Differential
Portraiture June
1900

Theory

A disc I, of white card that can be mounted on a revolving axis is divided into 11 spaces by 10 concentric circles, that is into a core and 10 rings. The core is left white, one tenth that is an arc of 36° of the ~~next~~ first ring is painted black, two tenths or 72° of the second ring is painted black, three tenths of the third ring and so on up to the outermost ring which is all black. On revolving the disc rapidly, ~~the disc presents to the eye an appearance of it the same appearance as that which would be afforded by [illegible] tinted rings, each ring being of its own uniform tint~~ Each ring presents to the eye the same appearance as if it had been uniformly tint having the same proportion of black to white as the angular width of the ~~length of~~ blackened portion of it bears to the white portion. That is the core contains 0.00 ~~per cent~~ of black, the first ring 0.10 ~~per cent~~ & so on up to the outermost which contains 1.00 ~~per cent~~ or which in other words, is wholly black. An exact negative II of this is made by dividing the rings on another disc in corresponding proportions of black & white, but in an inverse order, the core being wholly black & the outermost ring wholly white. We can combine the positive & negative tints on equal terms by a third disc III similarly provided with concentric rings, but which is divided into halves by a diameter ~~the one half corresponding with~~ the half core and half rings on the one side being blackened in the same proportions as those in I; namely in the arcs of 0°, 18°, 36°, ... 162°, 180°, and the other as in those in II, namely in the arcs of 180°, 162° .... 36°, 18°, 0°. On revolving III it will present the appearance of a disc that has been ~~tinted~~ painted with perfect uniformity, with a tint containing 0.50 of black & 0.50 of white.

F. 2v

Better take 0 = white 12 = complete black
(on account of the possibility of 12)

$\left(\frac{a}{2} + 6\right) + \frac{a}{2} = b + 6$ b cannot exceed 6

ungr Electric Light from 1 to 2 minutes exposure

$\left(b + \frac{a}{2}\right) + \frac{a}{2} = b$

between a & b

In differential portrait the aim is to obtain a tint x which when combined with a tint $\underline{a}$ shall form the desired other tint $\underline{b}$

$$\frac{x}{2} + \frac{a}{2} = b \quad (1) \qquad \text{or} \qquad \frac{x}{2} = b\left(-\frac{a}{2}\right) \qquad (II)$$

In order to obtain the value $-\frac{a}{2}$ is obtained by means of ~~we have recourse to~~ the equation obtained direct from the consideration that a positive tint when added in addition to its true negative tint forms the a perfect black, which may be called 1.00 12 and therefore when combined they are compounded in a half & half proportion it forms the a medium tint grey ~~0.50~~ 6

Calling the positive $\underline{a}$, and its true negative α we have

$$\frac{a}{2} + \frac{\alpha}{2} = \cancel{0.50}\ 6 \qquad \text{or}\left(-\frac{a}{2}\right) = \frac{\alpha}{2} - \cancel{0.50}\ 6 \quad (III)$$

Substituting in (1)

$$\frac{x}{2} = b + \frac{\alpha}{2} - \cancel{0.50}\ 6$$

$$\text{or}\left(\frac{x}{2} + \cancel{0.50}\ 6\right) = \left(b + \frac{\alpha}{2}\right) \qquad (IV) \qquad b + \frac{\alpha}{2} = \left(\frac{x}{2} + \text{grey}\right)$$

So we are not ~~able~~ to obtain $\frac{x}{2}$ ~~pure & simple~~ in this ~~way~~, ~~but we~~ We then can obtain ~~it~~ mixed with an equal dose of gray, and only ~~which~~

The truth of I can be tested by putting it into the form

$$\left(\frac{x}{2} + \cancel{0.50}\ 6\right) + \frac{a}{2} = b + \cancel{0.50}\ 6$$

$$\text{or} \quad b + \frac{\alpha}{2} + \frac{a}{2} = b + \cancel{0.50}\ 6 \qquad [V]$$

whence $b + \cancel{0.50}\ 6 = b + \cancel{0.50}\ 6$; which is an identical equation, as it should be.

from IV $b + \frac{\alpha}{2} = \frac{x}{2} + \text{grey}$, and from I, $\left(\frac{x}{2} + \text{grey}\right) + \frac{a}{2} = b + \text{grey}$

Similarly $a + \frac{\beta}{2} = \frac{y}{2} + \text{grey}$, and $\left(\frac{y}{2} + \text{grey}\right) + \frac{b}{2} = a + \text{grey}$

F. 4

6

~~This~~ ^general^ theory being ~~true generally~~ ^generally true^, that $\frac{x}{2} + 0.50$ is obtainable by giving two thirds of the total appropriate exposure to ^the positive^ $\underline{b}$ and the remaining one third to ~~a~~ the true negative, α, of $\underline{a}$, ~~shows~~ ^it follows^ that an entire portrait however varied its tints may be ~~admits of this treatment~~

The revolving disc ^would^ enable~~s~~ us to test ~~the~~ ^its^ ~~truth~~ so far as concern~~ed~~ a band of varied tints, whence its applicability to a surface of varied tints follows of course. But is unnessary to do so, as the figures are sufficient to prove it. Let ~~$a_1\ a_2\ a_3,\ \alpha_1\ \alpha_2\ \alpha_3,\ b_1\ b_2\ b_3$~~

~~can~~

Let a_1, α_1, b_1 be the notation for the elements as above, in the first band; a_2, α_2, b_2 for those in the second, and a_3, α_3, b_3 for those in the third

then by IV we should get

$$b_1 + \frac{\alpha_1}{2} + \frac{a_1}{2} = b_1 + 0.50$$

$$b_2 + \frac{\alpha_2}{2} + \frac{a_2}{2} = b_2 + 0.50$$

$$b_3 + \frac{\alpha_3}{2} + \frac{a_3}{2} = b_3 + 0.50$$

So the portrait b is reproduced, with the addition of a uniform ^transparent^ grey ~~shadow~~ ^colour^ ~~being thrown~~ ^washed as it were^ over it. However unwelcome this may be, it does not ~~affect~~ injure the ~~differential effect~~ ^glowing tint^ characteristic features of a picture, each unit of surface in the reproduction differing from its neighbour as much as they did in the original

The theoretical limiting values of the lightness and darkness in the tints a and b, that are mutually convertible by this ~~method of~~ compositing depends on the ~~fact~~ that the extreme value of x is ~~12~~ being or a perfect black, or 12, and on the corresponding value of y being 0; (or conversely, then x being 0 & y being 12)

$\frac{x}{2} = 6$, therefore from I

$$6 + \frac{a}{2} = b$$

$\frac{y}{2} = 0$ therefore from II

$$0 + \frac{b}{2} = a$$

whence $6 + \frac{b}{4} = b$; or $b = 8$, and $a = 4$.

~~So Both of the portraits must both be painted in sober tints, such as must be found within the medium third of the range greatest possible range of pigments~~

So, unless both ~~both~~ of the portraits ~~must~~ have been painted in sober tints, such as may be found within the medium third of widest possible range of pigments, the above method will not succeed.

But the darker ~~The practical~~ limits ~~are~~ is still narrower than ~~those~~ 8, on account of the addition of 6. Thus 4 cannot be converted into 8 + 6 or 14, nor can be converted 5 into 13, both 13 & 14 being more than perfect black. But 6 + 6 is feasible, therefore 6 is the darkest tint tolerable in the portrait. They ~~which~~ must be drawn with the tints 6, 5, 4 only, the remaining 9 tints being unserviceable: 0 to 3 and 7 to 12 inclusive.

a	α	b	$b+\frac{\alpha}{2}$	$b+\frac{\alpha}{2}-6 = \frac{x}{2}$	$\frac{a}{2}$	$\frac{x}{2}+\frac{a}{2} = b$
4	8					
5	7					
6	6					
7	5					
8	4					

Conversion of a sequence of tints ranging from 4 to 8 into one that ranges from 8 to 4.

a	α	$\frac{\alpha}{2}$	b	$b+\frac{\alpha}{2}$	$b+\frac{\alpha}{2}-6 = \frac{x}{2}$	$\frac{a}{2}$	$\frac{x}{2}+\frac{a}{2} = b$
4	8	4	8	12	6	2	8
5	7	$3\frac{1}{2}$	7	$10\frac{1}{2}$	$4\frac{1}{2}$	$2\frac{1}{2}$	7
6	6	3	6	9	3	3	6
7	5	$2\frac{1}{2}$	5	$7\frac{1}{2}$	$1\frac{1}{2}$	$3\frac{1}{2}$	5
8	4	2	4	6	0	4	4

f. 75

June 29/1900

y the a & b shaded rings   not good
(1) (2)

(3) $b + \frac{\alpha}{2} = \frac{x}{2}$ + grey   (3)

4 2

June 30. Arranged Electric light found exposure should be between 60 & 120 secs — used 90 secs afterwards

(4) | (4) Composited a & b rings & got a fairly uniform grey
(5) | 5 composited $\frac{x}{2}$ + grey with a on equal terms – very good result
composited $\frac{x}{2}$ + grey with $\frac{a}{2}$ on equal terms

July 2
with weak negative under electric light stop 2
10s too little 30s a trifle much say use 20s

8 | negative of crossamp position No. 92   mark
9 | " " " 118
10 } spoiled " } No. 50   500
11 }

f. 7

transformer y

$\left(\text{pos comp}_{\frac{1}{2}} + \frac{\text{neg } 177}{2}\right) + \text{pos } \frac{177}{2} = \text{pos comp}$

or $\left(2\,\text{pos comp}_{\frac{1}{2}} + \text{neg } 177_{\frac{1}{2}}\right) + \text{pos } 177_{\frac{1}{4}} = \text{pos comp}$

(The pos. leaves 177/2 in too dissociated 2 t y [illegible]

D. 8; position of this D. 7.

F. 8

July 2/ 1900

Enlargements to make composite from negatives glass side down

No 12	positive of No	164	Bethlehem	8
1	————	165		7
2		176 H		5
3	————	177		9
4	————	180		10
5		181		11
		"		12

next moment readjusted

plate good dropped

readjusted

1.b
2 b
3.b

(neg) composite of the above 6 ———— 4 b
pos " " 5 b

$$\frac{x}{2} = \frac{\text{neg composite}}{2} + \overset{\text{pos}}{(177)} \quad (1)$$ to convert positive into 177 7b & 10b

$$\frac{y}{2} = \frac{\text{neg} \; 177}{2} + \overset{\text{pos}}{\text{composite}} \quad (2)$$ makes b 8b & 9b

positive of No (1) above 12b

(2) 11

x converts composite into 177 | composite Negative - 1. C

" " " | positive of this " bis 2 3 C

y converts 177 into the composite

July 5 / 1900

~~Some~~ Much doubt whether the negatives were "mirror" ("or reversed") negatives. So the following are all such. That is the positive is placed face downwards and on a thick card with a hole in order to raise its face to the same level as if it had been face uppermost

(spoiled C 5)

Mirror (Reversed) negative of ~~165~~ 181 C ~~4~~ 5

~~181~~ 165 C 6

Composite (~~C 7 spoiled~~) ~~C 8~~ bad

1¼ minute expos C 9

177 C. 10

165 bis C 11

Composite bis C 12

($\frac{2}{3}$ of reversed neg of Composite + $\frac{1}{3}$ of pos 165) give negative of ~~g~~ d 1

$\frac{1}{3}$ " " + $\frac{2}{3}$ pos of 177 d 2

Positive of D.2 D 3

Positive of D 1 D 4

there were not coexd not reexposed The negs being very dense

f. 10

July 6

~~The positives~~
4 see 8b shone through with pos 177 ~~after~~ (back to face)
gave a fair composite = 5b so I laid them on the
stage of the Camera and photographed them negative D5
A positive from the wet negative . D6

	Positive	Ord: neg via camera	reversed neg	Contact Neg
164	12	8 1b		
165	1	7 2b		
176	2	6 3b		
177	3	9		
180	4	10		
181	5	11, 12		
Composite of the above	5b	4b		

Contact print with composite a negative of D A
177 D b
Composite a much denser negative of (Compare with No 1) | note printed mark ~~DC~~ 5b DC

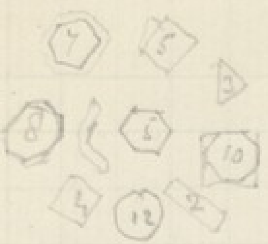
		neg	positive
F.1.	Composite of X. 5 negative & of positive of the same	$\frac{1}{2}$ &	$\frac{1}{2}$
F2.	negative	$\frac{1}{3}$	pos $\frac{2}{3}$
F3.		$\frac{1}{4}$ 15 secs	$3/4$ 45 secs
F.4.		$\frac{1}{4}$ 9. secs	$3/4$ 36. secs

the above are wrong being printed from a contact negative, & the pos & the neg being both exposed in camera film side uppermost

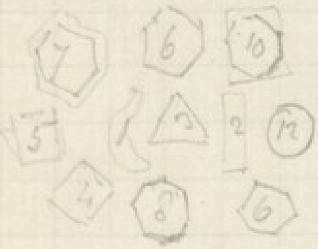
			Total	negative film uppermost	positive in camera film lowermost
F5			50	25 sec	25 sec
F6			45	15	30
F7		177	40	20	20
F/8	bearded man	165	40	20	20
F9		181	40	20	20
F.10	$\left(\frac{a+\alpha}{2}\right.$ of 165 with $\frac{b}{2}$ of 177 $= \frac{165 pos}{4} + \frac{165 neg}{4}\left.\right) + \frac{177 neg}{2}$		40	20 10a+10α	20 20b
F.11	(a = pos 165 α = neg 165) 40	b = neg 177 20	60	(a+α) 40	b neg 20

The process then converts

G.1



G.2



G3 position of G1

G4 position of G2