Worms do not appear to be sensitive to violent heat
or a high light — I find, for long held
a feeble light seems to have a dulling effect, at first, but
soon fades away,
and causes a very similar degree of warmth to be felt.

five worms
One of the, took no notice; a second withdrew into its
hole, but quickly; the third & fourth made no
haste
[Worms do not appear to sense of hearing. They took not the least
of the think notes of
when a metal - thimble
notice of a (violent) or (deep) tone of a
piano. My own mid parted to shouts, can hear
either. One of hearts did not; take them. When
the keys of
placed on a table close to the piano-forte, which
was played on loudly on purpose,
purposely
quite quieter.]

Petunia

Table 83

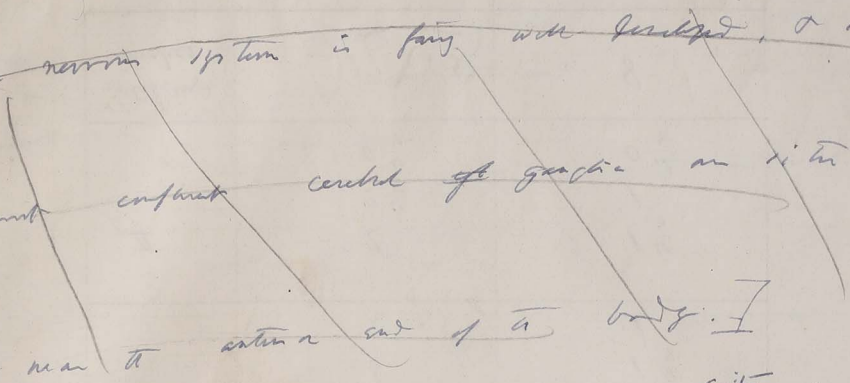
Petunia violacea

Plants growing in the open ground.

Westerham-croped plants (from self-fertilised plants of the 4th generation croped by a fresh stock.)	Intercroped plants (plants of one and the same stock intercroped for five generations.)	Self-fertilised plants (self-fertilised for five generations)
34 2/8	38	27 3/8
36 2/8	36 2/8	23
35 2/8	39 5/8	25
32 4/8	37	24 1/8
37	36	22 4/8
36 4/8	41 3/8	23 3/8
40 7/8	37 2/8	21 5/8
37 2/8	40	23 4/8
38 2/8	41 2/8	21 5/8
38 5/8	36	21 2/8
366 4/8 = 76	382 4/8 = 76	233 1/8 = 13

The ten Westerham-croped plants here average in height 36.6 inches; the ten intercroped plants 38.2 inches; and the ten self-fertilised 23.31 inches. These three lots of plants were also weighed; the ~~ten~~ Westerham-croped plants weighing 28 oz; the intercroped 41 oz. and the self-fertilised 14.75 oz. We thus get the following ratios.

The Westerham-croped plants in height to the self-fertilised } as 100 to 63



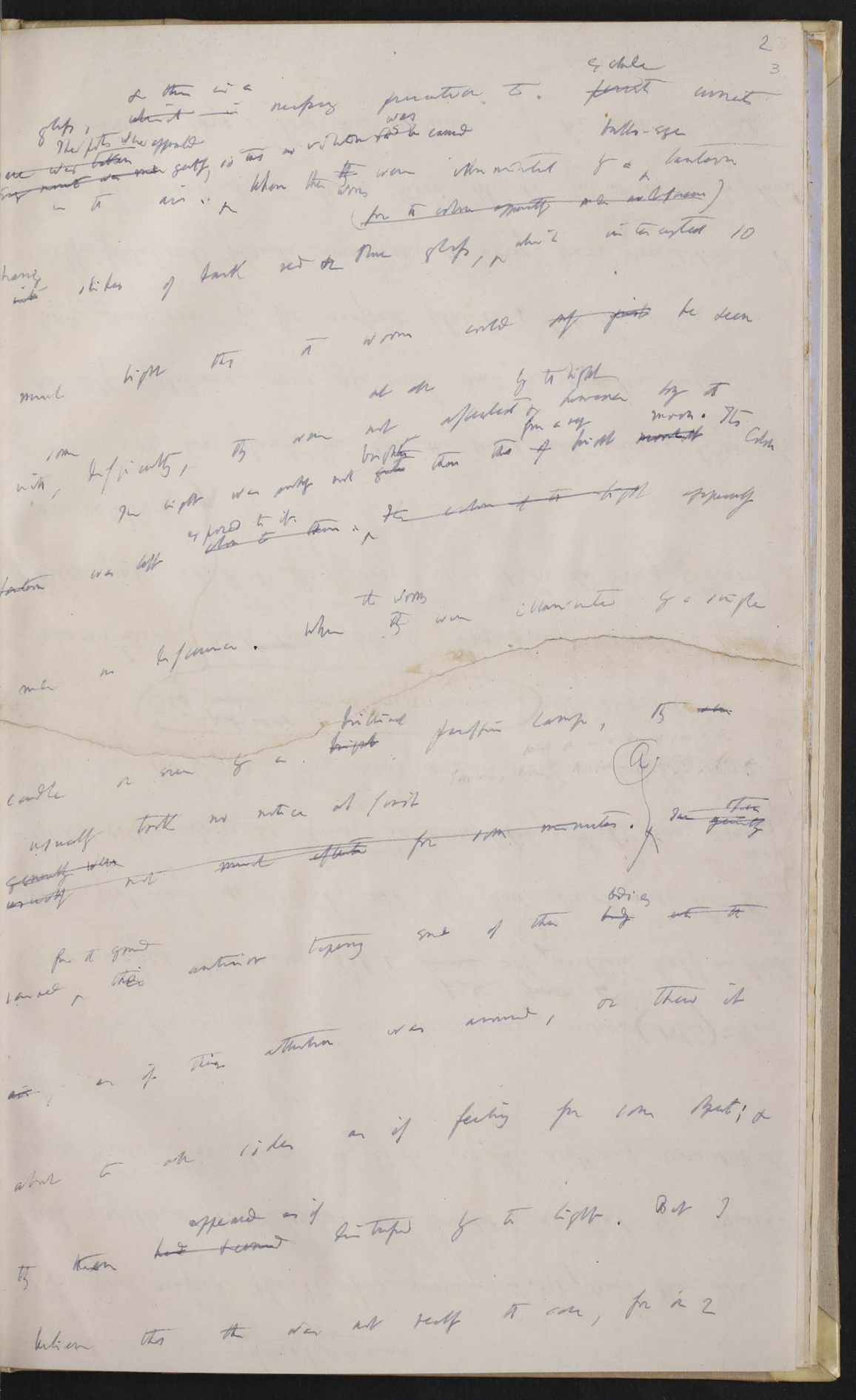
was no marked difference between the two lots. But even at this early age the leaves of the self-fertilised seedlings were smaller and of not so bright a green as those of the crossed seedlings. The pots were kept in the greenhouse, and as the plants on the following spring (1868) looked unhealthy, and had grown but little, they were plunged into the open ground. The plants all suffered much from the sudden change, especially the self-fertilised, and two of these latter died. The remainder were measured, and I give the measurements in the following Table, because I have never seen so great a difference, between crossed & self-fertilised seedlings at so early an age in any other species.

Table 58

Sarothamnus scoparius (very young plants)

No. of Pot	Crossed Plants	Self-fert. Plants
I	$4\frac{4}{8}$ 6 2	$2\frac{4}{8}$ $1\frac{4}{8}$ 1
II	2 $2\frac{4}{8}$ $0\frac{4}{8}$	$1\frac{4}{8}$ 1 $0\frac{4}{8}$
Total in inches	$17\frac{4}{8}$	8

3



Barothamnus

The six croped plants here average 2.91, and the six self-fertilised 1.33 inches in height; so that the former were more than twice as high as the latter; or as 100 to 46.

In the spring of the succeeding year (1869) the three croped plants in Pot I ~~were~~ had grown to all within half an inch of a foot ~~high~~ in height, and they had smothered the three little self-fertilised plants so completely that two were dead; and the third, only an inch and a half in height, was dying. ~~They were~~ The pot was now thrown away. It should be remembered that these plants had been bedded out in their pots, so that they were subjected to very severe competition.

The six plants in Pot II were all alive. One of the self-fertilised was an inch and a quarter taller than any one of the croped plants; but the other two self-fertilised plants were in a very poor condition. I therefore resolved to leave these plants to struggle together for some years. By the autumn of the same year

4

attempt to introduce in the

air unlike by us, by an ordinary device to

violation in the text. When the parts, with words

[illegible] which had remained understood

[illegible] were placed on the

[illegible] end of the pianoforte, were played on the

pianoforte; the note C in the bass clef was struck, by two

[illegible] at their bottom. After a time

both initially struck

the treble clef was struck by

the compass of three octaves

[illegible] in another night

open strings, or

[illegible] on a very high note

[illegible] into the bass

by one stroke, at the same time C in the

treble clef was struck.

[illegible] occasion the parts

[illegible] were not touch to

[illegible] in dances; so that the

sides of the note, which

the violins had to play for the whole band of the

Petunia

We here see that judging by weight, instead of as before by height, the Westerham-croped and the intercroped have an immense advantage over the self-fertilised. The Westerham-croped are inferior to the intercroped by a mere trifle; but it is almost certain that if they had been allowed to go on growing for another month, the former would have completely beaten the latter.

As I had an abundance of seeds of the same three lots, from which the foregoing plants were raised, there were sown in three long parallel and adjoining rows in the open ground, so as to try whether under these circumstances the results would be nearly the same as before. Lately in the autumn (Nov. 13) the ten tallest plants were carefully selected out of each row, their heights measured, with the following results.

remarkable, for nothing like them is known in any

other animal. These functions with the discipline which we

have & the digestive principle of the oesophagus is enlarged

to a curious cactus-worm into a large hopper

at the bottom to the gizzard which is lined with a

tough, thick, tough chitinous membrane; the gizzard is

but by very strong transverse muscles,

supplied & with capillaries & by strong transverse muscles,

which serrate saw-like corrugations across. The intestine

This intestine is then found, as the remarks must be chiefly plated

by the gizzard, organ, a worm how we pass on

to the gizzard, framed of sand, &c

texture of any kind. Small stones, for it is

1/10 of an inch in diameter, may generally be found

in the gizzard; but it is certain that worms

swallow any little stones, independently of

stones swallowed when they are accidentally there

Sarothamnus

the three self-fertilised 11.83 inches in height; or as 10 to 63. ~~In Pot I, as we have seen, the~~ It has already been shown that the three in Pot I croped plants, have beaten the self-fertilised plants ~~to such an extent~~ completely, that any comparison between them was superfluous.

The winter of 1870-1871 was severe. In the spring, the three croped plants in Pot II. had not even the tips of their shoots in the least injured; whereas all three self-fertilised plants were killed half-way down to the ground; this shows how much more tender they were. In consequence not one of these latter plants bore a single flower during the ensuing summer of 1871, while all three croped plants flowered.

Ononis minutissima

This plant, of which seeds were sent me from N. Italy, produces, besides the ordinary papilionaceous flowers, minute, imperfect, closed or cleistogene flowers which can never be self-fertilised, but are highly self-fertile. Some of the perfect flowers were croped with pollen from a distinct plant and six capsules thus produced yielded on an average of 3.66 seeds,

pr[illegible] thyf to lance, to wthe of to [illegible] &

to [illegible] & ne of angels, before reading to bodies of to

wms. Thy of the blood then sentenc when to

put in when to bind or to take in when they

then in accidently & will block; but they

sent up to such fires that to to victims of

to wives of to prophets; & then sentenc varied

times. It has been, said this of

as different occasions.

better or the wise made to think, wn to wms

to good in f

before they to a funeral of a rich & will

completely burn than burrows. I best to good

in ing place when wms attended, but not

one enough; but when to good in, dug of

a fork, + it in violently dis to bed beneath

sickly crawl of to burrow

where the c wm like, it with f as I have seen.]

- fertilised plants of the fifth generation, of which latter fact there could be no doubt.

These three lots of plants were cut down close to the ground and weighed. The 21 Westerham-croped plants weighed 32 oz.; the 22 intercroped plants, 34 oz. and the 21 self-fertilised plants 7¼ oz. The following ratios are calculated for an equal number of plants of each kind. But as the self fertilised plants were just beginning to wither, their relative weight is here slightly too small; and as the Westerham-croped were still growing vigorously, their relative weight would no doubt would have increased greatly if time had been allowed

The Westerham-croped plants in weight to the self-fertilised, } as 100 to 22

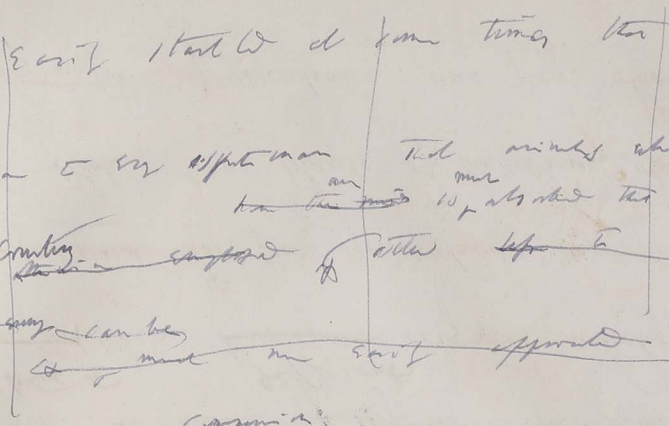
The Westerham-croped plants in weight to the intercroped, } as 100 to 101

The intercroped plants in weight to the self-fertilised, } as 100 to 22.3

[~~Fig. Note~~ ~~Lecture~~ ~~on~~ ~~Light~~ ~~passes~~ ~~to~~ ~~contact~~, a

light passes from air to this mineral causes
an internal reflection. If glass plates or the
parts did not fit closely, & I found this by
trying it moreover closely then left sufficient to
cause an equal reflection. ~~from~~ ~~to~~ ~~close~~ placed
~~by careful search for the best~~,
~~very gently~~ ~~pressing~~ a glass-plate, ~~(no gain by the thin layer)~~
& ~~pressing~~ when a wave passes from it to more,
~~contact~~ ~~action~~ more it, ~~& could enter a denser from~~ or
it generally
~~for like to like~~, apparently a an agent of
~~like to like~~, ; & when ~~as~~ it moves in which the
touch ; ~~more~~ is ~~described~~ ~~more~~ ~~with the~~ we
from here ~~with the~~ ~~more~~ ~~is described~~ ~~we~~
~~we like better~~ see reason for believing that if we then
~~like~~ ~~from touch~~ came
~~then~~ into of from I or
~~what~~ to a ~~contact~~, a &
of all other senses. That of touch,
objects. —
~~working~~ in the term that of a relation, seem
much the most highly developed. —]

previous generations with the exception of the abnormal ~~case~~ plants of the third generation. On the other hand the Westerham-croped plants are exceeded in height by the intercroped; and this is a surprising fact, judging from the other strictly analogous cases. But as the Westerham-croped plants were still growing vigorously, while the intercroped had almost ceased to grow, there can hardly be a doubt that if left to grow, they would in all probability have beaten the intercroped in height. That they were gaining on them is clear, as when measured before they were as 100 to 119, and now ~~only~~ as only 100 to 108 in height. The Westerham-croped plants had also leaves of a darker green, and looked altogether more vigorous than the intercroped; and what is much more important they produced, as we shall presently see, many more seed-capsules. So that in fact ~~reality the crop with a fresh stock did give it~~ the offspring from the self-fertilised plants of the fourth generation crossed by a fresh stock were a great deal superior to the intercroped, as well as ~~over~~ to the self-



to the intercroped plants in a much higher degree than in the pots; and this appeared to be due to their being much less branched, from having germinated in greater numbers and consequently having grown much more crowded. Their leaves were of a brighter green than those of the intercroped and self-fertilised plants.

Relative fertility of the ~~two~~ three lots of plants.

None of the plants in pots in the greenhouse ever produced a capsule; and this may be attributed in chief part to the exclusion of moths. Therefore the fertility of the three lots could be judged of only by the plants growing out of doors, ~~and~~ which from being left uncovered were probably cross-fertilised. The plants in the three rows were exactly of the same age and were subjected to ~~the~~ closely ~~same~~ similar conditions, so that any difference in their fertility must ~~depend on~~ be attributed to their ~~three-fold~~ different origin; namely from plants self-fertilised for four generations and then croped with a fresh stock; from plants of the same old stock intercroped for five generations; and from others self-

Worms are poorly provided with sense-organs, for they cannot see, although they can just discriminate between light & darkness; they are completely deaf & have only a feeble power of smell & probably not much taste; the sense of touch, being alone well developed. They can therefore learn little about the outside world, & it is remarkable surprising that they accurately exhibit their instincts & skill in lining their burrows with leaves, & in plugging up their castings with leaf-like constructions. But it is far more surprising that they apparently exhibit some intelligence in their manner of plugging up the mouths of their burrows, instead a mere blind instinctive impulse. They act in nearly the same manner as would a man who had to close a cylindrical tube with different kinds of leaves, particles, triangles of paper &c, for they commonly select the proper size & shape of the foreign body; but when the

Spirits on them, by draw in a certain number
by their broader ends. (like most of the larva animals)
by do not act
in the same unvarying manner in all cases
with the kinds of leaves on the spirits;
for instance by do not drop in leaves by
their fork-stalks, unless to base at part, in as
of the blade
manner as the apex
for manner than to it.
the apex part.]

The leaves which are thus dragged into
number into the burrows, after being torn into
fragments, partly digested, saturated with the intestinal
& urinary secretions, & contaminated with much
earth, from the dark-colored, rich humus which
almost everywhere

affected by being very gently breathed on, even when I had some chewed tobacco in my mouth, or a little cotton-wool, on which a few drops of perfume or of acetic acid had been placed.] We must suppose that they can taste; & they apparently like cabbage better than other leaves, but it is difficult to judge on this head for their omnivorous habits. One sense alone is highly developed that of touch, for they instantly perceived a very slight tap on the outside of the pots, or on the table on which the pots stood, though the vibration had to be transmitted through moist loose damp earth. They also readily perceived a slight puff of air. In such cases they show their perception by withdrawing into their tubes with extraordinary, flash-like, rapidity. At night the anterior extremity of the body, which is much more extensile than the posterior part, is constantly moved in all directions & touches as an organ of touch. With a few tentacles & with so many suckers it seems

Cabbage leaves, especially when ~~the~~ with the caterpillars are much liked by worms; but when these & horse-radish leaves (which are also liked) were placed together with those of the mint, the latter always & manifestly preferred. Leaves of cabbage, lime-tree, Ampelopsis, parsnip & celery were given together & the celery was preferred. Again. But when leaves of cabbage, turnip, beet, & celery, wild celery & carrots were given together the two latter kinds, especially the carrot was preferred to all the others. It was also manifestly & equally true, that the ~~other~~ celery was preferred to the leaves of the wild celery. The leaves of the wild celery were preferred to those of the lime & beech. (Caterpillars Pieris of the Leaves of cabbage, turnips, horse-radish & mint, were given together; ~~but~~ the latter being ~~given~~ last; ~~the~~ 22 days & a half) ~~were~~ devoured, ~~together with leaves of the~~ ~~other~~ ~~thing tasting~~ ~~strongly~~ ~~Kinds of strongly flavoured~~ ~~lime~~, namely those of an Artemisia, Thyme, Sage & Mint, ~~& none of the~~ were preferred by the caterpillars, except ~~those~~ of the mint, which were occasionally & very ~~of~~ leaves put on them, ~~since~~ as they ate more than twice as much ~~as~~ of these as of any other kind. These latter four kinds ~~were~~ as they ate, but ~~not~~ the ~~from~~ just mentioned kinds; & we can account for the ~~wide~~ difference in the result must be attributed to a difference in their tastes. ~~in the leaves~~ ~~of~~ ~~from~~ which can be accounted for ~~in some cases~~ by ~~the~~ ~~preference~~ ~~for~~ ~~one~~ kind of ~~thing~~ to that of another ~~(that of cabbage)~~ They are ~~apparently~~ fond of ~~manifest~~ & prefer it

rings, each furnished with stout bristles. The muscular

is well developed & the stout bristles bear evidence of

worm. Worms can crawl backwards as well as forwards, &

of their elongated tails can retract into the burrows with

astonishing rapidity

has been noticed. The mouth is situated

anterior end of the body; it is destitute of jaws,

is provided with a little proboscis or tube (as it has

animal called) which is used for the purpose. [illegible]

Beneath the mouth there is a strong pharynx, which is

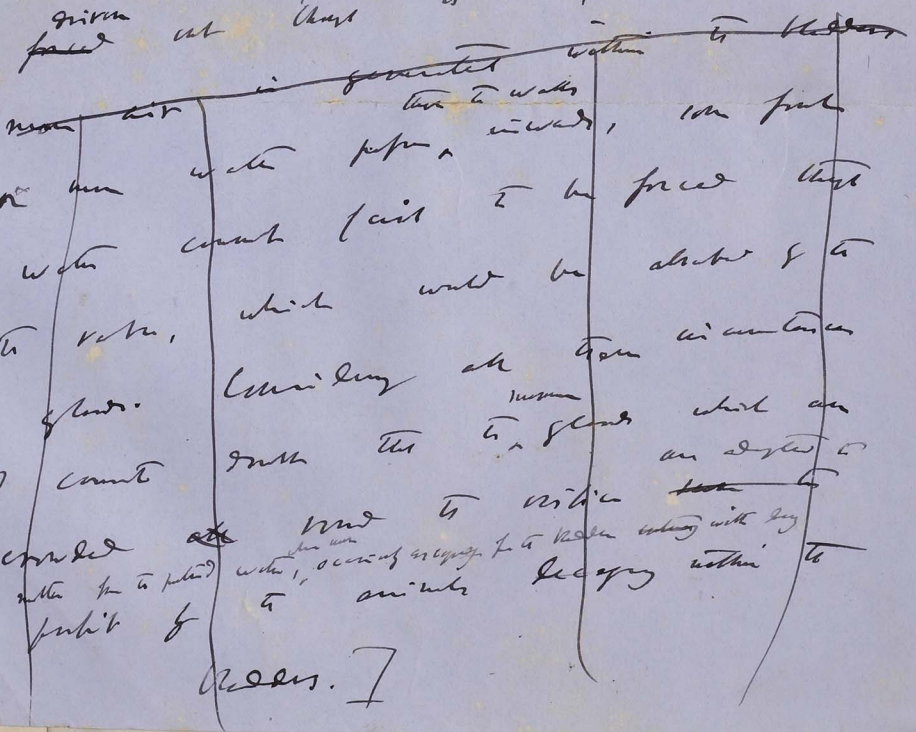
pushed forwards when the animal eats, & which, according to

Perrier,

believed to correspond with the protrudable trunk or

proboscis of the Gasteropods. The pharynx leads into the

[illegible]



worms.

Here I referred to Perrier's article

is furnished with numerous strong transverse muscles, which have been seen by Perrier in continued energetic action. This must play, as he remarks, a considerable part in the trituration of the food.* [* Archives de Zoolog.

[illegible]

a candle close to them when out of their burrows at night, & though they very timid they never took the least notice of the sudden light. No doubt

~~on may~~ a puff of [illegible]

letters on entering a bottle the glands.

must puff out &

Moreover I, have repeatedly found the ~~find~~ by gently pressing ~~the~~ must bubbles are

bladders containing air, ~~[illegible]~~ ~~& these~~

~~forced~~ driven out through the slits; ~~the bladders~~

~~must hit in generated within~~ then the walls inwards, some fresh

water when pressed to be forced through

water cannot fail which would be absorbed by the

the water, Considering all these circumstances

glands. I cannot doubt that the mucous glands which are adapted to excrete ~~[illegible]~~ the

crowded ~~the~~ round the water, occasionally escaping from the bladder entering with dry matter from the pulmonary the animals breathing within the

habit of

bladders.]

III. 3 bottom row: △ Equal Sides △

$\gamma = 19°21'$

$\beta = \pi - 2 \times 58°17' - 19°21'$

$= \pi - 97°13' = \frac{\pi}{2} - 7°13'$

because we are measuring with S plate instead of N

$116°34'$
$19°21'$
$97°13'$

$\rho = \cos 19°21' \cot \alpha$

$x = -\cos 19°21' \dfrac{\tan(97°13' + \alpha)}{\tan(7°13' \pm \alpha)}$

$\alpha = +9°, +18°, 27°$

$1°47'$, $10°47'$, $19°47'$

$\log \cos 19°21 = 9.97475 - \quad .0294$
8.49325
$\overline{2.46800}$

$\rho_9 = 5.957$
$\rho_{18} = 2.704$
$\rho_{27} = 1.852$

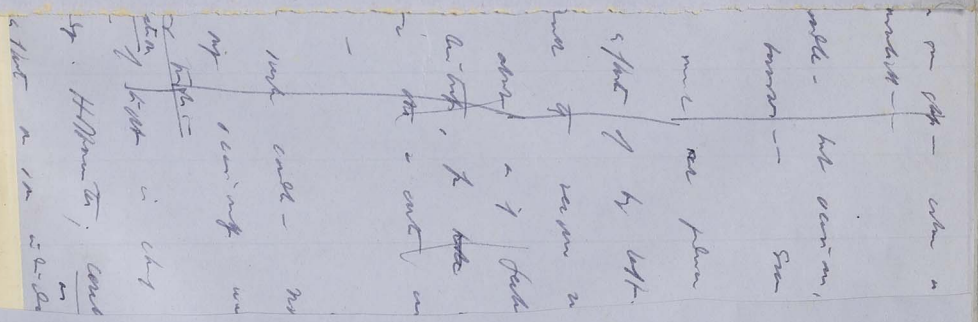
$9.97475 -$
9.27980
$\overline{T.25455} \quad .1797$

$Ox_9 = .0294$

$Ox_{18} = .1797$

$Ox_{27} = .3394$

$9.97475 -$
9.55593
$\overline{T.53068} \quad .3394$



That worms should be able to distinguish between a dry & a moist room at first surprising, for they are furnished with eyes, nor do they seem to possess any diffused sensitiveness to light as in the case of many low developed organisms; for I have repeatedly placed a candle close to them when out of their burrows at night, & though they very timid they never took to least notice of the sudden light. In order testing distinguish between the dry, warm air

[illegible] as before.

[illegible] as a control experiment

[illegible] from bladders with a solution of 2 gr. of gum arabic to one oz. of water, & two bladders with a

(x) l. 2 The [illegible]

Sometimes, however, they [illegible]. Nor were they [illegible] when the light was already [illegible] that off. Sometimes, however, they light fell on the [illegible] of [illegible], for as soon as the [illegible], they [illegible] with [illegible] not [illegible] [illegible] regularly.

This occurred, in [illegible] a dozen trials.

When they did not withdraw [illegible], they often

log tan 9° = 9.19971 / $\bar{1}$.17901

·1483
·0099
·1582
4·1384

·0099

19·97130
9·51178
$\bar{1}$·48308

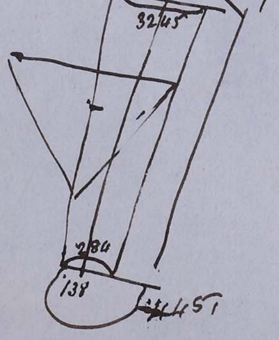
·3041
·0204
·3245
4·2837

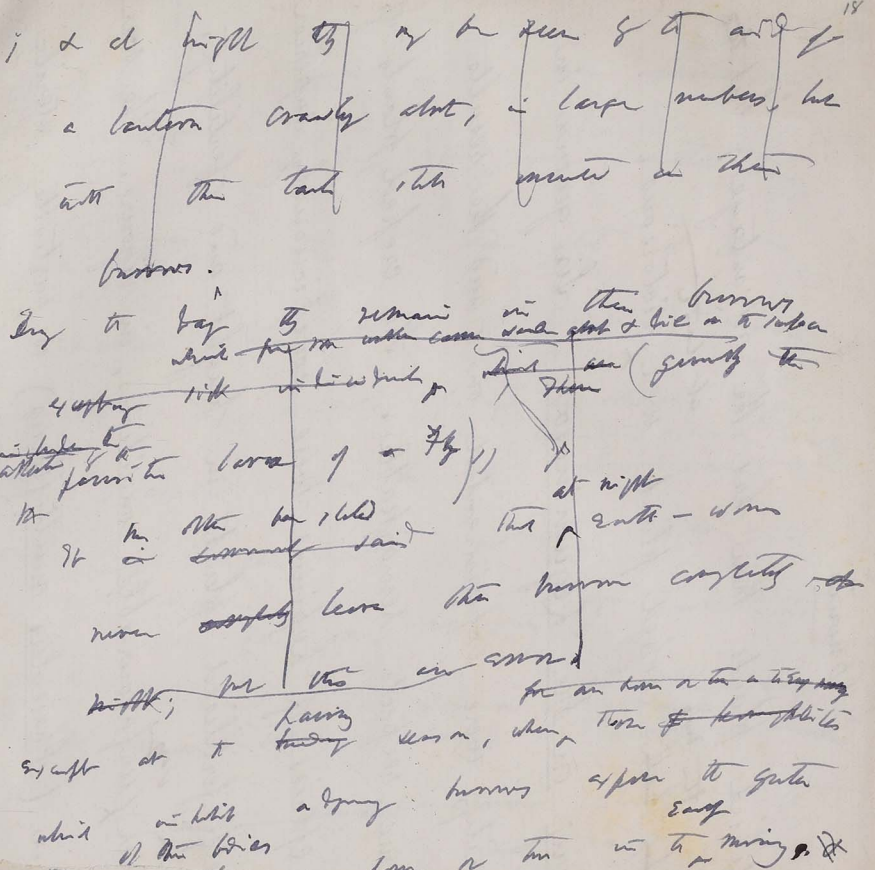
9·09907
9·51178
2|·0408 $\bar{2}$·61085
0204

19·97130
9·70717
$\bar{1}$·67847

·4770
·0319
·5089
4 ·4451

9·09907
9·70717
2|·06373 $\bar{2}$·80434
·03119





(a) 1 2 The [illegible]

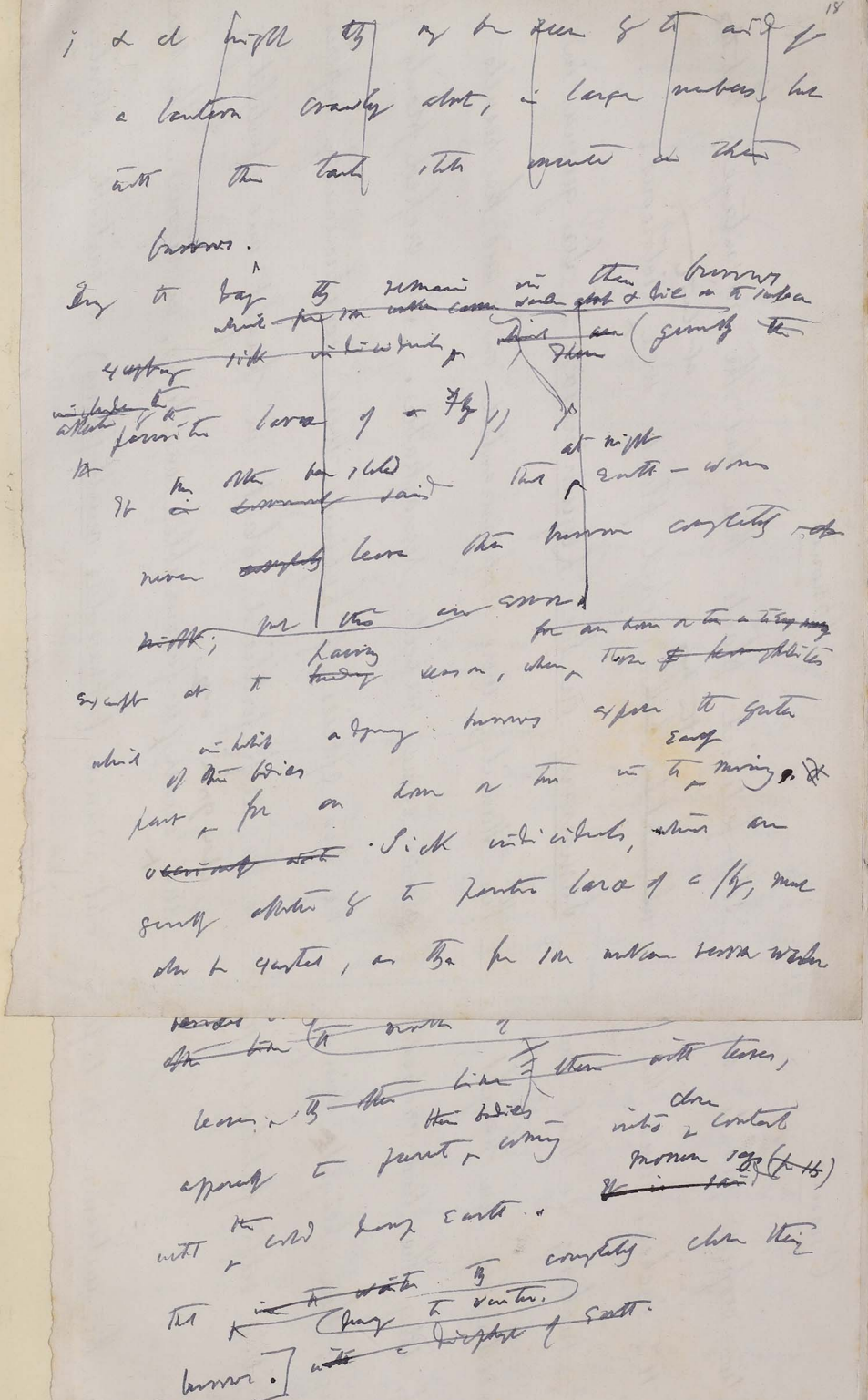
~~Sometimes, however, the~~ [illegible]. For [illegible] the [illegible] when the light was already admitted & [illegible] off. Sometimes, however, the light fell on the [illegible] of the plants, for as soon as the ~~[illegible]~~, the [illegible] with [illegible] not the [illegible] ~~[illegible]~~ [illegible] rapidity.

This occurred ~~[illegible]~~ in ~~[illegible]~~ a dozen ~~[illegible]~~ trials.

When the [illegible] not withdraw [illegible], the often

0.07175

~~We thus see that~~ Here the relative heights of the [p]lots ~~as~~ are very nearly the same (within three or [p]er cent) as with the ~~before described~~ plants [in] pots. In weight there is a much greater [differenc]e. The Westerham-crossed exceed the self-[fertilised] much less than before; but the self-fertilised in the pots, as before stated, had become slightly [...] and were in consequence unfairly light. The [Westerha]m-crossed plants are here inferior in weight



self-fertilised plants then had the advantage; but ~~the~~ ultimately ~~both~~ the two crossed plants at last were victorious.

Summary on the Leguminosæ. — Six genera in this Family were experimented on; and the results are in some respects remarkable. The crossed plants of the two species of Lupinus were conspicuously superior to the self-fertilised plants in height and fertility, and under unfavourable conditions, in vigour. The scarlet runner (Phaseolus multiflorus) is partially sterile

When we see the ~~sun~~ moon ~~shadow~~ early
or late.
& write, or on by the or with by,
we shall not ~~be~~ ~~see~~ ~~the~~ ~~sun~~ the sun of the
moon upon him; & I am [illegible] to say
that or with by or the sun by
occasioned ~~by~~ it by ~~only~~ ~~some~~ to
any longer, that of the times —
by late year
& I can see no reason to doubt this

It appears ~~that~~ ~~by~~ ~~keep~~ ~~that~~ ~~had~~ ~~pots~~ ~~with~~ and in money 19
~~to~~ ~~mouth~~ ~~of~~ ~~the~~ ~~horses~~, chiefly as to
the by can to take
money, & I believe ~~that~~ ~~by~~ ~~sat~~ in
, especially as to money.
~~the~~ ~~manner~~ for the sake of wealth; for
to the use
& we ~~like~~ ~~generally~~ ~~should~~ see that ~~by~~
~~beside~~ ~~doing~~ ~~to~~ mouth of the horses with
~~after~~ ~~him~~ ~~to~~ mouth of the horses
leaves in by ~~the~~ ~~like~~ them with leaves,
approach to parent or coming
the soldiers
with a contact
moment say (to H.)
~~It is to~~
with the cold damp earth."
~~This~~ ~~in~~ ~~a~~ ~~state~~ by completely close they
(dung to winter.
horses.] ~~with~~ ~~a~~ surface of earth.

(1868), the two croped plants were of exactly the same height, viz, $11\frac{4}{8}$ inches; and the two self-fertilised plants $12\frac{6}{8}$ and $11\frac{2}{8}$ inches; so that one of the self-fertilised exceeded considerably in height all the others. By the autumn of 1869 the two croped plants had acquired the supremacy; their heights being $16\frac{4}{8}$ and $15\frac{1}{8}$, whilst that of the two self-fertilised plants was $14\frac{5}{8}$ and $11\frac{4}{8}$ inches.

By the autumn of 1870, the heights were

nts then had the advantage; but the
at last
roped plants were victorious.

e Leguminosæ. — Six genera in
experimented on; and the results
s remarkable. The croped plants of
Lupinus were conspicuously superior
d plants in height and fertility,
urable conditions, in vigour. The scar-
olus multiflorus) is partially sterile

When we see the sun in a new [illegible] early
or late.
yesterday, or on any day in our whole life,
we think that it is the size of the
moon appears; & I in [illegible] to say
that an animal feeling or thinking exactly
occupied [illegible] its life only about 2
or 3 days, that at the time —
& I can see no reason to doubt this
to be [illegible] to be applied
to man; & to both animals — now that
the new system is but early yesterday, it is to
you a sense of danger at the pleasure that it
does, & the [illegible] occupied to pay life
attention to [illegible]. the of the
sun the moon or [illegible]
times —
[illegible] to make of me to do all which comes to each visions

tracks, after the last has long said &
the first [illegible] the Acapulco
[illegible] of October, towards
the end of January, he must be coming day to
[illegible] market. The number of tracks seen [illegible]
of moon; & each one piece of skin one mile square
the use of the tracked tracks. If we could be
[illegible] to [illegible] with [illegible] to the market of the Russian
— to find work; & [illegible] were followed for the [illegible]
very [illegible] by the 15 yards. Now on this
[illegible] [illegible] [illegible] to write: —

Ononis

(1868), the two croped plants wer
height, viz, 11 4/8 inches; and the
12 6/8 and 4 2/8 inches; so that one
exceeded considerably in height
autumn of 1869 the two croped
the supremacy; their height being
that of the two self-fertilised pl
inches.

By the autumn of 1870

maximum of 3 seeds in ~~one~~ one ~~capsule~~. So that the croped and self-fertilised ~~pods~~ capsules from the perfect flowers yielded seeds in the proportion of 100 to 65. Fifty-three capsules produced by the cleistogene flowers, contained on an average 4.1 seeds; so that these were the most productive of all; and the seeds themselves looked finer even than those from the croped perfect flowers.

The seeds from the croped perfect flowers and from the self-fertilised cleistogene flowers, were allowed to germinate on sand; but unfortunately only two pairs germinated at the same time. These were planted on

3

22

burrows, it is probable that they do so, like [illegible] to [illegible] the earth, so that mould-stones, [illegible] [illegible]

[illegible] matter, may be [illegible] [illegible]

Worms are [illegible] [illegible] to [illegible] [illegible] [illegible] [illegible] [illegible] the surface or live there. It has long ago often been said that all healthy worms never or very rarely leave their burrows; but this is an error. I have completely repeatedly observed, on a spring morning, that the film of mud over the gravel walks was plainly marked with their tracks, after there had been long rain; & this from August to January; but more are commonly seen in the later autumnal months. The number of tracks were sometimes [illegible]; & on one space of about one mid square yard there were 5 [illegible] tracks. They could be sometimes traced either to or from the mouth of the burrow in the gravel walk; & the worms could be followed for [illegible] to 15 yards. Worms can thus readily find new sites to inhabit. —

21

of the visits of bees are pu… maximum of 3 seeds in ~~two~~ one ~~capsule~~. So that the
to believe that varieties growing near one another …tilised pods from the perfect flowers
intercross. The five crossed plants ~~of this species~~ exceeded …e proportion of 100 to 65. Fifty-three
in height only by a little. The five self-fertilised ~~plants~~. … by the cleistogene flowers, contained
Phaseolus vulgaris is perfectly self-fertile; varieties …seeds; so that these were the most
growing in the same garden sometimes intercross …and the seeds themselves looked finer
largely. On the other hand the varieties of ~~the sweet~~ …rom the crossed perfect flowers.
~~pea~~ (Lathyrus odoratus) rarely never intercross in …om the crossed perfect flowers. and
this country; and though the flowers are not often …ised cleistogene flowers, were allowed
visited by efficient insects, I cannot account for this …and; but unfortunately only two pairs
… same time. These were planted on

burrows, it is probable that [illegible] like
[illegible] with [illegible] earth, [illegible]
[illegible]
[illegible]

the existence of [illegible] for [illegible], the
hypothesis, (or as it should [illegible] it, an
induction without an intervening [illegible]
[illegible] action; for when kept, in pots, covered by
glass-plates, on which were placed sheets of blotting-paper,
& placed before a N.E. window, remained long dry
that it was not to keep earth moist but to
[illegible] day time in the burrow, & come out every
night, for a week.
[illegible] light may have entered between
the sheets of [illegible] but we know from the
[illegible] with the lantern with closed slides that worms
are quite indifferent to a little amount of light.]

Sarothamnus

(1869), the self-fertilised plant which had been before victorious, was beaten. They were now measured as shown in Table 59.

Table 59.

Pot II
Sarothamnus scoparius

Croped Plants	Self-fert: Plants
$15\frac{6}{8}$	$13\frac{1}{8}$
$9\frac{6}{8}$	3
$8\frac{1}{8}$	$2\frac{4}{8}$

The same plants were again measured in the autumn

of the visits of bees are no[t] many

to believe that varieties growing near o[ne] intercross. A few croped plants of the five self-fertilised by a little. The five self-fertilised Phaseolus vulgaris is perfectly self-fertile growing in the same garden sometimes largely. On the other hand The varieties of Lathyrus odoratus [illegible] though the flowers this country; and the flowers visited by efficient insects, I cannot

manner, they probably all with benefit become firmly associated under the same or closely analogous heads. [It need hardly be premised that movements or changes in any part of the body, — as the wagging of a dog's tail, the ~~opposition~~ ~~drawing~~ depression of a horse's ears, the shrugging of a man's shoulders, or the ~~contraction~~ dilatation of the capillary vessels in ~~the~~ the skin of his face, may all equally well serve ~~for~~ as a means for ~~a means of~~ expression.

however appear to have become ... day to day with the burrows habitual action; for worms kept ~~loose~~ in pots, covered by glass-plates, on which were spread sheets of black-paper, & placed before a N.E. window, remained day after day ~~within~~ the burrows & came out every night for a week. ~~A day ... the air ... to~~ ~~Damp~~ No doubt a little light may have entered between the sheets of glass & black paper ~~& the glass~~, but we know from the trials with the lantern with coloured glass that worms are quite indifferent to a small amount of light.]

Saro thamnus

(1869), the self-fertilised plant which had been victorious, was beaten. They were now measured as shown in Table 59.

Table 59.

Pot II
Saro thamnus scoparius

Croped Plants	Self-fert: Plants
$15\frac{6}{8}$	$13\frac{1}{8}$
$9\frac{6}{8}$	3
$8\frac{2}{8}$	$2\frac{4}{8}$

Natural

self-fertilised flowers on the same plant, in comparison with plants of the cross-fertilised ~~ones~~ intercrossed ~~plants~~ plants having been left to be crossed by insects or to fertilise themselves. ~~It~~ The first five ~~plants~~ pairs of ~~Saro thamnus scoparius~~ Retamas crossed with pollen from other plants ~~were~~ arrange more than twice as high as their self-fertilised opponents by the plants self-fertilised for five generations, and nearly three or four or more of the plants ~~were~~ = crossed during the same number of generations. The Retamas-sexed plants were also much taller and

Petunia

self-fertilised for four generations, in comparison with plants of the old stock, then self-fertilised or intercroped for five generations; all the flowers on the plants having been left to be freely croped by insects or to fertilise themselves. ~~For the Westerham croped plants produced capsules on an~~ average more than twice as heavy as those produced by the plants self-fertilised for five generations, and

Abnormalism

matter keeping to perfection

this difficult operation.]

26

exists in inherited a distinction leading

Then or to certain tastes,

25

[illegible] readily

recognise actions becomes associated

with the actions, & with various other

to mind, that it will give a good

many instances, including among testing

[illegible] habits.

[illegible] it

It is known to engross be difficult

is, without repeated

to mere to birds in certain

practised directions. Birds have been

[illegible]. And so calls occur with sensations,

To find m for the Sun. 1

mean appl. diam. = 32′ 3″.64 = 1923″.64

radius = 961.82″ ✓

Take t = 25.3 days, T = 365.2569 m.s. days

log 3600 = 3.5563025 ✓
colog = 6.4436975 ✓
log π/180 = 8.2418774 ✓
log 961.82 = 2.9830938 ✓
7.6686687 ✓

log (α/D)³ = 3.0060061 ✓

log 25.3 = 1.4031205 ✓
col. = 8.5968795 ✓
2.5625984 ✓
1.1594779 ✓

log T/t = 2.3189558 ✓
3.0060061 ✓
5.3249639 ✓

log 365.2569 = 2.5625902 ✓
71 ✓
11 ✓
2.5625984 ✓

211333

m′ = .0000211333 ✓

$$m = \left(\frac{T}{t+\delta t}\right)^2\left(\frac{\alpha}{D}\right)^3 = \frac{T^2}{t^2}\left(-\frac{2\delta t}{t}\right)\left(\frac{\alpha}{D}\right)^3 = m' - \frac{2m'\delta t}{t}$$

log m′ = 5.3249639 ✓
2 = .3010300 ✓
col. t = 8.5968795 ✓
4.2228734 ✓

16706 ✓

m = .0000211333 − .0000016706 δt

Take δt = .08 (Carrington) δt = − .07 (Spörer)

.0000016706
.08
.0000013364 8 ✓
.0000211333

m = .0000210 0 ✓ ✗

.0000016706
07
− .0000011694 2 ✓
.0000211333
m = .0000212 50 ✓

.0000211333
.0000016706
11694 m = .0000182 9
28400 t = 27
.0000028 4

Abnormalism

Mott keeping [illegible] to [illegible]

this [illegible] difficult [illegible] operation.]

[illegible] 26

[illegible] expects an [illegible] a nightwise feeding

The [illegible] of an action or to [illegible] certain tastes,

to [illegible] performance [illegible] habit

food to [illegible] [illegible] is [illegible] food

[illegible] [illegible] requisite. [illegible] this is a

is often a [illegible] [illegible] parts of the horse

[illegible] [illegible] to a certain extent it is

pointing of the ears

with point [illegible] the first time [illegible]

[illegible] [illegible] upon [illegible]

[illegible] [illegible] often opening [illegible] with

[illegible] out, [illegible] even with [illegible] I have heard it

[illegible] [illegible] [illegible] be allowed

[illegible] aperated that if a calf [illegible] much more

to suck its mother [illegible] by me, it is a [illegible]

[illegible] difficult to [illegible] hand. * [3]

[illegible] [illegible] been [illegible]

Caterpillars [illegible] [illegible] [illegible]

of the leaves of one kind of tree,

[illegible] [illegible] [illegible] [illegible] [illegible]

longer [illegible] [illegible] [illegible] [illegible] [illegible]

of cattle [illegible] natural food, * [4] it is [illegible]

[illegible] [illegible] [illegible] [illegible] [illegible]

instances.

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible] [illegible]

unruffled scales, [illegible] [illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

in the air, with its long hair - like [illegible]

[illegible]

To find m for the Sun. 1

mean appt ~~sem~~ diam = 32′ 3″·64 = 1923″·64

radius = 961·82″ ✓

Lupton's Heat $\frac{\epsilon_\oplus}{m_\oplus} = \frac{\epsilon_\odot}{m_\odot}$ $\epsilon_\odot = (m' - \frac{2t-m'}{t}) \frac{\epsilon_\oplus}{m_\oplus}$ (2)

$\epsilon_\oplus = \frac{1}{297}$

log 297 = 2·4727564 ✓

col = 7·5272436 ✓

log 289·66 = 2·4618885 ✓

log m' = 5·3249639 ✓

5·3140960 ✓

20611 ✓

log $\frac{2m'}{t}$ = 4·2228734 ✓
7·5272436 ✓
2·4618885 ✓
4·2120055 ✓

16293 ✓

$\epsilon_\odot$ = ·00002061 1 − ·00001629 3 st

·00001629 3
·08
·00000130344

·00001629 3st
07
·00000114041 6
·00002048 1

·00002048 1 ✓ (Carrington) = ·00002059 5 ✓ (Spörer)

$\epsilon_\odot$ =

Let $\epsilon_0 = \frac{x}{1923·64}$

(Carr.)

log $\epsilon_\odot$ = 5·3113512 ✓
2·9830938 ✓
3·0103000 ✓
8·5954750 ✓

·039398 ✓ (Carr)

Spörer

5·3137618 ✓
2·9830938 ✓
3·0103000 ✓
8·5971856 ✓

·039617 (Spör) ✓

∴ Diff^{ce} betw. appt diam^{s} wd be ·0394″ ✓ (Carr.) or ·0396″ ✓ (Spör.)

log 17841 = 5·2514192
2·9830938
3·0103000
8·5355430

Diff. ·03432″ (t = 27)

$\epsilon_\odot$ = ·00001784 1
t = 27 m days

more probable, when (as sometimes occurred with ~~some of the~~ ~~sensitive~~ hypocotyls of Brassica & Beta, the stems of

act of [illegible] thus [illegible]

is produced in [illegible] which are habitually used. It 27

can hardly be doubted, for otherwise it is impossible to understand how the ~~inherited~~ tendency to certain [illegible] can be inherited. That they are inherited

acquired movements, ~~to the~~ the inherited [illegible] which are not natural to them, or contrary to

we see in certain races of the horse, this is the ~~inherited tendency~~

~~the [illegible] We [illegible]~~

ambling — the pointing of pointers & the setting of setters ~~[illegible]~~

in the peculiar manner of flight of certain breeds of the pigeons &c. —

set, ~~[illegible]~~ highly ~~complex~~ [illegible]

We have analogous cases in mankind [illegible] tricks or unusual gestures

being inherited, as will perhaps be alluded to.

in mankind, those who admit the principle of gradual evolution, a most

~~One of the most~~ striking instance of the performance of the

perfection with which consensual movements can be

most difficult [illegible] transmitted, is afforded by the Humming-bird

Sphinx-moth (Macroglossa); for this moth, shortly after its emergence from the cocoon, as shown by the peculiar bloom on its ~~[illegible]~~ unruffled scales, may be seen poised stationary in the air, with its long hair-like proboscis uncurled &

(3

If we take $\theta = 180°$

$\frac{5\bar{m}_0}{2\epsilon_0} = 3.289868$

log 3.289868 = ·517 1695 / 19 / ·5171785 ✓

log A = 9.6020600 ✓
col. = 0.3979400 ✓

col. = 9.4828286 ✓ / ·3979400 ✓ / 9.8807615 ✓

$\log m' =$ 5.3249639 ✓ / 5.2057254 ✓ / 185 / 9

·0000160592 ✓

$\frac{2m'}{t} =$ 9.8807615 ✓ / 4.2228734 ✓ / 4.1036349 ✓ / 267

·00000126957 ✓

∴ $\epsilon_0 =$ ·0000160592 − ·00000126957

·00000126957 / ·08 / ·000000101566 ✓ / ·0000160592

= ·0000159576 (Carr) = ·00000126957 / ·87 / ·000000 088865 ✓ / ·0000160592 / ·0000161481 ✓ (Shöer)

$\log \epsilon_0 =$ 5.2029675 ✓ / 2.9830938 ✓ / 3010300 ✓ / 8.4870933 ✓

30697 ✓

5.208 / 214 ✓ / 2.9830938 ✓ / 3010300 ✓ / 8.4922425 ✓ / 52

31063 ✓

If $f = \infty$

Diff. betw. appˢ diamᵉˢ = (Carr") ·03069 7" ✓ (Shöer) ·031063" ✓

t = 27

·000000 088865 / 12695 / ·000002 158 82

·0000160592 / ·0000215782 / ·0000139010

log 13901 = 5.1430460 / 2.9830938 / 3010300 / 8.4271698

Diffᵉ of diam ·02674"

⊙ t = 27 msdays

more probable, when (as sometimes occurred with the ~~radicle~~ hypocotyls of Brassica & Beta, the stems of Cucurbita ~~sulcata~~ and the cotyledons of Phalaris) ~~the~~ it
(bending up in a straight course ~~abruptly, began~~ suddenly began to circumnutate to ~~the~~ its full extent and in ~~their~~ its usual manner.

A few good instances of a sudden change of this kind from a nearly straight, upward course to one of circumnutation is shown in Fig 183; but more striking instances occasionally occurred with Beta, Brassica & Phalaris.] When on the other hand the upward apogeotropic course is 3/4-3/4, we may infer from the many cases given in our previous chapters, that we have a modified form of circumnutation.

We will now describe a few cases in which it may be observed that the gradually circumnutation becomes changed into apogeotropism, under circumstances to be specified in each instance.

Rubus idaeus (hybrid): a young plant, growing in a pot, 11 inches high, was placed horizontally & its upward movement

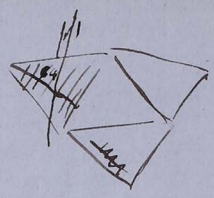
Other column

was examined after 2h 30m, & the other after 23h, but there was no marked change in any of them.

[This specimen was irrigated with a solution of 2 gr. of carbonate of ammonia to 1 oz. of water, & in 4. 5m the protoplasmic lining of most of the cells became thickened in walls & particles appeared contracted. The other was examined after 1h 30m & their appearance was not much changed. A third specimen was treated with a solution of 1 gr. to 1 oz. of water, & after 1h the glands had become pale brown, & contained numerous granules.]

[Four specimens were irrigated with a solution of 1 gr. of bichloride of ammonia to 1 oz. of water. One was examined after 15m & the glands showed protoplasmic lining of the cells thickened & the intercellular tissue was much changed & many granules were visible. In another specimen after 1h 10m there was a good deal of change & the protoplasmic lining of the cells was thickened & the intercellular tissue was also changed. In another specimen after 2h the glands were much changed & had become brownish. Similar effects were noticed in the other specimens, but there was not much change after 21h & the glands had a good deal of their cells destroyed & contained numerous granules.]

II. 1 isosc. △ nearest pole



$\gamma = 19°21'$

$\beta = 70°42'$

63
38
24

$\rho = \cos 19°21' \cot \alpha$ where $\alpha = 9° 18° 27°$

$x = -\cos 19°21' \cot(70°42 + \alpha)$

$\log \cos 19°21' = \begin{array}{r} 9.97475 \\ 10\ 80029 \\ \cdot 77504 \end{array}$ $\rho_9 = 5.957$

$\begin{array}{r} 9.97475 \\ 10\ 48822 \\ \cdot 46297 \end{array}$ $\rho_{18} = 2.904$

$\begin{array}{r} 9.97475 \\ 10\ 29283 \\ \cdot 26758 \end{array}$ $\rho_{27} = 1.852$

$\log \cot 79°42 = \begin{array}{r} 9.97475 \\ 9.25943 \\ 19.23418 \end{array}$ $\Delta x_9 = \cdot 1715$

$\log \tan 88°42' \quad \begin{array}{r} 9.97475 \\ 8\ 35590 \\ 18.33065 \end{array}$ $\Delta x_{18} = \cdot 0214$

$\log \tan 7°42' = \begin{array}{r} 9.97475 \\ 9\ 13099 \\ 19.10574 \end{array}$ $\Delta x_{27} = -\cdot 1276$

36°

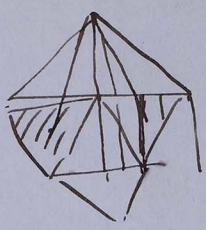
$\begin{array}{r} 9.97475 \\ 9\ 54431 \\ \hline 1.51906 \end{array}$

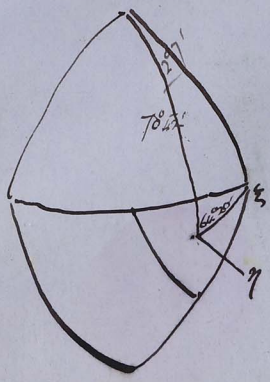
$\Delta d = \cdot 3304$

~~treated~~ in the same manner with urea, but was little affected after 9h.; nevertheless after 23h the ~~or with its~~ ~~of all the~~ spherical cells of the glands ~~were~~ had become ~~brownish~~ ~~brown~~ brown & more shrunk; & the several of the ~~bead~~ glands only the ~~protoplasmic~~ protoplasmic layer had become thin brown & contracted with irregular ~~outline~~ into little masses or particles.]

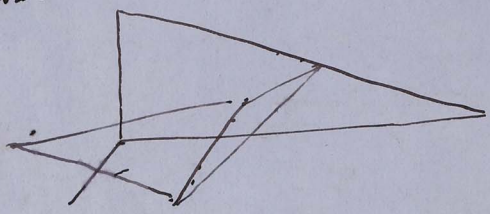
[Two other specimens with all the glands closely & well ~~shrunk~~ shrunk were treated in the same manner; After 5h ~~many of~~ the glands presented ~~some~~ a shrunken ~~& brown thin~~ of brown thin ~~layer~~ with the ~~protoplasmic~~ protoplasmic layer slightly shrunk; After 20h 40m some of the glands were quite brown with irregular aggregated masses of some protoplasmic ~~interior~~ layer shrunk; but the ~~greater~~ were ~~this~~ closely ~~set~~, with the ~~[illegible]~~ walls much affected; This was a greater number & not have unequally to ~~[illegible]~~ glands on the same leaflet ~~as~~ affected & ~~otherwise~~ ~~several~~ ~~after~~ good in time, sp. of which likewise my other ~~[illegible]~~ ~~the~~ ~~plants~~ ~~in a~~ ~~[illegible]~~ ~~[illegible]~~ be stored with ~~plants~~ growing in fresh water. Two other ~~[illegible]~~ plants specimens were treated with a solution of ~~urea~~ of the same ~~several~~ days ~~[illegible]~~ strength, but which had been kept for ~~[illegible]~~ ~~[illegible]~~ in a warm room & had partly ~~[illegible]~~ decayed: anyhow the ~~[illegible]~~ glands were not at all affected, changed ~~the~~ 21h. after irrigation.]

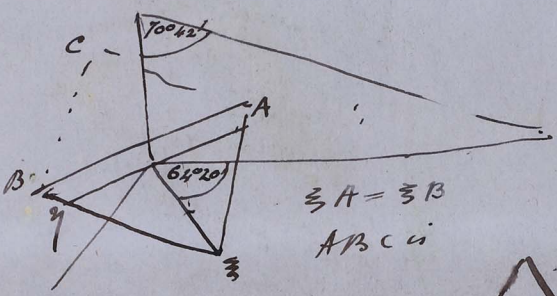
II Equatorial quasi: Δ
log. log cos: Δ



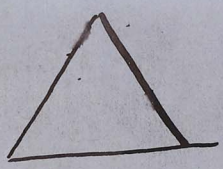


Sphere seen from inside



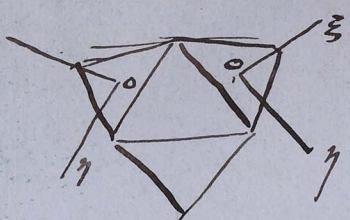


∠A = ∠B
ABC ∼



γ = 19°21'
β = 70°42'
θ = 64°20'

tan ψ = cos 70°42' cot 64°20'
tan χ = cos 70°42' tan 64°20'



log cos 70°42' = 9.51919
log tan 64°20' = 10.31826
9.83745

χ = 34°31'

log cos 34°31' = 9.91591
or χ

log cos 70°42 = 9.51919
log cot 64°20' = 9.68174
9.20093

ψ = 9°1'

log cos ψ = 9.99460

Mitchell

[illegible] Nutrition, by an act [illegible]
on, or any slightly [illegible] body. If however,
the protoplasmic layer contains living [illegible]
for cross grooves, does this not permit
[illegible] action for nutrition. Hence it
[illegible] that the gland [illegible] after absorbing to the
appears [illegible] full of this work! [illegible]
[illegible] full [illegible] of absorption; [illegible] I have
[illegible] nothing to publish, [illegible] this by an
never seen any appearance [illegible] this picture closely
[illegible] capable of receiving [illegible] this condition.

From the action of the Nutrient Acid [illegible] on the
glands, I presume that nitrogen is absorbed in the form of
bodies, more or less [illegible] aggregated protoplasmic living [illegible] of the other glands
[illegible] to [illegible], aggregates, [illegible] more [illegible] [illegible] [illegible] [illegible]
in the [illegible] other bodies which never seen by me or by any one to undergo [illegible] changes
of form so characteristic of protoplasm. [illegible]

hand the protoplasmic living [illegible] of the large spherical glands, [illegible] to
[illegible] the [illegible] edge of the valve [illegible]

I. 3

Bottom corner of polar sub-triangle

$\beta = 48°34'$ $\theta = -44°31'$

$\gamma = 19°21'$ ϕ of longitude be measured from the corner we must write $15°3' - \phi$

$\rho = \cos 19°21 \cot \alpha$ $\alpha = 54°, 45°, 36°, 27°$

$x = -\cos 19°21 \cot(\alpha + 48°34')$

36
65·26
26 34
48
54
102·34
90
12°

$x_{54} = \cos 19°21' \tan 12°34'$ 9·97475 9·34814 1·32289

$\rho_{54} = \cos 19°21' \cot 54°$ 9·97475 9·86126 1·83601

$x_{54} = ·2103$ $\rho_{54} = ·6856$

$x_{45} = \cos 19°21 \tan 3°34'$ 9·97475 8·79470 2·76945

$\rho_{45} = \cos 19°21 \cot 45°$

$x_{45} = ·0588$ $\rho_{45} = ·9435$

$x_{36} = -\cos 19°21 \cot 84°34'$ 9·97475 8·78825 2·95300

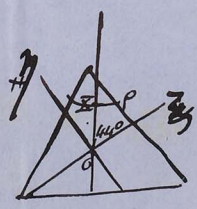
$\rho_{36} = \cos 19°21' \cot 36°$ 9·97475 10 1·38774 ·11349

$x_{36} = -·0897$ $\rho_{36} = 1·298$

$x_{27} = -\cos 19°21 \cot 75°34'$ 9·97475 9·41657 1·38832

$\rho_{27} = \cos 19°21' \cot 27°$ 9·97475 10·29183 ·26758

$x_{27} = -·2428$ $\rho_{27} = 1·852$



(43 A

Otherwise
chief
proposed of this function, would be absorption

of matter from the water occasionally emitted

from the which contain decaying animals, the

from the Wells

they would require to act more quickly

on them
the to endemics & epidemics; but their

in present contact with the decaying

matter.

I, 2 Central △

$\beta = 37°23'$
$\gamma = 20°54'$ $\quad \theta = 0$

58 17'
31 43
53 17

$\rho' = \cos 20°54' \cot \alpha$
$x = -\cos 20°54' \cot(37°23' + \alpha)$ when $\alpha =$ 54°, 45°, 36°

Dist^{ce} of N.P = $\cos 20°54' \tan 37°23'$
Intercept = $\cos 20°54' \sin 37°23' \tan \varphi$ when $\varphi = 9°, 18°,$

log cos 20°54' = 9·97044 / 9·86126 / T·83170

9·97044 / 10· / T·97044

9·97044 / 10·13874 / ·10918

$\rho_{54} = \cdot 6788'$
$\rho_{45} = \cdot 9342$
$\rho_{36} = 1.286$

9·97044 / 9·40108 = cot 74°54' / T·40152

9·97044 / 9·65062 cot 65°54' / T·62106

9·97044 / 9·81418 cot 56°54 / T·78462

log tan 37°23' 9·97044 / 9·88315 / T·85359

N.P
$x_{63} = \cdot 7138$

log tan 1°33' = 9·97044 / 8·38 / T·35 = -0226

log sin 37°23' = 9·97044 / 9·78329 / 9·75371 / 9·19771 / 2·95342

OM, $OM_1 = \cdot 0898$

log cot 82°23' 9·97044 / 9·12621 / T·09665

$x_{45} = \cdot 1249$

9·75371 / 9·51178 / T·26549

$OM_2 = \cdot 1843$

log cot 73°22' = 9·97044 / 9·47484 / T·44528

9·75371 / 9·70717 / T·46088

OM_3 ·2890

$x_{36} = \cdot 2788$

$\alpha = 27°$
log cot 27° = 10·29283 / ·28327

$P_{27} = 1.920$

x_{63} 37 23 / 27 / 100 64 23

9·97044 / 9·26301 / T·23345

37 23 / 45 / 82 23

37 23 / 54 / 91 23'

9·97044 / 9·68077 / T·65121

$x_{27} = \cdot 4479$

9·97044 / 9·70717 / T·67761

$P_{63} = \cdot 4760$

$x_{63} = \cdot 1712$

Ulricularia

33

The [illegible] is found by the inflexion of

the medial part of the dorsal surface of the

bladder; or the [illegible] by a similar inflexion
I believe this is the case with the [illegible] and [illegible] in my [illegible].
of the [illegible] when the bladders are

viewed from [illegible] above, a [illegible] change in

the action of the [illegible] will be seen at the

corners of the elliptical orifice, these [illegible]
(I know this is an [illegible] [illegible]
dorsal [illegible] surface, [illegible] [illegible]

from their [illegible], & [illegible] the

the reflexes of the [illegible] of the bladder

[illegible] I conclude that it is found by

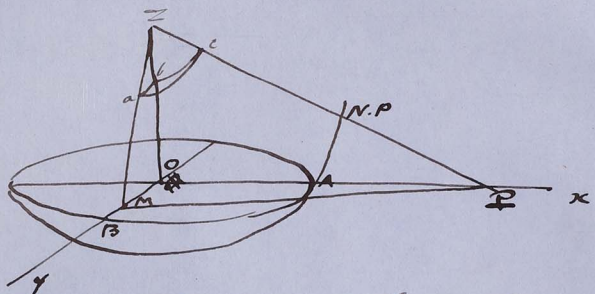
[illegible] the division of the [illegible]
by this edge.
[illegible] being [illegible]

left

the [illegible] lines which by their [illegible]

are fed by them, & carry on the centre of the

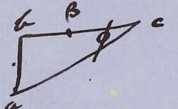
Next to find the meridians



Let PMZ be the meridian of long: ϕ measured from PAO

Then $OP = \cos\gamma \tan\beta$

$OM = OZ \tan OZB = \cos\gamma \tan OZB$



Now $\sin\beta = \cot\phi \tan ab$

$\therefore \tan OZB = \sin\beta \tan\phi$

$\therefore OM = \cos\gamma \sin\beta \tan\phi$

$\therefore$ The eq^{n} to the meridian is

$$\frac{x}{\cos\gamma\tan\beta} + \frac{y}{\cos\gamma\sin\beta\tan\phi} = 1$$

If the axes are rotated thro' an $\angle\theta$

$$x = \xi\cos\theta - \eta\sin\theta, \quad y = \xi\sin\theta + \eta\cos\theta$$

$$\therefore \xi\left(\frac{\cos\theta}{\cos\gamma\tan\beta} + \frac{\sin\theta}{\cos\gamma\sin\beta\tan\phi}\right) + \eta\left(\frac{-\sin\theta}{\cos\gamma\tan\beta} + \frac{\cos\theta}{\cos\gamma\sin\beta\tan\phi}\right) = 1$$

$$\xi\left(\frac{\cos\theta\cos\beta\sin\phi}{\cos\gamma\sin\beta\sin\phi} + \frac{\sin\theta\cos\phi}{\cos\gamma\sin\beta\sin\phi}\right)$$

$$+ \eta\left\{\frac{-\sin\theta\cos\beta\sin\phi + \cos\theta\cos\phi}{\cos\gamma\sin\beta\sin\phi}\right\} = 1$$

I Polar sub. triangle

1. Polar Δ.

$\beta = 19°21'$, $\theta = 0$
$\gamma = 19°21'$

$\rho = \cos 19°21' \cot\alpha \tan\alpha$
$x = -\cos 19°21' \cot(19°21' + \alpha)$

where $\alpha = 81°, 72°, 63°$

$\rho_1 = \cos 19°21' \cot 81°$

$\rho_2 = \cos 19°21' \cot 72°$

$x_1 = \cos 19°21' \tan 10°21'$

$x_2 = +\cos 19°21' \tan 1°21'$

Intercept $x = \cos 19°21' \tan\beta$ on north pole

$y = \cos 19°21' \sin 19°21' \tan\varphi$ where $\varphi = 9° 18° 27°$

$\log \cos 19°21' = 9.97475$
$\log \cot 81° = 9.19971$
$\overline{1.17446}$

$\rho_1 = .1495$

$\log \cot 72°$ 9.97475
9.51178
$\overline{1.48653}$

$\rho_2 = .3066$

$\rho_3 = .4804$

9.97475
$\overline{1.70717}$
$\overline{1.68192}$

9.97475
9.26158
$\overline{1.23633}$

$x_1 = .1723$

9.97475
9.12813
$\overline{1.10288}$

9.97475
8.37229
$\overline{2.34704}$

$x_2 = .0222$

$x_3 = -.1267$

$OM_1 = .0495$

$\sin 19° = 9.52027$
$\cos 19° = 9.97475$
9.49502
9.19971
$\overline{2.69473}$

$OM_2 = .1016$

9.49502
9.51178
$\overline{1.00680}$

9.49502
9.70717
$\overline{1.20219}$

$OM_3 = .1593$

Utricularia

Cocked divisions, ~~again~~ bifurcating at ~~first from the bladder~~, ~~bifurcating~~ their summits ~~in the same manner~~. And there can be little doubt that ~~in~~ the two are bifurcation of the dorsal division; for each consists ~~dorsal~~ of several rows of cells with chlorophyll, bearing papillae & [they do not include, as far as I could see, any vessels ~~...~~] ~~...~~ on the true leaves; spines, like those antennae. ~~bifurcation of the dorsal division~~. Whilst the true leaves are extremely young, the bifurcations are sometimes ~~very young~~ very near each other, so that the two divisions are ~~...~~ each other equal in size & nearly, but never quite opposite ~~...~~ sometimes nearly ~~of equal size~~. So it might be with the antennae, & in five instances ~~for occasions~~, I ~~...~~ observed that the antennae at an ~~early~~ ~~...~~ were not of equal length. [period of ~~development~~ growth. Hence we may infer that their development had not commenced at exactly the same ~~period~~ time.]

Therefore the intercept on the axis ξ

is $$\frac{\cos\gamma \sin\beta \sin\varphi}{\sin\theta\cos\phi + \cos\theta\cos\beta\sin\varphi}$$

& on η is $$\frac{\cos\gamma\sin\beta\sin\varphi}{\cos\theta\cos\phi - \sin\theta\sin\phi\cos\beta}$$

To adapt to logar. calc.

put $\tan\psi = \dfrac{\cos\beta\sin\theta}{\cos\phi\sin\theta}$ & $\tan\chi = \dfrac{\sin\varphi\cos\beta}{\cos\varphi}$

$= \cos\beta\cot\theta$ $= \cos\beta\tan\varphi$

$\tan\chi = \tan\theta\cos\beta$

$\therefore$ intercept ξ

$$= \frac{\cos\gamma\sin\beta\sin\varphi}{\sin\theta\cos\varphi + \sin\theta\sin\varphi\tan\psi}$$

$$= \frac{\cos\gamma\sin\beta\sin\varphi\cos\psi}{\sin\theta\cos(\varphi-\psi)}$$

intercept η $$= \frac{\cos\gamma\sin\beta\sin\varphi}{\cos\theta\cos\phi - \tan\chi\cos\theta\sin\varphi}$$

$$= \frac{\cos\gamma\sin\beta\sin\varphi\cos\chi}{\cos\theta\cos(\chi+\phi)}$$