—	—	—	—	—	—	—	—	H
		1.27	1.58	1.60	1.67	1.50	1.75	—	—	—	—	—	—	—	—	—	—	
Apr.	1	—	—	—	—	—	—	—	—	4.92	—	—	—	—	—	—	—	H
		—	—	—	—	—	—	3.52	3.77	2.44	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	—	1.48	—	—	—	—	—	—	—	
	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.62	—	—	3.74	—	—	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	3	5.20	—	—	5.41	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.74	—	—	3.87	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.46	—	—	1.54	—	—	—	—	—	—	—	—	—	—	—	—	
	4	—	—	—	5.43	4.29	—	—	—	—	—	—	—	—	—	—	—	Y
		—	3.13	1.60	3.80	2.94	—	—	—	—	—	—	—	—	—	—	—	H
		—	—	—	1.63	1.35	—	—	—	—	—	—	—	—	—	—	—	
	5	—	—	3.44	5.46	3.98	4.83	4.84	5.31	4.81	4.96	5.56	5.34	5.02	5.27	4.76	5.09	H
		3.69	—	1.61	3.80	2.69	3.69	3.47	3.54	3.36	3.54	3.60	3.51	3.33	3.87	3.49	4.04	K
		—	—	1.83	1.66	1.29	1.14	1.37	1.77	1.45	1.42	1.96	1.83	1.69	1.40	1.27	1.05	
	11	5.07	4.44	2.98	5.23	4.48	6.02	5.17	5.30	4.88	5.01	5.49	5.00	4.32	5.40	4.83	5.39	Y
		3.80	3.19	1.85	3.78	—	3.91	3.88	3.26	3.20	3.47	3.81	3.70	2.85	3.82	3.41	3.59	K
		1.27	1.25	1.13	1.45	—	2.11	1.29	2.04	1.68	1.54	1.68	1.30	1.47	1.58	1.42	1.80	
	12	5.04	4.89	2.99	5.10	4.34	5.10	5.00	5.05	4.99	5.00	5.17	5.26	4.78	4.97	4.38	—	H
		1.59	2.73	1.36	3.79	2.68	—	3.56	3.60	3.51	3.65	3.78	3.48	3.18	3.71	3.04	—	K
		1.45	2.16	1.63	1.31	1.66	—	1.44	1.45	1.48	1.35	1.39	1.78	1.60	1.26	1.34	—	

Date 1916	Pair: 41	42	(43)	44	(45)	46	47	48	(49)	50	51	52	(53)	(54)	(55)	56	
Apr. 13	—	—	—	—	—	—	—	—	5.14	5.28	5.66	5.21	4.87	4.94	4.98	4.99	Y
	3.48	—	—	—	—	—	—	—	3.43	3.66	4.03	3.69	3.47	3.63	3.32	3.63	K
	—	—	—	—	—	—	—	—	1.71	1.62	1.63	1.52	1.40	1.31	1.66	1.36	
14	—	—	—	—	—	—	—	—	4.67	—	—	5.29	5.23	5.28	5.24	4.79	Y
	—	—	—	—	—	—	—	—	3.37	—	—	4.10	3.45	4.19	3.08	3.23	H
	—	—	—	—	—	—	—	—	1.30	—	—	1.19	1.78	1.09	2.16	1.56	

Group VII. Group VIII.

Date 1916	Pair: (49)	50	51	(52)	(53)	(54)	55	56	57	58	59	60	61	62	(63)	64	
Apr. 18	4.74	5.04	5.68	5.05	4.65	5.35	—	—	—	—	—	—	—	—	—	—	Y
	3.34	3.53	3.78	3.60	3.35	3.63	3.25	3.98	3.79	—	—	—	—	—	—	—	H
	1.40	1.51	1.90	1.45	1.30	1.72	—	—	—	—	—	—	—	—	—	—	
19	4.85	5.19	5.44	4.89	4.59	—	—	—	—	—	—	—	—	—	—	—	Y
	3.27	3.55	3.75	3.35	3.24	—	—	—	—	—	—	—	—	—	—	—	H
	1.40	1.64	1.69	1.54	1.35	—	—	—	—	—	—	—	—	—	—	—	
20	4.44	4.80	4.94	—	4.67	—	—	—	5.10	5.29	4.68	4·94	6.05	5.24	5.58	5.47	Y
	3.12	3.05	3.45	—	2.87	—	—	—	4.01	3.54	3.44	3.92	3.91	3.92	3.99	3.75	H
	1.32	1.75	1.49	—	1·80	—	—	—	1.09	1.75	1.24	1.02	2.14	1.32	1.59	1.72	
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	3.61	3.65	3.70	3.32	H
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
22	4.77	4.85	5.25	5.22	5.02	5.14	4.79	4.91	5.12	5.27	5.12	5.09	5.14	4.93	5.35	—	Y
	3.26	3.35	3.81	3.84	3.43	3.69	3.36	3.56	3.79	3.64	3.67	4.24	3.93	3.50	3.65	3.91	H
	1.51	1.50	1.44	1.38	1.59	1.45	1.42	1.35	1.33	1.63	1.45	1.85	1.21	1.43	1.70	—	
25	4.65	4.89	6.07	4.79	4.95	5.19	4.09	—	—	—	—	—	—	—	—	4.70	Y
	3.27	3.58	3.63	3.48	3.45	3.55	3.86	—	—	—	—	—	—	3.62	3.18	3.66	H
	1.38	1.31	2.44	1.31	1.50	1.64	0.23	—	—	—	—	—	—	—	—	1.04	

		(49)	50	51	(52)	(53)	(54)	55	56	57	68	59	60	61	62	(63)	64	
	26	4.81	4.79	5.63	5.12	4.77	5.21	5.09	5.20	—	—	—	—	—	—	—	—	H
		3.28	3.33	3.82	3.56	3.27	3.44	3.24	3.79	—	—	—	—	—	—	—	—	K
		1.53	1.46	1.81	1.56	1.50	1.77	1.85	1.41	—	—	—	—	—	—	—	—	
	27	4.64	5.09	4.81	5.05	4.81	5.10	4.55	5.02	5.13	4.99	5.46	5.31	5.39	5.92	5.22	4.88	Y
		3.36	3.48	3.56	3·60	3.14	3.65	3.41	3.73	3.65	3.55	3.83	3.64	3.72	3.67	3.60	3.52	K
		1.27	1.61	1.25	1.45	1.67	1.45	1.14	1.29	1.48	1.44	1.63	1.67	1.67	1.35	1.62	1.36	
	28	4.63	5.15	5.24	5.13	4.84	5.26	4.83	5.14	5.26	5.27	5.13	5.09	5.28	5.47	5.27	4.65	H
		3.41	3.38	3.85	3.48	3.34	3.68	3.45	3.37	3.69	3.73	3.67	3.50	3.79	3.59	3.66	3.36	K
		1.22	1.77	1.39	1.65	1.50	1.58	1.38	1.76	1.57	1.54	1.49	1.59	1.49	1.88	1.61	1.29	
May.	3	4.31	4.73	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		—	3.59	—	—	—	—	—	—	—	—	—	—	—	3.70	3.44	3.62	H
		—	1.14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	4	4.83	—	—	—	4.82	5.01	4.83	4.84	4.99	5.41	4.98	4.75	5.17	5.02	5.14	4.94	Y
		3.37	—	—	—	3.23	3.76	3.20	3.13	3.66	3.68	3.82	3.59	3.56	3.46	3.46	3.54	H
		1.46	—	—	—	1.59	1.25	1.63	1.71	1.33	1.73	1.16	1.16	1.61	1.56	1.68	1.40	
	5	4.88	4.92	5.30	5.12	4.89	5.15	4.93	5.25	5.34	5.17	4.84	4.95	4.98	5.03	—	5.18	H
		3.29	3.38	3.47	3.52	3.35	3.68	3.28	3.55	3.74	3.53	3.35	3.70	3.80	—	—	3-44	K
		1.59	1 54	1.83	1.60	1.54	1.47	1.65	1.70	1.60	1.59	1.49	1.25	1.18	—	—	1.74	
	6	—	—	—	—	—	5.27	—	—	—	—	—	—	—	—	—	—	Y
		—	—	—	—	—	3.52	—	—	—	—	—	—	—	—	—	—	K
		—	—	—	—	—	1.75	—	—	—	—	—	—	—	—	—	—	
	9	5.00	4.96	5.24	4.23	5.04	4.78	5.16	5.38	5.65	5.85	5.55	5.24	5.73	5.14	4.70	5.03	Y
		2.98	3.63	—	3.13	2.90	3.36	3.03	3.48	3.81	3.63	3.47	3.21	3.57	3.48	3.44	3.23	K
		2.02	1.33	—	1.10	2.14	1.42	2.13	1.90	1.84	2.22	2.08	2.03	2.16	1.66	1.26	1.80	
	10	4.38	5.02	5.16	5.01	4.67	5.10	4.65	5.12	—	4.98	4.95	5.26	5.24	5.24	5.01	4.52	H
		4.24	3.41	3.57	3.37	3.08	4.04	3.18	3.44	—	3.54	3.53	3.68	—	—	3.66	3.24	K
		1.14	1.61	1.59	1.64	1.59	1.06	1.47	1.68	—	1.44	1.42	1.58	—	—	1.35	1.28	
	11	4.96	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Y
		3.12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H
		1.84	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

§ 10. Statistical Reviews of Observations.

In the whole period of observation covering two full years, the following statistical summaries were obtained :

Total number of pairs, observed with Research Instrument. 3444,
„ „ „ „ „ „ Internat. Instrument. 3878.
of which
The common Pairs, in total, ... 3371,
and of the one-sided pairs are,
Those observed alone with Research Instrument . . . 73,
„ „ „ „ International Instrument . . 507.

As for the order of Clamp-Changes, in the common pairs,
Pairs observed with both instruments in the *same* order . 3268,
„ „ „ „ „ „ „ *reverse* order . 103.
The complete groups observed with each instrument are
for the Research Instrument 223,
„ „ International Instrument . . . 261.

For the observers,

	Internat. Instr.	Research. Instr.
Kimura	1768 pairs	25 pairs
Hashimoto	2120 „	730 „
Yamamoto	0 „	2689 „

by which the common pairs are classified as :
Total No. of Y–H 1793,
„ „ „ Y–K 860,
„ „ „ H–K 693,
„ „ „ (K–H) . . . . 25.
Total No. of Nights in which the Research Instr. used . 384,
„ „ „ „ „ „ „ International Instr. . 413,
and the total No. of those in common 374,
of which
No. of Nights when observations were carried out with both instruments in the same order of the Clamp-Changes through the whole night 358,
and
No. of Nights when observations of both series were carried out in the reverse order of Clamp-Changes wholly or partially through the night . . . . 16.

Total no. of Nights in which the complete programme of
16 pairs was observed . . . Research Inst. . . 69.
Internat. Inst. . . 84.

In the whole period, the observers of the Research Instrument, mainly Yamamoto, were frequently prevented from attending to their field work, that is, sometimes by excursions, sometimes by sickness. Owing to these circumstances no one stood by the Research Instrument for observation on 26 nights.

For the observers:

Kimura	189 nights	2 nights
Hashimoto	224 ,,	71 ,,
Yamamoto	0 ,,	311 ,,

of which the common nights are classified according to combinations:

Y–H	197 nights
Y–K	105 ,,
H–K	70 ,,
K–H	2 ,,

§ 11. Personal Equations.

In our series of the "differential latitudes," derived from the common pairs, which are tabularly given in every third row of the daily results in Table III, above, there are four series for personality, i.e.

Table IV.

Personal Combination	No. of Observations	Mean value of Differential Latitude
Y–H	1771	1″.518
Y–K	865	1.553
H–K	711	1.549
K–H	24	1.564
All:	3371	Mean; 1.534

We have a here a set of simultaneous equations:

$$+y \quad -H \qquad\qquad = 1''.518, \qquad \text{Weight } 1771,$$
$$+y \qquad\qquad -K = 1.553, \qquad 865,$$
$$+h \quad -K = 1.549, \qquad 711,$$
$$-H \qquad\qquad +k = 1.564, \qquad 24,$$

where y and Y means observations with Research and International Instruments respectively by Yamamoto,

h ,, H ,, ,, ,, ,, Hashimoto, and

k ,, K ,, ,, ,, ,, Kimura.

Putting y=0 for the sake of reference, we have, in terms of the deviation from the mean, 1″.534,

$$\begin{aligned} h &= -0''.004, \\ H &= +\ 0.016, \\ k &= +\ 0.046, \\ K &= -\ 0.019. \end{aligned}$$

Of these, K and k are relatively very uncertain, for the material used here is decidedly poor in number.

When all the materials are grouped by half-years, thus :

1st. Summer : from May 12, 1914 to Dec. 6, 1914,
1st. Winter : ,, Dec. 7, 1914 ,, May 11, 1915,
2nd. Summer : ,, May 12, 1916 ,, Dec. 6, 1915,
2nd. Winter : ,, Dec. 7, 1915 ,, May 11, 1916.

we have the next table :

Table V.

	Y-H	Y-K	H-K	K-H	Weighted Mean
1st. Summer	1″.547	1″.576+29	1″.518−29	1″.576+29	1.547
,, Winter	1.512	1.506− 6	1.578+66	1.555+43	1.527
2nd. Summer	1.497	1.550+53	1.591+64	—	1.534
,, Winter	1.493	1.556+63	1.532+39	—	1.519

Arranging these according to each *annual mean* value, we have

1st. Year	1″.537	1″.536− 1	1″.548+11	1″.565+28	1.542
2nd ,,	1.495	1.552+57	1.553+48	—	1.524

while arranging the same according to *Seasons*, we have

Summer	1″.527	1″.563+36	1″.552+25	1″.576+49	1.542
Winter	1.502	1.537+35	1.547+35	1.555+53	1.522

The individual values of the above Table V. are liable to many kinds of possible causes. In the columns of Y–K, H–K, and K–H, the deviation of the values from those of the column Y–H (taken as standard for convenience), of the corresponding epochs, are annexed with proper signs for excess or not ; the cause of these deviation will most probably be personal in nature. But, those derivation, which are seen between one other in each personal column, will be mainly caused by seasonal, instrumental, methodological, and the like effects : these effects are studied fully in §14. It may be remarked that the uniform tendency between the Summer and the Winter values of each personality is agreeing with the " z "-term of the latitude variation, and indeed without final conclusion to explain it by the assumption of the anomalous refraction, proved in §14. Moreover, the difference between the two annual values in the last column (weighted mean) may partially be affected by the Entrance effect of the International Room, proved in § 17.

§ 12. Inequalities due to the Reversals of the Clamp.

The Clamp-Reversal Inequalities were examined separately in the three series, for each pair and epoch. The mean values of their absolute amounts and also of the algebraic ones are arranged for each Group-means in the following table. All values are given in hundreds of a second

Table VI.

Croup	Research Series				International Series				Differential Series			
	Preceding Group		Following Group		Preceding Group		Following Group		Preceding Group		Following Group	
1914	Abs.	Alg.	Abs.	Alg.	Abs.	Alg.	Abs.	Alg.	Abs.	Alg.	Abs.	Alg.
VIII	10	−30			11	+08			16	−00		
IX	15	+12	12	+07	12	+11	6	+02	14	−00	20	+00
X	4	+01	14	+04	10	+035	11	+015	7	−005	16	+07
XI	7	+00	12	−01	7	+03	8	+00	9	−005	10	00
XII	12	+03	17	−01	4	+02	9	+01	14	+01	22	−00
I	10	+05	16	+08	8	+08	11	+05	10	−01	13	+20
II	23	00	8	+03	12	+04	8	+07	30	+14	7	−60
III	19	00	38	+18	16	+16	11	+09	16	−12	28	+04
IV	29	−14	18	+05	12	+03	15	+065	34	−03	16	−01
V	24	+05	22	+01	8	−01	14	+11	20	+14	15	−11
VI	16	−12	11	+065	9	−04	13	−035	16	−07	10	+05
VII	16	−06	18	+045	13	+03	17	−105	15	−90	22	+15

Group	Research Series				International Series				Differential Series			
	Preceding Group		Following Group		Preceding Group		Following Group		Preceding Group		Following Group	
1914	Abs.	Alg.	Abs.	Alg.	Abs.	Als.	Abs.	Alg.	Abs.	Alg.	Abs.	Alg.
VIII	14	+03	12	−04	9	+05	11	−03	11	−03	12	+02
IX	6	−04	6	−04	7	+06	11	+06	12	−12	12	+09
X	10	−09	12	−08	13	+00	10	+04	12	−12	16	−12
XI	7	+04	17	−14	10	+02	17	−04	10	−02	25	−08
XII	9	+03	9	−04	11	−00	10	00	12	+04	15	−05
I	10	+03	11	−075	10	+08	10	+00	14	−09	15	−09
II	14	+03	10	−01	13	+07	16	+16	12	−03	22	−22
III	13	+05	10	−01	11	+02	10	+08	19	+06	12	−04
IV	14	+01	16	−03	7	+03	19	+13	14	+04	21	−18
V	11	+00	18	−06	13	+08	9	+05	12	−065	15	−08
VI	19	+05	9	−01	11	+09	11	+07	15	+05	14	−05
VII	15	−04	13	−02	8	+02	11	+06	15	−05	14	−03
VIII			9	−02			8	+02			16	−08

At first the whole time interval was divided into four equal periods, as in the ease of the preceding paragraph, comprising six consecutive values from each of the Preceding and of the Following Group columns, so that each is conveniently called the Summer and the Winter period. The mean values for each period are:

Table VII.

1914 Summer	+0″.03±0″.12+0″.40±0″.16	+0″.04±0″.09+0″.02±0″.10
1915 Winter	− 0.04± 0.25+ 0.00± 0.24	+ 0.04± 0.13± 0.02± 0.15
,, Summer	− 0.00± 0·11− 0.07± 0.12	+ 0.03± 0.12± 0.04± 0.14
1916 Winter	+ 0.01± 0.16− 0.01± 0.17	+ 0.05± 0.12± 0.07± 0.12
Total Mean	−0″.000 −0″.007	+0″.045 +0″.036
Serial Mean	−0″.0035±0″.047	+0″.041±0.034

1914 Summer	−0″.00±0″.12−0″.00±″0.20
1915 Winter	− 0.01± 0.24+ 0.02± 0.18
,, Summer	− 0.06± 0.12− 0.11± 0.17
1916 Winter	+ 0.00± 0.19− 0.08± 0.18
Total Mean	−0″.016 −0″.039
Serial Mean	−0″.028±0.051

If the mean errors of the semi-annual average values are combined, we obtain the following results which are each very near to the corresponding mean errors of the Differential Series.

$$\sqrt{(0.12)^2+(0.09)^2}=\pm0''.15 \qquad \sqrt{(0.16)^2+(0.10)^2}=\pm0''.19$$
$$\sqrt{(0.25)^2+(0.13)^2}=\ \pm0.28 \qquad \sqrt{(0.24)^2+(0.15)^2}=\ \pm0.28$$
$$\sqrt{(0.11)^2+(0.12)^2}=\ \pm0.16 \qquad \sqrt{(0.12)^2+(0.14)^2}=\ \pm0.18$$
$$\sqrt{(0.16)^2+(0.12)^2}=\ \pm0.20 \qquad \sqrt{(0.17)^2+(0.12)^2}=\ \pm0.21$$

The above coincidences show that the uncertainties of the Clamp-Reverse Inequalities of the Differential Series are generally due to those of the direct observations, and not to other uncertainties common to both the direct observations.

As to the absolute amount, we find, treating similarly for taking means semi-annually,

	Research Series		International Series		Differential Series	
	Prec. Gr.	Foll. Gr.	Prec. Gr.	Foll. Gr.	Prec. Gr.	Foll. Gr.
1914 Summer	0''.12	0''.15	0''.09	0''.09	0''.12	0''.15
1915 Winter	0.21	0.20	0.12	0.13	0.22	0.17
,, Summer	0.09	0.11	0.10	0.11	0.16	0.15
1916 Winter	0.14	0.13	0.10	0.11	0.16	0.15
Mean	0.14	0.14	0.10	0.11	0.15	0.16

The final means are fairly constant for each series. If we combine the corresponding amounts of the above series of the direct observations by squares, thus:

$$\sqrt{(0.12)^2+(0.09)^2}=0''.15 \qquad \sqrt{(0\ 15)^2+(0.09)^2}=0''.17$$
$$\sqrt{(0.21)^2+(0.12)^2}=\ 0.24 \qquad \sqrt{(0.20)^2+(0.13)^2}=\ 0.24$$
$$\sqrt{(0.09)^2+(0.10)^2}=\ 0.13 \qquad \sqrt{(0.11)^2+(0.11)^2}=\ 0.16$$
$$\sqrt{(0.84)^2+(0.10)^2}=\ 0.17 \qquad \sqrt{(0.13)^2+(0.81)^2}=\ 0.17$$

We see that the corresponding values of the Differential Series are all distinctly smaller than those which were obtained from the other two series by square combinations. These show that there are some common effects affecting the obrerved series in the same manner, and eliminated from the Differential ones. The roughly estimated amount of this unknown part is 0''.07.

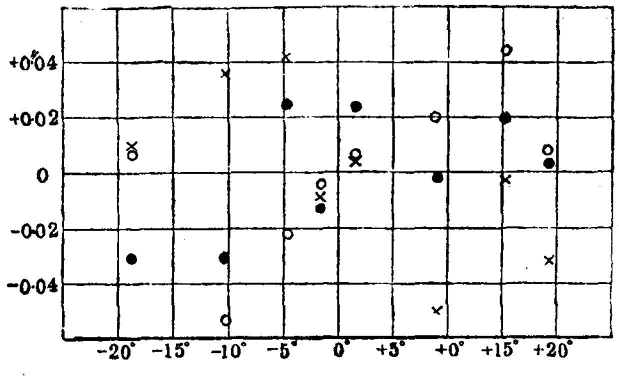
For the three points of view the causes were searched, i.e., the Zenith-distances, the Time-intervals between the pair-stars, and the Differential Magnitudes. To each of researches, the whole star-pairs were equally divided into eight classes according to measures of the arguments, and the mean values were taken.

i) *Zenith-distance Examinations.*

Table VIII.

Class	Mean Zenith-dist. 1st. Star.	Research Series		International-Series		Differential Series	
		WE/EW	Deviation from Mean	WE/EW	Deviation from Mean	WE/EW	Deviation from Mean
(1)	+19°.4	+0″.000	+0″.002	+0″.048	+0″.008	−0.″062	−0″.032
(2)	+ 15.2	+ 17	+ 19	+ 84	+ 44	− 33	− 3
(3)	+ 9.0	− 4	− 2	+ 60	+ 20	− 80	− 59
(4)	+ 1.8	+ 21	+ 23	+ 46	+ 6	− 26	+ 4
(5)	− 1.5	− 15	− 13	+ 35	− 5	− 39	− 9
(6)	− 4.9	+ 22	+ 24	+ 18	− 22	+ 12	+ 42
(7)	− 10.1	− 29	− 31	− 44	− 54	+ 6	+ 36
(8)	− 18.8	− 0.019	− 0.031	+ 0.046	+ 0.006	− 0.020	+ 0.010

Fig. 3.



North Z.D. South Z.D.

● Research Ser., o Intern. Ser, × Diff. Lat.

These are plotted in the Figure 3. We see here that a systematic effect is very conspicuous in the International Series, showing the negative and the positive maxima each at about $\zeta = 14°$ and $\zeta = -12°$, while the middle and both the extremes are near to zero. This is quite similar to those found by K. Hirayama in the Tokyo Latitudes some time ago[1].

1

In our Research Series the effect is somewhat uncertain, and not so conspicuous as in the former series. In the differential Series the similar effect is glimpsed, but the sense probably reversed, which is justified by the relative amounts of the preceding two series.

ii) *Time-Interval Examination.*

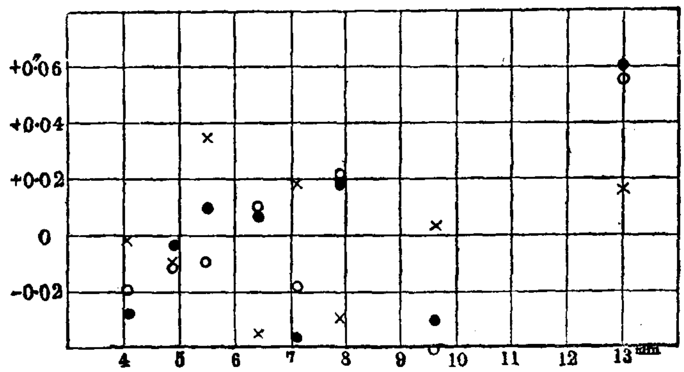
The time-interval between the first and second star of each pair was taken as the next argument.

Table IX.

Class	Mean Interval	Research Series		International Series		Differential Series	
		WE/EW	Deviation from Mean	WE/EW	Deviation from Mean	WE/EW	Deviation from Mean
(1)	m 4.1	−0″.035	−0″.028	+0″.021	−0″.019	−0″.033	−0″.001
(2)	4.9	− 10	− 3	+ 29	− 11	− 42	− 10
(3)	5.5	+ 3	+ 10	+ 31	− 9	+ 3	+ 35
(4)	6.4	+ 1	+ 8	+ 59	+ 10	− 67	− 35
(5)	7.1	− 44	− 37	+ 22	− 18	− 13	+ 19
(6)	7.1	+ 12	+ 19	+ 61	+ 21	− 61	− 29
(7)	9.6	− 38	− 31	− 1	− 41	− 29	+ 3
(8)	13.0	+ 0.054	+ 0.061	+ 0.096	+ 0.056	− 0.015	+ 0.017

These are also plotted in Figure 4. Here we see a very strange parallelism of changes between the Research and the In ernational Series. Both start with a linear tendency, fairly shown in the left of the figure. Between 6 min. and 7 min. of the Time-interval, however, they begin to fluctuate in a wide range, in which case the relative parallelism still holds to an exact degree. These phenomena are noteworthy, and suggest some kind of theoretical consideration mainly for the proper motions of the Talcott Levels. During the scrvice at Mizusawa, the writer made frequently sometime conversations about the matter with Director, when some definite opinion was in him. According to it, thc method of attachment of the Talcott levels in the zenith-telescope of the Wanschaff make is very much inexpedient. When the clamping screw which is centrally driven tnto the horizontal axis of the telescope through the centre of the frame of the level-supporter to an firm fastening of the telescope and level, is screwed in, an abominable shear and strain are expected to exist at the contact part of the instrument corresponding to the applied stress by the observer's hand. This strain causes a gradual proper motion of the level relative to the telescopic tube, by a reaction, and that in its direct amount, because the plane of the shear is parallel to that of the level and also to the meridian.

Fig. 4.



● Research Ser., ○ Intern. Ser., × Diff. Ser.

This effect, if any, may be widely common to all of the Wanschaff instrument, and naturally affects our observed series in quite the same manner. By these considerations, the latitude series by the Talcott method with this kind of instrument must generally be re-examined to a critical discussion. The apparent want of regularities in our Differential Series is reasonable here.

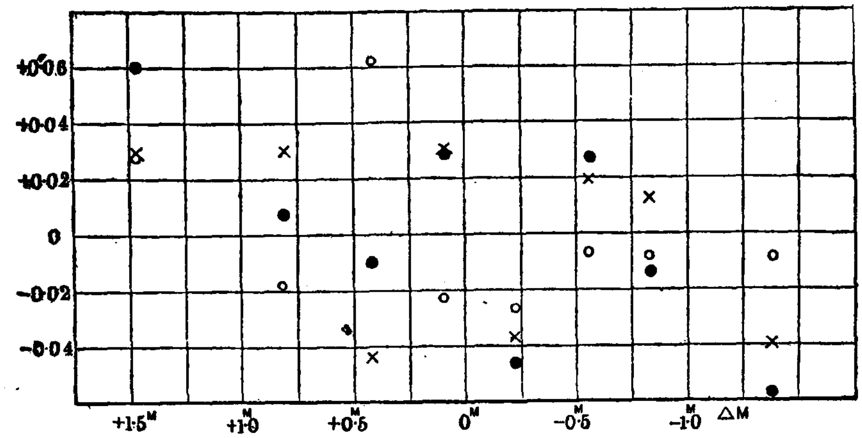
iii) *Differential Magnitude Examination.*

Lastly the Differential stellar magnitude, in the sense of (Mag. of Preceding Star) minus (Mag. of Following Star), was taken as the argument, thus :

Table X.

Class	Mean Diff. Mag.	Research Intervals		International Series		Differential Series	
		WE/EW	Deviation from Mean	WE/EW	Deviation from Mean	WE/EW	Deviation from Mean
(1)	m +1.46	+0″.056	+0″.060	+0″.069	+0″.028	+0″.002	+0″.029
(2)	+0.81	+ 3	+ 7	+ 22	− 19	− 1	+ 30
(3)	+0.42	− 14	− 10	+ 102	+ 61	− 74	− 43
(4)	+0.09	+ 25	+ 29	+ 19	− 22	− 1	+ 30
(5)	−0.23	− 50	− 46	+ 15	− 26	− 68	− 37
(6)	−0.56	+ 24	+ 27	+ 34	− 7	− 12	+ 19
(7)	−0.84	− 18	− 14	+ 33	− 8	− 18	+ 13
(8)	−1.39	− 0.061	− 0.052	− 0.033	− 0.008	−0″.070	− 0.039

Fig. 5.



● Research. Ser., ○ Intern. Ser., × Diff. Ser.

These results are again plot'ed in the Figure 5. Although there are ve y large deviations between the individual values, still a regula tendency of downward slope toward right is clear in the Research series. A similar behavior was detected by Battermann in his Berlin observations,[1] and was attributed by himself to a personal effect of bisection.

1

In the International Series of us, the individual values are too consistent to each other, except one or two cases. There are no apparent regularities in the Differential one.

As a whole, we have here detected more or less definite effects which affected our both observational series *in common.*

§ 13. Magnitude Equation of the Differential Series.

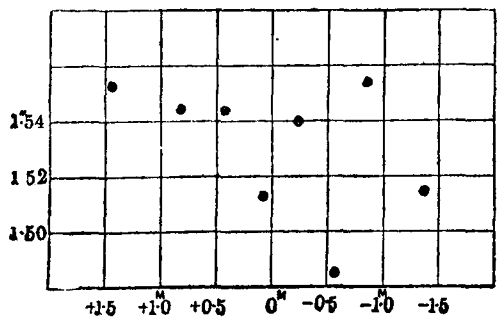
Prof. H. Nagaoka suggested me on an occasion that an effect of the differential magnitude might be found in the observational latitudes, which would probably affect our Differential Series to an extent. I, therefore, arranged the whole material according to each group of the magnitude difference, just as those adopted in the last kind of examination for the Clamp reversal inequalities. The result is :

Table XI.

Mean Differential Magnitude	Mean Value of Differential Latitude
+ 1.42	1″.552
+ 0.81	1.544
+ 0.42	1.543
+ 0.09	1.513
− 0.23	1.539
− 0.56	1.485
− 0.83	1.556
− 1.39	1.515

Plotting these values in the figure 6, we know that there are a slight tendency of the linear relation between the differential magnitudes and the differential latitudes. Moreover, the value corresponding to the zero of the differential magnitude is certainly *above* 1.52, which will be discussed below.

Fig. 9.



§ 14. Discusions of the Differential Latitudes.

For our original purpose of research, the treatments of the Differential Latitude Series, which are tabulated in every third row of each day observations of the Table III on pages 15–53, are necessary and the most effective for the final decisions of the problems here concerned. Because, in this series the effects of uncertainties of star declinations, of all cosmical origins, and of upper atmospheres are naturally eliminated. and those of the instrumental or methodical characters are only remained. The writer firstly made a rough survey of the general matter by obtaining a series of mean latitudes for each star-group which were observed continuously during an " interval " of about the twelfth of a year : the divison of the interval is according to the tabular form of the preceding Table III, and for the present computations no accounts were taken for distinguishing the star-pairs or the dates of observations. Let this series be called the " Simple Mean Differential Latitudes."

Before proceeding to any further examinations of these materials, the writer reminded the systematic effect, if any, of the reconstruction of the entrance in the observing room of the International Instrument, which took place in the end of October, 1915, (see § 7.) To get the effect in a simple manner, the writer computed the following two mean values just corresponding to the same season of the year :

Table XII.

Mean Differential Latitude	Interval of the materials, no account being taken of dates and pairs.
1″.536	From November 3,1914, to May 8,1915.
1″.522	,, October 29,1915, to May 11,1916.
Diff.=0″.014	

This amount of the systematic effect was applied to all values of the original series of the Differential Latitudes in Table III for dates *on* and *after* October 29, 1915.

Then the " Simple Mean Differential Latitudes " are :

Table XIII. "Simple Mean Series."

Mean Date	GROUP VIII	XI	X	XI	XII	I	II	III	IV	V	VI	VII	Mean	Weighted Mean	Smoothed	Annual Mean	Smoothed
1914 .40	1″.577	1″.611											1″.594	1″.595	—		
.47		1.563	1″.495										1.529	1.527	1″.563		
.58			1.552	1″.590									1.571	1.568	1.545		
.68				1.540	1″.540								1.540	1.539	1.540		
.78					1.547	1″.477							1.512	1.513	1.534		
.88						1.544	1″.565						1.554	1.550	1.550		
.96							1.568	1″.610					1.589	1.587	1.543		
1915 .06								1.521	1″.457				1.489	1.493	1.544		
.13									1.552	1″.554			1.553	1.553	1.521		
.18										1.570	1″.523		1.511	1.518	1.532		
.27											1.550	1″.500	1.525	1.525	1.522		
.33	1.536											1.507	1.521	1.523	1.514		
.40	1.509	1.476											1.497	1.494	1.521	1″.544	—
.48		1.577	1.500										1.538	1.545	1.525	1.536	1″.544
.57			1.523	1.552									1.537	1.536	1.538	1.552	1.541
.68				1.532	1.535								1.553	1.533	1.529	1.536	1.534
.78					1.514	1.525							1.519	1.518	1.537	1.515	1.435
.88						1.559	1.563						1.561	1.560	1.544	1.555	1.547
.97							1.554	1.551					1.552	1.553	1.535	1.570	1.539
1916 .04								1.493	1.486				1.489	1.493	1.528	1.493	1.536
.12									1.576	1.492			1.534	1.537	1.517	1.545	1.519
.19										1.521	1.520		4.520	1.521	1.534	1.519	1.533
.25											1.546	1.539	1.542	1.543	1.537	1.534	1.529
.33	1.552											1.546	1.549	1.548	—	1.535	—
														1.536		1.536	

Next, for every interval arithmetical mean values were taken for each *pair* during the individual interval, and then again these mean values were combined to another mean value for each group; by these treatments the micrometer-compensations were effected for each of the star-groups. Let the present series be called the "Pair Mean Differential Latitudes," which are tabulated as follows :

Table XIV. "Pair Mean" Series.

Mean Date	GROUP VIII	XI	X	XI	XII	I	II	III	IV	V	VI	VII	Mean	Smoothed	Annual Mean	Smoothed	
1914 .40	1″.589	1″.602											1″.595	—			
.47		1.557	1″.495										1.526	1.564			
.58			1.546	1″.597									1.571	1.544			
.68				1.540	1″.531								1.535	1.541			
.78					1.549	1″.488							1.518	1.535			
.88						1.539	1″.563						1.551	1.550			
.96							1.557	1″.604					1.580	1.541			
1915 .06								1.520	1″.465				1.492	1.540			
.13									1.549	1″.547			1.548	1.517			
.18										1.500	1″.523		1.511	1.527			
.27											1.549	1″.494	1.521	1.517			
.33	1.535											1.506	1.520	1.512			
.40	1.503	1.490											1.496	1.517	1″.545	—	
.48		1.572	1.496										1.534	1.520	1.53	1″.542	
.57			1.528	1.533									1.530	1.533	1.550	1.538	
.68				1.529	1.544								1.536	1.529	1.535	1.535	
.78					1.516	1.527							1.521	1.534	1.519	1.534	
.88						1.543	1.546						1.544	1.536	1.547	1.543	
.97							1.553	1.536					1.544	1.529	1.562	1.535	
1916 .04								1.515	1.483				1.499	1.526	1.495	1.532	
.12									1.577	1.493			1.535	1.516	1.540	1.516	
.19										1.514	1.515		1.514	1.530	1.512	1.527	
.26											1.547	1.534	1.540	1.533	1.530	1.525	
.33	1.548											1.543	1.545	—	1.532	—	

Here the syestematic effect of the entrance reconstruction of the International Instrument was computed just as in the preceding case, the two seasonal mean values corresponding to the same season being taken after reducing the materials for individual pairs. The obtained and the applied value is :

$$0''.009$$

in the sense that differential latitudes are smaller after the reconstruction.

Now, in the preceding case of treating the original materials of differential latitude series from the Table III, the deviations of mean differential latitudes of individual pairs from their general mean values for each group were made, every interval being separately treated of course. These deviations may include many kinds of errors, systematic as well as accidental. Of the systematic errors suspected, those due to uncertainties of micrometer-constants adopted for two instruments, the Research and the International respectively, (see § 6), were supposed to be most probable by the writer, who therefore put each of the deviations as in the following equation :

$$\text{Deviation} = \triangle(\triangle\varphi) + a.m. \dots\dots\dots\dots\dots\dots\dots\dots (1)$$

where m the micrometer-coefficient of each star-pair, by which the micrometer-constant was multiplied to be applied for the micrometer term of the reduction formula of latitude in the Talcott method, as in

$$\text{Talcott Latitude} = \text{Mean Declination} + \frac{m}{2}(\text{Differential Z.D.}) + \text{minor corrections.}$$

In (1), $\triangle(\triangle\varphi)$ and a are constants to be determined by the method of least squares, the former being quite independent of the micrometer effects and should give the " Ideal Differential Latitudes " if applied to a constant value, and the latter something seasonal to effect micrometer directly.

Let, in the following lines, be reproduced a *model* of material computations for the present case. From the first page of Table III. (p. 15), we get firstly :

	PAIRS OF GROUP VIII								
	57	58	59	60	61	62	(63)	64	Mean
Mean Value of Differential L=	1″.48	1″.68	1″.41	1″.73	1″.55	1″.59	1″.82	1″.45	1″.589
Devions from the Mean=	-″.11	″.09	″.182	″.14	-″.04	″.00	″.23	″.14	0″
m=	3′.4	-4′.1	2′.4	-′4.0	4′.6	0′.8	-5′.4	-5′.2	0′.3625
No. of Pairs	12	13	13	18	12	11	14	14	102

From these quantities, the least square solution necessitates the following equations :

$$
\begin{aligned}
-.11 &= \triangle(\triangle\varphi) + a\,(3.4), && \text{Weight}=12,\\
.09 &= \triangle(\triangle\varphi) + a\,(-4.1), && \text{,,}\quad =13,\\
-.18 &= \triangle(\triangle\varphi) + a\,(2.4), && \text{,,}\quad =13,\\
.14 &= \triangle(\triangle\varphi) + a\,(-4.0), && \text{,,}\quad =13,\\
-.04 &= \triangle(\triangle\varphi) + a\,(4.6), && \text{,,}\quad =12,\\
.00 &= \triangle(\triangle\varphi) + a\,(0.8), && \text{,,}\quad =11,\\
.23 &= \triangle(\triangle\varphi) + a\,(-5.4), && \text{,,}\quad =14,\\
.14 &= \triangle(\triangle\varphi) + a\,(5.2), && \text{,,}\quad =14.
\end{aligned}
$$

The normal equations are :

$$
\begin{aligned}
.11 &= 102.0\ \triangle(\triangle\varphi)\ a\,(27.9)\\
-51.90 &= \cdot 27.9\ \triangle(\triangle\varphi)\ a\,(1689.2)
\end{aligned}
$$

From these the following solutions are obtained :

$$\triangle(\triangle\varphi) = +0''.00995$$

$$a = -0.0324 \text{ per arc-minute}$$

Therefore,

$$\text{the `` Ideal Diff. Latitude ''} = 1''.59 + 0''.00995 = 1''.600$$

There are 12 intervals per year of our service, and hence 24 intervals in the whole period of the present research. But in each interval, two groups are regularly observed, so that we have 48 solutions of the above scheme in all, from which as many sets of constants are obtained.

The " Ideal Differential Latitudes " are tabulated as ;

Table XV. "Ideal" Series.

Mean Date	GROUP VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	Mean	Smoothed	Annual Mean	Smoothed
1914 ·40	1″.600	1″.602											1″.601	—		
.47		1.564	1″.489										1.526	1″.565		
.58			1.547	1″.589									1.568	1.544		
.68				1.539	1″.539								1.539	1.538		
.78					1.541	1″.471							1.506	1.531		
.88						1.536	1″.562						1.549	1.547		
.96							1.549	1″.622					1.585	1.540		
1915 .06								1.532	1″.439				1.485	1.539		
.13									1.535	1″.560			1.547	1.518		
.18										1.514	1″.528		1.521	1.531		
.27											1.550	1″.501	1.525	1.523		
.33	1.538											1.507	1.522	1.515		
.40	1.507	1.487											1.497	1.519	1″.549	—
.48		1.576	1.503										1.539	1.522	1.532	1″.540
.57			1.516	1.546									1.531	1.533	1.549	1.538
.68				1.526	1.533								1.529	1.522	1.534	1.530
.78					1.505	1.510							2.507	1.527	1.506	1.529
.88						1.546	1.547						2.546	1.534	1.547	1.540
.97							1.556	1.543					2.549	1.523	1.567	1.531
1916 .04								1.488	1.461				1.474	1.518	1.479	1.528
.12									1.474	1.491			1.532	1.511	1.539	1.514
.19										1.516	1.538		1.527	1.535	1.524	1.533
.26											1.552	1.542	1.547	1.543	1.536	1.533
.33	1.562											1.549	1.555	—	1.538	—
Closing Sum	+.074 +.148	+.096	+.094	+.106	+.099	+.024 Mean = +0″.125	+.049	+.135	+.069	+.177	+.169	+.130	1.533		1.533	

Here the systematic effect due to the entrance-reconstruction of the International Room was obtained from the fourth column (in its original form) from the right of the above Table VI, the result being :

0″.016

which were applied into all the materials available.

The probable errors of the individual values in the above tables are not the same naturally, because the weights and the numbers of actual observations included are different. However, they are of the order $\pm 0''.004$ for each group-mean which are arranged in a vertical column in the right.

On the other hand, the 48 a's obtained in the calculations of the preceding " Ideal " series were each assumed to be a linear function of temperature as a trial approximation, and put each in the following scheme :

$$a_0 + p.\theta = a \qquad \text{.............................. (2)}$$

where a_0 and p are constants to be determined by the method of least squares, and θ is the mean temperature from those readings of the thermometer which was attached to the zenith-telescope (International) in service, the calculations of these mean temperatures being made for each of star-groups and of the intervals. Our computation-model, above mentioned, gives the following example in this case :

$$a_0 + p \times 14^\circ.2 = -3.24$$

The complete solutions of normal equations, in the present case, give as their final results :

$$\left.\begin{array}{ll} & a_0 = -0''.00642 \\ \text{and} & p = +0''.0000672 \end{array}\right\} \text{ per arc-minute.}$$

so that the assumed formula is,

$$a = -0''.00642 + 0''.0000672.\theta \qquad \text{............ (3)}$$

Now, in each group of star-pairs of Talcott observations, the micrometer-compensations should always be aimed at as perfect as possible by proper selections of stars. But a strict perfection is impossible to be expected by a simple combination of stellar declinations, and the equinoctial precession makes it gradually worse even if it were pretty perfect at first. Hence a small residual of micrometer-compensations is inevitable in each group of stars. In our model case, for example, this residual is given by summing all m's, eight in number, thus :

$$3'.4 - 4'.1 + 2'.4 - 4'.0 + 4'.6 + 0'.8 - 5'.4 + 5'.2 = +2'.9$$

Therefore, in the simple mean of all pair-means, that is, in $1''.589$ given in the second line of the last column, page 385, the factor

$$+\frac{2'.9}{8} = +0'.3625$$

is affecting itself. For this case, the formula (3) just obtained was applied in the following manner ;

$$1.589-am=1''.589-0'.3625\ (-0''.00642+0''0000672\times 14^{\circ}.2)$$
$$=1''.591$$

This value may hereafter be called " compensated," and is justified to be reasonably treated for examination of its own serial character. This was carried out as in the following table :

Table XVI. " Compensated " Series.

Mean Date	GROUP VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	Mean	Smoothed	Annual Mean	Smoothed
1914 .40	1″.591	1″.601											1″.596	—		
.47	1.555	1.499	1″.499										1.527	1″.566		
.58			1.553	1″.597									1.575	1.545		
.68				1.539	1″.530								1.534	1.541		
.78					1.544	1″.483							1.513	1.431		
.88						1.534	1″.561						1.547	1.546		
.96							1.555	1″.599					1.577	1.537		
1915 .06								1.515	1″.461				1.488	1.537		
.13									1.545	1″.550			1.547	1.516		
.18										1.503	1″.525		1.514	1.528		
.27											1.551	1″.494	1.522	1.520		
.33	1.540											1.506	1.523	1.514		
.40	1.506	1.489											1.497	1.518	1″.546	—
.48		1.570	1.499										1.534	1.520	1.530	1″.543
.57			1.528	1.532									1.530	1.533	1.552	1.539
.68				1.527	1.541								1.534	1.526	1.534	1.533
.78					1.511	1.519							1.515	1.527	1.514	1.530
.88						1.535	1.542						1.538	1·531	1.542	1.538
.97							1.548	1.530					1.539	1.524	1.558	1.530
1916 .04								1.509	1.479				1.494	1.523	1.491	1.530
.12									1.573	I.497			1.535	1.516	1.541	1.516
.19										1.518	1.518		1.518	1.531	1.516	1.530
.26											1.550	1.535	1.542	1.536	1.532	1.528
.33	1.552											1.544	1.540	—	1.535	—
Closing Sum	+.051 +.186	+.078	+.093	+.133	+.110	+.041 Mean=0″.138	+.061	+.123	+.099	+.180	+.202	+.160	1.533		1.535	

Here the systematic effect of the entrance-change of the International room was obtained, as in the preceding case, from the fourth column from the right of the present Table VII, the resulting deviation being :

$$0''.008$$

which was applied, as usual, in the original material obtained from observations done after the re-construction.

Now we have four series showing the seasonal characters of the differential latiudes, that is,

1) the " Simple Mean " series,
2) the " Pair-Mean " series,
3) the " Ideal " series, and
4) the " Compensated " series,

all of which were obtained from the same material, only by different methods of treatment. In his first rough survey of the matter by graphical representations, the writer saw a good parallelism revealing itself between the " simple mean " series and the international " z-term " series published by the authority of the central bureau of the latitude variation of Potsdam. To confirm this nature quantitatively, he proceeded to compute the correlation factor between the two series. The factor for the whole period of two years was not large, even the initial " simple mean " series, after a direct comparison, was modified into a smoothed series by taking mean values of each *successive three* epochal values and again the correlation was sought. Next, the initial series extending in full two years was reduced to a simple annual one, by taking the arithmetical means of each pairs of values corresponding to the same season of the year ; this was also " smoothed out," and tested for the correlation factor which resulted as very *conspicuous.*

As to the data of the " z " of the latitude variation, the published values in Astronomische Nachrichten Nos. 4802, 4868, and 4908, were consulted. The x, y and z in A.N. 4858 are based on observation of four (Mizusawa, Carloforte, Gaithersburg, and Ukia) international observatories, while those in A.N. 4802 are based on six (Tschardjui and Cincinnati besides the above) such observatories. Hence the reduction to the same system of the coordinates were effected by the following amounts, which were given in the later number of the said journal :

Table XVII.

	x	y	z
Reduction from the system of four observatories to that of six.	$+0''.013$	$-0''.042$	$+0''.021$

Similarly the elements published in A.N. 4908, which were based on three observatories (excluding Gaithersburg), were reduced to the same uniform system by the following amounts, which are also given in the latest number of the publication :

Table XVIII.

	x	y	z
Reduction from the system of three observatories to that of six.	$+0''.013$	$-0''.038$	$+0''.023$

For the " z " values here to be used by the present writer, he computed the " local z " by subtracting the polar elements of the international origin from the direct results observed at the Mizusawa International Room, the formula being :

$$z'=\begin{pmatrix}\text{Intern. Latitude}\\ \text{Mizusawa}\end{pmatrix}-(x\cdot\cos\lambda+y\cdot\sin\lambda)$$

where z' is the required " local z " and λ is the longitude of Mizusawa. The x and y are of international authorities reduced, of course, to the system of the six observatories as mentioned above. In A.N. 4969, Dr. Wanach published a set of the elements x and y for the period 1912.1–1918.0 from observations made in the international service. It is his private study, and not in the name of the central bureau of the International Geodetic Association. There he assumed the full amount of the latitude variation to be exclusively due to the motion of the rotating axis of the earth, (the so-called " polar motion " according to Prof. H. Kimura, of Mizusawa), and consequently no account was taken as to the existence of the " z " as a universal term. The present writer obtained again a series of the " local " z by the similar method as in the preceding case, from Dr. Wanach's own x and y; this is denoted by " z'' " hereafter.

All the above quantities dere related are given in the following table.

Table XIX.

Date	International			Mizusawa Intern. Latitude		Wanach's [AN4969]		
	x	y	z	39°8′	z'	x_1	y_1	z''
1919 .4	+0″.218	+0″.095	+0″.015	3″.39	−0″.03	+0″.21	+0″.06	−0″.06
.5	+ .196	+ .020	+ .028	3.47	− .01	+ .19	− .02	− .04
.6	+ .144	− .069	+ .067	3.60	+ .02	+ .14	− .10	+ .00
.7	+ .064	− .148	+ .096	3.73	+ .04	+ .06	− .18	+ .02
.8	− .041	− .174	+ .113	3.84	+ .05	− .05	− .21	+ .02
.9	− .118	− .106	+ .107	3.84	+ .03	− .12	− .14	+ .01
1915 .0	− .195	+ .024	+ .062	3.80	+ .01	− .19	− .03	− .02
.1	− .196	+ .179	+ .073	3.73	+ .04	− .20	+ .13	+ .00
.2	− .133	+ .314	+ .088	3.62	+ .06	− .13	+ .26	+ .03
.3	− .043	+ .375	+ .077	3.49	+ .04	− .04	+ .32	+ .01
.4	+ .105	+ .354	+ .024	3.34	− .01	+ .11	+ .30	− .03
.5	+ .211	+ .241	+ .041	3.35	+ .01	+ .21	+ .19	− .02
.6	+ .271	+ .104	+ .090	3.44	+ .07	+ .27	+ .05	+ .03
.7	+ .227	− .027	+ .101	3.57	+ .08	+ .23	− .08	+ .05
.8	+ .130	− .166	+ .076	3.69	+ .04	+ .13	− .22	+ .00
.9	+ .012	− .193	+ .083	3.80	+ .04	+ .01	− .25	+ .00
1915 .0	− .112	− .120	+ .094	3.87	+ .06	− .11	− .18	+ .02
.1	− .196	− .019	+ .102	3.88	+ .07	− .20	− .08	+ .02
.2	− .236	− .172	+ .100	3.79	+ .06	− .24	+ .12	+ .03
.3	− .169	+ .278	+ .059	3.63	+ .03	− .12	+ .22	− .01
.4	− .027	+ .336	+ .008	3.43	− .03	− .03	+ .28	− .06

Seeing some very promising characters of the trial correlation factors between the differential latitudes and "z" as mentioned above, the writer proceeded to compute the similar factors between diverse sets of similar quantities. All results of these are summarised in the following Table

Table XX.

Series	Two Year			Annual		
	z	z'	z''	z	z'	z''
" Simple Mean "	−0.122	−0.196	−0.139	−0.339	−0.702	−0.538
" Pair-Mean "	− .142	− .313	− .268	− .325	− .676	− .475
" Ideal "	− .227	− .417	− .378	− .481	− .685	− .447
" Compensated "	− .181	− .380	− .316	− .574	− .743	− .541

This table is very interesting to close examiners. All factors are *negative* without a single exception ; this means that the Research observations are less affected by " z "-terms, relatively, than the International observations, because the present Differential Latitudes are obtained by subtracting the observed latitudes of the international service from those of the research works, i.e. :

$$\begin{pmatrix}\text{Differential}\\ \text{Latitude}\end{pmatrix}=\begin{pmatrix}\text{Research}\\ \text{Latitude}\end{pmatrix}-\begin{pmatrix}\text{International}\\ \text{Latitude}\end{pmatrix}$$

so that the increasing and the decreasing of the left-hand side is in the reverse order in the second term of the right-hand side. As to the absolute values of the correlation factors, those of the two-year columns are all relatively very small than those of the annual ones, although considerable diversities are seen in each of rows and columns. In all two-year columns, the inferiority of the " Simple Mean " series to the others is obvious. The same is almost the case with the next " Pair-Mean " series. These inferior characters of the first two rows are inevitable, for they were obtained only for approximation and without any serious considerations of themselves. It is rather strange, however that the annual columns do not generally reveal such inferiorities for the said two rows, although the factors in z column are suspected so a little. The susperiority of either of the " Ideal " or the " Compensated " series from each other is not too hastily decided, both in theoretical and the numerical considerations. Their original materials are indep ndent of each other in their respective derivations from the initial data. Moreover, either of them have their theoretical jusifications respectively, for they were derived by strict treatments of the data. The present writer takes the arithmetical mean values of these last columns as the *definite* measures of the correlations, thus :

Table XXI.

Two-year			Annual		
z	z'	z''	z	z'	z''
−0.204	−0.399	−0.347	−0.527	−0.714	−0.494

As for the discriminations of individual z's, on their relations with our Differential Latitudes, the inferiority of the *universal* z is definitely shown in every row of the Table XX. This fact means that the main feature of the z phenomenon is of *local* character in their origin, thus disproving the earliest notions of the students who sought the origin of z in several universal matters, for instance, in displacements of the centre of mass of the earth, in stellar parallaxes, in the yearly refraction, and the like.

On the other hand, the z' series are always superior to the other z''. Both of these are " local," and of the two, the z' is derived by subtracting the effects of the polar motions from the observed latitude under the fundamental assumption of three elements, x, y and z, in the latitude variation phenomena; while the z'' is derived similarly by subtracting the side effects from observation, but under the assumption of only two elements, x and y, in the present cases. Now, the fact, that the z' is definitely superior to the z'', means that the z-term of the latitude variation is *not* purely local and not peculiar to individual locality quite devoid of and simultaneous parallelism between different observatories ; but instead, somewhat common character of the similar phenomena are affecting many observatories at the same time, thus the general negligence of the common z making the above correlation more or less worse.

Lastly, the highest value of the correlation factor is a little more than 70% in the annual z' ; this means that the full amount of z is not accounted by the sole effect of the refraction anomalies of our initial suspection.

As the *definite* series of the Differential Latitudes, the arithmetical values of the quantities of the Tables VI and VII, each corresponding to the similar seasons and arranged similarly in both tables. From the fourth columns from the right extremity of both tables, we have :

Table XXII.

Mean Date	Definitive Differential Latitude	Smoothed
1914 .40	1″.598	—
.47	1.526	1″.565
.58	1.571	1.544
.68	1.536	1.539
.78	1.509	1.531
.88	1.548	1.546
.96	1.581	1.538
1915 .06	1.486	1.538
.13	1.547	1.517
.18	1.517	1.529
.27	1.523	1.521
.33	1.522	1.514
.40	1.497	1.518
.48	1.536	1.521
.57	1.530	1.532
.68	1.531	1.524
.78	1.511	1.523
.88	1.542	1.532
.97	1.544	1.523
1916 .04	1.484	1.520
.12	1.533	1.513
.19	1.522	1.533
.26	1.544	1.539
.33	1.551	

The general mean value of all differential latitudes of the above table, in its second column, is

$$1''.533$$

The whole series of the differential latitudes for 24 epochs in all in the preceding Table XXII were then reduced to an *annual* series by taking the arithmetical mean values of every pair corresponding to the same season. The following is the results :

Table XXIII.

Mean Date of the Year	Definitive Annual Differential Latitude	Smoothed
.40	1″.547	—
.475	1.531	1″·543
.575	1.550	1.538
.68	1.533	1.531
.88	1.510	1.529
.965	1.545	1.539
.05	1.562	1.531
.125	1.485	1.529
.195	1.540	1.515
.265	1.519	1.531
.33	1.533	1.529
	1.536	—

Fig. 7.

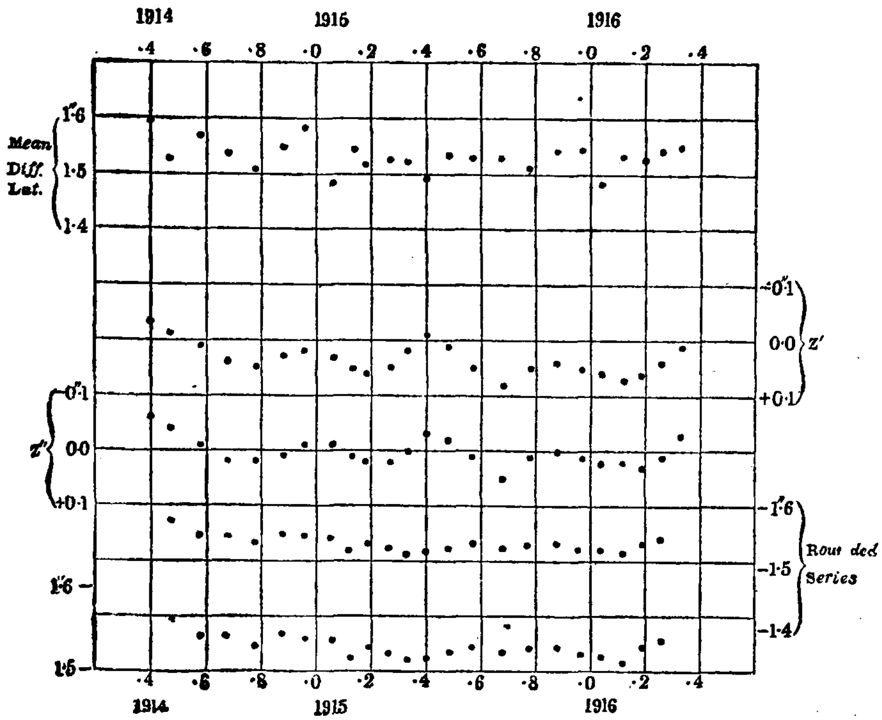
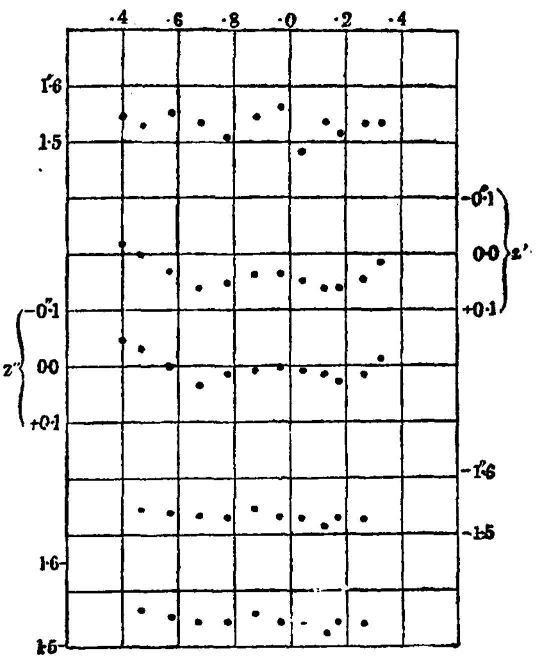


Fig. 8.



The general mean of the second column is $1''.533$, equal to the corresponding value from the preceding table of course.

The serial values of the Table XXII with the corresponding z's are plotted in the Figure 7; and those of the Table XXIII are in the Figure 8. Here it is to be remarked that the rounded series from consecutive values are reduced in its amplitude according to some formula assumed for the original series. Thus, if we assume an harmonic formula of an assignable period, then we have generally :

$$\frac{1}{3}\left\{\sin(\alpha-\theta)+\sin\alpha+\sin(\alpha+\theta)\right\}$$

$$=\frac{1}{3}\left\{2\cdot\sin\alpha\cdot\cos\theta+\sin\alpha\right\}=\frac{1}{3}(1+2\cdot\cos\theta)\cdot\sin\alpha \qquad (5)$$

where α is the angular argument of any epoch, and θ is the angular interval between any two consecutive values given by a fraction of the assumed period. The writer made here two kinds of assumption for the periods : the first is of one year suggested by the " z " of Director Kimura's discovery, which may possibly be occurred to be a reasonable cause of the serial run of these values ; the second is of half a year suggested by close inspection of the plotted figure, Fig. 8, from the same material of us. Therefore we have: as the reducing factors :

i) $\frac{1}{3}\left(1+2\cdot\cos\theta\right)=0.910$ because, $\theta=\frac{360^\circ}{12}$.

ii) $\frac{1}{3}\left(1+2\cdot\cos\theta\right)=\frac{2}{3}$ because, $\theta=\frac{360^\circ}{6}$.

In order to make the reader easily compare the parallelisms of these series between one another, the point series of these reduced values are drawn in magnified scales in our Figure, in the ratios of the tabulated values in the Table XIII :

$$\frac{1}{0.910}=1.10$$

$$\frac{1}{\frac{2}{3}}=\frac{3}{2}$$

respectively.

§ 15. The General Mean Value of the Differential Latitude.

As the simple mean value of *all* the differential latitudes given in the table XII, we obtain

$$1''.523$$

for the whole period of our work extending net two years.

On the other hand, the writer measured the distance (in Meridian) between the two observing room, sevaral times, with tapes and compasses, and obtained :

Table XXIV.

Date	Measured Distance	Weight	Instruments and Remarks
1914 Sept. 1	metres 45.37	1	4-in. Compass and Tape ; clear afternoon
Oct. 2	45.29	1	,, ,, ,, ,,
	45.74	½	,, ,, ,, ,, , small mechanical disturbances
Oct. 9	46.23	½	4-in. Compass and Tape, very rough measurement.
1918 Oct. 2	45.35	2	Tape and a Transit ; clear.
Weighed Mean	45.45±0.10		
or in Latitude	1.474±0″.0032		

This geodetic result is remarkably smaller than the above mentioned astronomical one, the difference being

$$1''.533—1''.474=+0''.059$$

which is no doubt beyond the tolerable errors of observations. If, however, we consider the formula, originally given by Prof. Shinjo,

$$\begin{aligned}\triangle(\varphi-\delta)=&f\cos(\odot-F)+g\cos(t-G)+x\cos\lambda+y\sin\lambda\\&+c\cos(\odot-C)+w(\odot+W)\\&-a\{(\sin\alpha\sin\delta\cos\varepsilon-\cos\delta\sin\varepsilon)\cos\odot-\cos\alpha\sin\delta\sin\odot\}\\&+\pi\{(\sin\alpha\sin\delta\cos\varepsilon-\cos\delta\sin\varepsilon)\sin\odot+\cos\alpha\sin\delta\cos\odot\},\end{aligned}$$

we may put

$$+0''.049=f\cos(\odot-F)+g\cos(t-G)$$

because the terms depending upon the Sun's longitude and several others which are common, in effects, to our both instruments such as the Eulerian motions of the Pole, possible real changes of the Earth, and the aberrational and the parallactic terms, are eliminated.

As to the nature of this residual, many suggestions are proposed for explanations. Prof. A. Tanakadate attributes this amount to the local irregularities in the directions of the plumb line (Lotabweichung). This theory cannot, however, be examined to a further details without any additional data.

Prof. H. Nagaoka suggested another theory to explain it with a stellar magnitude effect due to the diffraction images in the telescopic foci of our instruments. A statistical treatment from this standpoint which are given on page 380 is indeed a contribution from our numerical data available here. There we found a probable tendency of some regularity. But, a mean value of them corresponding to the zero of the magnitude difference almost exactly coincides with our astronomical mean result obtained in the present chapter. hardly promising to the geodetic result.

The Director Kimura is of the opinion that some instrumental effects are the most probable, though a sufficient data is not available to him to test it for detailed examinations.

Lastly, it came to the writer that an atmospheric or " room " effect would be most probable from the actual conditions of observations. It was already described that how the two observing room were constructed and used. The form and the type are entirely different between the two, and until their respective constructions or instruments will be interchanged and further observational data be obtained, we may here expect a constant and systematic effect to exist in our one-sided value. This is so far a theroetical consideration, and needed to be critically examined with a richer material. This is provisionally assumed here in our case, and arrived at an interesting contribution, which will be given in the next chapter.

§ 16. Closing Sum of the Differential Latitude Series.

During his calculations of the four series of the differential latitudes in § 14, the writer derived the Closing Sums of themselves, accumulating the data in the sense the preceding group minus follwing group following the example of authorities of the Postdam bureau. These are tabulated in the last rows of the Table XV and XVI. The general All are *positive*, meaning quite the reverse character as the international and many other cases. The general mean values are then :

	Closing Sum
From the " Ideal " series	$+0''.125$
„ „ " Compensated " series	$+0''.138$
Mean.............	$+0''.131$

The mean value of these is $+0''.131$, which is very near to the " Closing Sum " usually adopted in the International and other works, the sign being changed ; or we can say at least that the main part of it. This means clearly that our observations of the Research Instrument furnish no considerable amount of *its own* " Closing Sum " in the sense of the International Works.

We can put this *differential* " Closing Sum" in the formula, originally given by Prof. Shinjo in his paper,

$$\text{" Closing Sum "} = -3.6a + 1.0\,\pi + 6.2\,g \sin(t-G)$$

to the form :

$$-0''.131 = +\,6.2\,g \sin(t-G)$$

where the terms which are depending upon cosmical and other quantities and therefore common to our both instruments are omitted.

Moreover, we get another equation of the same kind, derived from Prof. Shinjo's formula

$$\Delta\varphi = f\cos(\odot - F) + g\cos(t-G)$$

for the latitude deviation, to the form ;

$$-0.059 = g\cos(t-G) \ldots\ldots\ldots\ldots\ldots \quad (7)$$

Here the terms of the nature as mentioned in the preceding case are also omitted. Thus we have two formulae including the two unknown quatities g and G, so that, solving, we obtain, t being 11^h generally,

$$\left.\begin{array}{l} t-G=1^h.3, \quad \therefore \quad G=9^h.7, \\ g=-0''.063 \end{array}\right\} \ldots\ldots\ldots\ldots (8)$$

These two factors give some idea of the diurnal variations of the atmospheric refraction near about the observing room, and furnish us a new means of reduction in many meridian works and allied phenomena. Prof. Shinjo suggests some formulae, of which I take here one instance for the constant of aberration. His formula of the constant from the Talcott Method is :

$$a = 20''.528 + 1''.64 \times g \sin(11^h - G)$$

the numerical values being taken from the Report of the International Latitude Service for the year 1901–1906. If we substitute the numerical values of g and G above obtained, we get as the adjusted constant of aberration :

$$a = 20''.493$$

17. Some Suspected Effects due to Instrumental Arrangements.

During our two year period of observations, two important changes were made in the methodical arrangements of the International Observation. The one is the reconstruction of the Entrance for the observer, as already described on page 11. The other is the Dew-cap Renewal, after the date of which telescope has been set always standing upright when not used. For these changes, special examinations were made with the present materials of actual observations.

i) *Entrance Effect.*

The new entrance worked on and after October 29, 1915. By this change we may reasonably expect some new arrangements in the neighboring atmospheric conditions of daily temperature distributions, and that during the actual observations. The writer obtained already the numerical effects of this kind of change during the calculations of series of the differential latitudes in §14, taking the differences between the values of two corresponding seasons. The following are the results:

Form the "Simple Mean"	0″.014
,, ,, "Pair-Mean"	0.009
,, ,, "Ideal"	0.016
,, ,, "Compensated"	0.008

The values of the last two of the above were combined together and their arithmetical mean was adopted as the definitive result. i.e.:

The entrance effect = 0″.012.

ii) *Telescope-Verticality Effect.*

This new arrangement began on February 9, 1916. By it the absolute amount of the latitudes cannot be affected in the total mean. With K. Hirayama, we may suspect some change of the Clamp-Reversal Inequality.

This effect was again derived from our two series of the differential latitudes, the "Ideal" and the "Compensated," as follows:

	"Ideal"	"Compensated"	Mena
Mean value after February 9, 1915.	1″.529	1″.526	1″.527
,, ,, ,, February 9, 1916.	1.524	1.528	1.526
	0.005	−0.002	0.001

This is practically nothing, hence no account was taken for the final values of the differential latitudes.

The writer re-calculated the Clamp-Reversal Inequality on the International Series of observations, dividing the total period into two: one before the new arrangement and the other after it. See the following:

	Clamp-reversal Inequality of International Latitudes		Mean
	Preceding Group	Following Group	
Mean before Verticality..............	+″0.043	+0″.033	+0″.038
,, after ,, ...	+ 0.075	+ 0.040	+ 0.057

	Absolute Values of International Clamp-Reversal Ineguality		
	Preceding Group	Following Group	Combined
Mean before Verticality	0″.10	0″.11	0″.11
,, after ,, ...	0.11	0.11	0.11

Thus we see that the general tendency is not appreciably changed. The absolute amounts are the same in both before and after the Vertical arrangements, and the total Mean of the algebraical values shows rather the increase in their amounts and deviations numerically. By these results we see at least at K. Hirayama's arguments on the problems relating to the flexure of the telescopic tube supposed to be caused by non-vertical arrangements are hardly of importance.

§ 18. Probable Errors of Observations.

In order to obtain the probable errors of the both series of observations and of the differential series, I selected as materials the observations of those days on which complete pairs were observed with both instruments. For each day, the arithmetical mean values of the observed latitudes were obtained, and then the reductions to the above mean were calculated. These reductions to the mean latitudes for each day were summarised for each group of the pairs as far as the pairs were observed in a continued epoch. Naturally, therefore, observations of the same group which were observed for two separated epochs just one year apart were treated separately. From these reductions and their mean, the probable errors of each observations were obtained, whose mean amounts are tabulated in the following table:

Table XXV.

Group	International Observations		Research Observations		Differential Series		Theoretical Series	Night Error	
VIII	±″.085		±″.147		±″.153		+″.170	±″.073	
IX	.098		.161		.177		.189	.067	
X	.094		.115		.125		.148	.079	
XI	.086		.111		.132		.140	.049	
XII	.104		.121		.159		.160	.013	

Group	International Observations		Research Observations		Differential Series		Teoretical Series	Night Error		
I	±″.098		±″.136		.148		±″.167	.077		
II	.095		.122		.125		.154	.090		
III	—		—		—		—	—		
IV	—		—		—		—	—		
V	.141		.140		.123		.198	.156		
VI	.084		.198		.111		.134	.075		
VII	.112		.109		.119		.156	.100		
VIII	.112	±″.098	.129	±″.138	.128	±″.140	.171	.113	±″.093	
IX	.106	.102	.103	.135	.146	.161	.152	.040	.053	
X	—	.094	—	.115	—	.125	—	—	.079	
XI	—	.086	—	.111	—	.132	—	—	.049	
XII	.092	.098	.096	.108	.123	.141	.133	.052	.032	
I	.115	.107	.113	.124	.136	.142	.161	.086	.082	
II	.111	.103	.136	.129	.158	.148	.176	.077	.084	
III	.106	.106	.131	.131	.100	.100	.168	.136	.136	
IV	.087	.087	.098	.098	.111	.111	.131	.069	.069	
V	.084	.112	.132	.136	.148	.136	.156	.050	.103	±0.094
VI	—	.084	—	.098	—	.111	—	—	.075	
VII	.092	.102	.114	.111	.121	.120	.145	.080	.090	
VIII	.072	.092	.176	.152	.158	.149	.190	.104	0.09	
Mean	±.098		±.125		±.135		±.159	.104		

In the above table, the 3rd, 5th, 7th, and 10th columns are the annual mean values for each group, being obtained by dividing the sums of the probable errors for each annual group. The 8th column is the square root of the squared sum of the 2nd and fourth column, so that if the Differential Series include only those errors which are due to those of the two observational series and not due to common factors to both at all, then the fifth column, that is the probable errors of the Differential Series, must be equal to the 8th Series. If these two series are not equal, but have some appreciable differences between them, the differences should be due to some common elements affecting to both observations, one of which would most probably the Night Error. Assuming this last cause, the 9th column was calculated by taking square roots of the squared differences of the 6th column from the 8th., in the designation of the "Night Error." It is reasonoble to suppose that these night errors are mainly caused from meteorological effects, the general tendency of which is easily seen in semi-annual mean values of the 10th column. The mean of the five groups representing the summer time observations, from IX to I, is

$$\pm 0''.059,$$

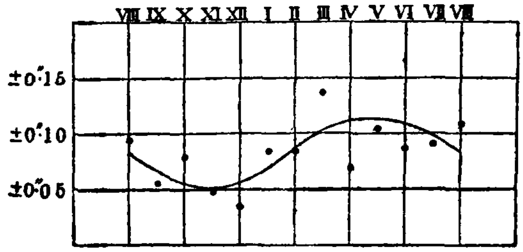
where that of the equal number of groups representing the winter time, from III to VII, is

$$\pm 0.094.$$

Here we see very clearly the bad condition of the winter nights. Transforming these two values into terms of the relative weights of a single observations, we get

$$\left(\frac{.094}{.059}\right)^2 = 2\ 5$$

Fig. 9.



Assuming that the chief cause of this night error is meteorological, and therefore of annual period, the writer calculated the annual runs of these values by overlapping those for each group of the first year on the corresponding one of the second year and by taking mean values. These mean values corresponding to each of definite seasons of the year are given in the third, fifth, and seventh columns of the Table XXV. The night errors were similarly treated and given in the last column, and moreover, in order to illustrate the general behavior, they are plotted in the Figure 9, in which we see a kind of harmonic run easily.

As a check of the numerical proof of the existence of the Night Errors as a common factor to both observational series, the coefficient of Correlation between the absolute amounts of the 2nd and 4th columns was calculated, to the result:

$$\text{Correlation factor} = +\ 0.392$$

§ 19. Summary.

For the verification of Prof. Shinjo's Theory of the anomalous refraction near the observing room of the Zenith-telescope and the like observations, the author made a special series of Latitude observations by the Talcott Method on the same ground of the International Latitude Observatory of Mizusawa. The Instrument was the Wanschaff Zenith-telescope of a little smaller dimension than that of the International Service, the type being quite the same except the reversing prism at the eye-piece end. The room was constructed under a special design to avoid the general peculiarity of the common case, so that the room had very elongated wings of the same cross-section and the roof was as flat as possible. In this way the direct effects due to the finite dimension of the room in NS-direction was to be neglected. The observing programme was quite the same as the International one, even in clamp positions. The observations began in May, 1914, and ended in the same season of 1916, so that the whole series extended in two years exactly.

The individual series of both observations, International and Research, could have afford each an independent determination of the latitude variation. But the Differential series, obtained by subtracting each other, were most effective for our propose, the star places and other common factors being sufficiently eliminated. These series of the Differential Latitudes shows a conspicuous parallelism with the *inverted* " z "-Term or the Kimura Term of International Service of the Latitude Variation of the same epoch as computed and published under names of Profs Th. Albrecht and Wanach. The parallelism is, however, more conspicuous between our series and those localised " z " which were obtained by subtracting the terms of the latitude variation including the x and y terms only from the observed latitudes of the International Service *at Mizusawa.* Moreover, the closing sum of our Differential Latitude series here obtained is very near to the like quantities of the International and other observations *in amount* and *Opposite in sense*, which is the proof that the cl sing sum of our Research Series is near to zero. By the above two kinds of results we see that the " z "-term of the International Latitude Observations is mainly due to the atmospheric effect near the observing room, and that in the sense as proved by Prof. Shinjo's theory of refraction.

The general mean value of the Differential Latiude series for the whole epoch of our simultaneous observations has a definite deviation from the value determined geometically. This value and the closing sum of the Differential Latitudes afford each a formula of the daily variation of the atmospheric refraction. From both of them, we can solve the assumed elements of this variation of refraction. And further, applying this formula, a new value of the abberation constant free from the refraction anomaly has been obtained.

In the Differential Latitude series, the personal equations affecting the second place below the decimal point of second of arc are shown.

The effects due o the reversal of the clamp during the usual manipulation of instruments were examined in three series, the International, the Research and the Differential. Some common factors affecting the first two was suspected, which is necessarily eliminated from the last one. Next, the three possible kinds of causes of these phenomena were examined also in each of the three series. The systematic effects of the zenith-distance, the time-interval and the differential stellar magnitudes are more or less shown, in parallel with the similar results of the former authorities.

The magnitude effect upon the general mean value of the Differential Latitude series, which has a large systematic deviation from the geometical determination, was examined. The result was found to be negligible.

As to the effects of the changes in the arrangements of the practical observations during the epoch, the examinations have been made. The reconstruction of the entrance of the International Service room in the Autumn of 1915 has shown an appreciable effect. The improvement in the vertical setting of the International Instrument in the beginning of February, 1916, has shown no practical effect upon the clamp-reversal inequality after the date, which means no influence of the suspected flexure of the telescopic tube upon the phenomena.

By the examination of the probable errors of the three series, we see that the relative weight of the International work 1.6 times greater than that of the Research work, mainly due to the instrumental efficiency. The night error affecting both the observational series is large, and variable with seasons. Generally the observation on a wintry night has a weight 1/2.5 of that on a summer one.

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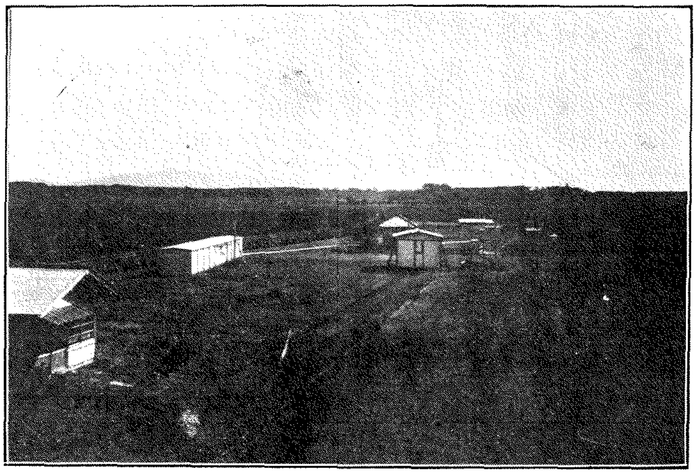
ISSEI YAMAMOTO,

March 25, 1922,

Kyoto University Observatory.

General View of the
INTERNATIONAL LATITUDE STATION
at Mizusawa.



↑ Research observation house

↑ International observation house