LXVIII. Comparison between the chords of arcs employed by Ptolemy and those now in use

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Institution, in which it has been twice carefully distilled at a low heat, it has still contained minute quantities of phosphorus.

It has been supposed that dry phosphoric acid is fixed at a white heat; but I find that this is not the case: it rapidly rises in vapour at this temperature, and evaporates even at the point of fusion of flint glass: and the hydrate of phosphoric acid is susceptible of being volatilized at a much lower temperature.

In converting the solid sublimate composed of phosphorus and chlorine into the liquid compound, when the phosphorus is first used in contact with the sublimate, a yellow crystalline mass is formed, which, when acted on by a higher degree of heat, affords the liquid chloride, which rises from it in vapour, and leaves phosphorus behind. It is possible that this yellow solid is a compound of phosphorus and chlorine, containing half as much chlorine as the liquid. Should this be proved to be the case by future experiments, it will give weight to the idea, that the hypophosphorous acid is a binary compound of oxygen and phosphorus.

LXVIII. *Comparison between the Chords of Arcs employed by PTOLEMY and those now in Use.* By G. A. WALKER ARNOTT, A.M. Edinburgh.

To Mr. Tilloch.

SIR, — **I**N a late elegant publication (*The Philosophy of Arithmetic*), it is stated that the ratio of 1 to 3.1416, or of the diameter to the circumference of a circle, must have been almost known to Claudius Ptolemy. This celebrated philosopher and mathematician, and first of ancient astronomers, left behind him, in the third book of his *Almagest*, a table of the chords of the arcs of the circle, calculated in sexagesimals to every 30 or half degree, and which are found to coincide with those in the trigonometrical tables we at present employ, with a much more considerable degree of exactness than could reasonably be looked for from the small advances made at that time in this subject. It is therefore my purpose here to exhibit a table of comparison between these, the insertion of which in your Magazine may gratify such of the curious as may not have seen the work itself of this distinguished man.

The *first* column contains the chords of every two degrees of the semicircle, as calculated by Ptolemy in *sexagesimals*. In the *second* column are the same chords converted into *sexagesimals* from our common *decimal* tables: and here I may add, that that number is taken, nearest to which, either above or below, the true number approaches, when extended to thirds, fourths, &c. of the radius. In the *third* are Ptolemy's calculations turned into decimals; and in the *fourth* we have an extract

tract from the trigonometrical tables now in use.—Before inserting the table, we may borrow the following example for the purpose of showing how near Ptolemy approached to our customary ratio of 1:3·1416: the chord of 2° in sexagesimals to radius ξ or 60° is $\beta \varepsilon \mu$, or $2^\circ 5' 40''$, which in decimals is nearly ·034907 to radius 1, and this multiplied by $\frac{180^\circ}{\frac{1}{2}^\circ} = 90$ gives 3·1416 nearly: now as the chord of 2° is almost the measure of its arc, the above number may be taken as the length of the semicircumference.

Edinburgh, 12th November 1818.

D.

2 ⁰	2° 5' 40"	2° 5' 39 $\frac{1}{2}$ "	·0349074	·0349048
4	4 11 16	4 11 16 $\frac{1}{2}$	·0697963	·0697990
6	6 16 49	6 16 49	·1046713	·1046720
8	8 22 15	8 22 15	·1395139	·1395130
10	10 27 32	10 27 31	·1743148	·1743114
12	12 32 36	12 32 36	·2090555	·2090570
14	14 37 27	14 37 27 $\frac{1}{2}$	·2437361	·2437386
16	16 42 3	16 42 3	·2783472	·2783462
18	18 46 19	18 46 20	·3128657	·3128690
20	20 50 16	20 50 16	·3472963	·3472964
22	22 53 49	22 53 49 $\frac{1}{2}$	·3816157	·3816180
24	24 56 58	24 56 58	·4158261	·4158234
26	26 59 38	26 59 39	·4498981	·4498024
28	29 1 50	29 1 50	·4838426	·4838438
30	31 3 30	31 3 30	·5176389	·5176380
32	33 4 35	33 4 35	·5512731	·5512748
34	35 5 5	35 5 4 $\frac{1}{2}$	·5847454	·5847434
36	37 4 55	37 4 55	·6180324	·6180340
38	39 4 5	39 4 5 $\frac{1}{2}$	·6511343	·6511364
40	41 2 33	41 2 33	·6840417	·6840402
42	43 0 15	43 0 15	·7167361	·7167358
44	44 57 10	44 57 10	·7492130	·7492132
46	46 53 16	46 53 16	·7814630	·7814622
48	48 48 30	48 48 30	·8134722	·8134732
50	50 42 51	50 42 51	·8452361	·8452366
52	52 36 16	52 36 16	·8767407	·8767422
54	54 28 44	54 28 44	·9079815	·9079810
56	56 20 12	56 20 12	·9389444	·9389432
58	58 10 38	58 10 38	·9696204	·9696192
60	60 0 0	60 0 0	1·0000000	1·0000000
62	61 48 17	61 48 16 $\frac{1}{2}$	1·0300787	1·0300762
64	63 35 26	63 35 25	1·0598426	1·0598386
66	65 21 24	65 21 24	1·0892778	1·0892780
68	67 6 12	67 6 11	1·1183889	1·1183858
70	68 49 45	68 49 45	1·1471528	1·1471528
72	70 32 3	70 32 3	1·1755694	1·1755706
74	72 13 4	72 13 4	1·2036296	1·2036300
76	73 52 46	73 52 46	1·2313261	1·2313230
78	75 31 7	75 31 6 $\frac{1}{2}$	1·2586435	1·2586408

D.

80	77° 8 5	77 8 4	1·2855787	1·2855752
82	78 43 38	78 43 37 $\frac{1}{2}$	1·3121204	1·3121180
84	80 17 45	80 17 44 $\frac{1}{2}$	1·3382639	1·3382612
86	81 50 24	81 50 23	1·3640000	1·3639968
88	83 21 33	83 21 32 $\frac{1}{2}$	1·3893194	1·3893168
90	84 51 10	84 51 10	1·4142130	1·4142136
92	86 19 15	86 19 15	1·4386806	1·4386796
94	87 45 45	87 45 45	1·4627083	1·4627074
96	89 10 39	89 10 38 $\frac{1}{2}$	1·4862917	1·4862896
98	90 33 55	90 33 54 $\frac{1}{2}$	1·5094213	1·5094192
100	91 55 32	91 55 31	1·5320926	1·5320888
102	93 15 27	93 15 27	1·5542917	1·5542920
104	94 33 41	94 33 41	1·5760231	1·5760216
106	95 50 11	95 50 10 $\frac{1}{2}$	1·5972731	1·5972710
108	97 4 56	97 4 55	1·6180370	1·6180340
110	98 17 54	98 17 54	1·6383056	1·638040
112	99 29 5	99 29 4	1·6580787	1·6580752
114	100 38 26	100 38 26	1·6773426	1·6773412
116	101 45 57	101 45 57	1·6960972	1·6960962
118	102 51 37	102 51 36	1·7143380	1·7143340
120	103 55 23	103 55 23	1·7320509	1·7320508
122	104 57 16	104 57 16	1·7492407	1·7492394
124	105 57 14	105 57 13	1·7658981	1·7658952
126	106 55 15	106 55 15	1·7820139	1·7820130
128	107 51 20	107 51 19	1·7975926	1·7975880
130	108 45 25	108 45 25	1·8126157	1·8126156
132	109 37 32	109 37 32	1·8270926	1·8270910
134	110 27 39	110 27 38	1·8410139	1·8410098
136	111 15 44	111 15 43 $\frac{1}{2}$	1·8543704	1·8543678
138	112 1 47	112 1 47	1·8671620	1·8671608
140	112 45 48	112 45 47	1·8793889	1·8793852
142	113 27 44	113 27 44	1·8910370	1·8910372
144	114 7 37	114 7 36 $\frac{1}{2}$	1·9021157	1·9021130
146	114 45 24	114 45 24	1·9126111	1·9126096
148	115 21 6	115 21 5	1·9225278	1·9225234
150	115 54 40	115 54 40	1·9318519	1·9318516
152	116 26 8	116 26 8	1·9405926	1·9405914
154	116 55 28	116 55 28	1·9487407	1·9487402
156	117 22 40	117 22 40	1·9562963	1·9562952
158	117 47 43	117 47 43	1·9632546	1·9632544
160	118 10 37	118 10 37	1·9696157	1·9696156
162	118 31 22	118 31 21	1·9753796	1·9753766
164	118 49 56	118 49 56	1·9805370	1·9805362
166	119 6 20	119 6 20	1·9850926	1·9850924
168	119 20 34	119 20 33 $\frac{1}{2}$	1·9890463	1·9890438
170	119 32 37	119 32 36	1·9923935	1·9923894
172	119 42 29	119 42 28	1·9951343	1·9951282
174	119 50 9	119 50 8	1·9972639	1·9972590
176	119 55 38	119 55 37	1·9987870	1·9987816
178	119 58 55	119 58 54	1·9996991	1·9996954
180	120 0 0	119 0 0	2·0000000	2·0000000