

see p 314

Look up color in Botany - Schyler Matthews 36.  
" " Mineralogy  
Mr. Watts at Suffolk Eng. Co. Color printing

Nov 13  
1900

Institute of Technology 12-1  
Prof. Cross - Says he is interested in my efforts -  
"Would like to have a scale (aesthetic) tested by  
photometer. "Since all is referred to the eye - which  
has a variable pupil, difficult to attain scientific  
results.

Cites the many complementaries which belong to any  
color - by addition of white light.  
.. Accepts the method of obtaining a spectrum circuit  
of middle value.  
Recounts his feelings - the two times he gave a course  
of lectures on color to the art students (request of  
Prof. Ware) - First time pleased - second disgusted -  
as the latter audience was young, amateur and unable  
to apply the scientific material practically.

Prof. Clifford: (lunch at Victoria 1.-2:30)  
Looks at Abney's apparatus and writes Queen of  
Philadelphia to ask if they have the revolving sector.  
Suggests giving a sample of red to several students,  
and letting them work out the balanced circle -  
to see if it exactly reproducible.

.. Is pleased to hear Prof. Cross accept the idea of  
the color-sphere-

Is emphatic that I had better not try to base it  
upon wave-length.

Nov 27

Studio, Trinity Court - Prof. Dolbeare 10:15-1:15 37.  
"The wave-lengths of the physicist are unserviceable  
for the artist and business man - being impracticable  
and impossible. Color is an ancestral and racial  
experience - not based on the spectrum.

This color-sphere arrives at a higher degree of  
accuracy and convenience than any methods hitherto  
devised.

The eye judges by sensations and is the ultimate test.  
Altho this sphere lacks perfection from a physical  
standpoint, (source and nature of light should be  
defined as well as its reflection), yet it eliminates  
the personal bias (that would make it a private matter)-  
and is an approach to a standard that can be depicted  
at will by numbers.

Terminology: - shall it be based on spectrum wave

lengths, - or upon the physiological effect  
which the wave lengths produce on the retina?

37.

To the artist it must be the latter.

To be ideal scientifically - it should define  
the nature of the original source of light, and  
the proportion of incidental light which is  
reflected and absorbed.

Yellow of the sphere not a typical color- (not  
the usually accepted type) - but a medium yellow  
between highest light and darkest dark.

(all color a question of contrasts, (simultaneous  
and successive) of which the eye is the  
ultimate judge.)

"Since pictures cannot possibly be painted  
with the spectrum hues - therefore the colors in  
that spectrum are not to be considered as a basis  
for works of art.

Pigments must be the basis - even with all their  
limitations, since they are the only possible and  
practicable means.

"Your system seems right. I would like <sup>one</sup> to use  
in the class-room and make it the basis of a  
lecture.

Dec 1

Studio at Trinity Court 10:30 -1:30  
Hall and Bailey (Bradley invalid) talk over the  
scheme, and believe it should be in the schools -  
since the present methods fail to teach harmony or  
color relations. Bailey wants to know what other  
parties are interested: - Asked if I have approached  
Frang - (said no) Acknowledges that the scheme  
explains these difficulties, - such as "potentiality"-  
and paths of increasing greyness.  
Hall is enthusiastic and calls it "perfect". Wants  
it as soon as possible in the schools.  
Bailey says what the supervisors choose for Mass.  
schools gets to its western market in five years  
(Matsuki's testimony). Likes the kindergarten  
specimens I show.

38.

Dec 5  
1900

Worthington Ford

You put a scale into the hands of everybody -  
The architect and designer can no longer claim  
exclusive estimates. It is like the inter-  
changeable parts in machinery, a universal scale.  
What atomic weights have done for chemistry -  
this will do for color. Can any manufacturer  
exactly reproduce it without variation?  
"Is your average middle value based upon a

sufficiently large number of estimates?

38.

Dec 9 Exhibited sphere at XX Century Club.  
Mr. Filene asks to have it shown to the  
Shopkeepers' Asso. - Fri. Dec. 21, 5:30-6:30

Dec 11 Call on Mr. Blodgett of W. T. Matheson & Co.  
496 Atlantic Ave. (Mr. Jepson)  
Mr. Perkins advises copyright on charts:-  
12" advises titles only for copyright,  
one for each chart.

227

Dec 13 Bailey and Sargent at Studio.  
Discuss introduction of the color-sphere and  
its stages - in Report of Board of Education, 1900.

39.

1st yr	spectrum	5 colored balls	-+ all on one ball
			<u>names &amp; order centrals</u> (?)
2nd "	"	10 " "	- and all on one ball - <u>intermediates</u>
3rd "	"	3 step sphere	- and middle grey
4th "	"	"	- three paths
5th "	"	5 step sphere	
6th "	"	"	- " finer distinctions
7th "	"	10 step sphere	" sequences complete
8th "	"	"	complementaries
9th "	"	"	"
10th "	"	"	"

Dec 27 Bailey writes enclosing Bradley's attempt at a  
"middle red"  
I answer that it is made up of parts (red 7 and  
grey 3) with values over 40' apart. Also ask to  
see proof if my classification or experiments are  
being used.

see p 89

2:30 Show same and two copies of chart 50<sup>v</sup>  
to Mr. Perkins.

Jan 2&3 1901 Write both Bailey and Sargent that I object to  
any use of my color-system or experiments - and  
reserve rights to give it publicity myself at the  
proper time.

Jan 7 Called on Fritchard - about printing charts. He  
writes Scribner & Co.

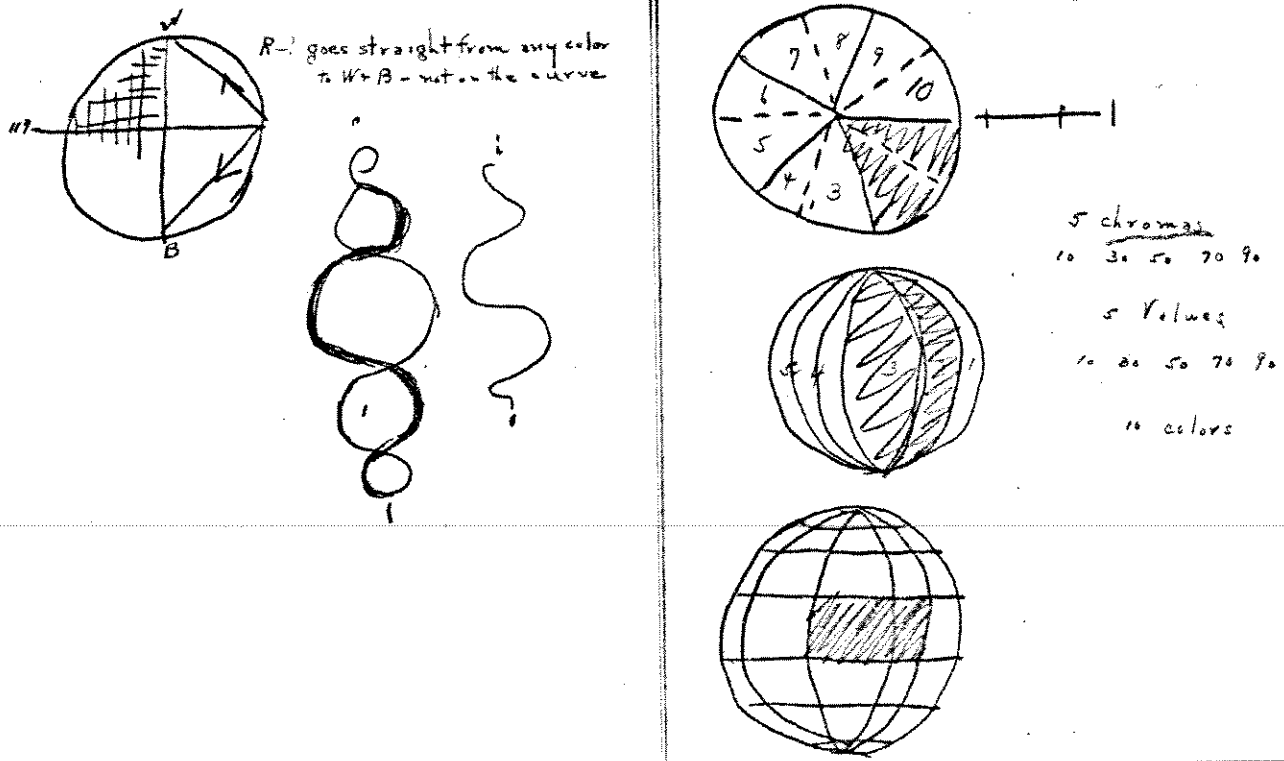
8 Called on Prof. Clifford - at M. I. T.

9 Lunched with Prof. Clifford at Tech Club..222

"Fit details, strictly combined in view of a large general result, nobly conceived."  
 Matthew Arnold.

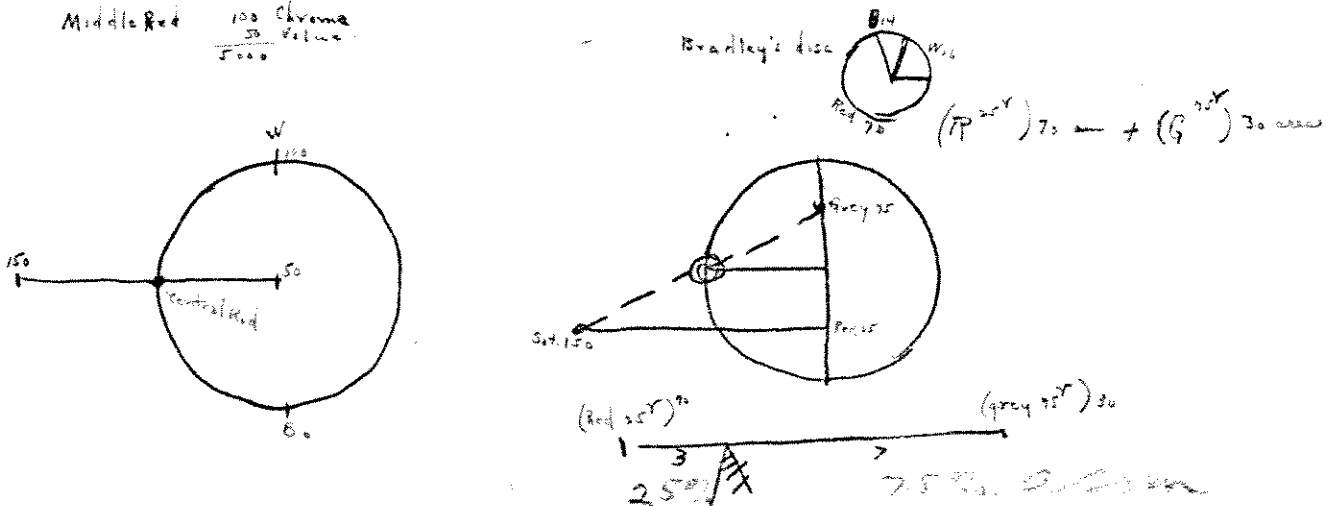
38a.

"The free and adiquate embodiment of an idea - in a form peculiarly appropriate to the idea itself."  
 Hejel.

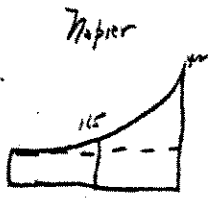


Middle Red  $\frac{100 \text{ Chroma}}{50 \text{ Value}}$

39a.

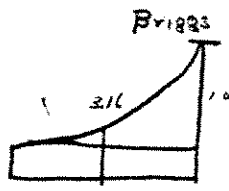


(Bradley's letter to Bailey shows me that the latter has discussed my plans and system with Bradley before passing in his annual report as State Agent for promotion of Drawing, and wishes to obtain a "middle red" by indirection. This I refuse to furnish.)



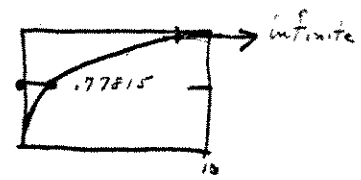
S = K log I

S <sub>cm.</sub>	I
1.5	2.72
1.4	1.85
1.3	1.37
1.2	1.11
1.0	1.



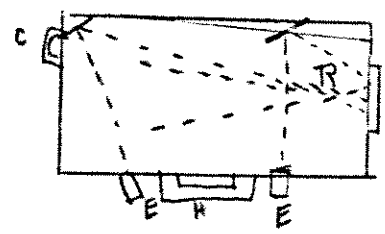
9) 2.16 (24%)  
18/36

Evidently the middle point must shift with the intensity of illumination.

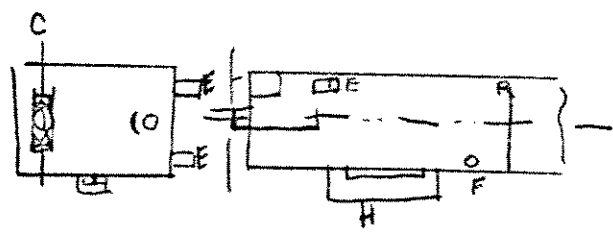


1.72 ) 1.53 (32.7%)  
516  
1340  
1370

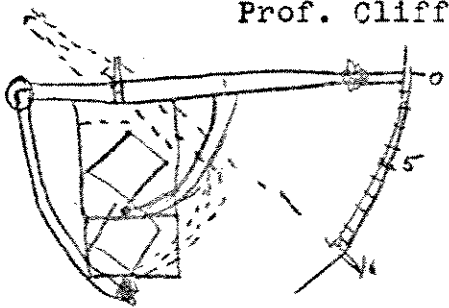
Jan 15 1901 Designed photometer - to measure luminosity of various pigments and stuffs - by daylight-



box 50<sup>cm</sup> long -  
2 d. c. lenses - 50<sup>cm</sup> focus  
6<sup>cm</sup> dia. set to converge  
on rod R.  
1 lens with square shutter  
calibrated O  
Eye-piece and mirror E  
Handle underneath H



Prof. Clifford approves - (doubts necessity for lenses) advises corner castseye.

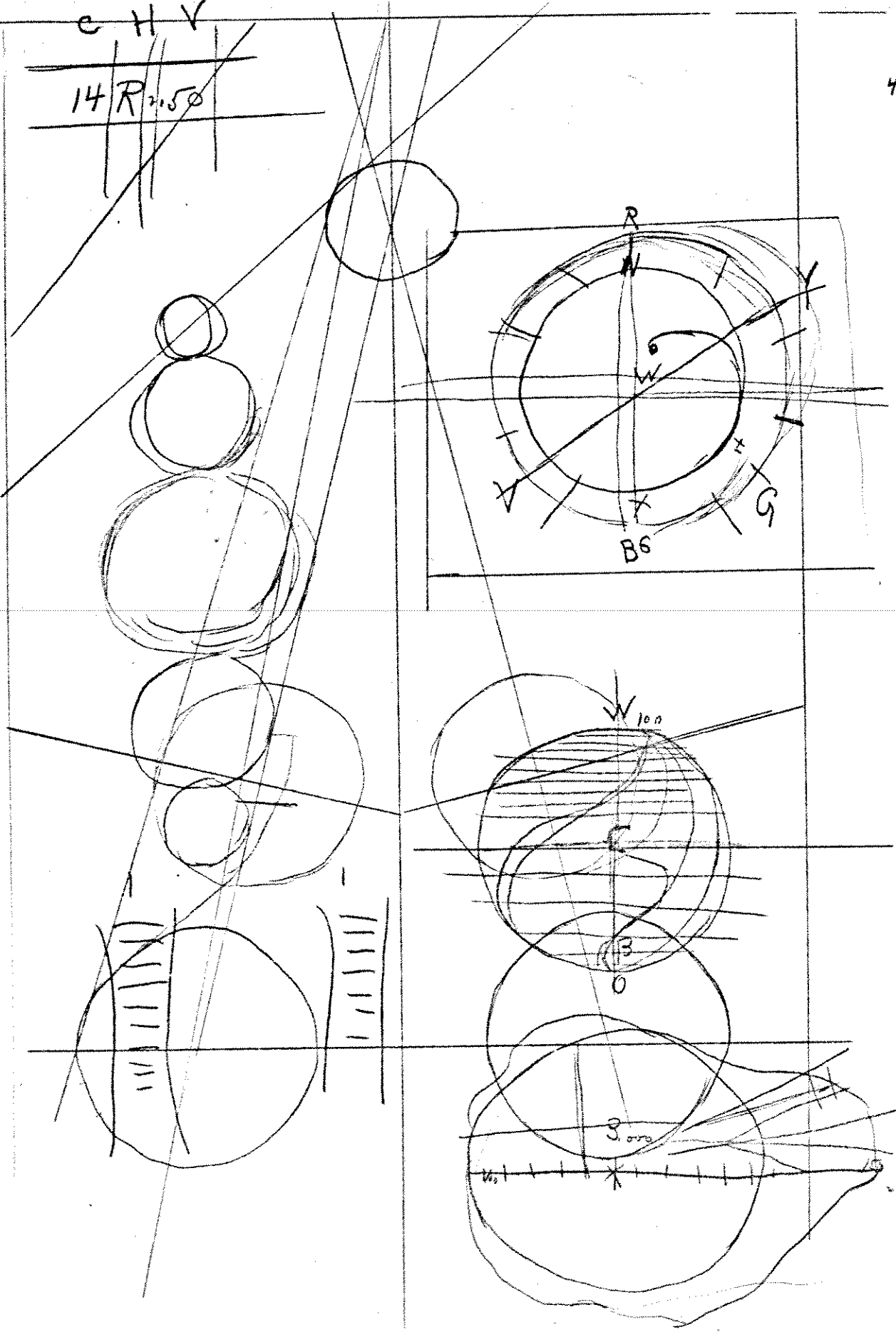


Jan. 16 - Found mirror and tubes unnecessary - Adapted stereoptican shutter - with square aperture - and elongated lens to act as vernier - and calibrated arc.

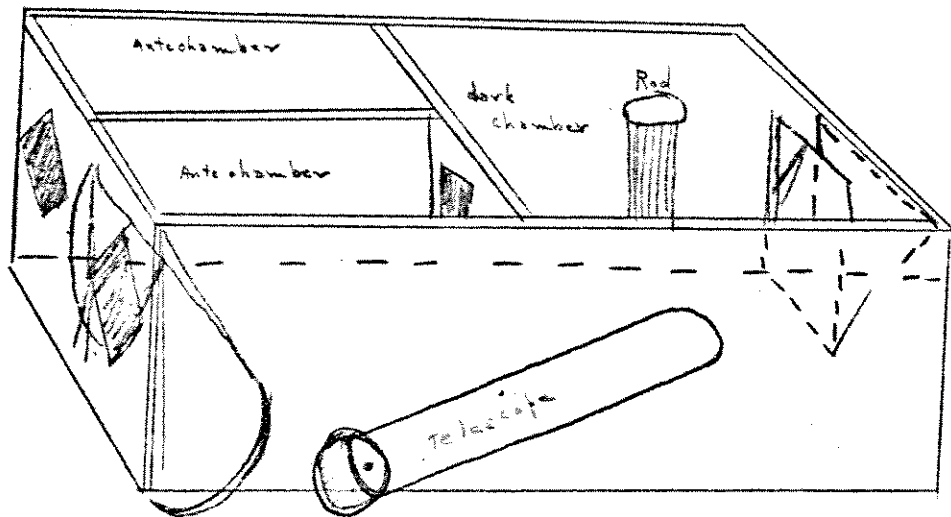
e H V

14 R 1.50

4/21



Jan. 17<sup>th</sup>

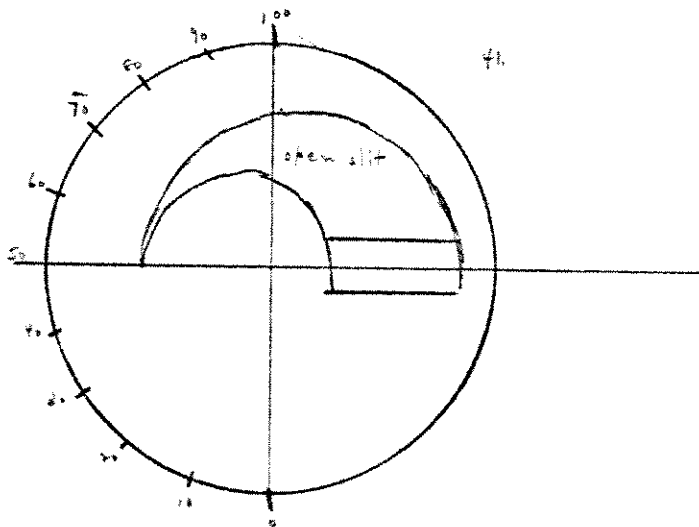


40.

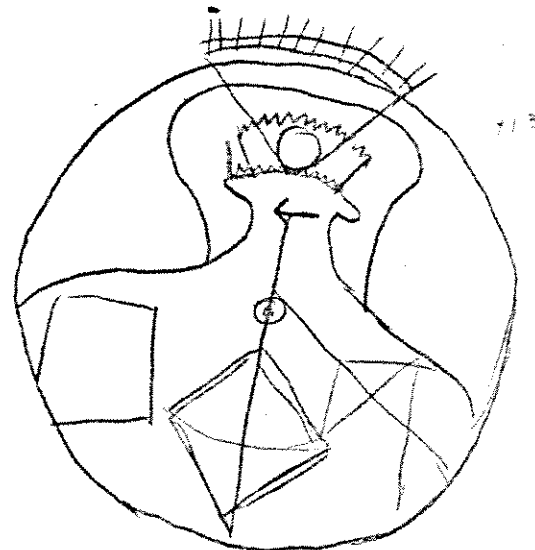
Jan 18. Showed daylight photometer to Mr. V. L. George and Mr. G. E. Morris -

Jan 19 Described it to Capt. Phinney going on a train and to E. W. Kingsbury who called at studio.

Jan 21 Made shutter in form of circle - with diminishing slit and graduated circumference.



41.

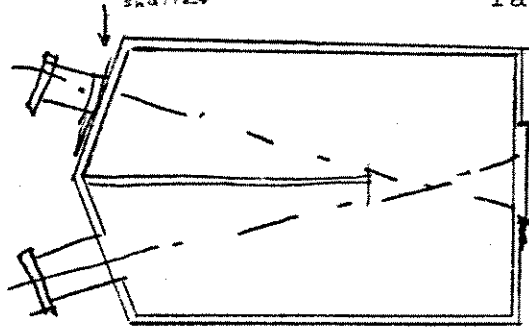


42.

Jan 22

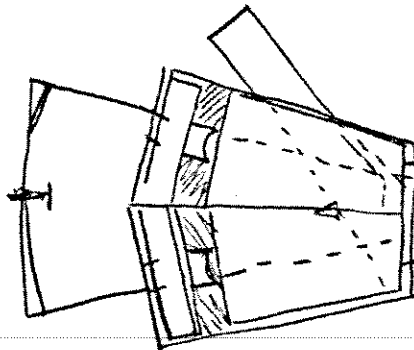
Made simpler form - cigar box - 3x5x7 - with facets on end.

41.



Area square of distance.

Jan 24



Joined two "brownie" cameras and fitted above shutter. Arranged two mirrors - at adjustable angle to throw light in axes of lenses. -

Made appointment with Prof. Clifford for Jan. 29 at 2 P.M. to establish photometer values.

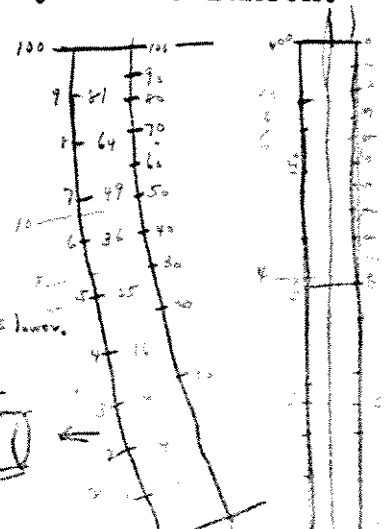
Jan 29

Prof. Clifford comes to test my photometer. - We measure six grey to white values- and five central colors (also one saturated red)

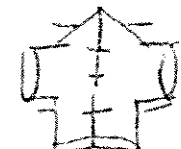
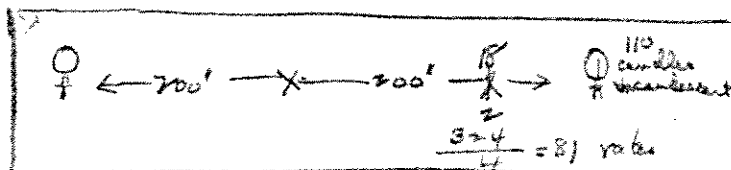
42.

No of Specimen	Readings			
	M's phot.	C	M	Inst. Phot. Rates
6	.54	4.	3.8	4
10	.68	1.49	1.44	2.2
2	.16	out of range		of Bunsen
8	.56	2.78	2.22	3.2
4	.33	10.	10.	9.7
1	0.			
R	37.5	126.	125.	3.
Y	40		133	4.
G	40	136	135	4.
B	39			
P	39			
Sat. red photo-mount (middle grey)	36			
	.6	4.30	4.15	

Light at midday - blue sky. Then repeat measures of Institute Bunsen Photometer. Prof. Clifford thinks mine better for diffused light than the Bunsen. Both for juxtaposition of samples and for extreme readings- which fall out of range of accuracy on the Bunsen.



No readings always lower.



42. ...





Jan 30

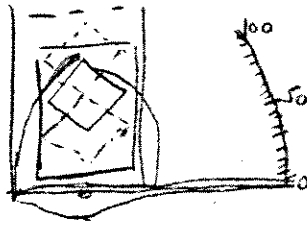
Telephoned Mr. Perkins that I have a new claim for patent - arranged for 4:45 at studio.

43.

Described Rumford and Bunsen photometers, their size - nature - limitations.

Saw Mr. Perkins - Abney's book on color-measurement. Showed my various models - from 4-24 inches in size. Explained antechambers and dark room - calibrated shutter, - ground glass screens - eye piece and mirror- explained its advantages over existing photometers.

viz:



Advantages

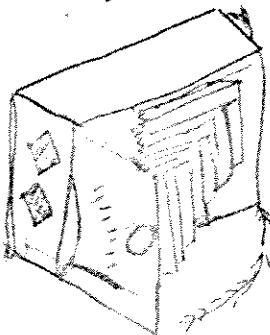
- 1 - Can be used in daylight or artificial light.
- 2 - No dark room or installation necessary.
- 3 - Reads accurately from 0 - 100 -  
(Bunsen only from 20 - 80 -)
- 4 - Can be carried in the pocket.
- 5 - Gives normal conditions of sight.  
(Eye greatly distended and fatigued in dark room)
- 6 - Places samples side by side - So that both eyes see both samples at once - at the same angle - So that the eye and the judgement. are both normal and at their ease.
- 7 - Prof. Clifford says it is better for color-measurement than the Bunsen because
  - 1 The juxtaposition of the two patches is an advantage.
  - 2 Its use of daylight instead of artificial light.
  - 3 Its accuracy.

Jan 31

Designed folding pocket form of daylight photometer.

44.

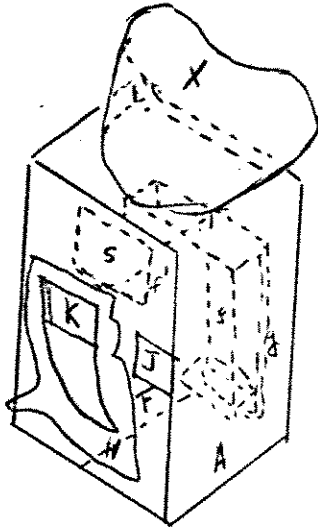
Hinged front board carrying scale and shutters - with eye-piece. Bellows to close down against box when folded for pocket.



Simplified design

Feb. 2, 1901.

44a.



- A- box 4"x3"x1 1/2".
- F-Central partition
- J.K. -apertures with ground glass 1"x3/4"
- N- Rotary shutter-calibrated on face
- s-mirror within
- x-adjustable hood to eye-piece
- f-f'- patches to be measured
- g.g- slides to hold f and f'

Feb 1 4-5 Discussed application and claims with Mr. Perkins at office.  
 "Measures color, pigments, lights, and other substances, and excitation of retina at each degree of illumination.  
 A box having two apertures in one end - with partition to isolate the two beams of light with calibrated shutter to measure the relative openings.  
 Can be used in daylight, by artificial light or in dark room.

Feb 2 Readings at midday. Very bright, clear sky.

		read previously	mean of readings	
6 -	50	50	49	49.66
	86	86	85	85.66
1/2	16	16	17	16.33
8	60	56	61	57.
4	33	33	34	33.33
R	37	37	39	37.83
Y	39	40	43	40.66
Q	43	40	41	41.33
B	43	39	45	42.33
P	42	39	40	40.33

mean of variation 1.13%

Note: Patches side by side is also in photometer by - LeChatellier - optical pyrometer Stevenson's

45a.

Feb 2 4:30-5:30 At Mr. Perkins' - recast application - and claim "An improved photometer, consisting of a box, -having two apertures in one face thereof, - a central partition located between said apertures, and isolating from each other the beams of light entering therein,-- combined with a calibrated shutter to vary the size of one of said apertures, substantially as described." -

45.

- 1901 Feb 5 ? 1. two or more apertures for admitting beams 45.  
 2. partitions for isolating said beams  
 3. shutters for measuring the relative amounts of light

lens or lenses? or other media -

- Feb 5 Prof Clifford suggests B--& Bergen to construct a cat's eye of 10 diagonal - with scale and pointer to give proportion of opening.

Mr. Perkins goes over papers and takes signatures.

- Feb 20 Patent examiner quotes Lovibond's Tintometer, as anticipating my photometer. (Dibdin's Practical Photometry- pages 152-153) 46.

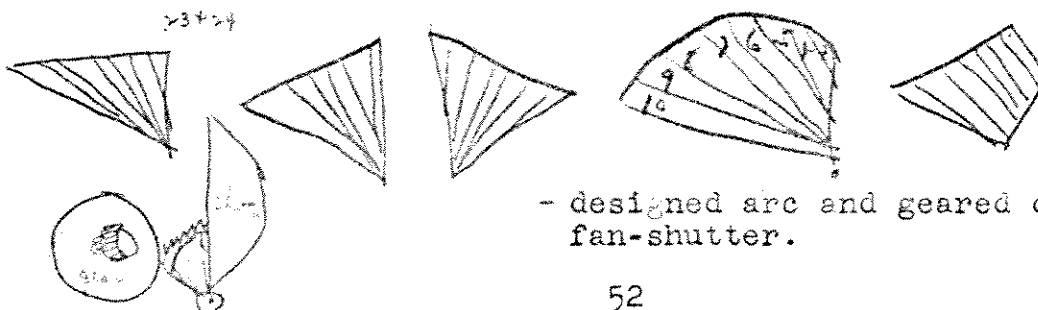
- Feb 21 Prof. Clifford calls to arrange for my talk before the M. P. Club - at Prof. Peabody's (10 Columbia St., Brookline) on Monday, Feb. 25 at 8 P. M.

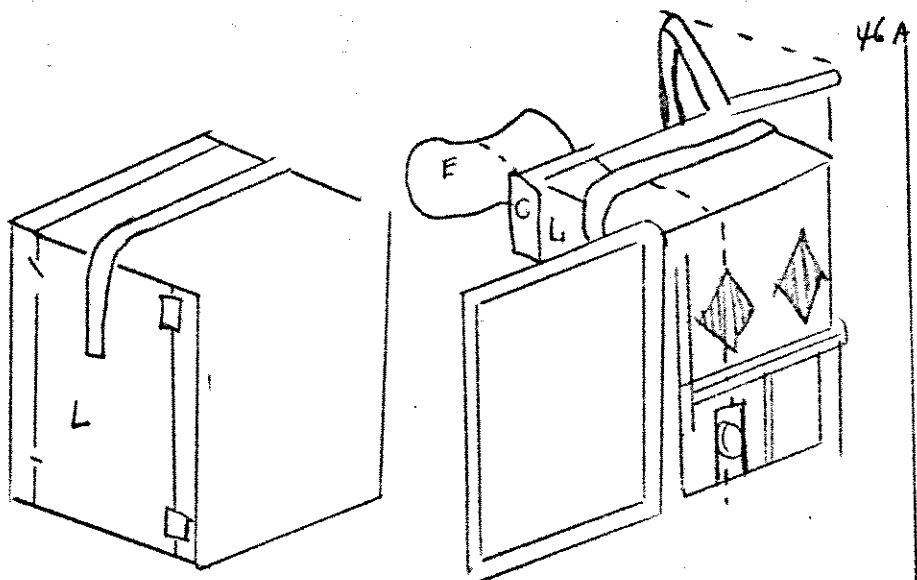
He says of Lovibond's Tintometer that it depends on absorbing media (glass, liquids, milk, etc) each of which has a variable color ratio, - and cannot therefore be related into one system; that my instrument is free from this limitation, - and guarantees identical conditions both of the light and the surfaces contrasted.

The calibrated shutter cannot be likened to the superposed media of Lovibond, - for the shutter measures the quantity of light which produces any illumination - while the media set up unrelated ratios of transmitted colors.

In short, Munsell's photometer "does not depend upon absorbing media - and consequently the illumination is not changed in quality. This is not true of the Tintometer, where the variable ratios for each colored media are fatal to colors, - and cannot be related into one system." He says this himself when stating that the red ratio is 77 as compared with 222 for blue and 239 for yellow.

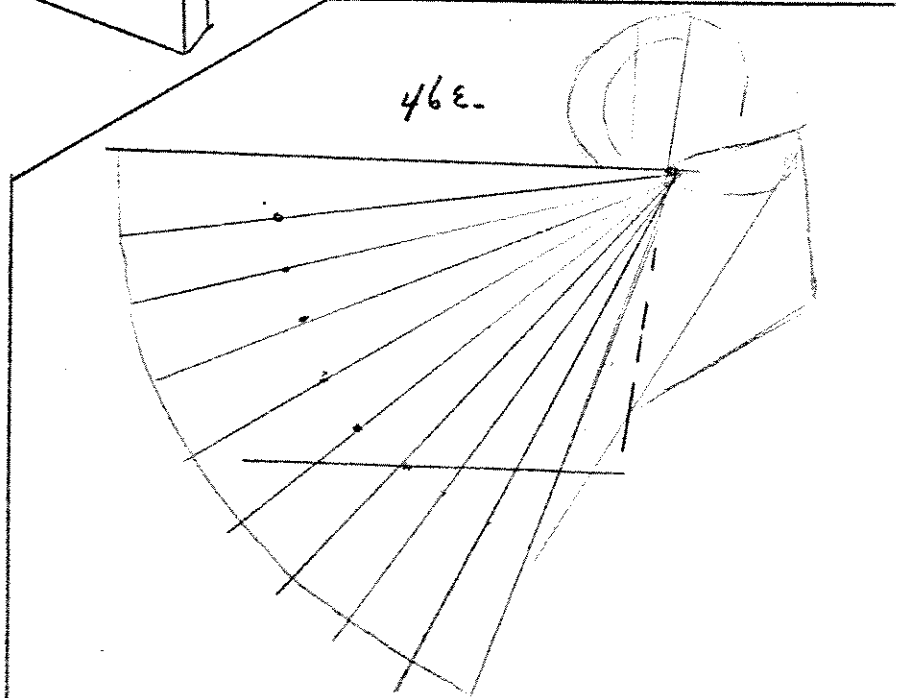
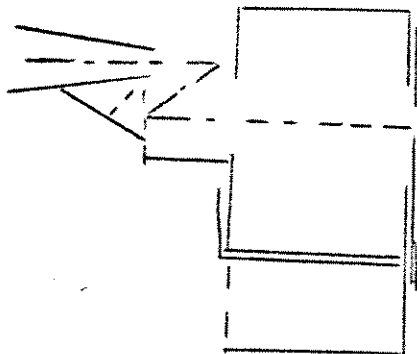
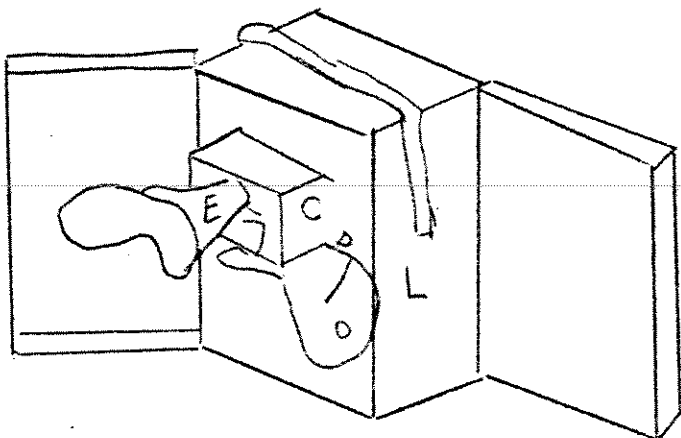
- Feb 22 Experimented on apertures describing sensation of retina to carry out logarithmic curve.





46A

46a.  
 A newspaper clipping appears here, beginning:  
 "There is hardly ever an invention of any importance brought out, but what some one springs up to claim a prior conception of the idea and device." ----- and it goes on to give examples.



46E

There are notes with this figure which are repeated on p. 52 - comparing the Munsell photometer and Lovibond's tintometer.

M. I. T.

February 15, 1901.

My dear Mr. Munsell,

Will you not give a little talk on your color sphere before the M. P. Club, quite informally, at its next meeting on Monday evening, February 25th. The club meets at the house of some one of our members and the mystic M. P. is not Metropolitan Police or Member of Parliament, but plain Mathematics and Physics. I have the misfortune to be secretary. A talk of say half an hour would I am sure interest the members and might bring out something in discussion. I will come in to your studio on your reappearance from what I take to be grippe.

Sincerely,

H. E. Clifford.

M. I. T.

February 19, 1901.

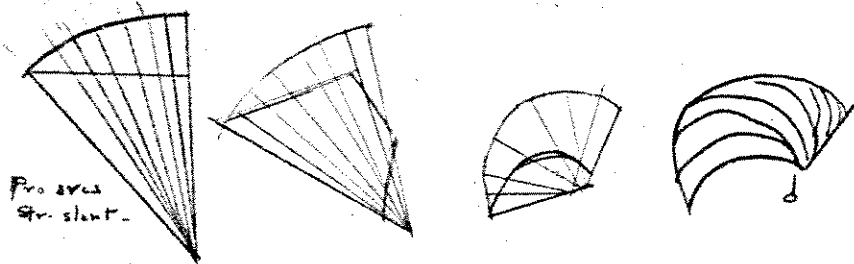
My dear Mr. Munsell,

I shall then depend upon you for half the evening's entertainment on Monday next, the 25th, and will come over to the studio on Thursday or Saturday, at 12 o'clock, to arrange about transport, and any accessories of the campaign.

I am much pleased, selfishly, at your being willing to present the matter for I have as yet not heard its sequential development.

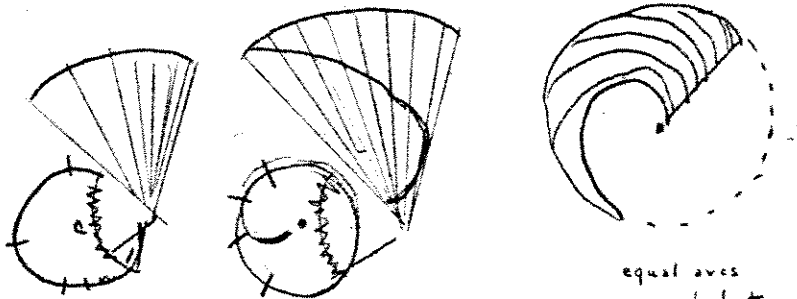
Sincerely,

H. E. Clifford.



Pro area  
90° slant.

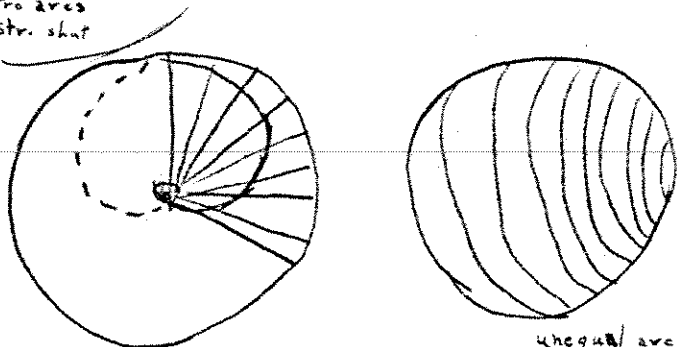
46  $\frac{1}{2}$  a.



equal area  
str. shut

equal area  
curved shut

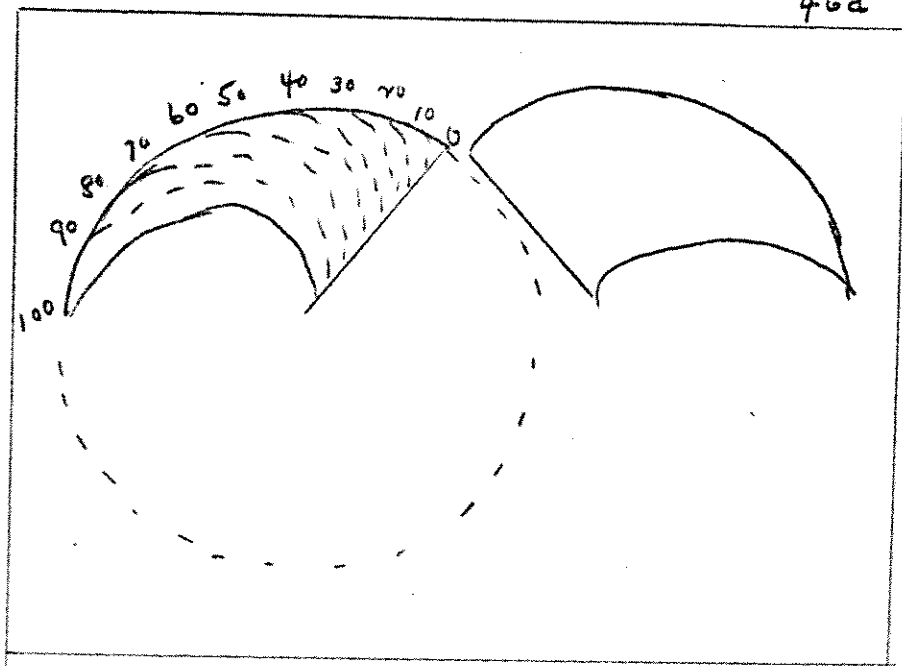
Pro area  
str. shut



← largest energy  
for area.

unequal area  
curved shut

462



Fechner's law.

—  
logarithmic curve  
worked out  
by 2 coms—

Feb 25  
1901.

8 P. M. M. P. Club.

47.

At Prof. Peabody's - 10 Columbia St., Brookline.  
Gave exposition of the color-sphere and charts -  
spiral machine and photometer.

Sketched my color education in public schools,  
art school and in Pa--- Studios.

Prof. Rood's double cone of 1879- and my double  
pyramid.

With Denman Ross in Venice - 1892-Spectrum order-

Shoals 93 - spiral sequences

" 98 - double spiral suggests sphere

- Argument -
1. There is no universal standard of color.
  2. What constitutes a " " "
  3. The sphere as " " "
  - Its tests.
  4. Uses of the color-sphere and charts  
in (education  
(industrial arts  
(physics  
(commerce

Ideal form -

Showed primary and kindergarten forms.

Questioned by Prof. Crosby-Prin. Lowell Textile  
School - wave length

Dr Bell - tests (photometer)

Prof. Wilson- Sec. Am. Science Ass'n.-  
Mr. Ross' opinion of it.

Prof. Peabody -Naval Arch- Technology.  
recalls my talk at studio - 1898.

Prof. Clifford - says repeatedly that  
it is a "good" presentation - calls  
my photometer "very sensitive"-

Feb 27 Saw Mr. Pritchard off for Florida - noon train.

28 Interview with Mr. Perkins - relative to examiners  
citation of Lovibond and Houston. Showed him new  
shutters and described cam to set forth Fechner's  
law.

Mar 6 At Mr. Perkins 5-6  
Discussed reply to examiners references- described  
circular openings and shutter- means for measur-  
ing colors if glass, liquids and translucent media.

48.





X 11

1.2105	0.10039	0.00004 0.9983 T.0017	2.86
--------	---------	-----------------------------	------

15577	0.20077	0.30109 0.9983 T.3027	6.46
-------	---------	-----------------------------	------

2.0055	0.30117	0.4771 0.9983 T.4788	11.00
--------	---------	----------------------------	-------

2.5211	0.40161	0.6021 0.9983 T.6038	16.71
--------	---------	----------------------------	-------

3.1769	0.5020	0.6990 0.9983 T.7007	23.90
--------	--------	----------------------------	-------

4.0434	0.60243	0.7782 0.9983 T.7799	33.00
--------	---------	----------------------------	-------

5.04355	0.70274	0.8451 0.9983 T.8468	44.4
---------	---------	----------------------------	------

6.3555	0.80315	0.9031 0.9983 T.9048	59.0
--------	---------	----------------------------	------

8.00635	0.90344	0.9542 0.9983 T.9559	77.1
---------	---------	----------------------------	------

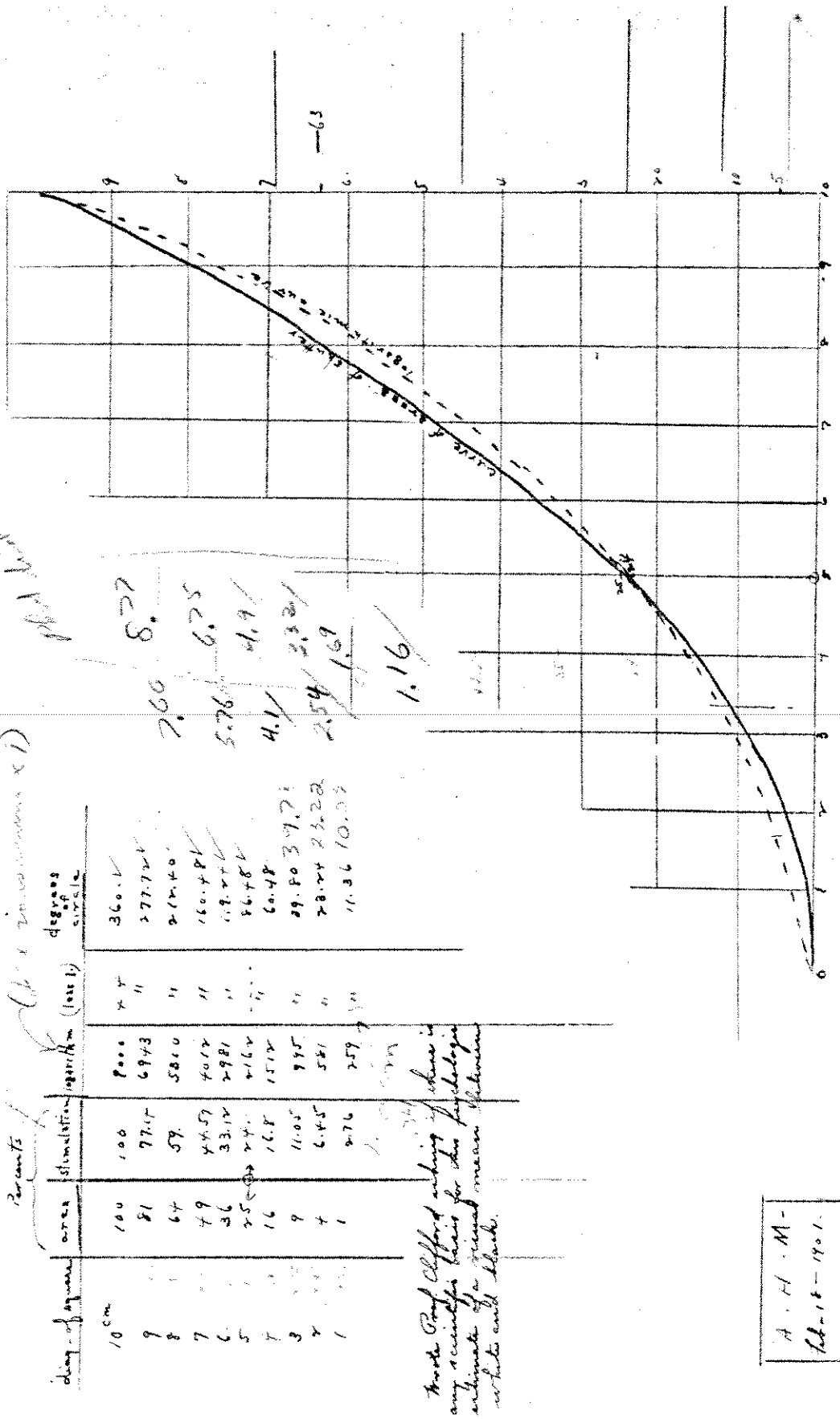
0.09	1.0039	1.0000 0.9983 0.0017	99.2
------	--------	----------------------------	------

4221	0.502	1.6990 0.9983 T.7007	1.34
------	-------	----------------------------	------

2.0055	0.30117	1.3979 9983	
--------	---------	----------------	--

(Bodwitch- p. 786) The smallest change in the magnitude of a stimulus, which we can appreciate through a in our sensation, always bears the same proportion to the whole magnitude of the stimulus. -- Foster's formula for Weber's law of sensation.

*Photometry of the eye where S=10 + 5=5% agree  
 where k=11 and c 9.9612*



*Handwritten note:* Made Prof Clifford writing of above is any scientific basis for the psychologic estimate of a normal mean between white and black.

A. H. M.  
 Feb 16 - 1901.

Writes two days later, "Your photometer interests me very much. I long to possess one. Is it for sale yet?"

- Mar 8 Prof. Gill -(Inst. of Tech) calls - 2-3 48.  
 Is very much pleased with the photometer and color system. Takes me to Mr. Smith at Chemical Laboratories and arranges to furnish me aniline colors for experiment - I take a brilliant green- to enhance vividian - soluble in water.  
 Met Mr. Bisby.  
 Prof. Gill suggests Mr. Mirwin of Tracy, Boardman & Platt of N. Y. in case a consulting expert is needed in patents.  
 Says the enamels could be defined as to components and temperature of fusing - so as to <sup>be</sup> exactly reproduced.  
 Believes the system is capable of establishing a practical standard of color.
- Mar 9 Mr. Perkins reply to examiner - asserts in three different paragraphs that my invention differs - those he quotes, (Lovibond-Houston-Kenelly) in construction, in mode of operation, and in accuracy of result, and asks reconsideration of all the claims.
- Mar 14 Prof. Louis Derr passes me his study on Visibility and Confusion of Baird's Nels' Signal Glasses -
- Mar 16 Denman Ross calls at studio.  
 Is very much pleased with the photometer, on which he reads sample 5a at 49.5-  
 I show him my large chart of 50% colors- and notes of my talk at the Club. He says it will be very stimulating. (Did not at first understand that chart to be only one of an unlimited number which unite to build up the complete spherical system.)  
 "I hope you will publish that scale of values very soon."
- Mar 20 Howard Forks comes in to see photometer and rotary discs. I show him the charts also. 49.
- 21 Receive Mr. Ross' pamphlet on "Design as a Science".  
 Mr. L. A. Lyon - 250 Cross St., Malden.
- 26 Mr. C. L. Gagnebin' 12:30 - 3. lunch at Westminster.  
 Thinks ten values sufficient.  
 Advises intensesst colors possible-  
 Suggests my reading the paper before the American Chemical Soc.  
 Discusses the tariff - and German supremacy with colored textiles.

Mar 28 Called on Denman Ross - meeting Mr. Clarke-  
Saw portrait study of Mr. Potter.

49.

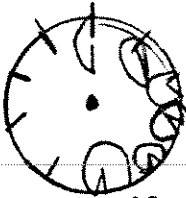
29 Walked in from Longwood Sta. with Reddington  
Fiske and Tudor Gardiner -  
Former says photometer would be needed by every  
scientific school and every railroad.

(paper-makers - architect  
(glass "  
(color "  
(mill etc

Advises \$5.00 as retail price, to allow 40% for  
introduction.

Has no patience with inventors as promoters -  
should leave it to business men.

April 1 Arranged decimal 50<sup>v</sup> disk to receive smaller disks  
at 10 equidistant radii. Each variable as to area -  
so as to establish balance by measured quantities  
of five complementary pairs.



April 2 Mr. B. I. Gilman lunches with me - and sees  
developments of a year in the color system.  
Says "Go on: it is making great progress."  
"I like to see the pot boiling". It is a  
"course de grande hateine", so don't go so fast  
as to have no breath for the finish. You have  
designed excellent "self-apparatus" - which  
accurately records each result.  
-- also working on this general question of  
"dimension".

"The revolving sphere is a beautiful instrument,  
and especially perfect in its being hung so as  
to revolve on any axis." The 10 proportionate  
discs in one field are also very satisfactory."  
I see no reason why you should not push your  
experiments to a definite conclusion.

In discussing Denman Ross' "Design as a Science"  
said "there are two separate questions.

1st questions of fact (balance of areas-energies-  
hues- values)

2nd " " aesthetic propriety (questions  
terms rythm & balance)

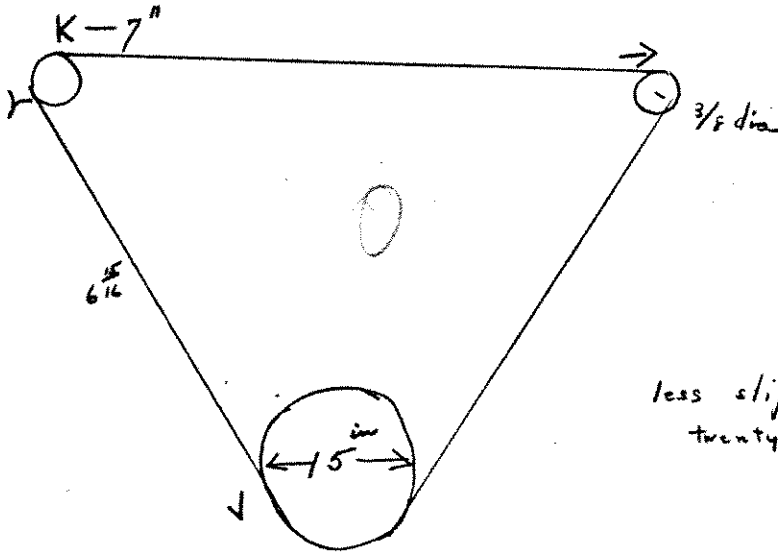
(geographer describes the facts of any  
country.

Monarch decrees its subdivision and  
government ---

but watershed decides the flow of water)

Until the country is mapped and described, how  
can we subdivide it.

50.



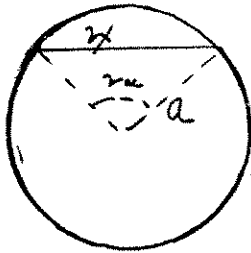
Pulley - dia. .295  
 in 1.178  
 Driver - dia. 1.5"

472.

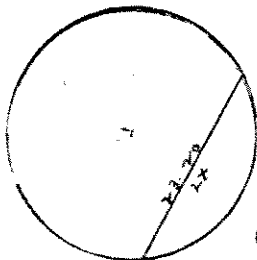
$$\begin{array}{r}
 7 \\
 .1785 \\
 12.875 \\
 \hline
 1.57 \\
 \hline
 1.178 \overline{) 23.730 \text{ cord.}} \\
 \underline{19.7}
 \end{array}$$

less slip - pulleys make nearly  
 twenty revs. to one knot of cord.

Use nat. sines  
 Always in terms of radius.



$$\text{Area desired} = a^2 \left[ \frac{\pi}{3} - \frac{\sqrt{3}}{2} \right]$$



$$(14.79)^2$$