TABLE IV.—Alloy $SnPb_3$.

Time in Seconds.	Temperature.	Deflection.
0	247° C.	8·9
30	242°	9·1
60	240°	7·3
90	232°	5·7
120	218°	5·7
150	203°	5·3
180	190°	5·2
210	176°	5·1
240	170°	5·0
270	164°	4·0
300	156°	4·1
330	146°	4·0
360	137°	4·1
390	130°	4·1

TABLE V.—Alloy Sn_3Pb.

Time in Seconds.	Temperature.	Deflection.
0	198° C.	6·8
30	188°	6·6
60	180°	6·3
90	170°	6·5
120	170°	5·8
150	168°	5·2
180	168°	3·7
210	165°	3·4
240	150°	3·1
270	140°	2·9
300	131°	2·8
330	121°	2·7

6. Examples upon the Reading of the Circle or Circles of a Knot. By the Rev. Thomas P. Kirkman, M.A., F.R.S.

How this reading is to be done is well known; but it may be useful to have more examples. Consider the two following circles of two unifilars each of fourteen crossings—

*a*F*bdc*A*dbe*G*f*E*gc*A*f*BDC*a*DBE*gfe*GC,
*afb*D*c*A*d*G*e*C*fbg*EAFB*d*C*a*D*g*E*c*FBC*e*,

which are the simplest possible that have their janal symmetries. I wish to show that the knots are completely given by their circles, as are also their symmetries.

In the circle of an unifilar every crossing is twice read, once in an odd and once in an even place, the thread passing alternately over and under itself at successive crossings. The only duads that occur twice are edges of 2-gons. The first knot has six 2-gons, *bd*, BD, *c*A, C*a*, *e*G, E*g*. At the 2-gon *bd* the thread F*bdc* passes over and under *ebd*A; and . . F*bdc* . . and . . *ebd*A . . are meshes collateral with the 2-gon *bd*. We take . . *ebd*A . . for a base on which to project the first knot, observing that as F*e* and F*b* are edges, F*be* is a triangle collateral with our base . . *ebd*A . . . At the 2-gon *e*G, *be*G*f* passes over and under F*e*GC, and . . *be*G*f* . . is a mesh collateral with *e*G. As *be* cannot be in three meshes, our base is . . A*dbe*G*f* . . , and since *f*A is an edge, this base is the 6-gon A*dbe*G*f*. The first circle is unaltered by exchanging throughout capital and small letters. There is then another 6-gon *a*DBE*g*F in the knot. Draw this within the base, *a* remote from A, D from *d*, &c., so that the meshes A*dbe*G*f* and *a*DBE*g*F are read in the same direction round; and make the 2-gons *db*, DB, E*g*, *e*G. There are two other 2-gons to construct. From *c* near A and C near *a*, between the 6-gons, draw 2-gons A*c* and *a*C. Our fourteen summits are properly projected, and we complete the projection by drawing the edges F*b*, *f*B, F*e*, *f*E, CG, *cg*, CD, *cd*.

It is evident that on this first knot in space every feature, edge, crossing or mesh, is diametrically opposite to a similar feature. There is no zonal trace, at every point of which the configurations on the right and left reflect each other; nor is there a diameter about which in revolution a configuration is repeated; that is, two opposite eyes in every diameter read round exactly the same asymmetric sequence; but this only when one reads with, and the other against, his watch. The opposite configurations are in every diameter asymmetric and *contrajanal*, and the knot is a *contrajanal anaxine* knot, on which a zonal trace is impossible. About a *janal* axis proper, zoned or zoneless, opposite observers read round like configurations when each reads with his watch. This first knot is a contrajanal anaxine *subsolid*, *i.e.*, one admitting section through no two points only, but through the crossings of a 2-gon. There are contrajanal anaxine *unsolids*, *i.e.*, admitting linear section not through the two crossings of a 2-gon, which have 12 or 10 crossings only.

The second knot has four 2-gons, *fb*, FB, G*e*, *g*E. At *fb* . . *afb*D . . , . . C*fbg* . . are meshes collateral with it; and as *b*D and *g*D are edges, D*bg* is a triangle collateral with . . C*fbg* . . which we choose for our base. The 2-gon *g*E is collateral with . . *bg*E*a* . . and . . D*g*E*c* . . . Since *bg* cannot be in three meshes, . . C*fbg* . . is . . *bg*E*a* . ., and our base is . . C*fbg*E*a* . . . As DC and D*a* are edges, this base is the 7-gon DC*fbg*E*a*. Inside this, with *d* remote from D, *c* from C, &c., we have to draw the heptagon *dc*FBG*e*A, and we complete the projection by the edges *af*, AF, *b*D, B*d*, *bg*, BG, *c*E, C*e*, *c*A, C*a*, and by making the 2-gons G*e*, *g*E, *fb*, FB. There is a zonal trace across the epizonal edges *bg* and BG, and the mid-points of the identical zoneless polar edges *ac* and AC, are the poles of a zoneless 2-ple contrajanal axis, about which in revolution there is a 2-ple repetition. We have constructed a 2-ple monaxine monozone subsolid knot. There are 2-ple monaxine monozone unsolid knots that have 12, 10, and 8 crossings only.

The 12-filar knot of 180 crossings, whose circles under written completely define it, has a zoneless symmetry of the highest possible complexity, and is the simplest knot of that symmetry that can be formed. Required its meshes and its symmetry.

$abca_1b_1cdefm_2n_2fghij_8k_8ijkla_{11}b_{11}lmnpa_3b_3p$,

$a_1b_1c_1abc_1d_1e_1f_1m_3n_3f_1g_1h_1i_1m_4n_4i_1j_1k_1l_1m_5n_5l_1m_1n_1p_1a_2b_2p_1$,

$a_2b_2c_2m_1n_1c_2d_2e_2f_2j_5k_5f_2g_2h_2i_2m_7n_7i_2j_2k_2l_2m_8n_8l_2m_2n_2p_2dep_2$,

$a_3b_3c_3mnc_3d_3e_3f_3m_{11}n_{11}f_3g_3h_3i_3m_9n_9i_3j_3k_3l_3a_4b_4l_3m_3n_3p_3d_1e_1p_3$,

$a_4b_4c_4j_3k_3c_4d_4e_4f_4j_9k_9f_4g_4h_4i_4a_6b_6i_4j_4k_4l_4a_5b_5l_4m_4n_4p_4g_1h_1p_4$,

$a_5b_5c_5j_4k_4c_5d_5e_5f_5m_6n_6f_5g_5h_5i_5a_7b_7i_5j_5k_5l_5d_2e_2l_5m_5n_5p_5j_1k_1p_5$,

$a_6b_6c_6g_4h_4c_6d_6e_6f_6g_9h_9f_6g_6h_6i_6d_{10}e_{10}i_6j_6k_6l_6d_7e_7lm_6n_6p_6d_5e_5p_6$,

$a_7b_7c_7g_5h_5c_7d_7e_7f_7j_6k_6f_7g_7h_7i_7a_{10}b_{10}i_7j_7k_7l_7a_8b_8l_7m_7n_7p_7g_2h_2p_7$,

$a_8b_8c_8j_7k_7c_8d_8e_8f_8m_{10}n_{10}f_8g_8h_8i_8d_{11}e_{11}i_8j_8k_8l_8ghl_8m_8n_8p_8j_2k_2p_8$,

$a_9b_9c_9j_{11}k_{11}c_9d_9e_9f_9g_{10}h_{10}f_9g_9h_9i_9d_6e_6i_9j_9k_9l_9d_4e_4l_9m_9n_9p_9g_3h_3p_9$,

$a_{10}b_{10}c_{10}g_7h_7c_{10}d_{10}e_{10}f_{10}g_6h_6f_{10}g_{10}h_{10}i_{10}d_9e_9i_{10}j_{10}k_{10}l_{10}g_{11}h_{11}l_{10}m_{10}n_{10}p_{10}d_8e_8p_{10}$,

$a_{11}b_{11}c_{11}jkc_{11}d_{11}e_{11}f_{11}g_8h_8f_{11}g_{11}h_{11}i_{11}j_{10}k_{10}i_{11}j_{11}k_{11}l_{11}a_9b_9l_{11}m_{11}n_{11}p_{11}d_3e_3p_{11}$.

No duad is found twice in the circles, except the pair of crossings of a 2-gon, which is read twice, as *ab*. Every crossing *s* occurs twice, either in one or in two circles, and is read central in two triplets $as\beta$, $a's\beta'$. The four angles about s are asa' opposite to $\beta s\beta'$, and $as\beta'$ opposite to $\beta sa'$. The crossing n occurs in circles 1 and 4 in the triplets mnp and mnc_3: its angles are

$$mnm \text{ opposite } pnc_3, \text{ and } mnc_3 \text{ opposite } pnm,$$

where the edges mn in the triplets are the two edges of a 2-gon mn.

As mc_3 is an edge as well as mn and nc_3, c_3mn is a triangular mesh, and $K = \ldots mn \ldots$ is a mesh not triangular. Both are collateral with the 2-gon mn.

The crossing p is read in two triplets, npa_3 and b_3pa, of the first circle: its angles are

$$npb_3 \text{ opposite } a_3pa, \text{ and } npa \text{ opposite } b_3pa.$$

The angles c_3np (1) and npb_3 are in the mesh $\ldots c_3npb_3 \ldots = L$, which since b_3c_3 is an edge in circle 4, is the 4-gon $c_3npb_3 = L$. Also the angles mnp (1) and npa (2) are in the mesh $K = \ldots mnpa \ldots$, which is collateral with the 2-gon mn and with the 4-gon L.

The crossing a_3 occurs in the circles 1 and 4 in pa_3b_3 and $p_3a_3b_3$, where the two edges a_3b_3 are different. Its angles are

$$pa_3p_3 \text{ opposite } b_3a_3b_3 \text{ and } pa_3b_3 \text{ opposite } p_3a_3b_3.$$

Here pa_3p_3 and a_3pa (2) are angles of the mesh $M = \ldots apa_3p_3 \ldots$

At a in pab and bac_1 in circles 1 and 2 the angles are

$$pab \text{ opposite } bac_1 \text{ and } pac_1 \text{ opposite } bab.$$

Here c_1ap, apa_3 (3), and p_3ap_3 (3), are angles in $M = \ldots c_1apa_3p_3 \ldots$, which, since d_1c_1 and d_1p_3 are edges in circles 2 and 4, is the 6-gon $M = d_1c_1apa_3p_3$. The angle pab is in the face $K = \ldots mnpab \ldots$, which is collateral with the 2-gon mn, the 4-gon L, the 6-gon M, and the 2-gon ab.

If now we repeat at the four like-posited triplets of the first circle, ca_1d, fm_2g, ij_8j, $la_{11}m$, what we have done at the triplet pa_3a, we shall complete the demonstration that our 15-gonal base

$$K = abcdefghijklmnp$$

is collateral with five 2-gons, five 4-gons, and five 6-gons. And such a 15-gon will be found in the same way from each of the

12 circles. Each 15-gon is o
collaterals are the meshes 246
zoneless repetition.

The knot must be the zoneles
i.e., of twelve 15-gons, twenty
5-ple axes, ten secondary 3-ple
all the axes zoneless-janal.
asymmetrical and all alike.

To construct the knot G. C
axine 5^{12}, and make what rem
You have the zoned hexarc
triangle abc of F is collateral
At a in A on the left of b, co
triangle $a\beta\gamma$, and at b in B a
triangles $b\gamma a$ and $c\beta a$. Do the
of F, operating in the same dire
structed.

It is easy in like manner t
hexarchaxine knots, both zoned
tetrarchaxine, and on the cube
knots.

The following examples of
noticed, may be found useful:—

1. $6^25^43^82^4$, 2-ple monaxine c
whose circles are

1*fedj*5423
1*deoa*

The contrajanal poles are the
zoneless axis is the only contraja

2. $9^25^63^{12}2^6$, 3-ple monaxine c
with the circles

12*ijkif*3*hg*34*dec*
2*hgfec*4*b*

The 3-ple contrajanal poles are

12*h*34*b*56*m*,

12 circles. Each 15-gon is of zoneless 5-ple repetition, whose collaterals are the meshes 246 . . . five times written, showing a zoneless repetition.

The knot must be the zoneless hexarchaxine $G = 15^{12}6^{20}4^{30}3^{60}2^{60}$, *i.e.*, of twelve 15-gons, twenty 6-gons, &c. It has six principal 5-ple axes, ten secondary 3-ple axes, and fifteen 2-ple tertiary axes, all the axes zoneless-janal. The triangles and 2-gons are all asymmetrical and all alike.

To construct the knot G. Cut away the summits of the hexarchaxine 5^{12}, and make what remains of the edges into thirty 2-gons. You have the zoned hexarchaxine knot $F = 10^{12}3^{20}2^{30}$. Each triangle *abc* of F is collateral with three 10-gons, A, B, and C. At *a* in A on the left of *b*, complete by the 2-gon $\beta\gamma$ the small triangle $a\beta\gamma$, and at *b* in B and *c* in C complete by 2-gons the triangles $b\gamma a$ and $c\beta a$. Do the like at each of the twenty triangles of F, operating in the same direction round each. Thus G is constructed.

It is easy in like manner to form upon the regular 20-edron hexarchaxine knots, both zoned and zoneless, on the 4-edron such tetrarchaxine, and on the cube or its reciprocal such triarchaxine knots.

The following examples of knot-symmetry, perhaps not yet noticed, may be found useful :—

1. $6^{2}5^{4}3^{8}2^{4}$, 2-ple monaxine contrajanal, a bifilar of 16 crossings, whose circles are

1*fedj*54234896790*cbac* ;
1*deoab*876532.

The contrajanal poles are the 6-gons 1248*bc*, and 90*ej*56, whose zoneless axis is the only contrajanal diameter.

2. $9^{2}5^{6}3^{12}2^{6}$, 3-ple monaxine contrajanal, a bifilar of 24 crossings, with the circles

12*ijkif*3*hg*34*decd*05*ba*568978*l*1*mn* ;
2*hgfec*4*ba*0976*mnljk*.

The 3-ple contrajanal poles are the 9-gons

12*h*34*b*56*m*, and 890*defigl*.

3. $9^2 6^3 4^6 3^6 2^9$, 3-ple monaxine monozone 6-filar of 24 crossings,

1*kj*1678*ih*8 ; 29*alma*3*pn*3 ; 5*ed*54*bcfgc* ;
*k*29*hij* ; *p*4*blmn* ; *e*679*fd*.

The zonal trace crosses 12 faces, 2446 2446 2446, and the contrajanal polar faces are zoneless 3-ple 9-gons.

4. $8^6 6^2 3^{12} 2^{12}$, 3-zoned monarchaxine homozone, a bifilar of 30 crossings, with the circles

12*gf*23*klmk*34*rq*45*suvs*567861*ecde* ;
*abdcbihfghijmljnpqrpntvuta*9879.

The 3-zoned poles are the 6-gons 123456, *abijnt*. Six like 2-ple 8-gons, 1*ecba*976, &c., terminate the three identical contrajanal axes.

5. $(12)^2 6^6 4^6 3^{12} 2^{12}$, 3-ple zoneless monarchaxine janal, of 36 crossings with the six circles,

12*r*1*bcdeβdpq* ; 2*rnpqnms*34*t*3 ; 4*tlmslku*56*v*5 ;
6*vjkujiw*78*x*7 ; 8*xhiwhgy*90*z*9 ; 0*zfgyfeβabcd*.

The principal poles are the 3-ple 12-gons, 1234567890*ab* and *defghijklmnp*.

The six secondary 2-ple janal axes, in a plane at right angles to the principal axis, have for alternate zoneless poles, six 6-gons and six 4-gons.

PRIVATE BUSINESS.

Sir William Thomson proposed the motion of which he had given notice, viz. :—"That henceforth the Meetings of the Royal Society be held in the afternoon instead of at 8 P.M."

A letter from Mr Murray was read by the Secretary. In this letter Mr Murray apologised for his absence, and recommended "That the Meetings should be held alternately at 4 o'clock and at 8 o'clock."

Mr T. H. Cockburn Hood proposed as a second amendment—"That the first Meeting in each month take place at 2 o'clock, an that Papers upon Geology, Meteorology, and Zoology be read at said Meetings."

On the suggestion of the Secretary, it was decided to remit to the