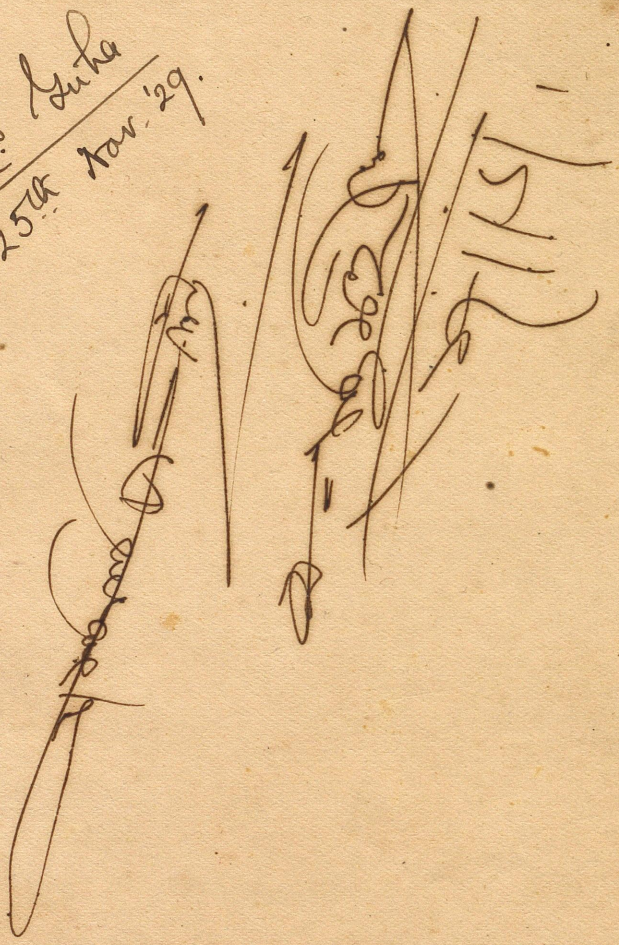
B.C. Guha
25th Nov. '29.



Nature - Jan. 1927. p. 170. See also the Suppt. p. 61.

Magne-Crystalline Action by Sir W. Bragg.

Tyndall's work

In 1845, at the Royal Institution, Faraday made a great step forwards in the science of magnetism. He constructed a powerful electromagnet with which he showed that practically all substances have magnetic properties and remarkable relations are found to exist between magnetic properties and crystalline structure. These results led to the conception of lines of force. Much work was done by Tyndall whose results were interpreted by Faraday as supporting his own theory

In particular Tyndall preferred an interpretation which laid much stress on the part played by the ether and fixed attention on the material bodies concerned. He subjected bodies to great pressure and showed how their magnetic properties seemed to be changed thereby. Quite recently the application of the X ray methods to the study of the crystalline structure of substances make it possible to offer a more complete explanation of Tyndall's results. The effects of pressure are to rearrange the minute crystals which most ordinary substances contain. So Tyndall's results form part not so

much for the branch of science for which they are intended books as for that which deals with the effects of stresses of all kinds in altering the internal arrangements and the properties of materials.

ω is the ang vel.

$\nu = \frac{\omega}{2\pi} = \frac{1}{T}$

5th Dec. 29. Period of Oscillation of Naphthalene crystal in a uniform magnetic field.

Let ν = frequency of oscillation of the crystal in the magnetic field

ν' = frequency when the field is off.

$T + T'$ corresponding periods.

ie $\nu = \frac{2\pi}{T}$ $\nu' = \frac{2\pi}{T'}$

Then $\nu'^2 = \frac{C}{I}$ where C = torsional couple of suspension

I = Moment of Inertia

$$\nu^2 = \nu_0'^2 + \frac{\text{vol. of cryst} \times H^2}{I} \times \Delta\chi.$$

where $\Delta\chi$ is the difference in volume susceptibilities along the two principal directions $\perp^r$ to the axis of suspension.

H is the magnetic field.

ie $\nu^2 - \nu'^2 =$ Const. $\times \frac{\Delta\chi \nu'^2}{I}$

Constant when the field is kept constant and the suspension and the crystal are the same.

$$\nu^2 - \nu'^2 = \frac{VH^2}{I} \times \Delta\chi$$

$$= \frac{VH^2}{C} \nu^2 \Delta\chi.$$

when the field and the suspension fibre are the same we can use the relation for finding the relative values of $\Delta\chi$ for suspensions along different axes of the same crystal.

In the following results obtained with a crystals of naphthalene the subscript 1 after the ν's, T's and χ's refer to suspension with the a b plane (plane of cleavage of crystal) vertical & b axis horizontal and subscript 2, (the same crystal with) a b plane vertical and b axis also vertical.

I

$T_1 = 2.8$ secs. | $T_2 = 0.6$ secs

$T_1' = 8.6$ secs. | $T_2' = 6$ secs.

$$\therefore \frac{\Delta\chi_1}{\Delta\chi_2} = \frac{\frac{\nu_1^2 - \nu_1'^2}{\nu_1'^2}}{\frac{\nu_2^2 - \nu_2'^2}{\nu_2'^2}}$$

$$= \frac{T_1^2 - T_1'^2}{T_1^2} \times \frac{T_2^2}{T_2'^2 - T_2^2}$$

$$\frac{\Delta\chi_2}{\Delta\chi_1} = \frac{7.84}{73.96 - 7.84} \cdot \frac{36 - .36}{.36}$$

$$= 11.74$$

II same crystal as in I – field diff.

$T_1 = 2.0$ secs $\quad T_2 = 0.6$ secs.

$T_1' = 8.6$ secs. $\quad T_2' = 6.6$ secs.

$$\frac{\Delta\chi_2}{\Delta\chi_1} = \frac{4}{73.96 - 4} \cdot \frac{43.56 - .36}{.36} = 6.861$$

I 'b' axis Vertical with the field

the period = ·44, without the field,

the period = 2·076.

'b' axis horizontal, with the field

the period = 1·595, without the field

the period = 3·613.

$(\cdot 44)^2 = \cdot 1936$, $(2\cdot 076)^2 = 4\cdot 31$.

$(1\cdot 595)^2 = 2\cdot 544$, $(3\cdot 613)^2 = 13\cdot 05$.

$$\frac{2\cdot 544}{13\cdot 05 - 2\cdot 544} \cdot \frac{4\cdot 31 - \cdot 1936}{\cdot 1936} = \frac{2\cdot 544}{10\cdot 506} \cdot \frac{4\cdot 116}{\cdot 1936}$$

$= 5\cdot 15$

II [Same Crystal] 'b' axis vertical with the field the period = ·4, without the field = 2·033

'b' axis horizontal with field = 1·6

& without the field = 3·68

$(\cdot 4)^2 = \cdot 16$, $(2\cdot 033)^2 = 4\cdot 133$

$(1\cdot 6)^2 = 2\cdot 56$, $(3\cdot 68)^2 = 13\cdot 54$

$$\frac{2\cdot 56}{13\cdot 54 - 2\cdot 56} \cdot \frac{4\cdot 133 - \cdot 16}{\cdot 16} \cdot = \frac{2\cdot 56}{10\cdot 98} \cdot \frac{3\cdot 973}{\cdot 16} \cdot$$

$= 5\cdot 788$.

The crystal is suspended with its 'b' axis horizontal and the plane of the crystal along the field. The null point is at $\frac{26}{80}$ of the 1% of $MnCl_2.4H_2O$

At wt of Mn = 54·9

The susceptibility of $MnCl_2$ at 19° = 127
at 18° = 122

$$125.8 : \frac{26 \times 125.8}{80 \times 100 \times 197.8} :: 127 : x$$

$$\frac{26 \times 125.8 \times 127}{80 \times 100 \times 125.8 \times 197.8}$$

20.12.29.

'b' axis horizontal. with the field
the time for 10 osc.

7·4 sec. 7·4, 7·4, 7·4

without the field. the time is 30
for 3 osc. 7, 7, 7, 7,

in 'b' axis Vertical with the field
the time for 10 osc.

4. 4, 4, 4.

without the field

7. 7. 7. 6·8.

Let ν be the frequency (about the position of rest) $\left(=\frac{2\pi}{T}\right)$ when the crystal is oscillating in a uniform magnetic field H, and ν' the frequency $\left(=\frac{2\pi}{T'}\right)$ when oscillating about the same axis without the magnetic field.

$$\frac{\nu^2 - \nu'^2}{\nu'^2} = \frac{\text{volume of crystal} \times H^2}{C} \Delta\chi_{\text{mol.}}$$

where C is the torsional couple.

defined by $C = \nu^2 I = \frac{4\pi^2}{T^2} I$.

$$\frac{\nu^2 - \nu'^2}{\nu'^2} \times \frac{M}{m} = \frac{H^2}{C} \times \Delta\chi_{\text{per gm. molec.}}$$

where M is the molec. wt and m the mass of the crystal experimented with.

$$\frac{\nu^2 - \nu'^2}{\nu'^2} = \frac{T'^2 - T^2}{T^2}$$

M = mol. wt.

To find the strength of the $MnCl_2 \times H_2O$ used for investigating the susceptibilities of naphthalene.

The wt of the $MnCl_2$ in 50 cc. of 1% soln. = ·4155 gm. ∴ the wt in 100 cc. the wt of $MnCl_2$ = ·831 gm ∴

8.1.30

The 'b' axis of the crystal horizontal and the plane of the crystal perp. to the field

$\frac{30}{100}$ of 1% $MnCl_2(4+x)H_2O$ slightly towards the left. right-

$\frac{35}{100}$ of 1% -- slightly towards the left-

$\frac{33}{100}$ of 1% may be taken as the actual value.

— o —

'b' axis vertical and inclined at 60°

$\frac{44}{100}$ of 1% sol. may be taken as the required value.

The 'b' axis of the crystal horizontal and the plane along the field

$\frac{10}{100}$ of 1% slightly towards the right.

$\frac{15}{100}$ of 1% very slightly towards the left.

$\frac{14}{100}$ of 1% may be taken as the reading.

'b' axis of the crystal vertical and the plane perpendicular to the field

$\frac{35}{100}$ of 1% sol^{n} may be taken as the required value.

ভুঙ্গুত

আমার বিসমিল আমার থান চাঁন বাই যো
ভাগে বসিত পরিতে চাণ করিতে পারী বোণ
আমিন ন হা মাঁ যারি ভাগ যা থান চঁন
মান পয়োইতে বসিতে পরি চঁন মতাক
সুদাষ পইবে ন আপনী করিতে পয়া
না মতা যে ভাগে বাসী চাণ করিতে
পন করিতে থান দাষ শিনরন মাস
বী মান মান দিগা দিগি সহ য
ঈ মতু মাইগে থান তেঁগেওয়া ছেনা তাকা
গোঃ ডেমারা আমাবক্তা ঈষিয়া
মা আবুল পাওয়ার গী সাহ য
ঈ মতু মাইগে

10th Jan'29.

8.?

The length of the brass rod = 8.33 mm.
diameter of the rod = 4.46 mm.
wt. of the rod = 1.0556 gms

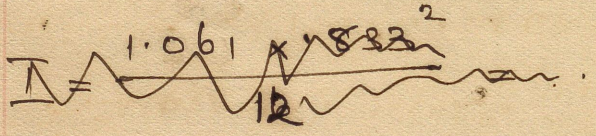
$$I = \frac{1.061 \times \pi \times 8.33 \times 2}{12}$$

For the

10th Jan'29.

8.0

The length of the brass rod = 8·33 mm.
diameter of the rod = 4·46 mm.
wt. of the rod = 1·056 gms



For the

21.1.30.

Aragonite suspended with its long axis (pseudo axis of symmetry) vertical.

~~Period of Oscillation~~. Current = 14·8 amps.

Time for 50 oscillations

With field	Without field
46·2 secs.	46·8 secs.
6·6	6·8
5·8	6·8
6·6	6·4
6·6	7·0
6·0	7·0
6·0	6·8
6·6	6·7
mean = 46·3 secs.	mean = 46·8
T = ·926 sec.	T = ·936 sec.

The face of the crystal parallel to the field (when ~~allow~~ suspended by a silk fibre vertically) the suspension being perpendicular to that face.

Time for 40 oscillations

with field	without field
50·0 sec	64·8
50·0	65·2
50·0	65·4
50·0	65·2
50·4	65·4
~~48·2~~	65·4
49·8	64·8
50·0	65·0
50·0	
Mean = 50·025	Mean = 65·15
T = ~~1·2516 sec.~~	T = 1·6287 sec.
T = 1·25$_1$ sec.	T = 1·62$_9$ sec.

22.1.30

The face of the crystal perpendicular to the field (when suspended vertically by a silk fibre) the suspension being perpendicular to that face.

Time for 40 oscillations

with field	without field
51·8	~~67·8~~
52·2	7·2
52·4	7·0
52·0	7·4
51·8	7·0
52·2	7·4
52·0	6·8
52·0	7·0

mean = 52·05

mean = 67·15

~~T = 1·301~~

~~T' = 1·679~~

T = 1·30$_1$ secs.

~~Weight of crystal~~

~~T' = 1·68~~

T' = 1·67$_9$ secs.

mass of the aragonite crystal used
= 0.421 gm.

Length of the brass rod used to find out the moment of inertia = 1.06 cm

Mass of the brass rod = .504 gm

Meantime for 100 oscillations when the rod is suspended horizontally in air. = 3 min. 2.025 sec.

T = 1.82

C = .563

$H =$

1·88

$H' = \frac{\theta_2 \cdot x\, x'}{A' n'}$

$H = \frac{\theta_1 \cdot x}{A n_2}$

$\frac{H'}{H} = \frac{\theta_2 \cdot x'}{\theta_1 \cdot x}$

$H' = \frac{\theta_2 \cdot x'}{\theta_1 \cdot x} H$

1

25.1.30

To measure the field of the electro-magnet.

Current in the solenoid = 2·1

Resistance = 400 Ω $\lambda/2$ at 400 Ω

Deflection = 2·7 cm = ·074

$H = 4\pi n i$ n = no. of turns per cm of the primary

$\frac{H A n_2}{G + S + 400} \propto K\theta_1$ n_2 = total no. of turns in secondary

$\frac{H' A' n'}{E + S + G + 3000} \propto K\theta_2$ A = Area of the primary

S = Resistance of the secondary.

n' = no. of turns in the exploring coil

E = resistance of the exploring coil

A' = Area of the exploring coil.

$n = \frac{44}{5.2} = 8.46$

$n_2 = 456$, radius of the primary $= 1.68$

$G = 6\ \Omega$

$S = 45.9\ \Omega$

$n' = 200$

$AE = 13.14\ \Omega$

radius of the exploring coil $= 1.9 + 8.2$

$H = 4\pi ni$

$= 4 \times \frac{22}{7} \times 8.46 \times 27$

$= 52.2$

$\frac{H A n_2}{G + S + 400} \propto K\theta_1 \qquad 467.3 \propto K\theta_1$

$H \times .756 \propto K\theta_2$

$$\frac{467.3}{H' \times .756} = \frac{\theta_1}{\theta_2} = \frac{2.7(1+.074)}{15.8(1+.059)}$$

$$\frac{467.3}{H' \times .756} = \frac{2.7 \times 1.074}{15.8 \times 1.059}$$

$$\frac{467.3 \times 15.8 \times 1.059}{2.7 \times 1.074 \times .756} = H'$$

$H' = 3556$ Jaus

27th Jan'30.

Current in amperes through the magnet-	Throw for breaking current.
10	12·8, 12·8, 12·9
13	15·4, 15·5, 15·5, 15·5
14	16, 16·2, 16·1, 16·1 16·2
14·5	16·5, 16·4, 16·5.
15	16·8, 16·8, 16·8, 16·7 16·8
16	17·2, 17·4, 17·4, 17·3 17·3

Ex the Resistance (in the Galv. circuit =) 3,000 ohms

Current (thro' the primary of mutual inductance) = 2·4 amp.

For reversing the throw - 3·1, 3, 3, 3·1 3·0

Resistance (in the Galv. circuit now) = 400 ohms

400 →

5·9	1·5	7	3
5·2	1·4	6·3	2·7
5·0	1·3	5·8	2·5
4·5	1·2	5·4	2·3
4·3	1·1	5	2·1
~~3~~ 4·8		4·5	2
		4·2	

3,000 →

5·6	4	6·8
5·2	3·8	6·4
4·9	3·5	6
4·6	3·4	5·6
4·3	3·1	5·2
3·9		4·8

Current

$H = 4\pi nI$ $I = .24$, $n = 8.46$

$H = 25.52$

$A = \pi r^2$ where r = radius of the primary

& A = the area

$A = \pi\ 3.143 \times 1.68 \times 1.68$

$$\frac{H\ A\ n_2}{E+G+C+400} = \frac{456 \times 25.3 \times 3.143 \times 1.68 \times 1.6}{13.14+6+45.9+400}$$

$$= \frac{456 \times 255.3 \times 3.143 \times 1.68 \times 1.68}{465.04}$$

$= 2220$

$T = 2\pi \sqrt{\frac{I}{C}}$.

15 amp $\quad \frac{2220}{H' \times .756} = \frac{3.04}{16.78}$.

$H' = \frac{2220 \times 16.78}{.756 \times 3.04}$

~~$H' = 19950$~~.

$H' = 966.1 \times 16.78$

$= 16,21$ gauss. $\times 2 = 3240$

16 amp $\quad \frac{2220}{H' \times .756} = \frac{3.04}{17.32}$

$H' = \frac{2220 \times 17.32}{3.04 \times .7558}$.

$= 16,73$ gauss. $\times 2 = 3350$

14.5 amp.

$H' = 966 \times 16.47$

$= 15,92$ gauss $\times 2 = 3180$

✓

14 amp. $H' = 966{\cdot}1 \times 16{\cdot}12$

$= 15{,}570$ gauss $\times 2 =$ 3110

13 amp. $H' = 966{\cdot}1 \times 15{\cdot}48$

$= 14{,}960$ gauss. $\times 2 = 2990$

10 amp. $H' = 966{\cdot}1 \times 12{\cdot}83$

$= 12{,}400$ gauss $\times 2 = 2480$.

19.2.30 Calcite $\Delta\chi_m = 8{\cdot}837 \times 10^{-6}$

Strontianite $\Delta\chi_m = 9{\cdot}14 \times 10^{-6}$

$= 9{\cdot}32 \times 10^{-6}$

Aragonite $= 8{\cdot}45 \times 10^{-6}$

Original length of fiber = 7.0 cms
new length = 6.7 cms

Time for 50 osc. with the steel ball

1 min. 18.8 Sec.
18.6 "
19.0 "
18.9 "
19.0
18.8
18.8
19.2

$T = 1.57_7$ Sec.

Radius of the ball = .3175 Cm
mass of the ball = 1.045 gms

$T = 4\pi^2 \frac{I}{C}$

$I = \frac{2}{5} M r^2$.

Original $C = \frac{4\pi^2}{T^2} \cdot I$

$= \frac{4\pi^2 \times 2 \times 1.045 \times .3175^2}{1.577^2 \times 5} \times \frac{6.7}{7.0}$

$= .640$

X

29th Jan. '30. Mass of the Calcite crystal = ·601 gm.

Length of the fibre about 8 cm.

~~Time for 20 osc. with the ball.~~

1	5
1	5·2
1	4·8
1	5
1	4·8
1	4·8
1	5·2
1	5·2

$\leq$ 4·6.

31st Time for 40 osc. with the ball

2 min 12 Sec.

2 –	12	1 – 11·8
	11·8	
	12·2	Mean
	12	= 2 min. 12·04 Sec.
	12	
	12·2	T = 3·30, Sec.
	12·2	
	12·2	

31st Jan '30

Time for 40 osc. with the Aragonite Crystal, when suspended vertically ie. along the length.

Without the field

53·8 sec.
54·0
54·2
54·2
54·0
53·8
54·2
53·8
53·8

~~Reject~~

With the field.

Omit { 45 sec
45·4

With the field for 20 osc

23·2
23·0
23·0
22·8
22·8
23·2
23·0
23·0
22·8
23·0

Reject

Aragonite Crystal Suspended Vertically ie. along the length.

2nd Feb '30

Time for 40 osc. Without the field	Time for 20 osc. With Field
54·6 sec	23·2
54·6	23·0
54·4	23·4
54·4	23·4
54·4	23·2
54·6	23·6
54·2	23·6
54·4	23·4
54·6	23·2
54·2	23·6
Mean = 54·44 sec.	Mean = 23·36
T = 1·36$_1$	T = 1·16$_8$.

Wt. of the aragonite crystal used = ·3642 gm

$\Delta \chi_m = 1\cancel{\cdot 46}_2 \times 10^{-6}$ or 60

Repeat. Aragonite crystal suspended perpendicular to that face which sets parallel with field when suspended vertically

Time for 20 oscs.
With field

39.4
39.2
39.4
39.2
39.2
39.0
39.6
39.2
39.2
39.6

Mean: 39.3 &c

T = 1.96$_5$ &c.

Time for 40 oscs.
Without Field

2 min 18.0
17.8
17.6
18.0
17.4
18.0
17.8
17.8
17.6
17.6

Mean = 2, 17.78

T = 3.44$_{45}$

$\Delta\chi_m = 3.51 \times 10^{-6}$

$\Delta\chi_m = 8.45_3 \times 10^{-6}$

Reject

Without the field
for 40 oscs.

2 min. 14·4 Secs.
14·2
14·2
14·6
15·0
14·4
14·4
15·0
14·2
14·4

Mean = 2 min. 14·48 Sec.

T = $3{\cdot}36_2$

With Field
Time for 20 oscs.

46·8 Secs.
46·4
46·8
46·6
46·0
46·4
46·8
45·8
46·0
46·8
45·8
46·6
46·0

Mean = 46·292

T = $2{\cdot}31_4$

$$\Delta\chi_m = \frac{1{\cdot}88}{4157_8} \times 10^{-6}$$

Time for 40 oscs.
with the steel ball

2 mins 10·2 secs.
10·2 "
10·4 "
10·2 "
10·0 "
10·2 "

Mean = 2 min 10·2 secs.

T = $3,25_5$

Calcite

Time for 40 oscs
Without the field

1 min 55·4 secs.
55·6.
55·4
55·4
55·6
55·2
55·4
55·2

Mean = 1 min 55·4

Reject

Calcite Crystal

2.2.30.

(11 P.M.)

Mass of the Crystal used = ·6016 gm

Time for 40 oscs.
Without Field

56·8 Secs.
56·8
56·8
57·0
56·8
57·0
56·8
56·8

mean = 56·85 sec.

T = 1·42$_1$ sec.

Time for 20 oscs
With field

26·6
27·0
26·4
27·0
26·6
26·8
26·6
26·8
27·0
26·8

mean = 26·76 sec

T = 1·33$_8$ sec

$\Delta\chi_m = 1·62 \times 10^{-6}$

Time for 40 oscs. with the steel bar

1 min 3·2 secs.
3·2
3·0
3·0
3·2
3·0
3·2
3·2

mean = 1 min 3·125 sec

T = 1·57$_8$ sec.

9th Feb. 30.

Anhydrite

Time for 50 oscs.

Without field.

~~36·2 secs.~~
35·8 secs.
35·8
35·8
35·4
35·8
36·0
36·0
35·8
36·0
35·6
36·0

Mean = ~~35~~·876 sec.

T = ·717$_5$ sec.

10th Feb '30. Anhidrite Crystal (along the fibre of the Crystal)

Time for 50 oscs.

With field	Without Field.
35·8	
36·0	
35·6	
36·0	
35·6	
36·0	
36·0	
35·8	
35·8	
36·0	
36·0	

Rejected

10th Feb

Crystal suspended along the fibre.

With field		For 200 scs. Without Field	
Time for 100 sec		1 min	43·6
28·8			43·0
28·8			43·2
28·6			43·6
28·4			42·8
28·8	Reject		43·0
28·6			43·4
28·6			43·6
28·4			43·0
28·8			43·4
28·8			

Mean = 1 min 43·26 secs

T = 5·163 sec

Anhydrite

With field
for 100 sc.s

30·2
30·0
30·0
30·2
30·0
30·6
30·6
30·0
30·2
30·2
30·0
30·4

Reject

Mean = 30·2

T = 3·02.

inclined at 15° to 20°

23·2

10·6
20·6

20·4
1·8

11

Anhydrite

11.2.30

The fibres of the crystal inclined at 15° to the field suspended perpendicular to the fiber (smaller edge)

With field Time for 10 oscs.	Without Field Time for 20. oscs
21·0	1 min – 11·0 secs.
20·6	11·2
20·8	10·6
20·6	10·8
21·2	11·0
21·2	10·8
20·6	10·8
20·8	11·2
21·0	10·6
21·2	10·8
20·6	
21·0	

mean = 20·883 secs. mean = 1 min 10·88 secs.

T = 2·088 secs T = 3·544 secs.

$$\Delta\chi_m = 2\cdot399 \times 10^{-6}$$
$$= 2\cdot4 \times 10^{-6}$$

Mass of the anhydrite crystal used for the investigation ·118 gm

Assago Anhydrite

11. 2. 30
Evening.

Along the fibre of the crystal. (inclined at an angle 25° to 30° to the field)

With Field Time for 20 oscs.	Without Field Time for 20 oscs.
12·8	53·4
12·4	53·0
12·2	53·0
12·4	53·2
12·6	53·0
12·4	53·0
12·4	53·0
12·2	53·0
12·6	
12·4	mean to be taken as
12·4	53·0 secs.
12·4	

mean = 12·43 secs.

T = ·621$_5$ sec.

T = 2·65 sec.

11.2.30.

Anhydrite

The crystal suspended perpendicular to both of the previous planes i.e. perpendicular to the flat face.

With Field

For 10 oscs.

27·8
28·6
27·8
28·4
27·8
28·6
27·8
28·0
27·8
28·2
27·8

mean = 28·054

T = 2·805

Without Field

For 20 oscs.

1 min 17·2
17·8
17·2
17·4
17·8
17·6
17·4
17·8

mean 1 min. 17·52

T = 3·876.

The steel ball suspended with the fibre now

Time for 10 oscs

2 — 4·2
4·6
5·2
3·8
5·2

2 · 0
1 59·8
1 58·2

12.2.30.

The steel ball suspended with by the same fibre.

For 5 oscs.

60.0 sec.
59.6
60.2
60.2
60.4
59.8
60.2
60.0
60.4
60.0

C = .01152

mean = 60.08

T = 12.016

12.2.20

C for fibre = .0115

Strontionite

The crystal is suspended vertically ie. along the length.

Time for 50 oscs.

With Field

29·0 secs
28·4 secs
29·0
28·6
28·6
29·0
28·4
28·4
29·0
28·4
28·6
29·0

mean = 28·7 secs

T = 5·74 sec

Time for 50 oscs.

Without Field

30·8
31·0
30·6
30·4
31·0
30·6
31·0
30·8
31·0
30·8
31·2
31·0

mean = 30·85

T = 6·17 secs

·03 $\Delta\chi$ = ~~·067~~ ·07 $\times 10^{-6}$

12.2.30

Perp to the axis which ~~in~~ sets along ~~the~~ ~~11th place~~ the field when suspended along the length of the crystal.

Time for 50 oscs.

Without Field	With Field 100 oscs
54·4 secs	25·2
54·2	24·6
54·6	24·8
54·4	24·4
54·4	25·4
54·2	24·8
54·2	24·0
54·4	24·6
	22·8
	22·6
	22·2
	23·2
	22·8
	22·0
	22·8
	22·6
	22·8
	22·8

mean = 54·35 secs

T = 10·87

mean = 22·66

T = 2·266 secs

13.2.30

$\Delta\chi = 9.32 \times 10^{-6}$

3.84×10^{-6}

13.2.30

Strontianite

Perp. to the previous direction

With Field For 10000 secs.	Without Field For 5000 secs.
25·0 secs.	59·8
24·8	59·2
25·2	59·0
25·0	59·4
25·2	59·2
25·0	59·4
25·0	
24·8	

mean = 25·0 secs.

T = 2·50 secs.

mean = 59·33 secs.

T = 11·86.

mass of the crystal used

= ·3815 gm

$$\Delta\chi = \text{[illegible]} \times 10^{-6}$$

$$3{\cdot}75 \times 10^{-6}.$$

Reject

Witherite

With long axis vertical & suspended along the length of the crystal.

Without Field
For 10 oscs.

1 min 2·4
2·6
2·4
2·0
2·4
2·2
2·0
2·0
2·4
2·0

mean = 1 min 2·24 secs.

T = 6224 secs.

X

18th Feb.

Calcite

Mass of the crystal used = .342 gm.

The crystal is suspended with the optic axis horizontal.

With Field	Without Field
for 10 oscs.	10 oscs.
26·4	1 min 5·4
26·2	" 5·8
26·0	

$$\Delta\chi_m = 1{\cdot}69 \times 10^{-6}$$

18th Feb.

Calcite

Mass of the crystal = ·3319 gm

For 10 oscs.

With the Field	Without Field
~~14·0~~ secs	1 min 6·0 sec
14·4	5·4
13·8	6·2
14·6	6·0
14·0	6·2
14·6	6·4
14·2	5·6
14·2	

mean = 14·225

T = 1·42~~5~~

T = 6·0 secs.

$$\Delta\chi_m = \frac{3.68}{\cancel{6.79}} \times 10^{-6}.$$

19th Feb. mass of the ball = 1·037 gm

Radius of the ball = ·3175

Time for 5 oscs.

59·0 sec
59·4
59·8

52·2 sec
52·6
52·2
52·4
51·6
51·8
~~52·6~~
52·6
52·4

$c = ·01512$

mean = 52·225 secs

T = 10·445 secs.

Calcite Crystal

19th Feb.

Without Field

Time for 10 oscs.

1 min 4·2 sec
4·4
4·2
4·0
4·0
3·8
4·0
4·6

mean = 1 min 4·15 sec.

T = 6·415 secs

With Field

Time for 10 oscs.

15·0 secs.
14·8
15·2
15·2

19.2.30

Calcite Crystal

The same crystal suspended so that its optic axis is horizontal (it ~~(optic axis)~~ perp. to the field)

With Field

Time for 10 oscs

13·8 secs
14·0
14·0
13·8
14·0
14·0
13·8
13·8
14·0
13·8

mean = 13·9 secs.

T = 1·39 secs.

The mass of the crystal

= ·331 gm

$\Delta \chi_m = \frac{3.64}{8.85} \times 10^{-6}$

20th Feb.

Calcite Crystal

Mass of the Crystal = ·2315 gm

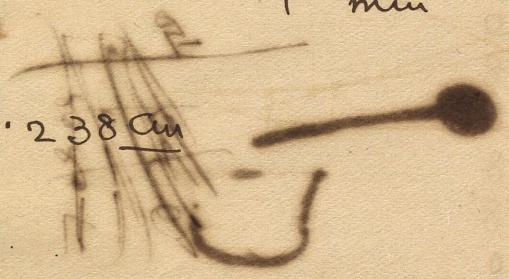
With Field	Without Field
20 oscs.	10 oscs
23·0 secs.	47·0 sec
22·6	46·8
22·8	46·4
22·6	46·8
22·4	46·6
22·8	46·8
23·0	46·8
22·8	47·0
23·0	
22·8	
mean = 22·78 secs.	mean = 46·775
T = 1·139 secs	T = 4·677

$\Delta \chi_m = 4.09 \times 10^{-6}$

23rd Feb. '30.

Mass of the steel ball = ·438 gms.

Time for 10 oscs.



r = ·238 cm

1 min	34·8 sec.
	31·6
	31·0
	31·6
	31·4
	31·8
	31·8

C = ·004674

mean 1 min 31·57 sec

T = 9·157 sec

Sodium Nitrate (Perp to optic axis)

Without the field
for 10 oscs.

21·0	sec.
21·0	sec.
21·0	"
21·2	"
21·0	"
21·0	"
21·0	"

Mean to be taken as
21·0 sec.

T = 2·10 sec.

Sodium Nitrate

With Field

For 10 osc.

5·8 secs.

6·0

5·8

5·8

5·8

5·8

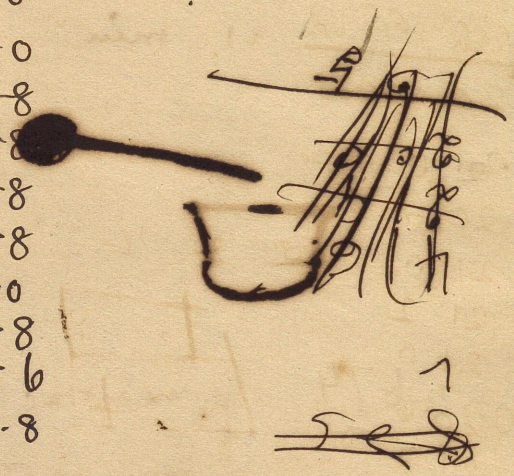
6·0

5·8

5·6

5·8

Mean = 5·8 sec.



T = ·58 sec.

Mass of the Crystal = ·038 gm

Reject

$\Delta \chi_m$ = ~~·121 × 10~~ 6

12·1 × 10^{-6}

4·72 × 10^{-6}

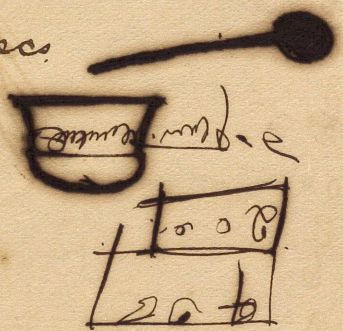
25th Feb.

Sodium Nitrate

Suspended perpendicular to the optic axis.

Mass of the Crystal = ·1011 gm

With Field	Without Field
For 20 oscs.	For 10 oscs
21·0 secs	54·0 secs
20·6	53·8 "
21·0	54·0
21·2	53·8
21·6	54·0
20·6	53·4
21·0	53·6
21·0	53·2
20·6	53·0
20·8	53·2



mean = 20·88 secs

T = 1·044 sec.

mean = 53·6 secs

T = 5·36 secs

$$\Delta\chi_m = \frac{9\cdot508 - 9\cdot608}{} \times 10^{-6}$$

$$3\cdot91 \times 10^{-6}.$$

25th Feb. 30.

Sodium Nitrate

mass of the crystal = ·0385 g

Suspended as before.



Without Field		With Field	
For 10 osc.		For 20 osc.	
21·2	secs	12·8	secs.
21·0	"	13·0	
21·2		12·4	
21·4		13·6	
21·2		12·4	
21·6		12·6	
21·4		12·8	
21·2		12·4	
21·4		12·6	
21·2		12·8	

Mean = 21·28 secs

T = 2·128 secs.

Mean = 12·68 secs

T = ·634 sec

$\Delta X = 4 \cdot 22 \times 10^{-6}$

27th Feb.

Mass of air ~~fl~~ steel ball = 438 gm

r = 238 cm

Time for 20 oscs.

1 min 8.4 sec

8.6

8.0

8.4

8.2

8.0 Mean = 1 min 8.266 sec

C = .03362

T = 3.413 sec.

27th Feb' 30. Potassium Nitrate 8

Along the long axis.

20 oscs.

With Field	Without Field
28·0 secs.	30·2
28·2	30·0
28·4	30·0
28·2	30·4
28·4	30·6
28·2	30·0
28·0	29·8
28·4	
28·2	mean = 30·0 secs.
28·2	T = 1·50 sec.

mean = 28·22 secs.

T = 1·411 Secs

$\Delta\chi_m = \frac{\cdot 12 \cdot 299}{\text{Mass of the Crystal used}} \times 10^{-6}$

= ·141 gm

27th Feb.

Potassium Nitrate

The crystal is suspended perpendicular to that face which sets parallel to the field when suspended vertically.

20 ccs

With Field	Without Field
37.2 secs.	1min 31.6 secs.
37.0	32.2
36.8	31.6
37.2	32.0
36.4	31.6
36.8	32.0
37.0	32.0
37.2	31.6
37.2	
36.8	

mean 36.96

T = 1.848 Dec

mean = 1min 31.825 sec.

4.87×10^{-6}

T = 4.591

$\Delta \chi_m =$ 4.9 × 10⁻⁶

27th Feb '30. Potassium Nitrate

⊥ to the previous direction.

Without Field		With Field	
10 oscs.		10 oscs.	
45·6 oscs.		18·2	
45·0	"	18·0	
45·0	"	18·2	
44·4	"	18·0	
45·0	"	18·0	
44·8		18·2	
44·4		18·2	
44·6		18·2	
44·4		18·0	
44·8		18·0	
44·6			
44·8			

mean = 44·68 secs

T = 4·468 secs

mean = 18·12 secs

T = 1·812 secs

$$\Delta\chi_m = \frac{4\cdot82}{11\cdot67} \times 10^{-6}$$

28th Feb. mean T = 3·436 with the steel ball

C = ·03318

Potassium Nitrate

Pseudo axis of symmetry Vertical

Without Field 10 oscillations.	With Field For 10 Oscs.
30·6 secs.	28·4 secs.
30·2	28·6
30·4	28·8
30·0	28·2
30·0	28·8
29·8	29·0
29·8	28·4
30·2	28·6
30·4	
30·0	
mean = 30·14	mean = 28·60
T = 3·014 sec.	T = 2·860

$\Delta\chi_m = ·118 \times 10^{-6}$

28th Feb. Potassium Nitrate

1 1st dirn. along

With Field 10 oscs.	Without Field 10 oscs.
24·8 secs.	~~1 min 26·4~~
24·4	~~27·0~~
24·8	1 min 25·8
24·6	25·4
24·4	25·4
24·6	25·0
24·0	25·2
24·0	26·4
24·4	26·6
24·6	26·0
	26·4
	25·8

Mean = 24·46 secs mean = 1 min 25·8 secs

T = 2·446 secs T = 8·58 secs

$$\Delta \chi_m = \cancel{11{\cdot}44}\ 4{\cdot}68 \times 10^{-6}$$

28th Feb.

Potassium Nitrate

1 to the previous form

With Field 10 secs.	Without Field 10 secs
25·4	1 min 28·2
24·6	27·4
25·4	26·6
25·0	27·8
25·0	27·6
25·0	27·8
25·0	26·8
25·0	26·6
	27·0
	27·4

mean = 25·0 secs

T = 2·50 secs.

mean 1 min 27·32

T = 8·732 sec

Mass of the crystal = ·316 gm.

$$\Delta \chi_m = \cancel{11{\cdot}33 \times} \; 4{\cdot}65 \; 10^{-6}$$

13.3.30.

Internal diameter of search coil
= 3·3 cm

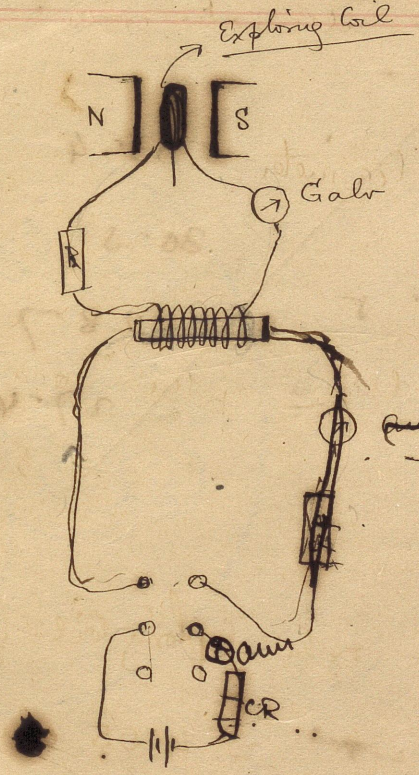
External diameter " " "
= 3·8 cm

Internal diam of the search coil (small)
= 2·2 cm

External " " "
= 2·6

Resistance of the Exploring coil (small)
= 4·05 ohms.

No. of turns on the coil (Exploring) = 50



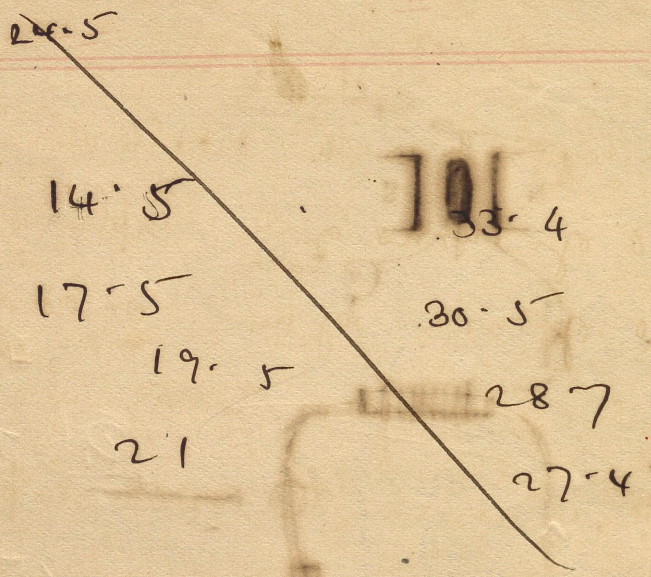
$H = 4\pi n I$

$\phi N = \frac{4\pi n_1 I n_2 R}{R}$

$\frac{H \alpha n_2}{R} = Q = k\theta$

$\left(\frac{4\pi n i}{}\right)$

$\frac{H \alpha' n_3}{R'} = k\theta'$


14·5
17·5
19·5
21
33·4
30·5
28·7
27·4

20.3.30

Resistance in the circuit = 3,000 Ω

Current through the Electromagnet = 15 amps.

No. of turns of the exploring coil (small) = 50

No. of turns of the secondary = 1000

No of turns per cm. of the primary = 4·54

External diameter of the exploring coil (small)
= 2·6 cm.

Internal diameter of the exploring coil (small)
= 2·2 cm.

~~Inter~~ Diameter of the primary = 3·76 cm

Current passing through the exploring coil
= 2·6 amps.

Resistance used in the circuit
= 200 ohms.

Resistance of the secondary = 593 Ω

1st Exploring Coil

null = 24.2

1)	14.4	33
	17.3	30.3
	19.4	28.3
	20.8	27.1
2)	14.4	33
	17.3	30.2
	19.4	30.2
3)	14.5	32.9
	17.4	30.2
	19.5	28.4
	20.9	27.1

$\chi = .0758$

Current in magnet reversed

1)	34.5	16.2
	31.3	18.5
	29.1	20.2
	27.6	21.4

$\chi = .0821$

2)	34.5	16.1
	31.3	18.5
	29.1	20.2
3)	34.3	16.3
	31.1	18.6
	29.0	20.3

6. Current through the coil (explain)

Null 24

1)	35.8	18.5
	26.8	22.6
	24.6	23.7
2)	35.9	18.5
	26.8	22.6
	24.7	23.6
3)	36.0	18.3
	26.8	22.6
	24.7	23.6

$\chi = .2947$

4) 35·9 18·5
26·7 22·6
24·7 23·6

$H = 14{\cdot}86$

$$H' = \frac{2 \times 10 \times 1{\cdot}049 \times 3635{\cdot}6 \times 14{\cdot}86 \times (1{\cdot}88)^2 \times 20}{(1{\cdot}2)^2 \times 831{\cdot}5 \times 11{\cdot}9 \times 1{\cdot}1473}$$

taking the mean deflection & χ, $H' = 4863$

$= \cancel{4969}$ gauss.

$\cancel{4970}$

On ~~reversal~~ sudden reversal

1) 11·1 Resistance = 5,000 36
14 null = 24 33·3
16·1 31·2

2) 11 χ = ·0513 36·2
14 33·3
16·1 31·2

$$H' = \frac{13 \times 1{\cdot}026 \times 5635 \times 14{\cdot}86 \times (1{\cdot}88)^2 \times 20}{(1{\cdot}2)^2 \times 831 \times 11{\cdot}9 \times 17473}$$

$H' = 4833$

Exploring coil taken away suddenly from the field resistance 20,000

Mean $\theta = 9{\cdot}2$ null 25·3

1)	16·2	34·0
	17·2	33·1
	18·1	32·2
2)	16·1 $\lambda = {\cdot}0225$	34·0
	17·1	33·2
	18·0	32·4
3)	16	34
	—	—
	16·9	32·5

Resistance of the exploring Coil = 8·7 Ω
mean diameter of the - - - - = 3·6 cm
No. of turns in the coil = 100.

mean λ = ·0236 ~~·1236~~

Reversed

null 22.

1)	31·3	13
	30·4	14·2
	29·5	15·0
2)	31·3	13·2
	30·1	14·1
	29·3	15·0
3)	31·2	13·1
	30·4	14
	29·5	15·0

λ = ·0247 ~~·1284~~

Resistance in the galv. circuit = 700 Ω

current 2·6 amp.

Null 25·3

1)	33·7	20
	28·7	23·2
	26·7	24·5

2)

38.3	20.1
28.8	23.2
26.7	24.5

$\chi = .204$

3)

33.7	19.7
28.8	23.0
27.7	24.4

$$H' = \frac{10 \times 9.2 \times 1.012 \times 20640 \times 14.86 \times (1.88)^2}{(1.8)^2 \times 1.331 \times 4.2 \times 1.102}$$

$$= \underline{5050} \text{ gauss.}$$

Null at 25·3

Extra Resistance in the circuit = 3,000.

1)	15·5	The small explosive Coil	34
	18·2		31·2
	20·3		29·3
2)	15·3		34
	18·2	$\chi = 0796$	31·2
	20·3		29·3
3.	15·4		34
	18·2		31·2
	20·2		29·3

Current through the Coil = 3 amps

Resistance Extra = 300 Ω

47
22.5
245

1) 38 Null 25.3 18.1
28.7 23.4
26.2 X = .2517 24.6

2) 87.8 19
28.6 23.5
26.7 24.7

3) 38.2 18.7
28.7 23.3
26.7 24.6

Reversed

1) 13.5 X 31.8
21.8 27

X = .2727

2) 13.5 31.8
21.9 27
24.2 25.7

$$H' = \frac{40 \times 10 \times 104 \times 3635 \times 17.14 \times 1.88}{(1.2)^2 \times 931.5 \times 12.38 \times 11363}$$

$$= 4859$$

At make with the Explosive Cel.

Resistance in the circuit = 20,000 Ω

mean θ = 8.8 mean λ = .0218

Null 25.5

1) 16.5
17.2
18.3

35.5
33.0
32.3

Null 25.4
Reversed

1) 34.1
33.2
32.5

16.9
17.8
18.5

$$H = \frac{10 \times 8.8 \times 1.011 \times 20640 \times 14.86 \times (1.88)^2}{(1.8)^2 \times 1331 \times 4.2 \times 1.102}$$

Field = 4833 gauss.

At break

Resistance in the

Galv. limit = 20,000 Ω

Null point 25.0

1) 33.5 16.6
32.7 17.5
31.8 18.2

Null 24.9

2) 33.5 16.5
32.5 17.4
31.8 18.2

Null 25

33.3 16.5
32.2 17.4
31.5 18.1

Current reversed

Null 25.2

1.	16.3	33.4
	17.2	32.6
	18.0	31.9
2.	16.3	33.4
	17.3	32.6
	18.0	31.8

Mean θ = 8.64

Mean χ = .0226

Field = 4750 Gauss

22.3.30

Zero of halv. 25·0

With Field Coil Suddenly removed

Resistance in halv. Circuit = 3,000Ω

13·7	36·2
13·9	36·1
13·8	36·3
13·8	36·2

mean = 11·2

χ = ·078

17·2	31·4
19·5	29·4
21·5	28·1

Standard inductance

Zero of halv. 25·0.

Current 2·5 amps

Ex. resistance 200

12·6	37·3
12·7	37·3
12·6	37·2

mean = 11·3

18·2	28·1
23·4	25·7
24·6	

$(1+\chi/2) = 1·057$

2/

$$\text{Field} = \frac{\cancel{4\pi} \times 11{\cdot}2 \times 1{\cdot}039 \times 3635 \times 14{\cdot}28 \times (1{\cdot}88)^2}{(1{\cdot}2)^2 \times 831{\cdot}5 \times 12{\cdot}3 \times 1{\cdot}154}$$

Field = 5035 dynes.

Resistance in the Galv. circuit
= 200 Ω

Current = 1·5 amps. H = 8·57

Zero of Galv = 24

16·6
16·6
23·5

16·6
22·1

23·5

24
16·6
7·4

29·5
24·8

mean = 7·4
χ_2 = ·146

Resistance in same as before

Current 2 amps

$H = 11.42$

Zero of galv = 24

34
33·8

33·8
26·3
24·5

14·2
21·6
23·3

14·1
21·5
23·3

19
22·7

28·6
25·1

—
25·1

mean $\frac{x}{2}$ = 1·43

mean defl^{n} = 9·88

Ω 4,000

25 ~~Temp~~ Galv.

16·1
16
15·9
16·1
15·9
16

21·5 28
22·3 $\chi/2 = ·03$ 27
23·0 26·7

Defl. = 9

Ω 4,500

17·35
17·2
17·05
17·0
16·95
16·95
17·3
17·3
17·15
17·3

Mean = 17·155
defl. = 7·84

$\chi/2 = ·026$

~~17·45~~ 3·16

19·25 30·5
20·65 28·75
21·65 27·75

$$H = \frac{2 \times 7.84 \times 1026 \times 5135 \times 11.42 \times (1.88)^2 \times 20}{(1.2)^2 \times 831.5 \times 9.88 \times 1.153}$$

Field = 4890 lam

$$H = \frac{2 \times 7.84 \times 1.026 \times 5135 \times 857 \times (1.88)^2 \times 20}{(1.2) \times 831.5 \times 7.4 \times 1.1462}$$

Field = 4928 lam

$$H = \frac{2 \times 9 \times 1.03 \times 4635 \times 11.42 \times (1.88)^2 \times}{(1.2)^2 \times 831.5 \times 9.88 \times 1.153 \times}$$

Field = 5080

$$H = \frac{2 \times 9 \times 1.03 \times 4635 \times 8.57 \times (1.88)^2 \times}{(1.2)^2 \times 831.5 \times 7.4 \times 1.1462}$$

= 5120 lam

25.3.30

$KClO_3$

'b' an ~~vertical~~ horizontal.

With Field 20 oscs.	Without Field 20 oscs.
18.4 secs.	23.6 secs.
18.4	24.0
18.55	23.6
19.2 secs	23.6
19.0	23.8
19.0	23.6
18.8	23.6
18.9	23.8
19.0	
18.8	
19.2	
19.0	
19.0	
19.0	
19.0	

C = .03318

mean = 23.7

mean 19.0

T = .95 secs.

T = 1.185

Field = 5000

$\Delta\chi_m$ = 2.26

$KClO_3$

'b' axis vertical

15.4

With Field 20 osc.		Without Field 20 osc.
15.8 secs.		23.0
16.2	mass of the crystal	23.2
16.1		23.0
16.2	= .04 gm	23.0
16.2		22.8
16.2		23.0
16.2		23.0
16.2		
16.4		
mean = 16.2		mean = 23.0
T = .81		T = 1.105

$\Delta \chi_m = \underline{3.45}$

Steel ball

10 cc.

35·0

34·0

34·8

34·2

34·6

34·4

35·0

34·8

34·6

T = 3·46

C = ·03273

18th April.

Steel ball

20 ozs.

46·6 ozs.
46·6
46·6
46·8
46·6
47·0
46·8
47·0
46·4
47·0

20th April.

Steel ball

weight of the ball = ·437 gm

Radius of the ball = ·238 cms

For 10 oscs

C = ·08004

22·2 oscs
22·0
22·0
22·2
22·2
22·0
22·2
22·0

mean = 22·1 oscs

T = 2·21 oscs

Reject X

Mass of crystal = ·076 gm

Calcite

The crystal is suspended perpendicular to the optic axis.

The crystal is inclined at 42° to 45° perp. to the field.

Without Field

20 ozs.

14·6 Secs
14·8
14·6
14·4
14·6
14·8
14·8
14·8
14·6
14·8

Mean = 14·68 Secs

T = ·734 Secs

200 ozs. With Field

11·2 Secs
11·2
11·4
11·2
11·0
11·2
11·2
11·2

Mean = 11·2 Secs

T = ·56 sec

Talking Field = 5000 gauss

$\Delta\chi_m$ = ~~3.02~~ 2.97 $\times 10^{-6}$

Reject-

Wt. of the crystal = ·265 gm

21st April.

Calcite Crystal

Suspended as before: light came fibre, the inclination being 45° to the field.

20 secs.

With Field	Without Field
22·2 secs	41·0 secs
22·2 "	41·0
22·0	40·8
22·2	41·0
22·0	40·8
21·8	41·2
22·2	41·0
22·0	40·8
21·8	41·0
22·0	40·8

Taking the field as 5,000 gauss

$\Delta X_m = 2 \cdot 94 \times 10^{-6}$

mean = 22·04 secs

T = 1·102 sec

mean = 40·94 secs

T = 2·047 secs

22nd April Steelball (Another fibre)

for	20 osc.
	35·6 secs.
	35·4
	35·6
	35·6
	35·8
	35·6
	35·6
	35·8
	35·6
	35·6
mean =	35·6
T =	1·78

9th May.

For 10 osc.

40·8 secs.
41·0 "
41·0
40·6
41·0
40·8
40·8
41·0
40·8
41·2

40

Calcte wt. of the crystal
·503 gm

9th May '30.

For 10 osc.		For 20 osc.
Without Field		with Field
1 min	5·2 secs.	28·8 secs.
	5·6	27·6
	5·4	27·6
	5·8	28·4
	5·6	28·2
	5·6	27·6
	5·4	27·8
	5·4	27·6
	5·6	27·6
	5·6	27·6

c = ·02343

log c = $\bar{2}$·3697

mean = 1 min, 5·52 secs.

T = 6·552 sec.

mean = 27·74

T = 1·387 sec

14·85, 31·8, 20·1, 30·05, 21·6, 28·85,
22·7, 27·9, 23·5,

$\Delta \chi_m = 3{\cdot}89 \times 10^{-6}$

Calibration of mi Field

1) magnetic field.

Extra resist = 3430 Ω

current = 15.1 amp. const.

Zero. Reading after throw.

1)	25.1	14.85	$\frac{\lambda}{2} = .0315$
2)	25.1	.8	
3)	.2	.8	
4)	.1	.75	
5)	.1	.8.	
mean	= 25.1	14.8.	
		throw = 10.3	

Solenoidal field. Current kept const at 2.20 amp.

Extra resist = 200 Ω H for 2.2 = 12.57

Zero. Reading after throw.

1.	25.2	14.5	$\frac{\lambda}{2} = .1382$
2.	25.2	14.4	
3.	25.2	14.4	
4	.2	14.4	
5	.2	14.4	
mean	25.2	14.4	throw = 10.8

X

Wt. of the Crystal
= ·133 gm

11th may '30

Aragonite

Suspended along the length of the crystal
ie ~~along~~ "c" axis vertical

For 10 oscs. Without field		For 10 oscs. With field
19·8 Secs.	T for bar = 4·09 secs.	18·2
19·8	C = ·02349	18·0
19·4		18·0
19·8	log c = $\bar{2}$·3697	17·8
19·8		18·4
19·4		18·0
19·6		18·2
19·6	$\Delta\chi_m = ·12 \times 10^{-6}$	18·0
19·4		18·4
19·6		18·0
		mean = 18·1 Secs
T = 1·962		T = 1·81 secs.

Suspended with the "c" axis vertical

→ "b" axis set ⊥r to field (?)
i.e. χ_b is numerically greater than χ_a

12th May:

Aragonite

fibre along the "b" axis (i.e. b axis vertical)

Perpendicular to the face which sets

par along the field

The crystal sets perp to the Field

20 Secs With Field	10 Secs Without Field
23·0 Secs.	27·0
23·2	27·0
23·0	27·0 Secs.
22·8	26·8
23·2	27·0
22·8	27·2
23·0	27·2
23·0	27·0
	27·0
	27·2
	27·0
	27·0

$\log c = \bar{2}\cdot3697$

mean = 23·0 Secs.

T = 1·15 Sec.

mean = 27·03 Sec.

T = 2·703 Secs

$\Delta \chi_m = \cancel{3\cdot936 \times 10^{-6}}$

$3\cdot11 \times 10^{-6}$

Aragonite

"a" axis vertical

⊥ to the previous direction.

10 ccs.
Without Field

26·4
26·2
26·4
26·2
26·2
26·6
26·4
26·4
26·4
26·4

mean = 26·36 secs.
T = 2·636 secs

20 ccs.
With Field

22·4
22·4
22·4
22·4
22·2
22·2
22·2
22·2
22·2
22·4

mean = 22·3 secs
T = 1·115 secs

$\Delta \chi_m = 3{\cdot}17 \times 10^{-6}$

13th. May. '30

Potassium Nitrate

Suspended perpendicular to C axis & along the length

Without Field	With Field
10 oscs	10 oscs
~~38~~ 33·8 Secs	29·4 Secs
33·4	29·4
33·8	29·4
33·4	29·0
33·6	29·2
33·8	29·0
33·8	29·2
33·6	29·4
33·6	29·2
33·8	
mean = 33·66 Secs	mean = 29·2 Secs
T = 3·366 secs	T = 2·92 "

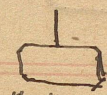
39
14
48
101

2·12

Wt. of the Crystal = ·18 gm

13th May.

Pot. Nitrate



Suspended ~~⊥ to 'a' axis~~ with "a" axis vertical

100 secs. Without Field	20 secs. With Field
42·0 secs.	26·2 ~~secs.~~
42·2	26·4
41·8	26·2
42·0	26·2
42·2	26·2
42·2	26·4
42·2	26·4
42·4	26·4
42·0	26·4
42·2	26·4
	26·4
	26·2

$\Delta \chi_m = 4{\cdot}796 \times 10^{-6}$

mean = 42·12 secs.

T = 4·212 secs

mean = 26·31

T = 1·315

"b" axis sets along the field and "c" ⊥r to it

ie χ_c is numerically greater than χ_b.

$\chi_c - \chi_b =$



18th May

KNO_3

Suspended ~~⊥ to 'c' axis~~ along the length a ie vertical.

Without Field 10 oscs	With Field 10 oscs
33·4 sec	29·2 sec
33·2	29·4
33·4	29·0
33·6	29·4
33·4	29·0
33·6	29·0
33·6	29·0
33·4	28·8
33·6	29·0
33·4	29·4
	29·0

$\cdot 164 \times 10^{-6}$

Mean = 33·46 sec

T = 3·346 sec

T = 2·912 sec

Suspended with "c" axis vertical "b" sets along field & "c" ⊥r to it

∴ χ_a numerically greater than χ_b

$$\chi_b - \chi_a = \cdot 16 \times 10^{-6}$$

more reliable since it is difficult to suspend the plate with its plane horizontal



17th May. KNO_3

along 'b' axis i.e. keep the flat surface is vertical — "c" axis set ⊥r to the field.

10 cms. Without Field		20 cms. Without Field	
51·2		33·2	
50·8		33·4	
51·0		33·2	
51·4		33·4	
51·2		33·2	
51·6	$\Delta\chi_m = 4{\cdot}4 \times 10^{-6}$	32·8	
51·2		32·8	
51·4		33·2	
51·2		33·4	
51·6		33·2	
mean = 51·26		mean = 33·2	
T = 5·126		T = 1·166	

~~"b" ax is vertical~~

χ_c numerically greater than χ_a

$\chi_c - \chi_a =$

Wt: of the crystal = ·381 gm

13th May.

Strontianite $SrCO_3$

Along the length of the crystal i.e. 'c' axis vertical

Without Field	With Field
10 secs.	10 secs.
41·8 secs	26·0 secs
42·0	26·6
41·8	26·0
41·6	26·6
42·0	26·2
42·0	26·4
41·8	26·0
41·8	26·0
42·2	26·2
41·6	26·2
mean = 41·86 secs	mean = 26·16
T = 4·186 secs.	T = 2·616

$\Delta\chi_m = \cdot 55 \times 10^{-6}$

14th may

$SrCO_3$

Without Field 10 osc.		With Field 10 osc.
1 min	18·4 secs	22·8
	18·0 "	23·2
	18·4 "	23·0
	19·0	23·0
	18·6	22·8
	18·4	22·8
	18·6	23·0
	18·4	23·2
	18·4	
	18·8	

$\Delta X_m = \cancel{3{\cdot}79 \times 10^{-6}}$ ...

$3{\cdot}79 \times 10^{-6}$

Mean = 1 min 18·6 secs

T = 7·85 secs.

Mean = 23·0 secs

T = 2·3 secs

The long side of the crystal sets perp. to the field

H_4Cl

$SrCO_3$

10 osc. Without Field		10 osc. With Field
1 min 13·8 sec		22·4 sec
14·0 "		22·4
14·0 "		22·0
14·2 "		22·0
14·4		22·0
14·4		22·2
14·2		22·0
14·4		22·0
14·0		22·0
14·4		22·0
1 min 14·18 sec.		mean = 2×2·1 sec
T = 7·418 secs		T = 2·21 sec

~~The long side~~ The long side of the crystal sets perp. to the field.

$\Delta X_m = 3·65 \times 10^{-6}$

15th may '6' axis vertical

$KClO_3$ wt. of the crystal = ·03 gm

Without Field
5 osc.

28·8
28·2
28·0
28·6
28·2

mean = 28·4 sec
T = 5·68 sec.

$\log e = 3·3533$

With Field
20 osc.

23·4
23·2
23·2
23·0
23·2

mean = 23·2
T = 1·16 sec

$\Delta X_m = 8·30 \times 10^{-6}$

14th.

wt. of the $KClO_3$ crystal = .021gm

M = 122·6 $KClO_3$

'a' axis vertical.

10 secs.

With Field

7·8 secs.
7·8
7·8
7·8
7·8

$\log C = \bar{2}\cdot3699$

10 secs.

With Field

9·4
9·4
9·4
9·4
9·4

T = ·78

T = ·94

$\Delta\chi_m = 2\cdot42_5 \times 10^{-6}$.

15th.

Steel ball

5 secs.

1 min 6·2
6·0
6·4
5·4
5·8
6·2

Mean 1 min 5·9 secs.

T = 13·18

C = ·002256

$\log C = \bar{3}\cdot3537$.

mass of the crystal = ·3775 gms

18th

$SrSO_4$ M = 183·6

'b' sets along the field

'c' axis vertical.

'a' sets ⊥ to the field

With Field		Without Field	
100 secs.		5 secs	
44·0 secs		2 min	18·8 secs
44·0			19·8
43·8			19·2
44·2	$\log C = \bar{3}\cdot 3533$		19·6
43·8			18·2
44·0	$\log C = \bar{3}\cdot 3533$		17·8
44·0			18·4
44·0			21·2
			18·2
			19·8
mean = 44·0 secs		mean = 2m 19·1 secs	
T = 4·4 secs		T = 27·82 secs	

χ_a numerically greater than χ_b

$\chi_b - \chi_a = \Delta\chi_m = 11677 \times 10^{-6}$

1.68×10^{-6} per gm molec.

19th May

$SrSO_4$

Suspended "a" axis vertical

"b" axis along in field

c " ⊥ to in field

With Field

10 osc.

43·8
45·2
43·8
44·4
44·8

mean = 44·44

T = 4·44

$\log c = \bar{3}\cdot3533$

$\Delta\chi_m = \cdot73_3 \times 10^{-6}$

Without Field

5 osc.

1 min 34·8
35·4
34·0
33·8
34·0
34·6

mean = 1 min 34·43

T = 18·88

χ_c numerically greater than χ_b

$\chi_b - \chi_c = \cdot73 \times 10^{-6}$ per gm molec.

19th May '30

$SrSO_4$

Suspended 'b' axis vertical. 'a' sets ⊥ to field; 'c' axis sets ∥ to field

With Field		Without Field
10 secs		5 secs
58·2 secs	2 min	18·8 secs
57·2		18·2
56·0		18·8
55·8		18·4
56·4		
56·2		

mean = $56·6_3$ secs — mean = 2 min $18·55_5$ secs

$T = 5·66_3$ — $T = 27·7_1$ secs

$$\Delta\chi_m = ·9877 \times 10^{-6}$$

χ_a is numerically greater than χ_c

~~$\chi_a - \chi_c = ·99 \times 10^{-6}$~~

$$\chi_c - \chi_a = ·99 \times 10^{-6}$$

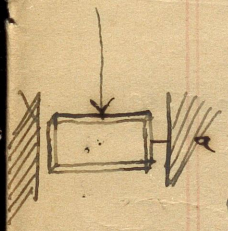
21st may. Ball

100 secs
44·6
44·2
44·4

T = 4·44

c = ·01991

$\log c = \bar{2}\cdot 2991$



Anhydrite

mass of crystal = ·2045

with field	without field
500 secs	10 secs
15·8 secs	48·0 secs
16·0	48·0
16·2	48·0
16·0	
16·2	
16·8	

mean = 16·0 secs

T = 1·6 secs.

mean = 48·0

T = 4·8 secs.

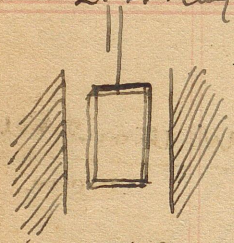
$\Delta\chi_m = ·6492 \times 10^{-6}$

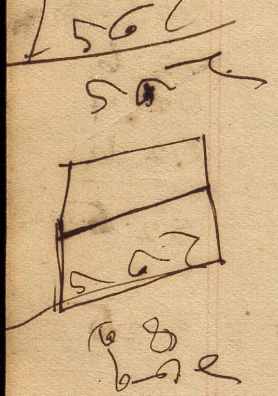
$= ·65 \times 10^{-6}$.

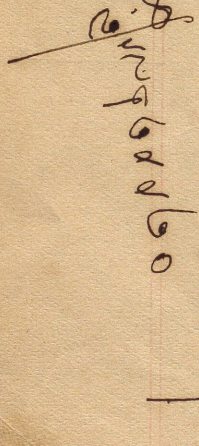
3·2

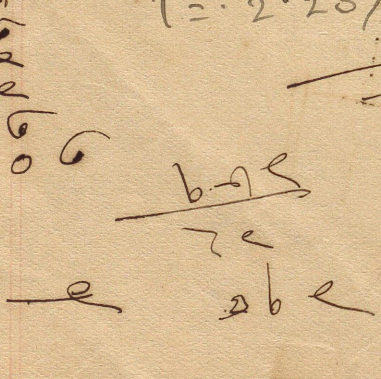
21st May '30

Anhydrite





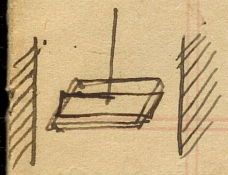




With Field	Without Field
10 oz	10 oz
22.6 sec	27.8
22.2	27.6
22.4	27.6
22.2	28.0
22.4	27.6
22.4	27.4
mean = 22.37 sec	mean = 27.66
T = 2.237 sec	T = 2.766

$\Delta\chi_m = \cdot 2691 \times 10^{-6}$

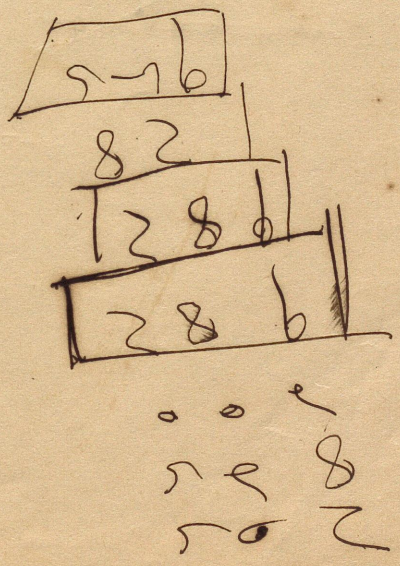
$= \cdot 27 \times 10^{-6}$



21st May '30

Anhydrite

With field		Without field
10 oscs		10 oscs
39·4 oscs		52·4 oscs
39·6		52·6
39·4	$\Delta\chi_m = 3980 \times 10^{-6}$	52·4
39·6	$= \cdot 40 \times 10^{-6}$	52·6
mean = 39·5 oscs		mean = 52·5 oscs
T = 3·95 oscs		T = 5·25



22nd May '30

Barite BaSO4

Mass of the crystal = '5019 gm.

M = 233·4

100 cc

Ball

42·6
42·4
42·6
42·6

mean = 42·55.

T = 4'255

log C = $\bar{2}$·3353

Without Field

1 min 2·2 oscs.
2·2
2·2

T = 6·22 oscs.

$4\chi_m = 1{\cdot}19 \times 10^{-6}$

Without Field

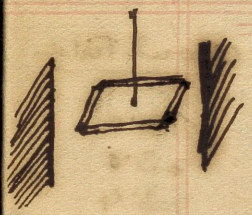
31·2 oscs.
31·0
31·0
31·2

T = 3·11 oscs.

Suspended 'c' axis vertical, the crystal sets at 46½ or 47° parpendicular to the normal to the field i.e. inclined to 43° or 44° to the field



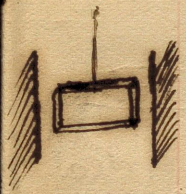
Anhydrite



mass of the crystal = ·632 gm

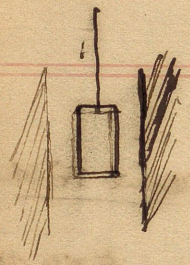
With Field	10 osc.	Without Field
1 min 7·6 secs		1 min 53·0 secs
6·8		53·0
7·0		52·6
		53·8
mean = 67·1 secs.		mean = 1 min 53·1 secs.
T = 6·71 secs.		T = 11·31 secs.

$$\Delta\chi_m = ·3362 \times 10^{-6}$$
$$= ·34 \times 10^{-6}$$



With Field	10 osc.	Without Field
51·8 secs.		1 min 41·4 secs.
51·4		41·8
51·6		41·8
51·8		41·8
mean = 5·165 secs.		1 min 41·7 secs.
T = $5·16_5$ secs.		T = 10·17

$$\Delta\chi_m = ·53 \times 10^{-6}$$



Anhydrite

With Field	Without Field
10 oscs	10 oscs
21·8 secs	23·2
21·8	23·0
21·8	23·4
22·0	23·2
21·6	23·2
21·8	23·0
21·8	23·4
21·8	23·2
T = 2·18 secs	T = 2·32

$\Delta\chi_m = \cdot 223 \times 10^{-6}$

Barite $BaSO_4$

11th July

Crystal suspended with 'c' axis vertical

With Field	10 oscs	Without Field
30·2 secs	M = 233·4	61·8 secs
30·2	m = ·5019	62·0
30·4	log c = $\bar{2}$·3553	62·0
29·8	$\Delta\chi_m = 1{\cdot}32 \times 10^{-6}$	62·0
30·2		T = 6·19 secs
T = 3·01 secs		

11th July 30

Barite $BaSO_4$.

Perpendicular with plane which sets along the field.

Without Field 10 secs		With Field 10 secs
~~67 secs~~	$M = 233.4$	
60.0 secs	$m = .5019$	37.8
59.4		37.6
60.0	$\log C = \bar{2}.3553$	37.6
60.0		37.8
60.0	$\Delta\chi_m = +630 \times 10^{-6}$	38.0
59.6		37.6
$T = 5.98$ secs.		$T' = 3.77$ secs.

12th July '30.

$BaSO_4$

Without Field	10 cc	With Field
63·2 sec		39·6 sec
63·4		38·4
63·6	$\log c = \bar{2}\cdot 3701$	38·4
63·4		39·2
63·6		39·0
		38·4
T = 6·314 sec		T = 3·87 sec

$$\Delta \chi_m = \cdot 7194 \times 10^{-6}$$
$$= \cdot 72 \times 10^{-6}$$

12th July '30

$KClO_3$

Weight of the crystal = ·118 gm

'b' axes vertical, 'a' axes horizontal

Without Field	10 ocs.	With Field
44·0 cgs		22·2 cgs
44·0		22·2
44·2		22·0
43·8		22·2
		22·2
		22·2

$\Delta\chi_m = 2{\cdot}8 \times 10^{-6}$

T = 4·4 cgs

T′ = 2·22 cgs

Inclined at an angle 24° with normal to the field.

12th July '30. $KClO_3$

'a' axis vertical.

Wt. of the crystal = ·118 gm.

Without Field	10 ocs	With Field
34·6 ocs		17·0 ocs
34·2		17·0
34·4		17·2
34·0		17·0
34·8		17·2
T = 3·44 ocs		T' = 1·71 ocs

Inclined at an angle 27°·5

to the normal to the Field.

13th July '30.

Anhydrite - $CaSO_4$



Weight of the crystal = ·203 gm

The plane of the crystal set parallel to the field

With Field	With Field
18·8 sec	22·6 sec
19·0	22·2
18·8	22·6
18·4	22·2
18·0	22·0
18·8	22·8

T = 1·86 sec

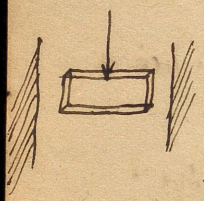
T = 2·23 sec

$\Delta\chi_m = \cdot 28 \times 10^{-6}$

13th July. '30

Anhydrite

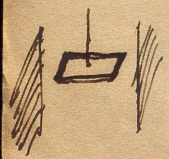
2) The plane of the crystal cels parallel to the field



Without Field	10 ozs	With Field
65.4		47.0
65.8		47.0
65.2		46.6
65.4		46.8
65.2		47.0
T = 65.4 secs		T = 4.69 secs

$\Delta\chi_m = .58 \times 10^{-6}$

3) The long side of the crystal cels ∥ to the field



Without Field	10 ozs	With Field
66.4 secs	wgt = 2.3793	56.0 secs
66.4		55.4
66.4	$\Delta\chi_m = .28 \times 10^{-6}$	55.4.
T = 6.64 secs		T' = 5.55 secs

15th July. '30

Quartz. - SiO_2

M = 60·0 axis sets ⊥r to field.

Wt. of the crystal = ·5425gm

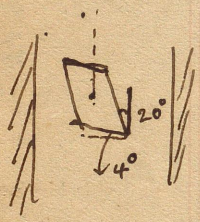
log c = $\bar{1}$·0373.

With Field	10 000	Without Field
~~Zero~~		
35·0 deg.		37·8
35·0		38·0
35·0		37·8
35·0		38·0
35·2		38·0
T' = 3·5 deg		T = 8·79

$\Delta\chi_m$ = ·084 × 10^{-6}

Reject

$CaSO_4, 2H_2O$ - Gypsum - (Celestite)

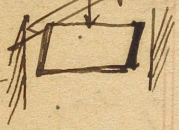


Without Field		With Field
44·8		38·2
44·4		37·8
44·0		38·0
44·6		37·8
44·2		37·8
T = 4·44		T = 3·79

$\log C = \bar{1}.0373$

$\cdot 692 \times 10^{-6}$

Reject



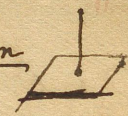
Gypsum

The plane of the crystal sets ⊥ to the field

With Field	10 deg	Without F.
31·4 deg		35·6
31·2		35·2
30·6		35·6
31·2		35·6
30·8		35·4
T = 3·1 deg		T = 3·55 deg

$\cdot 58 \times 10^{-6}$

·6665

Wt. of the Crystal = ·625 gm 

17th July '30 Gypsum $CaSO_4, 2H_2O$, (Selenite)

Suspended perp. to the plane of the Crystal, 'b' axis vertical.

Without	With Field
10	42·0 secs
53·2 secs	42·4
53·4	41·8
53·4	41·6
53·4	41·6
T = 5·34 secs	41·9 secs
	T = 4·19 secs

$\therefore \log C = T \cdot 0373$.

$\Delta\chi_m = \cdot 73_3 \times 10^{-6}$

17th July. ~~Without~~

Suspended with 'c' axis horizontal the plane of the Crystal sets ⊥ to the field.

With Field	10 secs	Without F.
35·4		40·8
35·2		41·0
35·0		40·8
34·6		40·8
35·2		40·6
T = 3·52$_4$ secs,		T = 4·08

$\Delta\chi_m = \cdot 40 \times 10^{-6}$

17th July. 1934

Suspended 'C' axis vertical

Plane grain crystal cell ⊥ to the field

With Field	10 secs	Without Field
33·0 secs		37·8 secs
33·0		38·4
33·4		38·0
33·0		37·6
33·0		37·6
32·8		37·6
T = 3·30 secs		37·8
		T = 3·78 secs

$\Delta \chi_m = 36_7 \times 10^{-6}$

kc ·0261 gm

St. ball.

5000

57·4

57·6

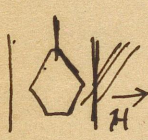
T=11·5

34·4

15.8.30

Napthalene

wt = ·0385 gm.



'b' axis of the crystal horizontal, 'a' vertical in the field the plane of the crystal sets parallel.

With Field	Without Field
10 osc.	5 osc.
4·6 sec.	33·2
5 sec.	33·6
5 sec.	33·4
5 sec.	33·0
4·8 "	33·0
4·8 "	
5·0 "	33·2
5·0	

T = ·49 sec.

T' = 6·64

23
12
38

Napthalene

'b' axis vertical,

A.I.T.S.

6

50 Kg
without Field

34.6
35.0
34.8
34.6
35.0

15

½

8

8.561.428
80
56
40
16

20

10 Kg Steelball

29.2
28.8
28.8
29.2

T = 2.9

log c = 2.6683

Naphthalene

fibre and glass plate - new.

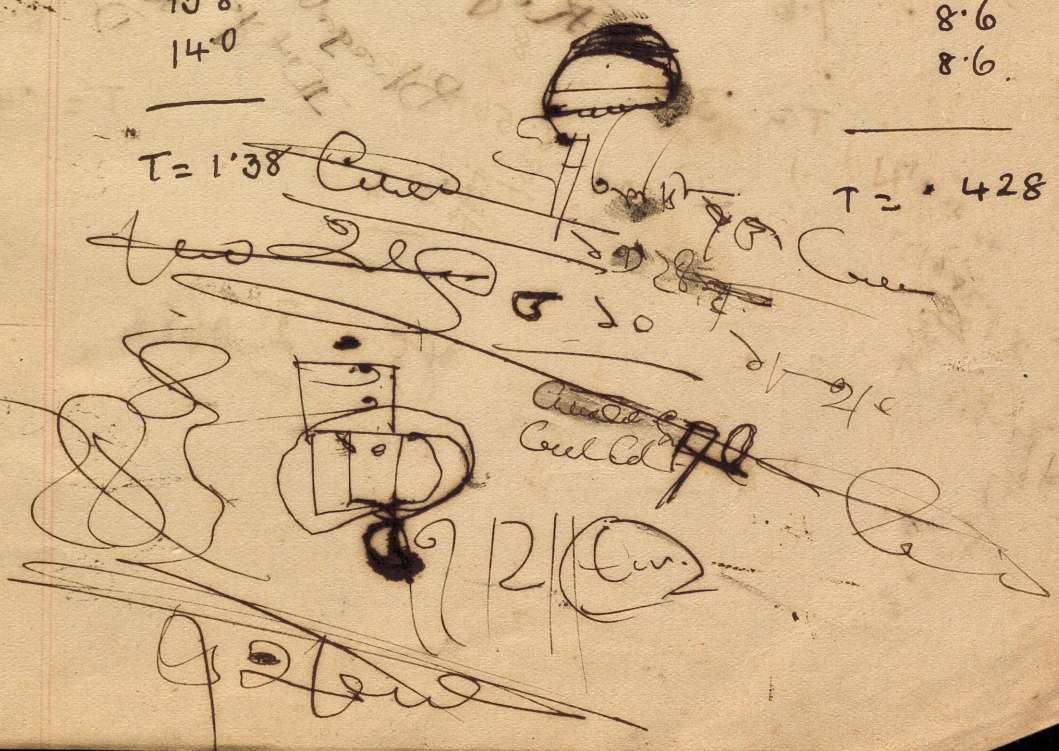
15th Aug.

Naphthalene

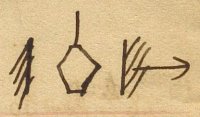
Wt. of the crystal = ·0385 gm.

Suspended with 'b' axis vertical the plane of the crystal is inclined at an angle 24° to the normal of the field.

Without Field	10 ocs	20 ocs	With Field
13·6 ocs.			8·2 ocs
13·8			8·6
13·8			8·8
14·0			8·6
			8·6
T = 1·38			T = ·428.



Wt. of the



18th Aug 30.

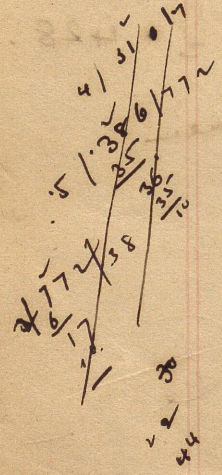
Naphthalene

The crystal suspended with 'b' axis horizontal 'a' axis vertical. Plane of the crystal set ⊥r to the field.

With Field		Without Field	
20 obs.		20 obs.	
7·8 obs.	Rejected	8·4	Bhagabati Charan Saha
7·6 "		8·6	IInd year M.Sc. Student
7·6 "		8·6	Research Department
8·0		8·4	Dacca University
7·6	Rejected	8·44	
T = ·38₆		T = ·42₂	

$-\Delta\chi_m = 6{\cdot}5 \times 10^{-6}$.

$\chi_{gc} = \bar{2}{\cdot}6683$.



Crystal = ·007 gm

18th Aug 30.

Napthalene

The crystal suspended with 'b' axis vertical 'a' horizontal. Inclined at 17° to the normal to the F

without	with Field
20 secs	20 secs
9·8 secs	6·8
9·6	7·2
9·6	7·2
9·6	7·0
9·8	7·2
	7·0
$T = \cdot 48_4$	$T' = \cdot 35_3$

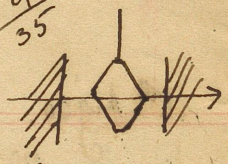
Reject

Reject

$29{\cdot}3 \times 10^{-6}$

Wt. = ·0815gm

26/9/35



Potassium chlorate

Crystal suspended with "a" axis vertical.

'b' sets ~~at an angle~~ along the field. ~~to the normal to the field~~.

Rejected

With field	10 secs	Without field
5·6 ~~sec~~		15·2
5·6		15·0
5·6		14·8
5·6		15·0
		15·0

$\log c = \bar{2}\cdot 6927$

T = ·56 sec

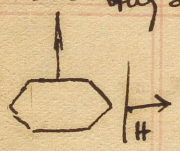
T = 1·50 sec

6

Wt. of the crystal = ·0578 gm

$KClO_3$ M = 122·6

18th Aug '30



Crystal suspended with the "b" axis vertical

Inclined at an angle 35° to 36° to the ~~vert~~ normal

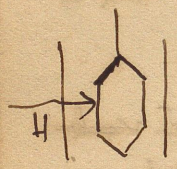
With Field	100 cc	Without Field
12·0 cc		14·8 cc
12·0		14·6
11·6		15·2
12·2		15·2
12·0		14·8
12·0		14·6
T = 1·2$_0$ cc		T' = 1·48$_7$ cc

$\log c = \bar{2}·7175$

$\Delta\chi_m = 2·35 \times 10^{-6}$ per gm. mole

18th Aug. 1930.

$KClO_3$



Suspended with "a" vertical
The crystal set in the field

without field	1000 G	with F
11.6 deg		9.8 deg
12.0		9.6
12.0		9.6
11.8	$\log c = 2.7175$	9.4
11.8		9.4
11.8		9.6

T = 11.8 deg T = 9.57 deg

$= 2.356 \times 10^{-6}$

17th

$KClO_3$

Suspended perpendicular to the plane of the crystal, 'a' axis is inclined at 33° to 34° to the field.

10 secs

With Field	Without Field.
13·4 sec	18·8 sec
13·4	18·8
13·4	18·6
13·4	18·4
	18·4

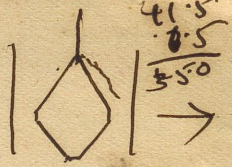
$\log c = \bar{2}\cdot7175$

T = 1·34 sec

T' = 1·86 sec

$4{\cdot}02 \times 10^{-6}$

Wt. of the crystal = 0815 gm



19th Aug '30.

$KClO_3$

Suspended with 'b' axis vertical.
Inclined at an angle 35° to the field.

Without F.	With F
15·0 sec	10·2 sec
15·2	10·6
15·0	10·6
15·0	10·2
15·4	10·6
15·1 sec	$10·04_4$ sec
T = 1·51 sec	T = $1·04_4$ sec.

$\log c = 2·7175$

$\Delta\chi_M = 3·3 \times 10^{-6}$ per gm. molec.

19th Aug'30.

$KClO_3$

'a' axis vertical, the plane of the crystal set ⊥r. to the field.

With Field		100 cc.
13·2		18·2
13·0		17·8
13·2		18·2
13·0	$\log c = \bar{2}\cdot 7175$	18·0
13·2		17·8
13·2		
$T = 1\cdot 31_3$		$T' = 1\cdot 80$

$\Delta\chi_m = 2\cdot 7 \times 10^{-6}$ per gm. molec.

13·4		17·6
13·8	2	17·6
13·4		17·4
13·4	$\log c = \bar{2}\cdot 7303$	17·6
13·6		17·2
13·62		17·48
$T = 1\cdot 35_2$	$\Delta\chi_m = 2\cdot 126 \times 10^{-6}$.	$T' = 1\cdot 748$

19th Aug '30. $KClO_3$

Plane of the crystal horizontal, 'b' sets ⊥r. to the field.

With F	Without F
18·6	23·0
~~18·4~~	23·8
18·8	23·4
19·0	23·2
18·6	23·4
19·0	
18·4	

$\log c = \bar{2}\cdot 7175$

$T = 1\cdot 87_3$

$T' = 2\cdot 32$

$1\cdot 64 \times 10^{-6}$

19th Aug'30 Another crystal $KClO_3$ Wt. of this Crystal = .052 gms

Suspended with 'b' axis vertical

sets at an angle 36°37' to the normal.

Without F.	10 osc	With F
15·0	← →	11·2
15·0		11·4
15·4		11·4
14·6		11·6
15·0		11·2
15·4		
15·06		11·36
$T' = 1·50_6$		$T = 1·136$

$\log c = \bar{2}·7175$

$3·65_1 \times 10^7$

19th Aug. '30.

$KClO_3$

suspended with 'a' axis vertical.
'b' and the plane of the crystal set ⊥r. to the field

With Field	10 oscs	Without F
14.6 Secs		17.4 Secs
14.6 "		17.8
14.6		17.4
14.4		17.4
14.6		17.6
14.56 Secs	$\log c = \bar{2}.7303$	17.52 Secs
$T = 1.45_6$ "		$T' = 1.75_2$ Secs

$$\frac{2.22 \times 10^{-6}}{2.22 \times 10^{-6}}$$

20th Aug 30.

$KClO_3$

suspended plane of the crystal horizontal, 'b' sets ⊥r. to the field.

with F	100 sec	without F
20.0 sec		23.0 sec
19.6		23.4
20.0		23.0
20.2		23.0
19.8		23.0
		23.08 sec
19.92 sec		2.30 sec
1.99_2 sec		

$\log c = \bar{2}.7303$

1.697×10^{-6}

1.70×10^{-6}

21st Aug '30. A new Crystal – $KClO_3$ wt. of the crystal = ·039 g.

suspended with 'a' axis of the crystal vertical, 'b' axis and the plane of the crystal set ⊥r. to the field.

With Field		Without F
10 osc.		5 osc.
19·4 sec		24.4 sec
19·0		24·2
19·0		24·2
19·2		24·6
19·2		24·2
18·6		24·4
19·0		24·2
19·05 sec		24·3 sec
T = 1·90 sec		4·86 sec

$\log c = \bar{2}.1825$

$\bar{3}.5267$

$\Delta \chi_m = 2.28_3 \times 10^6$

$KClO_3$

Suspend with b axis of the crystal vertical the plane of the crystal sets at 35° to the normal.

With F	Without F
10 secs	500 secs
16.2 degs	20.8 degs
15.8	21.0
15.6	21.2
15.8	21.2
15.6	21.4
15.8 degs	mean 21.1/2 degs
1.58 degs	T' = 4'22/4 degs

2.6×10^{-6}

26th Aug '30

Quartz

Wt. of the crystal = 2·6524 gm

M = 60 .

Suspended with optic axis horizontal, the plane (axis) of the crystal sets ⊥r to this field.

With Field	5 osc	Without Field
34·8 Sec		42·6 Sec
34·4		42·2
34·4		42·4
34·8		42·8
34·4		42·6
34·56 Sec		42·52 Sec

$\log c = \bar{1}\cdot4377$

$T = 6\cdot91_2$ Sec $\quad \cdot1220 \times 10^{-6}$

$\cdot12 \times 10^{-6}$

$T' = 8\cdot504$ Sec

26th Aug. '30.

Quartz

Wt. of the crystal = 1·402 gm

M = 60

Suspended with optic axis horizontal, axis sets ⊥r. to the field.

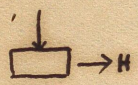
With Field	5 secs	Without Field
24·4 secs		27·4 secs
24·2		27·2
24·6		27·6
24·0		27·8
24·6		27·6
24·8		
24·46 secs		27·52 secs
T = 4·89$_2$ secs		T' = 5·50$_4$ secs

log c = $\bar{1}$·4493.

$\Delta\chi_m$ = ·125$_6$ × 10^{-6}.

26th Aug 30.

Anhydrite (Castor)



sets 11e. 10th field.

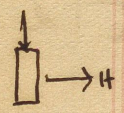
Field	10 secs	No Field
25.2 secs		29.0 secs
25.6		28.6
25.6		28.8
25.4		28.6
25.4		28.4
25.44 secs		28.68 secs
T = 2.544 secs		T = 2.868 secs

$\log c = T \cdot 4493$

$\Delta \chi_m = .63_6 \times 10^{-6}$ per gm molecule

26th Aug.

Anhydrite

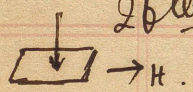


sets ||le to the field.

Field	10 Osc	No Field
18.6 sec		19.6 sec
18.2		19.4
18.4		19.4
18.6	$\log C = \bar{1}.4493$	19.4
18.4		19.6
18.6		
18.47 sec		19.52 sec
$T = 1.847$ sec		$T = 1.952$ sec

$\Delta \chi_m = .28 \times 10^{-6}$ per gm molecule

26th Aug '30. **anhydrite**



long side sets along the field

Field	1000 sec	no field
30.2 sec		32.0 sec
30.0		31.8
30.0	$\log c = \bar{1}.4493$	32.0
29.8		31.8
30.0 sec		31.9 sec
3.0 sec		3.19 sec

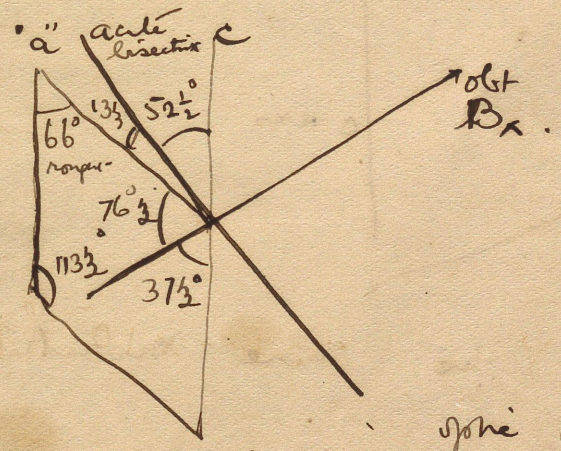
$\Delta \chi_m = .313 \times 10^{-6}$ per gm molecule

Gypsum

Crystal ~~sets~~ suspended into "b" axis vertical ie. plane of the crystal horizontal.

~~"c" axis sets along the field.~~

["a" & "c" axes in the plane of the crystal can be readily identified by putting under X^ed nicols.



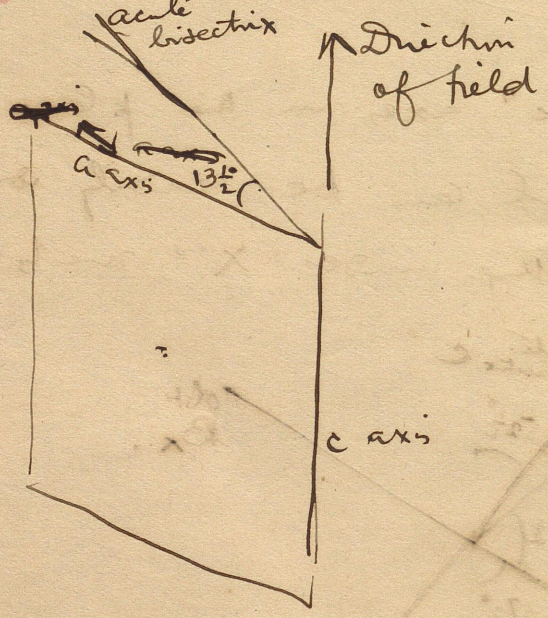
One of the principal optic axes of extinction in the plane lies very close to the "a" axis (in fact inclined at 13½°)

$Bx_a \wedge a = 13\frac{1}{2}^\circ$ $Bx_a \wedge c = 52\frac{1}{2}^\circ$

$Bx_0 \wedge c = 76\frac{1}{2}^\circ$ $Bx_0 \wedge c = 37\frac{1}{2}^\circ$

∴ the thin L^bs are much larger.

"c" sets along the field as shown



using the same notation as before

25th Aug '30. ~~Anhydrite~~ Gypsum $CaSO_4 . 2H_2O$

Plane of the crystal horizontal, 'C' sets along the field.

Wt. of the crystal = ·1195 gm.

10 osc. With Field	50 osc. with F.
37·6	39·8
36·4	39·8
37·4	39·4
37·4	40·0
37·4	
37·4	
38·0	
T = 3·74	T′ = 7·95

$\log C = \bar{3}\cdot7435$

$\Delta x_m = 1\cdot1 \times 10^{-6}$ per gm. molecule

Gypsum

Plane of the crystal horizontal, c cels along the field,

Wt. = ·1195 gm.

without	10 osc	Field
23·8 sec		20·8 sec
23·4		20·8
23·4	$\log c = \bar{2}\cdot7807$	20·8
23·2		20·4
23·4		20·4
23·44 sec		20·64 sec
T = 2·344 sec		T = 2·064 sec

$\Delta x_m = 1{\cdot}21 \times 10^{-6}$ per gm. molec.

28th Aug '30

Same Crystal. Gypsum wt -- ·1195

Suspended 'C' axis horizontal, 'b' axis and the plane of the crystal set along the field.

Field	10 ~~cc~~	No field
23·8 Sec		29·0 Sec
24·0		28·6
23·8		28·8
23·6	$\log C = \bar{2}\cdot3823$	28·6
24·2		28·4
24·0		29·2
24·0		29·0
23·9, Sec		28·8 Sec

T = 2·39, Sec

T' = 2·88 Sec

$\Delta X_m = \cdot614 \times 10^{-6}$ per gm. molecule

28th Aug '30

Gypsum

'C' axis vertical,
the plane of the crystal set ⊥r to the field, 'b' axis set along the field.

With Field	Without F
21·2	23·2
20·8	23·4
21·0	22·8
21·2	23·0
21·2	23·2
21·0	22·8
21·06	23·06
2·106	2·306

$\chi_{gyp} = \bar{2}\cdot 3823$

$\Delta\chi_m = 27_1 \times 10^{-6}$

28th Aug 30

Gypsum

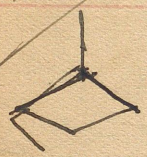
The crystal was suspended with its 'b' axis vertical & plane of the crystal horizontal. The crystal was slightly broken near one edge, and the new [illegible] = 1165 μm. 'c' axis of the crystal sets along the field.

Field	No Field
10 secs	10 secs
27.2 secs	34.8
27.4	35.2
27.4	35.0
27.33	35.0 secs
T = 2.733 secs	T = 3.5 secs

The couple of the couple is the same as before

$\Delta\chi_m = .896 \times 10^6$ per gm. mole

21st Sept



Azobenzene

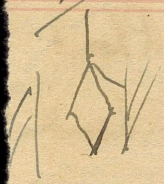
Mass of the crystal = ·0248 fm.

sets along field

Field	1000 cs	No field
7·0		29·2
6·6		29·4
6·8		29·6
6·8		29·2
7·0		29·2
6·8		29·4
7·0		29·6
6·6		29·6
7·0		29·4
7·0		29·4
6·8		
6·8		
T = ·685		T' = 2·94

$38{\cdot}02 \times 10^{-6}$

22nd Sept



Azobenzene

sets along the field

Field 200 sec	Without Field 100 sec
7·4	15·2
7·6	15·0
7·6	15·2
7·6	15·0
7·4	15·6
7·2	15·4
7·2	15·8
7·4	15·2
7·4	15·2
7·4	
7·42	15·29
T = ·371	1·529

T = 7·187 sec.

log c = 3·8800

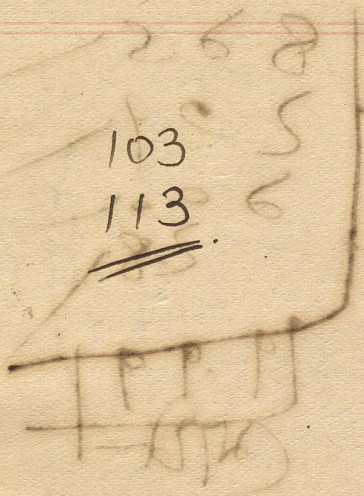
$34·9 \times 10^{-6}$

AsI_3 Arsenic triiodide - Rhombic

Al_2O_3 Aluminium Oxide Rhombic

BaS_2O_6 Barium dithionate monochinic

Li Lithium Carbonate



103
113

1776) 1820 · 103
4400

434) 490 (113 $\frac{7}{\cancel{8}_2}$ × $\frac{\cancel{28}7}{217}$
560
1260

7 $\frac{\cancel{11}0 \times 26}{8 \cancel{11} \times \cancel{4} \times 226}$ 2·8

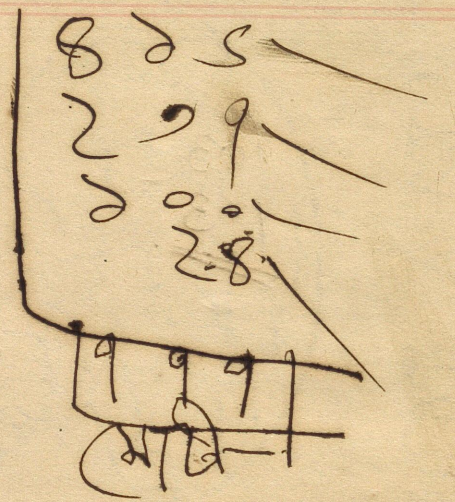
17·0
4·7
22·

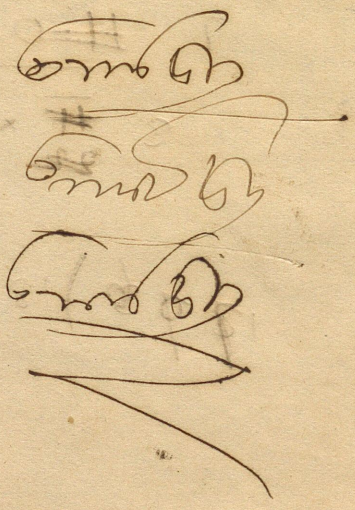
1796) 182 (100 mi Hours

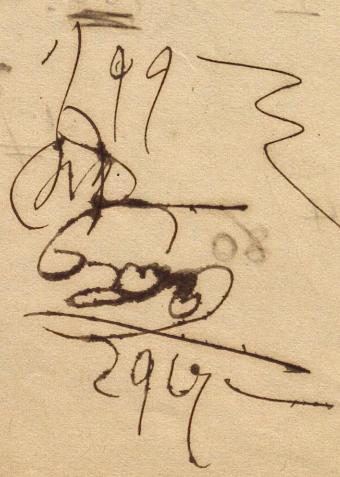
21·7 7 × $\frac{\cancel{1} \times 26}{\cancel{22 \times 4} \times 22\cancel{6}}$
8

4/80

Borax
Gypsum
Celenite
Topaz
Colestine
Graphite
Quartz
Ortho Clase
Biotite
Zeron
Celenite







Potassium Nitrate

It is interesting to watch the crystallisation of a drop of a slightly supersaturated warm solution of KNO_3 on a glass slip under the microscope. Crystallisation starts on the edges. Here rhombohedral crystalline plates are first formed with axial ratios

$$a : b : c = 0.5910 : 1 : 0.7011.$$

These are followed by needle like rhombic crystals.

Rubidium Nitrate forms rhombic bipyramidal (pseudo-hexagonal) crystals with axial ratios

$$a : b : c = 1.7306 : 1 : 0.7108$$

which were thought hexagonal. Similar remarks apply to Caesium Nitrate. $RbNO_3$ is dimorphous trimorphous $CsNO_3$ is

dimorphous.

Dia - Magnetism

Atomic wt. for Some Elements

Symbol		At wt	At no.	Element
Al	-	27·1	13	Aluminium
Sb	-	120·2	51	Antimony
As	-	74·96	33	Arsenic
Ba	-	137·37	56	Barium.
C		12·005	6	Carbon
N		14·08	7	Nitrogen
Na		23·00	11	Sodium
Mg		24·32	12	magnesium
Cl		35·46	17	Chlorine
K		39·10	19	Potassium
Ca		40·07	20	Calcium
Mn		54·93	25	manganese.

See towards the end

Ethylene Bromide
Sp gr - 2·18

Ethylene Iodide
Sp. g. - 2·13.

Ethylidene Iodide
Sp g. - 2·84.

Allyl Iodide
Sp. g. - 1·83

Bromo Naphthalene
α can be used
Sp g - 1·48

Bromoform
Sp. gr. - 2·89.

Carbon Tetrachloride
Sp. gr. - 1·59.

Ammonium Nitrate can be obtained in six-sided prisms or pyramids or in thin needles by careful evaporation and slow cooling. At ordinary temp., the crystals are rhombic bipyramids.

$a : b : c = 0.9092 : 1 : 1.0553$

Lithium Nitrate crystallises in rhombohedra (trigonal system)

Sodium Nitrate forms trigonal crystals with the axis ratio $a : c = 1 : 0.8297$ The crystals of $NaNO_3$ closely resembles those of calcite in their angular measurements and optical properties.

.936 .726

T.9713 T.9666

T.9426 T.9332 ✓

.8962
.8574
.0188

1.629 1.251

1.679 1.301

2119 0972
4238 1944 ✓
2.654 ✓
1.584 ✓
1.090

$$\frac{.1702}{5020^2} \times \frac{100}{.421} \times$$

2250 1142 .15
4500 ✗ 2284 ✓ 4.61

1.8413 3.7007
7.0257 3.7007
.8206 T.6243

2.754 2.818
1.692 1.692
1.062 1.126

.7806
0515
.8321
2284
.6037

~~.7806~~
2.2742 ✓
T.0948
T.9332 ✓
T.1616
1216
.6021
.4971
.4971
.3010
.0191
T.5018
T.5018
.8261
1.7461

~~.7806~~
0374 ✓
.8580
1944 ✓
~~.6636~~
.6236 ✓
1978
1978
6990
8451
1.7461
1.9397
T.8064

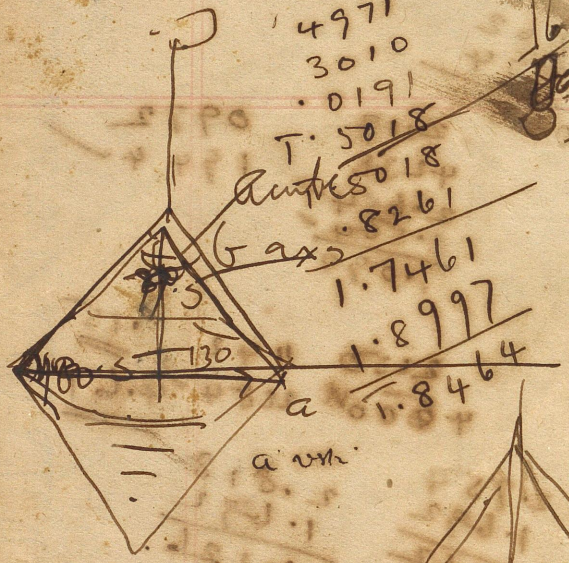
~~.7806~~
0261
.8067
2284
.5783.1451

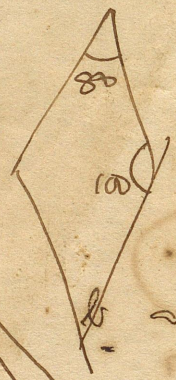


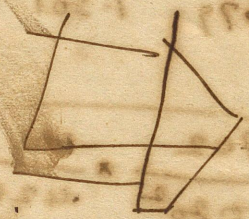
6021
4971
4971
3010
.0191
T. 5018
Acute 5018
.8261
1.7461
1.8997
1.8464

L. 1778
1778
6990
8451

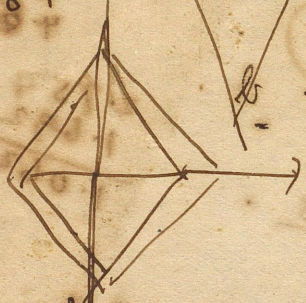
C = 1.702 E.







A C.



B

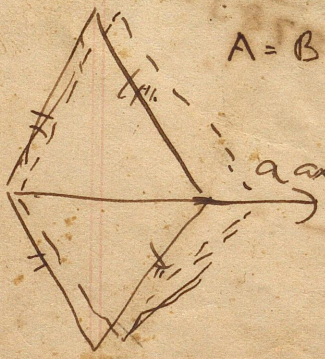
B — $(A \cos^2 \theta + C \sin^2 \theta)$ = 2.4

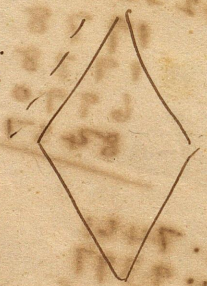
A — C

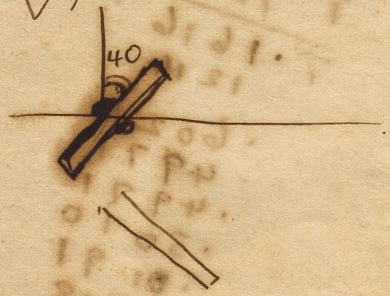


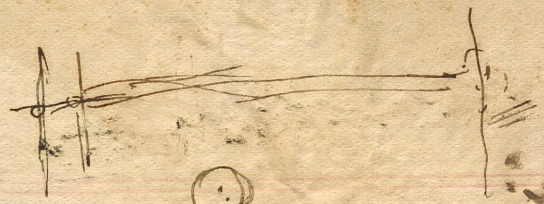
( )

A = B roughly





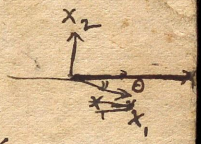




$$T' = 2\pi\sqrt{\frac{I}{C}}$$

$$T = 2\pi\sqrt{\frac{I}{C + \Delta\chi \times V \times H^2}}$$

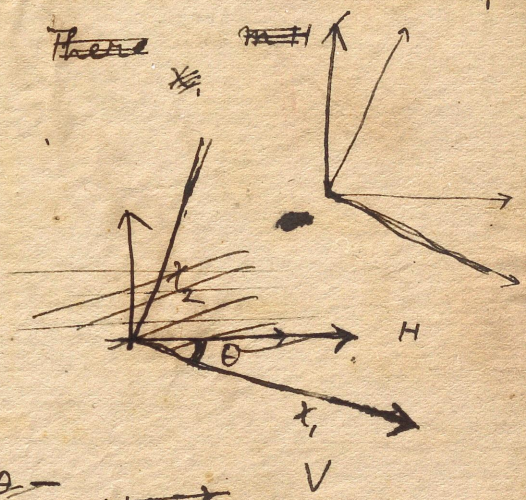
$\cancel{T' = 2\pi\sqrt{\frac{I}{C}}}$



B

~~There~~ ~~H~~

$\frac{1}{2}$



$$\chi = \chi_1 \cos^2\theta + \chi_2 \sin^2\theta$$

$$\cancel{\text{Energ} = \frac{H^2}{8\pi}} \quad \cancel{-(\chi_1 H \cos\theta -} \quad \cancel{1 + 4\pi\chi}$$

$4\pi\chi$

$$\frac{H^2}{2} \times \chi_1 \cos^2\theta + \chi_2 \sin^2\theta$$