1999

NAD

(a) Assume: 150,000 cones /mm^2
eyeball diameter of 20mm
viewing distance of 300mm
visual acuity means that one cone should be able to see at least one whole pixel

then: min ppi $= \dfrac{25.4 \text{ mm/inch}}{\text{max pixel size in mm}}$

$$\text{max pixel size in mm} = \frac{300}{20} \times \frac{1}{\sqrt{150{,}000}}$$

$$= 0.0387 \text{mm}$$

$$\therefore \text{ min ppi} = \underline{\underline{657 \text{ ppi}}}$$

this is only a rough calculation so say 700ppi

so long as sensible assumptions are made the answer could range from 300 to 1000 ppi

(b) The principal extra assumption here is the resolution of the halftone cells. ~~the~~ The best answer is to have 16×16 cells, giving 257 grey levels. This implies ppi 16× that in the previous section. In this case: 11,200 ppi.

I'd be happy with anything from 8×8 up to 128×128 (the latter is "film quality"). ~~This~~ gives a range of answers from 2400ppi to 130,000 ppi. The latter would need some pretty fancy justification.

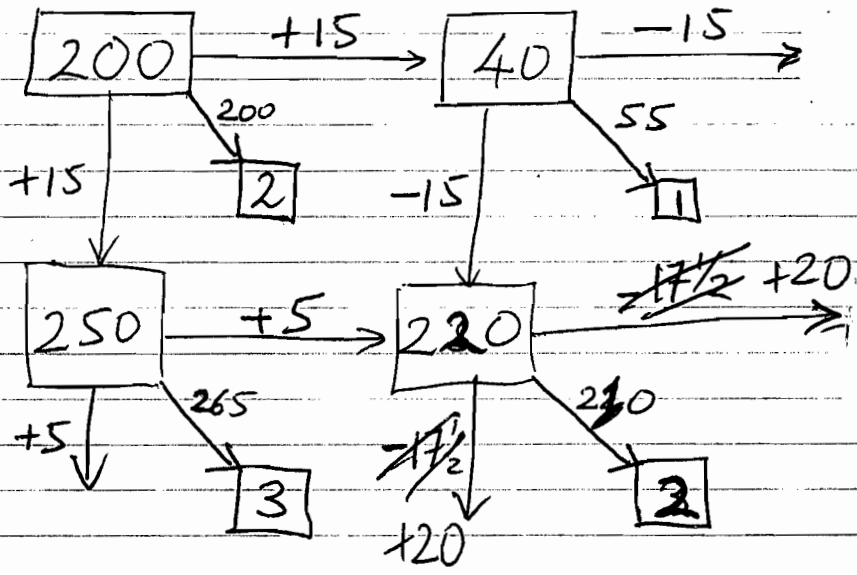
(c) Each pixel in turn, from left to right, top to bottom, is examined. It is converted from an 8-bit to a 2-bit value as described below and an error value calculated. This error is passed, half to the pixel to the right and half to the pixel below. ~~The~~ Errors are added into ~~the~~ a pixel's value before it, in turn, is converted.

Conversion is as follows

$$f_{i,j} = p_{i,j} + \frac{1}{2} e_{i-1,j} + \frac{1}{2} e_{0,j-1}$$

$f_{i,j}$	$\hat{p}_{i,j}$	$e_{i,j}$
≤ 42	0	$f_{i,j} - 0$
43 - 127	1	$f_{i,j} - 85$
128 - 212	2	$f_{i,j} - 170$
≥ 213	3	$f_{i,j} - 255$

(d)



(e) ~~Ordered dither has a fixed dither matrix. The~~

(e) In error diffusion ~~any~~ errors in the re-quantised values ~~are~~ spread out to the right + down to give an overall correct effect.

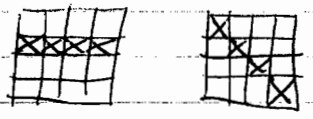
Ordered dither has no way of handling errors. The re-quantised value depends solely on the original value + the pixels position with respect to the ~~ordered~~ dither matrix.

Ordered dither ~~produces~~ more noticable visual artefacts than error diffusion generally

(e) for an ordered dither matrix you should follow this rules:

1. you must not introduce visual artefacts in areas of constant intensity

e.g. these won't work well for a value of 4



2. every pixel on in intensity level j must also be on in levels $\geq j$

i.e. <u>on</u> pixels form a <u>growth</u> sequence

3. pattern must distribute on pixels as evenly as possible for every level

[N.B. this is DIFFERENT to the rule for halftone matrix design]

e.g.

1	9	3	12
15	5	16	7
4	13	2	10
11	8	14	6