ON

A SIMPLIFICATION

OF THE

COMPUTATIONS

RELATING TO

RECTANGULAR CO-ORDINATES.

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On a Simplification of the Computations relating to Rectangular Co-ordinates.

From time to time various proposals have been put forward to alter the method of changing the rectangular co-ordinates of a point from one origin to another. To some minds the method explained in the Topographical Hand-book, 3rd edition, page 66, appeared unnecessarily complicated, while to others it appeared, what it undoubtedly is, inaccurate. It is with a view of trying to satisfy both these classes that the present method is put forward. It is claimed that the computations are not longer than they were before and are so simple that any ordinary computer can carry them out. The method depends on the fact that where approximate latitudes and longitudes are required they can be taken off the traverse plot with sufficient accuracy. This of course necessitates plotting the corners of the graticule on the traverse plot to give lines to measure from, but as these corners have eventually to be plotted they may as well be done in the first instance and the computation on form P.48 to find the rectangular co-ordinates of these corners is very simple.

If x and y are the rectangular co-ordinates in chains of a point P whose lat. and long. are λ and L with reference to an origin whose lat. and long. are λ_0 and L_0,

$$x = \frac{\nu \cos \lambda \sin 1''}{66}\left(L - L_0\right) + \frac{\nu \cos \lambda \sin 1''}{66} \cdot \Upsilon'\left(L - L_0\right)^3.$$

$$y = \rho_{\frac{\lambda_0 + \lambda}{2}} \frac{\sin 1''}{66}\left(\lambda - \lambda_0\right) + \rho_\lambda R' \frac{\sin 1''}{66} \cdot \left(L - L_0\right)^2.$$

$(L - L_0)$ being in seconds and the notations being those used in the Auxiliary Tables.

(1). When the spherical coordinates are given it is quite straightforward to obtain x and y; and the new form is probably as simple and short as anything yet suggested.

(2). When x and y are given and it is required to find λ and L, the old form necessitated the determination of an approximate value of λ and L. In this method the latitude and longitude are taken off the traverse plot. This can be done correctly to 1 second of λ and L from plots of 1-inch scale and to much greater accuracy from larger scale plots, and since 1″ in the coefficient of $(L - L_0)$ only makes a difference of $1\frac{1}{2}$ links in a distance of 5000 chains in latitude 35°, while in the other terms the error is much smaller, the approximation is sufficient, and the approximate values of λ and L, found and used in the old form, were no more accurate.

We then have

$$(L - L_0) \text{ in seconds} = x \div \frac{\nu \cos \lambda \sin 1''}{66} - \text{correction for } (L - L_0)^3 \div \frac{\nu \cos \lambda \sin 1''}{66}$$

and $\frac{\nu \cos \lambda \sin 1''}{66}$ varies between 1·5 and 1·2. So, if we take it 1·3 or $\frac{4}{3}$ as a divisor in the last term we make very little mistake, but when greater accuracy is required a value of the divisor corresponding to the mean latitude can be used and will be the same for all the points.

When $L - L_0$ has been determined λ follows from

$$\lambda - \lambda_0 = \left[y - \text{correction for } (L - L_0)^2 \text{ for } \lambda\right] \div \rho_{\frac{\lambda_0 + \lambda}{2}} \frac{\sin 1''}{66}.$$

(3). When it is a question of changing from one origin λ_o, L_o to another λ_n, L_n.

$$x' = x + \frac{\nu \cos\lambda \sin 1''}{66}\left(L_o - L_n\right) + \frac{\nu \cos\lambda \sin 1''}{66} Y'\left[(L - L_n)^3 - (L - L_o)^3\right]$$

$$y' = y + \rho_{\frac{\lambda_o + \lambda_n}{2}} \frac{\sin 1''}{66}\left(\lambda_o - \lambda_n\right) + \rho_\lambda R' \frac{\sin 1''}{66}\left[(L - L_n)^2 - (L - L_o)^2\right]$$

where x' and y' are the rectangular co-ordinates referred to the new origin.

Here as before we require λ and L to be taken from the chart, but $L_o - L_n$ is constant for all the points and so is $\rho_{\frac{\lambda_o + \lambda_n}{2}} \frac{\sin 1''}{66}\left(\lambda_o - \lambda_n\right)$. So that in each case with a table of squares and cubes, such as is provided in Table LXXII, there is very little difficult computation.

The only difficulty is in interpolating for the latitude in the tables and perhaps in finding the value of the square of a number above 1000. The first has been explained in its proper place and as a number of 4 digits can always be represented as $10a \pm b$ when a is a number of three digits and b is a number of one digit not exceeding 5, then the square which is $100a^2 \pm 10a \times 2b + b^2$ is sufficiently closely represented by $100a^2 \pm 10a \times 2b$ and $2b$ now never exceeds 10 so that the multiplication can be done with ease.

TABLE LXVIII.—*Logarithm of the Linear value in Chains of one Second of Arc measured along the Meridian.*

The logarithms of the length in chains of one second are given for every 5′ of latitude. The argument with which to enter the table is the mean latitude and the corresponding logarithms should be found by interpolation.

Example:—Required the logarithm of the length in chains of one second of arc along the meridian at mean latitude 30° 35′ 47″·21.

30° 35′ 47″·21 = 30° 35′·79		
Quantity from Table for 30° 35′		= 0·1848815
Tab. diff. for 5′	= + 55	
„ for 0·79	= + 11 × 0·79	= + 9
Therefore the logarithm of the length of one second in chains		= 0·1848824

TABLE LXIX.—*Logarithm of the Linear value in Chains of one Second of Arc measured along the Parallels of Latitude.*

The logarithms of the length in chains of one second are given for every 5′ of latitude. The argument in this table is the latitude of the parallel on which the length is required and the corresponding values of logarithms should be found by interpolation.

Example:—Required the logarithm of the length in chains of one second of arc along the parallels at latitude 30° 54′ 27″·07.

30° 54′ 27″·07	= 30° 54′·451	
Quantity from the Table for	30° 50′	= 0·1208547
Tab. diff. for 5′ =	−3759	
„ for 4·451	= −4·451 × 751·8	= − 3346
Therefore the logarithm of the length of one second of arc in chains		= 0·1205201

TABLE LXX.—*Correction corresponding to m in determining the meridional co-ordinate in chains.*

In computing rectangular from spherical co-ordinates or *vice versâ* the quantity m is $(L-L_o)^2$, but when changing from one origin to another m is $(L-L_n)^2 - (L-L_o)^2$.

This table gives the correction for m for every 10′ of latitude. The quantity at the top of each column is the correction in chain for the values of m in the column for different latitudes.

The arguments in this table are the latitude and the values of m. The corresponding correction should be found by interpolation for both latitude and m.

When m exceeds 1000000 interpolation for the nearest minute will be necessary, otherwise the nearest 10 minutes will be sufficient and there will be no necessity for interpolation.

Example:—Required the correction in chains at latitude 30° 54′ 27″, when $m = 4856280$.

In this case 30° 54′ 27″ = 30° 54′ (taking nearest minute).

In the horizontal line of 30° 50′, we find 42655 in the column of 0·07, and 4265500 is the next lowest number to 4856280 and corresponds to 7·00.

We must therefore interpolate for 4′ in this column.

At 30° 50′ m =	42655
The change for 10′ =	− 133
for 4′ = − 13·3 × 4 =	− 53
∴ at 30° 54′ m is	42602.

∴ For 42602* at 30° 54′ the correction is 0·07.

			correction
	4856280		
For	4260200	0·07 × 100 =	7·00
	596080		
For	548420	0·09 × 10 =	0·90
For	47660	=	0·08

∴ For 4856280 at lat. 30° 54′ the correction is 7·98 chains.

TABLE LXXI.—*Correction corresponding to n in determining the longitudinal co-ordinate in chains.*

In computing rectangular from spherical co-ordinates and *vice versâ* the quantity n is $(L-L_o)^3$ but when changing from one origin to another n is $(L-L_n)^3 - (L-L_o)^3$.

This table gives the correction for n for every 20′ of latitude. The quantity at the top of each column is the correction in chains for one million times the numbers given in the column for different latitudes. There is no necessity for interpolation and latitudes may be taken to nearest 20′.

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* If preferred the rest of the interpolation may be done by the ordinary rule of three; the resulting correction $= \frac{4856280 \times 0{\cdot}07}{42602} = 7{\cdot}98$.

Example:—Required correction at lat. 30° 54′ 27″ when n is 15987,723892.

30° 54′ 27″ may be taken as 31° 0′.

As n should be kept to the nearest million the last six figures of n should be dropped.

	15988	correction
at 31° for	14588	0·04
	1400	

Therefore for 15987,723892 at lat. 30° 54′ 27″ the correction is 0·04 of a chain.

TABLE LXXII.—*Squares and Cubes of Numbers.*

This table contains squares and cubes of all numbers from 1 to 1000. Squares and cubes of numbers above 1000 may be found approximately, but sufficiently accurately for the purpose, from this table in the following manner:—

It is required to find the squares of 1579 and 1574 from this table:—

(i) $(1579)^2 = (1580 - 1)^2 = (1580)^2 - 2 \times 1 \times 1580 + 1^2$

$= (158)^2 \times 100 - 3160$ (leaving out the last term),

or $= 2496400 - 3160 = 2493240$ (158^2 having been found from the table)

(ii) $(1574)^2 = (1570 + 4)^2 = (157)^2 \times 100 + 2 \times 4 \times 1570 + 4^2$

$= 2464900 + 12560$ (leaving out the last term)

$= 2477460.$

When the last figure is more than 5, the 1st form should be used, otherwise the second.

It is required to find the cube of 1579 from this table:—

$(1579)^3 = (1580 - 1)^3$ which may be taken for this purpose as,

$(1580)^3 = (158)^3 \times 1000 = 3944312000$

i.e., the number should be kept to nearest 10, the cube of the modified number leaving out last zero may be at once found from the table, and then three zeros should be added to the end of the cube thus found.

TABLES.

TABLE LXVIII.—Logarithm of the Linear value in Chains of one Second of Arc measured along the Meridian.

Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains
° ′		° ′		° ′		° ′		° ′		° ′		° ′	
0 0	0·1837611	6 0	0·1838083	12 0	0·1839480	18 0	0·1841742	24 0	0·1844768	30 0	0·1848430	36 0	0·1852568
5	7611	5	8097	5	9506	5	1779	5	4815	5	8485	5	2618
10	7612	10	8110	10	9532	10	1816	10	4863	10	8540	10	2688
15	7612	15	8124	15	9558	15	1853	15	4910	15	8595	15	2748
20	7612	20	8137	20	9584	20	1891	20	4957	20	8649	20	2808
25	7613	25	8151	25	9610	25	1928	25	5004	25	8705	25	2868
30	7615	30	8165	30	9637	30	1966	30	5051	30	8759	30	2929
35	7615	35	8179	35	9663	35	2004	35	5099	35	8815	35	2989
40	7617	40	8194	40	9691	40	2042	40	5147	40	8870	40	3050
45	7618	45	8208	45	9717	45	2080	45	5195	45	8925	45	3110
50	7620	50	8224	50	9745	50	2119	50	5243	50	8980	50	3170
55	7622	55	8238	55	9772	55	2157	55	5290	55	9036	55	3231
1 0	0·1837624	7 0	0·1838253	13 0	0·1839800	19 0	0·1842196	25 0	0·1845339	31 0	0·1849092	37 0	0·1853291
5	7626	5	8269	5	9827	5	2235	5	5387	5	9147	5	3352
10	7629	10	8284	10	9855	10	2274	10	5436	10	9203	10	3412
15	7631	15	8300	15	9883	15	2313	15	5484	15	9259	15	3473
20	7634	20	8316	20	9911	20	2352	20	5533	20	9315	20	3533
25	7637	25	8331	25	9939	25	2391	25	5582	25	9371	25	3594
30	7641	30	8348	30	9968	30	2431	30	5630	30	9427	30	3655
35	7644	35	8364	35	9997	35	2471	35	5680	35	9483	35	3716
40	7648	40	8381	40	0·1840025	40	2511	40	5728	40	9539	40	3777
45	7651	45	8397	45	0054	45	2551	45	5777	45	9596	45	3838
50	7655	50	8414	50	0083	50	2591	50	5827	50	9652	50	3899
55	7659	55	8432	55	0113	55	2631	55	5876	55	9709	55	3960
2 0	0·1837664	8 0	0·1838448	14 0	0·1840143	20 0	0·1842671	26 0	0·1845926	32 0	0·1849765	38 0	0·1854022
5	7668	5	8466	5	0172	5	2712	5	5976	5	9822	5	4083
10	7673	10	8484	10	0202	10	2753	10	6025	10	9879	10	4144
15	7677	15	8501	15	0232	15	2793	15	6075	15	9936	15	4205
20	7683	20	8520	20	0262	20	2834	20	6125	20	9992	20	4267
25	7688	25	8538	25	0292	25	2875	25	6176	25	0·1850049	25	4329
30	7693	30	8556	30	0323	30	2917	30	6226	30	0106	30	4389
35	7699	35	8574	35	0353	35	2958	35	6276	35	0164	35	4451
40	7704	40	8593	40	0384	40	2999	40	6327	40	0221	40	4513
45	7710	45	8612	45	0415	45	3041	45	6377	45	0278	45	4574
50	7717	50	8631	50	0446	50	3083	50	6428	50	0335	50	4635
55	7723	55	8650	55	0477	55	3125	55	6479	55	0393	55	4697
3 0	0·1837730	9 0	0·1838669	15 0	0·1840509	21 0	0·1843167	27 0	0·1846529	33 0	0·1850451	39 0	0·1854759
5	7736	5	8689	5	0540	5	3209	5	6580	5	0508	5	4821
10	7743	10	8708	10	0572	10	3251	10	6632	10	0566	10	4882
15	7750	15	8729	15	0603	15	3294	15	6683	15	0623	15	4944
20	7757	20	8749	20	0635	20	3337	20	6734	20	0681	20	5005
25	7765	25	8769	25	0668	25	3379	25	6786	25	0739	25	5068
30	7772	30	8789	30	0700	30	3422	30	6837	30	0797	30	5129
35	7780	35	8810	35	0733	35	3465	35	6888	35	0855	35	5192
40	7788	40	8830	40	0765	40	3508	40	6941	40	0913	40	5253
45	7796	45	8851	45	0798	45	3551	45	6992	45	0972	45	5316
50	7805	50	8872	50	0831	50	3595	50	7045	50	1030	50	5378
55	7812	55	8894	55	0864	55	3638	55	7096	55	1088	55	5440
4 0	0·1837821	10 0	0·1838915	16 0	0·1840897	22 0	0·1843682	28 0	0·1847149	34 0	0·1851146	40 0	0·1855502
5	7830	5	8937	5	0931	5	3726	5	7201	5	1205	5	5564
10	7839	10	8959	10	0964	10	3770	10	7253	10	1264	10	5626
15	7849	15	8980	15	0998	15	3814	15	7306	15	1322	15	5689
20	7858	20	9003	20	1032	20	3858	20	7358	20	1381	20	5751
25	7867	25	9025	25	1065	25	3902	25	7411	25	1439	25	5813
30	7877	30	9047	30	1100	30	3947	30	7464	30	1499	30	5875
35	7887	35	9070	35	1134	35	3991	35	7517	35	1557	35	5938
40	7897	40	9093	40	1169	40	4036	40	7570	40	1616	40	6000
45	7908	45	9115	45	1203	45	4081	45	7623	45	1676	45	6062
50	7918	50	9139	50	1239	50	4126	50	7676	50	1734	50	6125
55	7929	55	9162	55	1274	55	4171	55	7729	55	1793	55	6187
5 0	0·1837940	11 0	0·1839186	17 0	0·1841308	23 0	0·1844216	29 0	0·1847782	35 0	0·1851853	41 0	0·1856250
5	7951	5	9209	5	1344	5	4262	5	7836	5	1912	5	6311
10	7962	10	9233	10	1379	10	4307	10	7890	10	1972	10	6375
15	7973	15	9257	15	1415	15	4352	15	7943	15	2030	15	6437
20	7985	20	9281	20	1450	20	4398	20	7997	20	2090	20	6500
25	7996	25	9306	25	1486	25	4444	25	8051	25	2149	25	6562
30	8009	30	9330	30	1522	30	4490	30	8105	30	2209	30	6625
35	8020	35	9355	35	1558	35	4536	35	8159	35	2269	35	6687
40	8033	40	9380	40	1595	40	4582	40	8213	40	2328	40	6750
45	8045	45	9405	45	1631	45	4629	45	8267	45	2388	45	6813
50	8058	50	9430	50	1668	50	4675	50	8321	50	2448	50	6875
55	8071	55	9455	55	1705	55	4722	55	8376	55	2508	55	6938
60	8083	60	9480	60	1742	60	4768	60	8430	60	2568	60	7001

TABLE LXIX.—Logarithm of the Linear value in Chains of one Second of Arc measured along the Parallels of Latitude.

Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains	Latitude	Log. Length in chains
° ′		° ′		° ′		° ′		° ′		° ′		° ′	
0 0	0·1866535	6 0	0·1842836	12 0	0·1771202	18 0	0·1649975	24 0	0·1476223	30 0	0·1245448	36 0	0·0951097
5	6531	5	2172	5	0·1769863	5	7930	5	3420	5	1813	5	0·0946521
10	6517	10	1499	10	8515	10	5875	10	0607	10	0·1238166	10	1931
15	6494	15	0816	15	7157	15	3810	15	0·1467783	15	4507	15	0·0937326
20	6462	20	0124	20	5789	20	1734	20	4948	20	0835	20	2708
25	6421	25	0·1839423	25	4412	25	0·1639648	25	2102	25	0·1227151	25	0·0928075
30	6371	30	8713	30	3026	30	7553	30	0·1459244	30	3455	30	3428
35	6312	35	7993	35	1629	35	5447	35	6376	35	0·1219747	35	0·0918767
40	6243	40	7264	40	0223	40	3331	40	3497	40	6026	40	4092
45	6166	45	6526	45	0·1758808	45	1204	45	0606	45	2292	45	0·0909402
50	6079	50	5779	50	7383	50	0·1629068	50	0·1447705	50	0·1208547	50	4699
55	5983	55	5022	55	5948	55	6921	55	4792	55	4788	55	0·0899980
1 0	0·1865878	7 0	0·1834256	13 0	0·1754504	19 0	0·1624764	25 0	0·1441868	31 0	0·1201018	37 0	0·0895248
5	5764	5	3481	5	3050	5	2597	5	0·1438933	5	0·1197235	5	0501
10	5641	10	2697	10	1586	10	0419	10	5987	10	3439	10	0·0885740
15	5508	15	1903	15	0113	15	0·1618232	15	3030	15	0·1189631	15	0964
20	5367	20	1100	20	0·1748630	20	6034	20	0061	20	5811	20	0·0876174
25	5216	25	0288	25	7138	25	3826	25	0·1427082	25	1977	25	1369
30	5057	30	0·1829466	30	5636	30	1607	30	4091	30	0·1178132	30	0·0866550
35	4888	35	8636	35	4124	35	0·1609379	35	1089	35	4273	35	1716
40	4710	40	7795	40	2603	40	7139	40	0·1418075	40	0402	40	0·0856868
45	4523	45	6946	45	1072	45	4890	45	5050	45	0·1166518	45	2004
50	4326	50	6087	50	0·1739531	50	2630	50	2014	50	2622	50	0·0847127
55	4121	55	5219	55	7980	55	0360	55	0·1408967	55	0·1158713	55	2234
2 0	0·1863906	8 0	0·1824342	14 0	0·1736420	20 0	0·1598080	26 0	0·1405909	32 0	0·1154791	38 0	0·0837327
5	3683	5	3455	5	4850	5	5789	5	2839	5	0857	5	2405
10	3450	10	2559	10	3270	10	3488	10	0·1399757	10	0·1146909	10	0·0827468
15	3208	15	1654	15	1681	15	1177	15	6665	15	2949	15	2516
20	2957	20	0740	20	0082	20	0·1588855	20	3561	20	0·1138977	20	0·0817550
25	2697	25	0·1819816	25	0·1728473	25	6523	25	0445	25	4991	25	2568
30	2427	30	8883	30	6855	30	4180	30	0·1387318	30	0992	30	0·0807572
35	2149	35	7940	35	5227	35	1827	35	4180	35	0·1126981	35	2560
40	1861	40	6988	40	3588	40	0·1579463	40	1031	40	2956	40	0·0797534
45	1564	45	6027	45	1941	45	7089	45	0·1377869	45	0·1118919	45	2492
50	1258	50	5056	50	0283	50	4705	50	4697	50	4869	50	0·0787436
55	0943	55	4076	55	0·1718616	55	2310	55	1512	55	0805	55	2364
3 0	0·1860619	9 0	0·1813087	15 0	0·1716939	21 0	0·1569904	27 0	0·1368317	33 0	0·1106729	39 0	0·0777277
5	0285	5	2088	5	5252	5	7488	5	5110	5	2640	5	2175
10	0·1859943	10	1080	10	3555	10	5062	10	1891	10	0·1098537	10	0·0767058
15	9591	15	0063	15	1848	15	2625	15	0·1358660	15	4422	15	1925
20	9230	20	0·1809036	20	0132	20	0178	20	5418	20	0293	20	0·0756777
25	8860	25	8000	25	0·1708406	25	0·1557720	25	2165	25	0·1086151	25	1614
30	8481	30	6955	30	6670	30	5251	30	0·1348900	30	1096	30	0·0746435
35	8092	35	5900	35	4924	35	2772	35	5623	35	0·1077828	35	1241
40	7695	40	4835	40	3168	40	0282	40	2334	40	3647	40	0·0736032
45	7288	45	3762	45	1403	45	0·1547782	45	0·1339034	45	0·1069452	45	0807
50	6872	50	2679	50	0·1699627	50	5271	50	5722	50	5245	50	0·0725566
55	6447	55	1586	55	7842	55	2740	55	2309	55	1023	55	0310
4 0	0·1856013	10 0	0·1800484	16 0	0·1696047	22 0	0·1540217	28 0	0·1329064	34 0	0·1056789	40 0	0·0715038
5	5570	5	0·1799373	5	4242	5	0·1537675	5	5716	5	2541	5	0·0709751
10	5117	10	8252	10	2427	10	5131	10	2358	10	0·1048280	10	4448
15	4656	15	7122	15	0602	15	2557	15	0·1318987	15	4006	15	0·0699129
20	4185	20	5983	20	0·1688767	20	0·1529982	20	5605	20	0·1039718	20	3795
25	3705	25	4834	25	6922	25	7307	25	2210	25	5416	25	0·0688444
30	3215	30	3675	30	5068	30	4800	30	0·1308804	30	1101	30	3078
35	2717	35	2507	35	3203	35	2193	35	5386	35	0·1026773	35	0·0677696
40	2209	40	1330	40	1329	40	0·1519576	40	1957	40	2431	40	2298
45	1693	45	0143	45	0·1679444	45	6947	45	0·1298515	45	0·1018076	45	0·0666884
50	1166	50	0·1788947	50	7550	50	4308	50	5061	50	3706	50	1454
55	0631	55	7741	55	5645	55	1658	55	1596	55	0·1009324	55	0·0656009
5 0	0·1850087	11 0	0·1786526	17 0	0·1673731	23 0	0·1508998	29 0	0·1288118	35 0	0·1004927	41 0	0·0650547
5	0·1849533	5	5301	5	1806	5	6326	5	4629	5	0517	5	0·0645068
10	8970	10	4067	10	0·1669872	10	3644	10	1127	10	0·0996094	10	0·0639574
15	8398	15	2823	15	7927	15	0951	15	0·1277614	15	1656	15	4064
20	7817	20	1570	20	5973	20	0·1498247	20	4088	20	0·0987205	20	0·0628537
25	7227	25	0307	25	4008	25	5532	25	0550	25	2740	25	2994
30	6627	30	0·1779035	30	2034	30	2806	30	0·1267001	30	0·0978261	30	0·0617434
35	6018	35	7753	35	0049	35	0069	35	3439	35	3769	35	1859
40	5400	40	6462	40	0·1658055	40	0·1487322	40	0·1259865	40	0·0969262	40	0·0606266
45	4773	45	5162	45	6050	45	4563	45	6279	45	4742	45	0658
50	4137	50	3851	50	4035	50	1794	50	2681	50	0208	50	0·0595033
55	3491	55	2532	55	2010	55	0·1479014	55	0·1249070	55	0·0955659	55	0·0589391
60	2836	60	1202	60	0·1649975	60	6223	60	5448	60	1097	60	3733

TABLE LXX.—Correction corresponding to m in determining the meridional co-ordinate in chains.

Lat.	Correction in chain								
	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
° ′	∞	∞	∞	∞	∞	∞	∞	∞	∞
0 0									
10	922739	1845478	2768217	3690956	4613695	5536434	6459173	7381911	8304650
20	461380	922760	1384140	1845520	2306900	2768280	3229660	3691040	4152420
30	307594	615189	922783	1230378	1537972	1845567	2153161	2460756	2768350
40	230706	461411	692117	922823	1153528	1384234	1614940	1845646	2076351
50	184573	369146	553719	738292	922865	1107438	1292011	1476583	1661156
1 0	153818	307636	461454	615273	769091	922909	1076727	1230545	1384363
10	131855	263710	395565	527421	659276	791131	922986	1054841	1186696
20	115382	230763	346145	461526	576908	692290	807671	923053	1038434
30	102571	205143	307714	410285	512857	615428	717999	820570	923142
40	92324	184648	276972	369297	461621	553945	646269	738593	830917
50	83941	167882	251823	335764	419706	503647	587588	671529	755470
2 0	76956	153912	230869	307825	384781	461737	538693	615650	692606
10	71047	142093	213140	284186	355233	426279	497326	568372	639419
20	65981	131963	197944	263926	329907	395889	461870	527851	593833
30	61593	123186	184779	246372	307965	369557	431150	492743	554336
40	57754	115507	173261	231015	288769	346522	404276	462029	519783
50	54366	108732	163098	217464	271831	326197	380563	434929	489295
3 0	51357	102713	154070	205427	256784	308140	359497	410854	462210
10	48664	97328	145991	194655	243319	291983	340647	389310	437974
20	46241	92481	138722	184963	231204	277444	323685	369926	416166
30	44049	88097	132146	176195	220244	264292	308341	352390	396438
40	42056	84113	126169	168225	210282	252338	294394	336450	378507
50	40238	80477	120715	160953	201192	241430	281668	321906	362145
4 0	38572	77143	115715	154286	192858	231430	270001	308573	347144
10	37039	74077	111116	148155	185194	222232	259271	296310	333348
20	35625	71250	106875	142500	178125	213749	249374	284999	320624
30	34316	68631	102947	137263	171579	205894	240210	274526	308841
40	33100	66200	99301	132401	165501	198601	231701	264802	297902
50	31969	63938	95907	127876	159845	191813	223782	255751	287720
5 0	30913	61827	92740	123653	154567	185480	216393	247306	278220
10	29927	59854	89781	119708	149635	179562	209489	239416	269343
20	29002	58003	87005	116006	145008	174010	203011	232013	261014
30	28133	56266	84400	112533	140666	168799	196932	225066	253199
40	27316	54632	81948	109264	136580	163896	191212	218528	245844
50	26546	53091	79637	106183	132729	159274	185820	212366	238911
6 0	25819	51638	77457	103276	129096	154915	180734	206553	232372
10	25132	50263	75395	100526	125658	150789	175921	201052	226184
20	24480	48961	73441	97921	122402	146882	171362	195842	220323
30	23863	47726	71589	95452	119315	143177	167040	190903	214766
40	23277	46553	69830	93107	116384	139660	162937	186214	209490
50	22719	45439	68158	90878	113597	136316	159036	181755	204475
7 0	22189	44378	66566	88755	110944	133133	155322	177510	199699
10	21683	43366	65049	86732	108416	130099	151782	173465	195148
20	21201	42401	63602	84802	106003	127204	148404	169605	190805
30	20740	41481	62221	82961	103702	124442	145182	165922	186663
40	20300	40600	60899	81199	101499	121799	142099	162398	182698
50	19878	39757	59635	79513	99392	119270	139148	159026	178905
8 0	19474	38949	58423	77898	97372	116846	136321	155795	175270
10	19088	38175	57263	76350	95438	114526	133613	152701	171788
20	18716	37432	56149	74865	93581	112297	131013	149730	168446
30	18360	36719	55079	73439	91799	110158	128518	146878	165237
40	18017	36034	54051	72068	90085	108101	126118	144135	162152
50	17688	35375	53063	70750	88438	106125	123813	141500	159188
9 0	17371	34741	52112	69482	86853	104223	121594	138964	156335
10	17065	34130	51195	68260	85326	102391	119456	136521	153586
20	16771	33542	50313	67084	83855	100625	117396	134167	150938
30	16487	32975	49462	65950	82437	98924	115412	131899	148387
40	16214	32427	48641	64854	81068	97281	113495	129708	145922
50	15949	31899	47848	63797	79747	95696	111645	127594	143544

TABLE LXX.—Correction corresponding to m in determining the meridional co-ordinate in chains.

Lat.	Correction in chain								
	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
° ′									
10 0	15694	31388	47083	62777	78471	94165	109859	125554	141248
10	15447	30895	46342	61790	77237	92684	108132	123579	139027
20	15209	30418	45627	60836	76045	91254	106463	121672	136881
30	14978	29956	44934	59912	74890	89868	104846	119824	134802
40	14755	29509	44264	59019	73774	88528	103283	118038	132792
50	14538	29077	43615	58154	72692	87230	101769	116307	130846
11 0	14329	28657	42986	57314	71643	85971	100300	114628	128957
10	14125	28251	42376	56501	70627	84752	98877	113002	127128
20	13928	27857	41785	55714	69642	83570	97499	111427	125356
30	13737	27474	41212	54949	68686	82423	96160	109898	123635
40	13552	27103	40655	54206	67758	81310	94861	108413	121964
50	13371	26743	40114	53486	66857	80228	93600	106971	120343
12 0	13196	26393	39589	52785	65982	79178	92374	105570	118767
10	13027	26053	39080	52106	65133	78159	91186	104212	117239
20	12861	25722	38584	51445	64306	77167	90028	102890	115751
30	12700	25401	38101	50802	63502	76202	88903	101603	114304
40	12544	25088	37632	50176	62721	75265	87809	100353	112897
50	12392	24784	37175	49567	61959	74351	86743	99134	111526
13 0	12244	24488	36732	48976	61220	73463	85707	97951	110195
10	12100	24199	36299	48399	60499	72598	84698	96798	108897
20	11959	23918	35877	47836	59796	71755	83714	95673	107632
30	11822	23645	35467	47289	59112	70934	82756	94578	106401
40	11689	23378	35067	46756	58445	70134	81823	93512	105201
50	11559	23118	34677	46236	57795	69354	80913	92472	104031
14 0	11432	22865	34297	45730	57162	68594	80027	91459	102892
10	11309	22618	33927	45236	56545	67853	79162	90471	101780
20	11188	22377	33565	44753	55942	67130	78318	89506	100695
30	11071	22141	33212	44282	55353	66423	77494	88564	99635
40	10956	21911	32867	43823	54779	65734	76690	87646	98601
50	10844	21687	32531	43374	54218	65062	75905	86749	97592
15 0	10734	21468	32203	42937	53671	64405	75139	85874	96608
10	10627	21254	31881	42508	53136	63763	74390	85017	95644
20	10523	21045	31568	42091	52614	63136	73659	84182	94704
30	10421	20841	31262	41682	52103	62523	72944	83364	93785
40	10321	20642	30962	41283	51604	61925	72246	82566	92887
50	10223	20446	30670	40893	51116	61339	71562	81786	92009
16 0	10128	20255	30383	40511	50639	60766	70894	81022	91149
10	10034	20069	30103	40138	50172	60206	70241	80275	90310
20	9943	19886	29830	39773	49716	59659	69602	79546	89489
30	9854	19708	29562	39416	49270	59123	68977	78831	88685
40	9767	19533	29300	39066	48833	58600	68366	78133	87899
50	9681	19362	29043	38724	48405	58085	67766	77447	87128
17 0	9597	19195	28792	38389	47987	57584	67181	76778	86376
10	9515	19031	28546	38061	47577	57092	66607	76122	85638
20	9435	18870	28395	37740	47176	56611	66046	75481	84916
30	9356	18713	28069	37426	46782	56138	65495	74851	84208
40	9279	18559	27838	37118	46397	55676	64956	74235	83515
50	9204	18408	27612	36816	46020	55223	64427	73631	82835
18 0	9130	18260	27390	36520	45651	54781	63911	73041	82171
10	9058	18115	27173	36231	45289	54346	63404	72462	81519
20	8987	17973	26960	35947	44934	53920	62907	71894	80880
30	8917	17834	26751	35668	44586	53503	62420	71337	80254
40	8849	17698	26546	35395	44244	53093	61942	70790	79639
50	8782	17564	26346	35128	43910	52691	61473	70255	79037
19 0	8717	17433	26150	34866	43583	52299	61016	69732	78449
10	8652	17304	25956	34608	43261	51913	60565	69217	77869
20	8589	17178	25767	34356	42945	51534	60123	68712	77301
30	8527	17054	25581	34108	42635	51162	59689	68216	76743
40	8466	16933	25399	33866	42332	50798	59265	67731	76198
50	8407	16814	25220	33627	42034	50441	58848	67254	75661

TABLE LXX.—Correction corresponding to m in determining the meridional co-ordinate in chains.

Lat.	Correction in chain								
	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
° ′									
20 0	8348	16696	25045	33393	41741	50089	58437	66786	75134
10	8291	16582	24872	33163	41454	49745	58036	66326	74617
20	8235	16469	24704	32938	41173	49407	57642	65876	74111
30	8179	16358	24538	32717	40896	49075	57254	65434	73613
40	8125	16250	24375	32500	40625	48749	56874	64999	73124
50	8072	16143	24215	32286	40358	41430	56501	64573	72644
21 0	8019	16038	24058	32077	40096	48115	56134	64154	72173
10	7968	15936	23904	31872	39840	47807	55775	63743	71711
20	7918	15835	23753	31670	39588	47505	55423	63340	71258
30	7868	15736	23604	31472	39340	47207	55075	62943	70811
40	7819	15638	23457	31276	39096	46915	54734	62553	70372
50	7771	15542	23314	31085	38856	46627	54398	62170	69941
22 0	7724	15449	23173	30897	38622	46346	54070	61794	69519
10	7678	15356	23034	30712	38391	46069	53747	61425	69103
20	7633	15266	22898	30531	38164	45797	53430	61062	68695
30	7588	15176	22764	30352	37941	45529	53117	60705	68293
40	7544	15089	22633	30177	37722	45266	52810	60354	67899
50	7501	15003	22504	30005	37507	45008	52509	60010	67512
23 0	7459	14918	22377	29836	37295	44754	52213	59672	67131
10	7417	14835	22252	29670	37087	44504	51922	59339	66757
20	7377	14753	22130	29506	36883	44259	51636	59012	66389
30	7336	14672	22009	29345	36681	44017	51353	58690	66026
40	7297	14594	21890	29187	36484	43781	51078	58374	65671
50	7258	14516	21774	29032	36290	43547	50805	58063	65321
24 0	7220	14440	21659	28879	36099	43319	50539	57758	64978
10	7182	14364	21546	28728	35911	43093	50275	57457	64639
20	7145	14290	21436	28581	35726	42871	50016	57162	64307
30	7109	14218	21327	28436	35545	42653	49762	56871	63980
40	7073	14146	21220	28293	35366	42439	49512	56586	63659
50	7038	14076	21114	28152	35191	42229	49267	56305	63343
25 0	7004	14007	21011	28014	35018	42021	49025	56028	63032
10	6970	13939	20909	27878	34848	41818	48787	55757	62726
20	6936	13873	20809	27745	34682	41618	48554	55490	62427
30	6903	13807	20710	27613	34517	41420	48323	55226	62130
40	6871	13742	20613	27484	34356	41227	48098	54969	61840
50	6839	13678	20518	27357	34196	41035	47874	54714	61553
26 0	6808	13616	20424	27232	34040	40848	47656	54464	61272
10	6777	13555	20332	27109	33887	40664	47441	54218	60996
20	6747	13494	20241	26988	33736	40483	47230	53977	60724
30	6717	13435	20152	26869	33587	40304	47021	53738	60456
40	6688	13376	20064	26752	33440	40128	46816	53504	60192
50	6659	13319	19978	26637	33297	39956	46615	53274	59934
27 0	6631	13262	19893	26524	33155	39786	46417	53048	59679
10	6603	13206	19809	26412	33016	39619	46222	52825	59428
20	6576	13152	19727	26303	32879	39455	46031	52606	59182
30	6549	13097	19646	26195	32744	39292	45841	52390	58938
40	6522	13044	19567	26089	32611	39133	45655	52178	58700
50	6496	12992	19488	25984	32481	38977	45473	51969	58465
28 0	6471	12941	19412	25882	32353	38823	45294	51764	58235
10	6445	12891	19336	25781	32227	38672	45117	51562	58008
20	6420	12841	19261	25682	32102	38522	44943	51363	57784
30	6396	12792	19188	25584	31981	38377	44773	51169	57565
40	6372	12744	19116	25488	31860	38232	44604	50976	57348
50	6348	12697	19045	25394	31742	38090	44439	50787	57136
29 0	6325	12650	18976	25301	31626	37951	44276	50602	56927
10	6302	12605	18907	25209	31512	37814	44116	50418	56721
20	6280	12560	18840	25120	31400	37679	43959	50239	56519
30	6258	12516	18773	25031	31289	37547	43805	50062	56320
40	6236	12472	18708	24944	31180	37416	43652	49888	56124
50	6215	12429	18644	24858	31073	37287	43502	49716	55931

TABLE LXX.—Correction corresponding to m in determining the meridional co-ordinate in chains.

Lat.	Correction in chain								
	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
° ′									
30 0	6194	12387	18581	24774	30968	37161	43355	49548	55742
10	6173	12346	18519	24692	30865	37037	43210	49383	55556
20	6153	12305	18458	24610	30763	36916	43068	49221	55373
30	6133	12265	18398	24530	30663	36796	42928	49061	55193
40	6113	12226	18338	24451	30564	36677	42790	48902	55015
50	6094	12187	18281	24374	30468	36562	42655	48749	54842
31 0	6075	12149	18224	24298	30373	36447	42522	48596	54671
10	6056	12112	18168	24224	30280	36335	42391	48447	54503
20	6038	12075	18113	24150	30188	36225	42263	48300	54338
30	6020	12039	18059	24078	30098	36117	42137	48156	54176
40	6002	12003	18005	24007	30009	36010	42012	48014	54015
50	5984	11969	17953	23937	29922	35906	41890	47874	53859
32 0	5967	11934	17901	23868	29836	35803	41770	47737	53704
10	5950	11901	17851	23801	29752	35702	41652	47602	53553
20	5934	11868	17801	23735	29669	35603	41537	47470	53404
30	5918	11835	17753	23670	29588	35505	41423	47340	53258
40	5902	11803	17705	23606	29508	35410	41311	47213	53114
50	5886	11772	17657	23543	29429	35315	41201	47086	52972
33 0	5871	11741	17612	23482	29353	35223	41094	46964	52835
10	5855	11711	17566	23422	29277	35132	40988	46843	52699
20	5841	11681	17522	23362	29203	35043	40884	46724	52565
30	5826	11652	17478	23304	29130	34956	40782	46608	52434
40	5812	11623	17435	23246	29058	34870	40681	46493	52304
50	5798	11595	17393	23190	28988	34786	40583	46381	52178
34 0	5784	11568	17351	23135	28919	34703	40487	46270	52054
10	5770	11540	17311	23081	28851	34621	40391	46162	51932
20	5757	11514	17271	23028	28786	34543	40300	46057	51814
30	5744	11488	17232	22976	28721	34465	40209	45953	51697
40	5731	11462	17194	22925	28656	34387	40118	45850	51581
50	5719	11438	17156	22875	28594	34313	40032	45750	51469
35 0	5707	11413	17120	22826	28533	34240	39946	45653	51359
10	5695	11389	17084	22778	28473	34167	39862	45556	51251
20	5683	11366	17048	22731	28414	34097	39780	45462	51145
30	5671	11343	17014	22685	28357	34028	39699	45370	51042
40	5660	11320	16980	22640	28300	33959	39619	45279	50939
50	5649	11298	16946	22595	28244	33893	39542	45190	50839
36 0	5638	11276	16914	22552	28190	33828	39466	45104	50742
10	5627	11255	16882	22510	28137	33764	39392	45019	50647
02	5617	11234	16851	22468	28086	33703	39320	44937	50554
30	5607	11214	16821	22428	28035	33642	39249	44856	50463
40	5597	11194	16791	22388	27985	33582	39179	44776	50373
50	5587	11175	16762	22349	27937	33524	39111	44698	50286
37 0	5578	11156	16734	22312	27890	33467	39045	44623	50201
10	5569	11137	16706	22274	27843	33412	38980	44549	50117
20	5560	11119	16679	22238	27798	33358	38917	44477	50036
30	5551	11102	16652	22203	27754	33305	38856	44406	49957
40	5542	11084	16627	22169	27711	33253	38795	44338	49880
50	5534	11068	16601	22135	27669	33203	38737	44270	49804
38 0	5526	11051	16577	22102	27628	33154	38679	44205	49730
10	5518	11035	16553	22071	27589	33106	38624	44142	49659
20	5510	11020	16530	22040	27550	33059	38569	44079	49589
30	5502	11005	16507	22010	27512	33014	38517	44019	49522
40	5495	10990	16485	21980	27475	32970	38465	43960	49455
50	5488	10976	16464	21952	27440	32927	38415	43903	49391
39 0	5481	10962	16443	21924	27405	32885	38366	43847	49328
10	5474	10948	16423	21897	27371	32845	38319	43794	49268
20	5468	10935	16403	21870	27338	32806	38273	43741	49208
30	5461	10923	16384	21845	27307	32768	38229	43690	49152
40	5455	10911	16366	21821	27277	32732	38187	43642	49098
50	5449	10899	16348	21797	27247	32696	38145	43594	49044
40 0	5444	10887	16331	21774	27218	32661	38105	43548	48992

TABLE LXXI.—Correction corresponding to n in determining the longitudinal co-ordinate in chains.

Lat.	Correction in chain								
	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
° ′	∞	∞	∞	∞	∞	∞	∞	∞	∞
0 0	24541435*	49082870	73624305	98165740	122707175	147248610	171790045	196331480	220872915
20	6134794	12269588	18404382	24539176	30673970	36808764	42943558	49078352	55213146
40									
1 0	2725210	5450420	8175630	10900840	13626050	16351260	19076470	21801680	24526890
20	1717117	3434234	5151351	6868468	8585585	10302702	12019819	13736936	15454053
40	1081932	2163864	3245796	4327728	5409660	6491592	7573524	8655456	9737388
2 0	681711	1363422	2045133	2726844	3408555	4090266	4771977	5453688	6135399
20	520475	1040950	1561425	2081900	2602375	3122850	3643325	4163800	4684275
40	397283	794566	1191849	1589132	1986415	2383698	2780981	3178264	3575547
3 0	303319	606638	909957	1213276	1516595	1819914	2123233	2426552	2729871
20	250669	501338	752007	1002676	1253345	1504014	1754683	2005352	2256021
40	207109	414218	621327	828436	1035545	1242654	1449763	1656872	1863981
4 0	171159	342318	513477	684636	855795	1026954	1198113	1369272	1540431
20	147537	295074	442611	590148	737685	885222	1032759	1180296	1327833
40	127204	254408	381612	508816	636020	763224	890428	1017632	1144836
5 0	109648	219296	328944	438592	548240	657888	767536	877184	986832
20	97252	194504	291756	389008	486260	583512	680764	778016	875268
40	86258	172516	258774	345032	431290	517548	603806	690064	776322
6 0	76507	153014	229521	306028	382535	459042	535549	612056	688563
20	69072	138144	207216	276288	345360	414432	483504	552576	621648
40	62373	124746	187119	249492	311865	374238	436611	498984	561357
7 0	56312	112624	168936	225248	281560	337872	394184	450496	506808
20	51594	103188	154782	206376	257970	309564	361158	412752	464346
40	47261	94522	141783	189044	236305	283566	330827	378088	425349
8 0	43311	86622	129933	173244	216555	259866	303177	346488	389799
20	40077	80154	120231	160308	200385	240462	280539	320616	360693
40	37094	74188	111282	148376	185470	222564	259658	296752	333846
9 0	34332	68664	102996	137328	171660	205992	240324	274656	308988
20	32070	64140	96210	128280	160350	192420	224490	256560	288630
40	29957	59914	89871	119828	149785	179742	209699	239656	269613
10 0	27990	55980	83970	111960	139950	167940	195930	223920	251910
20	26309	52618	78927	105236	131545	157854	184163	210472	236781
40	24729	49458	74187	98916	123645	148374	173103	197832	222561
11 0	23243	46486	69729	92972	116215	139458	162701	185944	209187
20	21968	43936	65904	87872	109840	131808	153776	175744	197712
40	20768	41536	62304	83072	103840	124608	145376	166144	186912
12 0	19629	39258	58887	78516	98145	117774	137403	157032	176661
20	18651	37302	55953	74604	93255	111906	130557	149208	167859
40	17730	35460	53190	70920	88650	106380	124110	141840	159570
13 0	16846	33692	50538	67384	84230	101076	117922	134768	151614
20	16073	32146	48219	64292	80365	96438	112511	128584	144657
40	15336	30672	46008	61344	76680	92016	107352	122688	138024
14 0	14635	29270	43905	58540	73175	87810	102445	117080	131715
20	14006	28012	42018	56024	70030	84036	98042	112048	126054
40	13406	26812	40218	53624	67030	80436	93842	107248	120654
15 0	12832	25664	38496	51328	64160	76992	89824	102656	115488
20	12323	24646	36969	49292	61615	73938	86261	98584	110907
40	11830	23660	35490	47320	59150	70980	82810	94640	106470
16 0	11361	22722	34083	45444	56805	68166	79527	90888	102249
20	10942	21884	32826	43768	54710	65652	76594	87536	98478
40	10541	21082	31623	42164	52705	63246	73787	84328	94869
17 0	10153	20306	30459	40612	50765	60918	71071	81224	91377
20	9804	19608	29412	39216	49020	58824	68628	78432	88236
40	9467	18934	28401	37868	47335	56802	66269	75736	85203
18 0	9141	18282	27423	36564	45705	54846	63987	73128	82269
20	8847	17694	26541	35388	44235	53082	61929	70776	79623
40	8564	17128	25692	34256	42820	51384	59948	68512	77076
19 0	8289	16578	24867	33156	41445	49734	58023	66312	74601
20	8037	16074	24111	32148	40185	48222	56259	64296	72333
40	7791	15582	23373	31164	38955	46746	54537	62328	70119

* The unit of the quantities forming argument is million, *i.e.*, 24,541,435 stands for 24,541,435,000,000.

TABLE LXXI.—Correction corresponding to n in determining the longitudinal co-ordinate in chains.

Lat.	Correction in chain								
	0·01	0·02	0·03	0·04	0·05	0·06	0·07	0·08	0·09
° ′									
20 0	7554	15108	22662	30216	37770	45324	52878	60432	67986
20	7335	14670	22005	29340	36675	44010	51345	58680	66015
40	7125	14250	21375	28500	35625	42750	49875	57000	64125
21 0	6918	13836	20754	27672	34590	41508	48426	55344	62262
20	6734	13468	20202	26936	33670	40404	47138	53872	60606
40	6557	13114	19671	26228	32785	39342	45899	52456	59013
22 0	6383	12766	19149	25532	31915	38298	44681	51064	57447
20	6219	12438	18657	24876	31095	37314	43533	49752	55971
40	6058	12116	18174	24232	30290	36348	42406	48464	54522
23 0	5903	11806	17709	23612	29515	35418	41321	47224	53127
20	5761	11522	17283	23044	28805	34566	40327	46088	51849
40	5623	11246	16869	22492	28115	33738	39361	44984	50607
24 0	5488	10976	16464	21952	27440	32928	38416	43904	49392
20	5364	10728	16092	21456	26820	32184	37548	42912	48276
40	5244	10488	15732	20976	26220	31464	36708	41952	47196
25 0	5126	10252	15378	20504	25630	30756	35882	41008	46134
20	5015	10030	15045	20060	25075	30090	35105	40120	45135
40	4908	9816	14724	19632	24540	29448	34356	39264	44172
26 0	4802	9604	14406	19208	24010	28812	33614	38416	43218
20	4705	9410	14115	18820	23525	28230	32935	37640	42345
40	4612	9224	13836	18448	23060	27672	32284	36896	41508
27 0	4521	9042	13563	18084	22605	27126	31647	36168	40689
20	4434	8868	13302	17736	22170	26604	31038	35472	39906
40	4350	8700	13050	17400	21750	26100	30450	34800	39150
28 0	4267	8534	12801	17068	21335	25602	29869	34136	38403
20	4189	8378	12567	16756	20945	25134	29323	33512	37701
40	4112	8224	12336	16448	20560	24672	28784	32896	37008
29 0	4038	8076	12114	16152	20190	24228	28266	32304	36342
20	3968	7936	11904	15872	19840	23808	27776	31744	35712
40	3899	7798	11697	15596	19495	23394	27293	31192	35091
30 0	3833	7666	11499	15332	19165	22998	26831	30664	34497
20	3769	7538	11307	15076	18845	22614	26383	30152	33921
40	3708	7416	11124	14832	18540	22248	25956	29664	33372
31 0	3647	7294	10941	14588	18235	21882	25529	29176	32823
20	3593	7186	10779	14372	17965	21558	25151	28744	32337
40	3540	7080	10620	14160	17700	21240	24780	28320	31860
32 0	3487	6974	10461	13948	17435	20922	24409	27896	31383
20	3436	6872	10308	13744	17180	20616	24052	27488	30924
40	3386	6772	10158	13544	16930	20316	23702	27088	30474
33 0	3337	6674	10011	13348	16685	20022	23359	26696	30033
20	3291	6582	9873	13164	16455	19746	23037	26328	29619
40	3246	6492	9738	12984	16230	19476	22722	25968	29214
34 0	3201	6402	9603	12804	16005	19206	22407	25608	28809
20	3160	6320	9480	12640	15800	18960	22120	25280	28440
40	3120	6240	9360	12480	15600	18720	21840	24960	28080
35 0	3080	6160	9240	12320	15400	18480	21560	24640	27720
20	3043	6086	9129	12172	15215	18258	21301	24344	27387
40	3007	6014	9021	12028	15035	18042	21049	24056	27063
36 0	2971	5942	8913	11884	14855	17826	20797	23768	26739
20	2936	5872	8808	11744	14680	17616	20552	23488	26424
40	2901	5802	8703	11604	14505	17406	20307	23208	26109
37 0	2867	5734	8601	11468	14335	17202	20069	22936	25803
20	2836	5672	8508	11344	14180	17016	19852	22688	25524
40	2805	5610	8415	11220	14025	16830	19635	22440	25245
38 0	2775	5550	8325	11100	13875	16650	19425	22200	24975
20	2747	5494	8241	10988	13735	16482	19229	21976	24723
40	2720	5440	8160	10880	13600	16320	19040	21760	24480
39 0	2693	5386	8079	10772	13465	16158	18851	21544	24237
20	2669	5338	8007	10676	13345	16014	18683	21352	24021
40	2645	5290	7935	10580	13225	15870	18515	21160	23805
40 0	2621	5242	7863	10484	13105	15726	18347	20968	23589

TABLE LXXII.—Squares and Cubes of Numbers.

No.	Square	Cube	No.	Square	Cube	No.	Square	Cube	No.	Square	Cube	No.	Square	Cube
1	1	1	76	5776	438976	151	22801	3442951	226	51076	11543176	301	90601	27270901
2	4	8	77	5929	456533	152	23104	3511808	227	51529	11697083	302	91204	27543608
3	9	27	78	6084	474552	153	23409	3581577	228	51984	11852352	303	91809	27818127
4	16	64	79	6241	493039	154	23716	3652264	229	52441	12008989	304	92416	28094464
5	25	125	80	6400	512000	155	24025	3723875	230	52900	12167000	305	93025	28372625
6	36	216	81	6561	531441	156	24336	3796416	231	53361	12326391	306	93636	28652616
7	49	343	82	6724	551368	157	24649	3869893	232	53824	12487168	307	94249	28934443
8	64	512	83	6889	571787	158	24964	3944312	233	54289	12649337	308	94864	29218112
9	81	729	84	7056	592704	159	25281	4019679	234	54756	12812904	309	95481	29503629
10	100	1000	85	7225	614125	160	25600	4096000	235	55225	12977875	310	96100	29791000
11	121	1331	86	7396	636056	161	25921	4173281	236	55696	13144256	311	96721	30080231
12	144	1728	87	7569	658503	162	26244	4251528	237	56169	13312053	312	97344	30371328
13	169	2197	88	7744	681472	163	26569	4330747	238	56644	13481272	313	97969	30664297
14	196	2744	89	7921	704969	164	26896	4410944	239	57121	13651919	314	98596	30959144
15	225	3375	90	8100	729000	165	27225	4492125	240	57600	13824000	315	99225	31255875
16	256	4096	91	8281	753571	166	27556	4574296	241	58081	13997521	316	99856	31554496
17	289	4913	92	8464	778688	167	27889	4657463	242	58564	14172488	317	100489	31855013
18	324	5832	93	8649	804357	168	28224	4741632	243	59049	14348907	318	101124	32157432
19	361	6859	94	8836	830584	169	28561	4826809	244	59536	14526784	319	101761	32461759
20	400	8000	95	9025	857375	170	28900	4913000	245	60025	14706125	320	102400	32768000
21	441	9261	96	9216	884736	171	29241	5000211	246	60516	14886936	321	103041	33076161
22	484	10648	97	9409	912673	172	29584	5088448	247	61009	15069223	322	103684	33386248
23	529	12167	98	9604	941192	173	29929	5177717	248	61504	15252992	323	104329	33698267
24	576	13824	99	9801	970299	174	30276	5268024	249	62001	15438249	324	104976	34012224
25	625	15625	100	10000	1000000	175	30625	5359375	250	62500	15625000	325	105625	34328125
26	676	17576	101	10201	1030301	176	30976	5451776	251	63001	15813251	326	106276	34645976
27	729	19683	102	10404	1061208	177	31329	5545233	252	63504	16003008	327	106929	34965783
28	784	21952	103	10609	1092727	178	31684	5639752	253	64009	16194277	328	107584	35287552
29	841	24389	104	10816	1124864	179	32041	5735339	254	64516	16387064	329	108241	35611289
30	900	27000	105	11025	1157625	180	32400	5832000	255	65025	16581375	330	108900	35937000
31	961	29791	106	11236	1191016	181	32761	5929741	256	65536	16777216	331	109561	36264691
32	1024	32768	107	11449	1225043	182	33124	6028568	257	66049	16974593	332	110224	36594368
33	1089	35937	108	11664	1259712	183	33489	6128487	258	66564	17173512	333	110889	36926037
34	1156	39304	109	11881	1295029	184	33856	6229504	259	67081	17373979	334	111556	37259704
35	1225	42875	110	12100	1331000	185	34225	6331625	260	67600	17576000	335	112225	37595375
36	1296	46656	111	12321	1367631	186	34596	6434856	261	68121	17779581	336	112896	37933056
37	1369	50653	112	12544	1404928	187	34969	6539203	262	68644	17984728	337	113569	38272753
38	1444	54872	113	12769	1442897	188	35344	6644672	263	69169	18191447	338	114244	38614472
39	1521	59319	114	12996	1481544	189	35721	6751269	264	69696	18399744	339	114921	38958219
40	1600	64000	115	13225	1520875	190	36100	6859000	265	70225	18609625	340	115600	39304000
41	1681	68921	116	13456	1560896	191	36481	6967871	266	70756	18821096	341	116281	39651821
42	1764	74088	117	13689	1601613	192	36864	7077888	267	71289	19034163	342	116964	40001688
43	1849	79507	118	13924	1643032	193	37249	7189057	268	71824	19248832	343	117649	40353607
44	1936	85184	119	14161	1685159	194	37636	7301384	269	72361	19465109	344	118336	40707584
45	2025	91125	120	14400	1728000	195	38025	7414875	270	72900	19683000	345	119025	41063625
46	2116	97336	121	14641	1771561	196	38416	7529536	271	73441	19902511	346	119716	41421736
47	2209	103823	122	14884	1815848	197	38809	7645373	272	73984	20123648	347	120409	41781923
48	2304	110592	123	15129	1860867	198	39204	7762392	273	74529	20346417	348	121104	42144192
49	2401	117649	124	15376	1906624	199	39601	7880599	274	75076	20570824	349	121801	42508549
50	2500	125000	125	15625	1953125	200	40000	8000000	275	75625	20796875	350	122500	42875000
51	2601	132651	126	15876	2000376	201	40401	8120601	276	76176	21024576	351	123201	43243551
52	2704	140608	127	16129	2048383	202	40804	8242408	277	76729	21253933	352	123904	43614208
53	2809	148877	128	16384	2097152	203	41209	8365427	278	77284	21484952	353	124609	43986977
54	2916	157464	129	16641	2146689	204	41616	8489664	279	77841	21717639	354	125316	44361864
55	3025	166375	130	16900	2197000	205	42025	8615125	280	78400	21952000	355	126025	44738875
56	3136	175616	131	17161	2248091	206	42436	8741816	281	78961	22188041	356	126736	45118016
57	3249	185193	132	17424	2299968	207	42849	8869743	282	79524	22425768	357	127449	45499293
58	3364	195112	133	17689	2352637	208	43264	8998912	283	80089	22665187	358	128164	45882712
59	3481	205379	134	17956	2406104	209	43681	9129329	284	80656	22906304	359	128881	46268279
60	3600	216000	135	18225	2460375	210	44100	9261000	285	81225	23149125	360	129600	46656000
61	3721	226981	136	18496	2515456	211	44521	9393931	286	81796	23393656	361	130321	47045881
62	3844	238328	137	18769	2571353	212	44944	9528128	287	82369	23639903	362	131044	47437928
63	3969	250047	138	19044	2628072	213	45369	9663597	288	82944	23887872	363	131769	47832147
64	4096	262144	139	19321	2685619	214	45796	9800344	289	83521	24137569	364	132496	48228544
65	4225	274625	140	19600	2744000	215	46225	9938375	290	84100	24389000	365	133225	48627125
66	4356	287496	141	19881	2803221	216	46656	10077696	291	84681	24642171	366	133956	49027896
67	4489	300763	142	20164	2863288	217	47089	10218313	292	85264	24897088	367	134689	49430863
68	4624	314432	143	20449	2924207	218	47524	10360232	293	85849	25153757	368	135424	49836032
69	4761	328509	144	20736	2985984	219	47961	10503459	294	86436	25412184	369	136161	50243409
70	4900	343000	145	21025	3048625	220	48400	10648000	295	87025	25672375	370	136900	50653000
71	5041	357911	146	21316	3112136	221	48841	10793861	296	87616	25934336	371	137641	51064811
72	5184	373248	147	21609	3176523	222	49284	10941048	297	88209	26198073	372	138384	51478848
73	5329	389017	148	21904	3241792	223	49729	11089567	298	88804	26463592	373	139129	51895117
74	5476	405224	149	22201	3307949	224	50176	11239424	299	89401	26730899	374	139876	52313624
75	5625	421875	150	22500	3375000	225	50625	11390625	300	90000	27000000	375	140625	52734375

TABLE LXXII.—Squares and Cubes of Numbers.

No.	Square	Cube	No.	Square	Cube	No.	Square	Cube	No.	Square	Cube	No.	Square	Cube
376	141376	53157376	451	203401	91733851	526	276676	145531576	601	361201	217081801	676	456976	308915776
377	142129	53582633	452	204304	92345408	527	277729	146363183	602	362404	218167208	677	458329	310288733
378	142884	54010152	453	205209	92959677	528	278784	147197952	603	363609	219256227	678	459684	311665752
379	143641	54439939	454	206116	93576664	529	279841	148035889	604	364816	220348864	679	461041	313046839
380	144400	54872000	455	207025	94196375	530	280900	148877000	605	366025	221445125	680	462400	314432000
381	145161	55306341	456	207936	94818816	531	281961	149721291	606	367236	222545016	681	463761	315821241
382	145924	55742968	457	208849	95443993	532	283024	150568768	607	368449	223648543	682	465124	317214568
383	146689	56181887	458	209764	96071912	533	284089	151419437	608	369664	224755712	683	466489	318611987
384	147456	56623104	459	210681	96702579	534	285156	152273304	609	370881	225866529	684	467856	320013504
385	148225	57066625	460	211600	97336000	535	286225	153130375	610	372100	226981000	685	469225	321419125
386	148996	57512456	461	212521	97972181	536	287296	153990656	611	373321	228099131	686	470596	322828856
387	149769	57960603	462	213444	98611128	537	288369	154854153	612	374544	229220928	687	471969	324242703
388	150544	58411072	463	214369	99252847	538	289444	155720872	613	375769	230346397	688	473344	325660672
389	151321	58863869	464	215296	99897344	539	290521	156590819	614	376996	231475544	689	474721	327082769
390	152100	59319000	465	216225	100544625	540	291600	157464000	615	378225	232608375	690	476100	328509000
391	152881	59776471	466	217156	101194696	541	292681	158340421	616	379456	233744896	691	477481	329939371
392	153664	60236288	467	218089	101847563	542	293764	159220088	617	380689	234885113	692	478864	331373888
393	154449	60698457	468	219024	102503232	543	294849	160103007	618	381924	236029032	693	480249	332812557
394	155236	61162984	469	219961	103161709	544	295936	160989184	619	383161	237176659	694	481636	334255384
395	156025	61629875	470	220900	103823000	545	297025	161878625	620	384400	238328000	695	483025	335702375
396	156816	62099136	471	221841	104487111	546	298116	162771336	621	385641	239483061	696	484416	337153536
397	157609	62570773	472	222784	105154048	547	299209	163667323	622	386884	240641848	697	485809	338608873
398	158404	63044792	473	223729	105823817	548	300304	164566592	623	388129	241804367	698	487204	340068392
399	159201	63521199	474	224676	106496424	549	301401	165469149	624	389376	242970624	699	488601	341532099
400	160000	64000000	475	225625	107171875	550	302500	166375000	625	390625	244140625	700	490000	343000000
401	160801	64481201	476	226576	107850176	551	303601	167284151	626	391876	245314376	701	491401	344472101
402	161604	64964808	477	227529	108531333	552	304704	168196608	627	393129	246491883	702	492804	345948408
403	162409	65450827	478	228484	109215352	553	305809	169112377	628	394384	247673152	703	494209	347428927
404	163216	65939264	479	229441	109902239	554	306916	170031464	629	395641	248858189	704	495616	348913664
405	164025	66430125	480	230400	110592000	555	308025	170953875	630	396900	250047000	705	497025	350402625
406	164836	66923416	481	231361	111284641	556	309136	171879616	631	398161	251239591	706	498436	351895816
407	165649	67419143	482	232324	111980168	557	310249	172808693	632	399424	252435968	707	499849	353393243
408	166464	67917312	483	233289	112678587	558	311364	173741112	633	400689	253636137	708	501264	354894912
409	167281	68417929	484	234256	113379904	559	312481	174676879	634	401956	254840104	709	502681	356400829
410	168100	68921000	485	235225	114084125	560	313600	175616000	635	403225	256047875	710	504100	357911000
411	168921	69426531	486	236196	114791256	561	314721	176558481	636	404496	257259456	711	505521	359425431
412	169744	69934528	487	237169	115501303	562	315844	177504328	637	405769	258474853	712	506944	360944128
413	170569	70444997	488	238144	116214272	563	316969	178453547	638	407044	259694072	713	508369	362467097
414	171396	70957944	489	239121	116930169	564	318096	179406144	639	408321	260917119	714	509796	363994344
415	172225	71473375	490	240100	117649000	565	319225	180362125	640	409600	262144000	715	511225	365525875
416	173056	71991296	491	241081	118370771	566	320356	181321496	641	410881	263374721	716	512656	367061696
417	173889	72511713	492	242064	119095488	567	321489	182284263	642	412164	264609288	717	514089	368601813
418	174724	73034632	493	243049	119823157	568	322624	183250432	643	413449	265847707	718	515524	370146232
419	175561	73560059	494	244036	120553784	569	323761	184220009	644	414736	267089984	719	516961	371694959
420	176400	74088000	495	245025	121287375	570	324900	185193000	645	416025	268336125	720	518400	373248000
421	177241	74618461	496	246016	122023936	571	326041	186169411	646	417316	269586136	721	519841	374805361
422	178084	75151448	497	247009	122763473	572	327184	187149248	647	418609	270840023	722	521284	376367048
423	178929	75686967	498	248004	123505992	573	328329	188132517	648	419904	272097792	723	522729	377933067
424	179776	76225024	499	249001	124251499	574	329476	189119224	649	421201	273359449	724	524176	379503424
425	180625	76765625	500	250000	125000000	575	330625	190109375	650	422500	274625000	725	525625	381078125
426	181476	77308776	501	251001	125751501	576	331776	191102976	651	423801	275894451	726	527076	382657176
427	182329	77854483	502	252004	126506008	577	332929	192100033	652	425104	277167808	727	528529	384240583
428	183184	78402752	503	253009	127263527	578	334084	193100552	653	426409	278445077	728	529984	385828352
429	184041	78953589	504	254016	128024064	579	335241	194104539	654	427716	279726264	729	531441	387420489
430	184900	79507000	505	255025	128787625	580	336400	195112000	655	429025	281011375	730	532900	389017000
431	185761	80062991	506	256036	129554216	581	337561	196122941	656	430336	282300416	731	534361	390617891
432	186624	80621568	507	257049	130323843	582	338724	197137368	657	431649	283593393	732	535824	392223168
433	187489	81182737	508	258064	131096512	583	339889	198155287	658	432964	284890312	733	537289	393832837
434	188356	81746504	509	259081	131872229	584	341056	199176704	659	434281	286191179	734	538756	395446904
435	189225	82312875	510	260100	132651000	585	342225	200201625	660	435600	287496000	735	540225	397065375
436	190096	82881856	511	261121	133432831	586	343396	201230056	661	436921	288804781	736	541696	398688256
437	190969	83453453	512	262144	134217728	587	344569	202262003	662	438244	290117528	737	543169	400315553
438	191844	84027672	513	263169	135005697	588	345744	203297472	663	439569	291434247	738	544644	401947272
439	192721	84604519	514	264196	135796744	589	346921	204336469	664	440896	292754944	739	546121	403583419
440	193600	85184000	515	265225	136590875	590	348100	205379000	665	442225	294079625	740	547600	405224000
441	194481	85766121	516	266256	137388096	591	349281	206425071	666	443556	295408296	741	549081	406869021
442	195364	86350888	517	267289	138188413	592	350464	207474688	667	444889	296740963	742	550564	408518488
443	196249	86938307	518	268324	138991832	593	351649	208527857	668	446224	298077632	743	552049	410172407
444	197136	87528384	519	269361	139798359	594	352836	209584584	669	447561	299418309	744	553536	411830784
445	198025	88121125	520	270100	140608000	595	354025	210644875	670	448900	300763000	745	555025	413493625
446	198916	88716536	521	271441	141420761	596	355216	211708736	671	450241	302111711	746	556516	415160936
447	199809	89314623	522	272484	142236648	597	356409	212776173	672	451584	303464448	747	558009	416832723
448	200704	89915392	523	273529	143055667	598	357604	213847192	673	452929	304821217	748	559504	418508992
449	201601	90518849	524	274576	143877824	599	358801	214921799	674	454276	306182024	749	561001	420189749
450	202500	91125000	525	275625	144703125	600	360000	216000000	675	455625	307546875	750	562500	421875000

TABLE LXXII.—Squares and Cubes of Numbers.

No.	Square	Cube	No.	Square	Cube	No.	Square	Cube	No.	Square	Cube	No.	Square	Cube
751	564001	423564751	801	641601	513922401	851	724201	616295051	901	811801	731432701	951	904401	860085351
752	565504	425259008	802	643204	515849608	852	725904	618470208	902	813604	733870808	952	906304	862801408
753	567009	426957777	803	644809	517781627	853	727609	620650477	903	815409	736314327	953	908209	865523177
754	568516	428661064	804	646416	519718464	854	729316	622835864	904	817216	738763264	954	910116	868250664
755	570025	430368875	805	648025	521660125	855	731025	625026375	905	819025	741217625	955	912025	870983875
756	571536	432081216	806	649636	523606616	856	732736	627222016	906	820836	743677416	956	913936	873722816
757	573049	433798093	807	651249	525557943	857	734449	629422793	907	822649	746142643	957	915849	876467493
758	574564	435519512	808	652864	527514112	858	736164	631628712	908	824464	748613312	958	917764	879217912
759	576081	437245479	809	654481	529475129	859	737881	633839779	909	826281	751089429	959	919681	881974079
760	577600	438976000	810	656100	531441000	860	739600	636056000	910	828100	753571000	960	921600	884736000
761	579121	440711081	811	657721	533411731	861	741321	638277381	911	829921	756058031	961	923521	887503681
762	580644	442450728	812	659344	535387328	862	743044	640503928	912	831744	758550528	962	925444	890277128
763	582169	444194947	813	660969	537367797	863	744769	642735647	913	833569	761048497	963	927369	893056347
764	583696	445943744	814	662596	539353144	864	746496	644972544	914	835396	763551944	964	929296	895841344
765	585225	447697125	815	664225	541343375	865	748225	647214625	915	837225	766060875	965	931225	898632125
766	586756	449455096	816	665856	543338496	866	749956	649461896	916	839056	768575296	966	933156	901428696
767	588289	451217663	817	667489	545338513	867	751689	651714363	917	840889	771095213	967	935089	904231063
768	589824	452984832	818	669124	547343432	868	753424	653972032	918	842724	773620632	968	937024	907039232
769	591361	454756609	819	670761	549353259	869	755161	656234909	919	844561	776151559	969	938961	909853209
770	592900	456533000	820	672400	551368000	870	756900	658503000	920	846400	778688000	970	940900	912673000
771	594441	458314011	821	674041	553387661	871	758641	660776311	921	848241	781229961	971	942841	915498611
772	595984	460099648	822	675684	555412248	872	760384	663054848	922	850084	783777448	972	944784	918330048
773	597529	461889917	823	677329	557441767	873	762129	665338617	923	851929	786330467	973	946729	921167317
774	599076	463684824	824	678976	559476224	874	763876	667627624	924	853776	788889024	974	948676	924010424
775	600625	465484375	825	680625	561515625	875	765625	669921875	925	855625	791453125	975	950625	926859375
776	602176	467288576	826	682276	563559976	876	767376	672221376	926	857476	794022776	976	952576	929714176
777	603729	469097433	827	683929	565609283	877	769129	674526133	927	859329	796597983	977	954529	932574833
778	605284	470910952	828	685584	567663552	878	770884	676836152	928	861184	799178752	978	956484	935441352
779	606841	472729139	829	687241	569722789	879	772641	679151439	929	863041	801765089	979	958441	938313739
780	608400	474552000	830	688900	571787000	880	774400	681472000	930	864900	804357000	980	960400	941192000
781	609961	476379541	831	690561	573856191	881	776161	683797841	931	866761	806954491	981	962361	944076141
782	611524	478211768	832	692224	575930368	882	777924	686128968	932	868624	809557568	982	964324	946966168
783	613089	480048687	833	693889	578009537	883	779689	688465387	933	870489	812166237	983	966289	949862087
784	614656	481890304	834	695556	580093704	884	781456	690807104	934	872356	814780504	984	968256	952763904
785	616225	483736625	835	697225	582182875	885	783225	693154125	935	874225	817400375	985	970225	955671625
786	617796	485587656	836	698896	584277056	886	784996	695506456	936	876096	820025856	986	972196	958585256
787	619369	487443403	837	700569	586376253	887	786769	697864103	937	877969	822656953	987	974169	961504803
788	620944	489303872	838	702244	588480472	888	788544	700227072	938	879844	825293672	988	976144	964430272
789	622521	491169069	839	703921	590589719	889	790321	702595369	939	881721	827936019	989	978121	967361669
790	624100	493039000	840	705600	592704000	890	792100	704969000	940	883600	830584000	990	980100	970299000
791	625681	494913671	841	707281	594823321	891	793881	707347971	941	885481	833237621	991	982081	973242271
792	627264	496793088	842	708964	596947688	892	795664	709732288	942	887364	835896888	992	984064	976191488
793	628849	498677257	843	710649	599077107	893	797449	712121957	943	889249	838561807	993	986049	979146657
794	630436	500566184	844	712336	601211584	894	799236	714516984	944	891136	841232384	994	988036	982107784
795	632025	502459875	845	714025	603351125	895	801025	716917375	945	893025	843908625	995	990025	985074875
796	633616	504358336	846	715716	605495736	896	802816	719323136	946	894916	846590536	996	992016	988047936
797	635209	506261573	847	717409	607645423	897	804609	721734273	947	896809	849278123	997	994009	991026973
798	636804	508169592	848	719104	609800192	898	806404	724150792	948	898704	851971392	998	996004	994011992
799	638401	510082399	849	720801	611960049	899	808201	726572699	949	900601	854670349	999	998001	997002999
800	640000	512000000	850	722500	614125000	900	810000	729000000	950	902500	857375000	1000	1000000	1000000000

COMPUTATION FORMS.

P. .

Survey of India.

NO..... PARTY (.....) SEASON '19 ..-..

Computation of Rectangular Co-ordinates of Stations from the given Spherical Co-ordinates.

From Origin .....

Sheet Number				
Name of Station (S)				
Lat. of (S) = λ	° ′ ″	° ′ ″	° ′ ″	° ′ ″
,, Origin = λ_o ...				
$\Delta\lambda = \lambda - \lambda_o$	−	−	−	−
$\Delta\lambda$ (in seconds)	−	−	−	−
$\phi = \frac{\lambda + \lambda_o}{2}$	° ′ ″	° ′ ″	° ′ ″	° ′ ″
Long. of (S) = L				
,, Origin = L_o				
Difference = $L - L_o$	−	−	−	−
$d = (L - L_o)$ in seconds ...				
$m = d^2$ (keeping d to nearest second) ...				
$n = d^3$ (to be kept to nearest million)				
Log. d				
Log. from Table LXIX for λ ...				
Sum = log. p				
p				
Corrn. from Tab. LXXI for n for lat. of (S)				
*X = Sum = Eastg. or Westg. in chns.	EW	EW	EW	EW
Log. $\Delta\lambda$ (in seconds)				
Log. from Table LXVIII for ϕ ...				
Sum = log. q				
† q	−	−	−	−
Corrn. from Tab. LXX for m for lat. of (S)	+	+	+	+
‡Y = Sum = Northg. or Southg. in chns.	− NS	− NS	− NS	− NS

* $\frac{\text{Easting}}{\text{Westing}}$ according as $(L-L_o)$ is $\frac{+}{-}$. † Sign same as $\Delta\lambda$. ‡ $\frac{\text{Northing}}{\text{Southing}}$ according as the sum is $\frac{+}{-}$.

Computed and compared by ..... *19* .....

P. . # Survey of India.

NO. ..... PARTY (.....) SEASON 19..... - .....

Computation of Spherical Co-ordinates of Stations from the given Rectangular Co-ordinates.

From Origin .....

Name of station (S)	° ′ ″	° ′ ″	° ′ ″	° ′ ″
Lat. of (S) (from Chart) = λ_s ...				
„ „ Origin = λ_o				
$\phi = \frac{\lambda_s + \lambda_o}{2}$				
Long. of (S) (from Chart) = L_s ...				
„ Origin = L_o				
Difference = $L_s - L_o$				
d = ($L_s - L_o$) to nearest second ...				
$m = d^2$				
$n = d^3$ (to be kept to nearest million)				
*X = Easting or Westing in chains ...	−	−	−	−
Log. X = ...				
Log. from Tab. LXIX for λ_s ...				
Difference = log. P in seconds ...				
P „ ...				
⅄ correctn. for n from Tab. LXXI for λ_s				
†Difference = (L − L_o) in arc ...	− ° ′ ″	− ° ′ ″	− ° ′ ″	− ° ′ ″
L = (L − L_o) + L_o = Longitude of (S)				
*Y = Northing or Southing in chains ...	−	−	−	−
Correctn. from Tab. LXX for m for λ_s	+	+	+	+
Difference = R ...	−	−	−	−
Log. R ...				
Log. from Tab. LXVIII for ϕ ...				
Difference = log. ($\lambda - \lambda_o$) in seconds				
‡ ($\lambda - \lambda_o$) „ ...	−	−	−	−
„ in arc	− ° ′ ″	− ° ′ ″	− ° ′ ″	− ° ′ ″
$\lambda = (\lambda - \lambda_o) + \lambda_o$ = Latitude of (S) ...				

* $\frac{+}{-}$ according as the Co-ordinate is $\frac{\text{East}}{\text{West}}$ or $\frac{\text{North}}{\text{South}}$. † Sign same as X. ‡ Sign same as R.

Computed and compared by ..... *19*.....

P. .

Survey of India.

NO. ____ PARTY (____) SEASON 19__-__.

Transformation of Rectangular Co-ordinates of Stations from one Origin to another.

Name of Old Origin ...	
„ „ New Origin ...	
Long. of Old Origin = L_o ...	° ′ ″
„ „ New „ = L_n ...	
$L_o - L_n$ = ...	−
„ in seconds ...	−
Lat. of Old Origin = λ_o ...	
„ „ New Origin = λ_n ...	
$\phi = \frac{\lambda_o + \lambda_n}{2}$ ...	
$\Delta\lambda = \lambda_o - \lambda_n$ ...	−
$\Delta\lambda$ in seconds	−
Log. $\Delta\lambda$ „	
Log. from Tab. LXVIII for ϕ	
Sum = log A	
*A	−

Name of Station (S)	
Lat. of (S) (from chart) = λ ...	° ′ ″
Long. of (S) (from chart) = L ...	
„ „ Old Origin = L_o ...	
„ „ New „ = L_n ...	
$L - L_n$ = ...	−
„ to nearest second = ...	−
$L - L_o$ = ...	−
„ to nearest second = ...	−
$(L - L_n)^2$ = ...	+
$(L - L_o)^2$ = ...	+
m = diff. = $(L - L_n)^2 - (L - L_o)^2$ ...	−
†$(L - L_n)^3$ (to be kept to nearest million)	−
‡$(L - L_o)^3$ „ „	−
n = diff. = $(L - L_n)^3 - (L - L_o)^3$ ...	−

Log. $(L_o - L_n)$	
Log. from Tab. LXIX for λ ...	
Sum = log. p	
‖ p	−
⊕X = Co-ord. with refer. to Old Origin	−
§Corrn. from Tab. LXXI for n for λ...	−
⊕X′ = Sum = E. or W. with refer. to New	− EW
⊕Y = N. or S. with reference to Old ...	−
*A = ...	−
$ Corrn. from Tab LXX for m for λ...	−
⊕Y′ = Sum = N. or S. with refer. to New	− NS

* Sign same as $\Delta\lambda$

† „ „ $(L - L_n)$

‡ „ „ $(L - L_o)$

‖ „ „ $(L_o - L_n)$

⊕ $\frac{+}{-}$ according as the co-ordinate is $\frac{\text{Easting}}{\text{Westing}}$ or $\frac{\text{Northing}}{\text{Southing}}$ and *vice versâ*.

§ Sign same as n

$ „ „ m

Computed and compared by ..... 19....