

A New Angle On Descreening Art

Topics: Optimal ways of reproduction when given a prescreened original.

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Source of this file: Scans of the actual magazine pages.

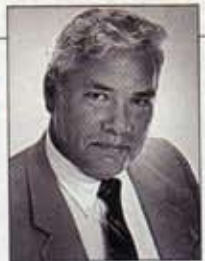
Author's comment: Even today we still are forced to scan artwork that has already been printed. This column and the next one explain the theory, and emphasize two key words: *thirty degrees*.

This archive, to be released over several years, collects the columns that Dan Margulis wrote under the *Makeready* title between 1993 and 2006. In some cases the columns appear as written; in others the archive contains revised versions that appeared in later books.

Makeready in principle could cover anything related to graphic arts production, but it is best known for its contributions to Photoshop technique, particularly in the field of color correction. In its final years, the column was appearing in six different magazines worldwide (two in the United States).

Dan Margulis teaches small-group master classes in color correction. Information is available at <http://www.ledet.com/margulis>, which also has a selection of other articles and chapters from Dan's books, and more than a hundred edited threads from Dan's Applied Color Theory e-mail list.

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By Dan Margulis

A NEW ANGLE ON DESCREENING ART

Faced with a messy moiré like the one at center below, the temptation is to look for a magic bullet. This atrocity represents a problem that all of us face from time to time, although we would rather not: reproduction of a prescreened original. People recommend all sorts of magic bullets for dealing with it. Frequently the bullets wind up in their feet. My own magic bullet is shown to the

right. Can you guess what I did to the file to produce such a resounding improvement?

Nothing. I did nothing at all. The two versions are exactly the same. They access the same file; they are cropped identically.

For identical pictures, that is rather a dramatic difference in print quality. It indicates that prescreened originals present some unique problems, many of which can be solved by keeping two words in mind: *thirty degrees*. That's the real magic bullet.

Here and in my next column, I will discuss proper descreening technique, but first, we'd better have a quick review of what this screening stuff is all about.

Limiting ourselves for the moment to black and white, successful reproduction depends on a full range of tone: whites, blacks, dark grays, light grays, medium grays. Unfortunately, we have no gray ink to work with on press, merely black ink and white paper.

A little legerdemain is therefore in order. By subtly laying down smallish quantities of black ink in conjunction with showing smallish amounts of white paper, we can fool the viewer into perceiving gray.

There are several ways of doing this. Randomly placed dots will work. If such dots are intended to be readily visible, we call the result

a mezzotint; if the dots are very small, it's a stochastic screen. Overwhelmingly, though, the printing industry uses some kind of regular pattern of ink coverage that gets darker or lighter to portray different shades of gray. Nowadays that pattern is invariably one of dots that vary in size but not in distance from one another. The pattern is called a screen; the number of dots per linear inch is the screen frequency or ruling. A higher ruling implies better print quality: the pictures of Madeleine Albright are screened at 65lpi, which is more appropriate for a newspaper than a magazine (133

is this magazine's standard).

The dot pattern is modestly more pronounced if the rows of dots are exactly horizontal and vertical with respect to the page. Therefore, it is customary to angle them. The exact angle makes not a whit of difference, unless the picture is being printed with more than one ink—or unless we are trying to reproduce a prescreened image.

THE 30-DEGREE SOLUTION

Most of us have a vague awareness that cyan, magenta, yellow, and black are printed at four different screen angles. It is normally quite irrelevant whether we know what those angles are or why. If, however, we are going to be working with prescreened originals, understanding the theory of angling is critical.

Whenever two regular patterns are superimposed on one another, there will be some kind of interference, or moiré. The moiré can range from spectacular, as in the image at left, to almost unnoticeable.

Obviously, we prefer the

Prescreened originals present some unique problems, many of which can be solved by keeping two words in mind: *thirty degrees*.

What's the secret that makes the moiré in the image at right so much less pronounced than in the one at left? It's simpler than you might expect.





1

latter. However, if we print all the CMYK inks at the same screen angle, we are guaranteed to get one of the former variety.

CMYK printing with halftone dots has been around long enough for a lot of experimentation. In that time printers have learned that, while a lot of angle combinations work, the most reliable is one where they are 30° apart.

If you think about it, you will realize that only three inks can be 30° apart from one another. If an ink were angled at 0° (i.e., the row of dots perfectly horizontal) it also would be 90°, since a row of dots would also be perfectly vertical. We could have a second ink at 30° and a third at 60°, but we have to scramble for a fourth angle.

Fortunately, yellow is so much lighter than the other three colors that it really doesn't matter what its screen angle is. As long as the cyan, magenta, and black are 30° apart from one another, we're home. Conven-

tionally, the magenta is at 75° (measured clockwise from the horizontal), the black at 45°, and the cyan at 15°, but it's the 30° relationship of the three that's important, not these particular numbers.

Now, back to Madeleine Albright. The original appeared in *The New York Times*, which uses the above angles. Its black is therefore at 45°. My scan captured its dot pattern, and although I may not have had the original exactly straight when I scanned it, the pattern probably is somewhere between 43° and 47°.

On top of that, we impose *Computer Artist's* black screen, which is also angled at 45°. This is why the left image on the opening page is in Moirésville. The right version is vastly better, because instead of two screens at around 45°, there is one at 45° and another 30° away at 75°. *Computer Artist's* screen angle didn't change. The image's did.

This demonstration should convince you that if you are dealing with prescreened B/W originals, you will obtain a decisive quality gain by rotating them all 30° on the printed page. Regrettably, that is a somewhat unrealistic method.

Confronted with a moth that persisted in trying to throw itself into a lighted candle, archy the cockroach remarked, "why do you fellows pull this stunt/because it is the conventional thing for moths or why/... have you no sense [?!]"

Take it to heart. The 45° black angle is, indeed, the conventional thing. But it is no more mandatory than throwing oneself into the flame. The mountain does not have to come to Mohammed. If the original art and the new screen both have the same angle, and you can't rotate the original art, rotate the screen.

If we save the image in EPS format in Photoshop, we are allowed to choose a screen angle and/or frequency that will override the image-setter's default. If we want our Albright image oriented the same way as the left version but not have that revolting moiré, all we have to do is set the black screen angle to 15° or 75°, either of which is that magic 30° away from the original screen.

Changing screen frequencies and angles can be devastatingly effective. It can have devastating effects of an entirely different nature if you or somebody else later picks up the image and uses it for something else. Photoshop issues no warning that an EPS file has embedded screens. If you are interested in preventing a later disaster, embed your own warning by naming your file `albright.screens.in` or something similar.

PageMaker's Print>Color Options allows us to change the angle and frequency in the same way, without the dangerous practice of embedding them in the image file. QuarkXPress has no such feature.



2

Different approaches to a prescreened original: (1) an uncorrected scan; (2) the same file with a 200-line screen embedded; (3) the same image scanned and corrected with the methods recommended in this column; (4) the same file with a 150-line screen at a 15° black screen angle; (5) the first scan treated with Linotype-Hell's automated range correction and descreening routine.



3



4



5

EMBEDDING A SCREEN

With black-and-white images, we should feel free to embed screen rulings that minimize moiré. With color images, there is considerably more risk, and this should be an experts-only tactic. But in B/W, nothing much can go wrong if we change the angle to 15° or 75°, which are optimal if the prescreened original was at 45°.

But while we are doing this, we ought to give thought to screen frequency as well, because this is another case where prescreened originals should be treated in a way completely foreign to what we are used to.

The version of President Clinton at top left on the preceding page illustrates why we should not be overly intent on destroying every dot. Although it's an uncorrected scan of a prescreened image, and I haven't fiddled with the angles, the moiré is scarcely noticeable. It is in fact scanned from the same newspaper as the Albright image.

The only variable is that Albright is rescreened at 65lpi, whereas Clinton is at the standard 133. The coarser the patterns, the worse the moiré. The finer we make the output screen pattern, the better off we'll be.

The flip side is, the smaller the dots, the less controllable they are on press. If the printer can't hold dot integrity the picture will start to go blurry. Ordinarily, that is a terrible thing, but in the case of a prescreened original, it's a good thing. Ordinarily, we trust what the printer says about maximum screen ruling—but not in this case.

Magazines, for example, recommend a 133-line screen. If you are submitting a prescreened B/W piece, I recommend that you embed a 150-line screen—and with a black angle of 15°, not 45°.

There is an interesting test of this on the preceding page. One of the Clinton images has a 200-line screen, which the printer would likely have a heart attack over if he knew in advance it were there. Web presses like the one that prints *Computer Artist* are not meant for

such abuse; even the finest sheet-fed presses using the best stock have difficulty with 200-line screens, as do imagesetters.

I've never tried this in a magazine before, so I'll be as interested to see the result as you. Overly fine screens are overrated as a cause of problems. I don't expect the image to be a disaster. I certainly concede that for normal pictures a 200 line screen will give worse results in a magazine than 133 will. There's no way of telling from the proof, but I have a small bet with myself that this 200, absurdly fine as it is, will look better on press. Did I win?

THIRTY DEGREES AGAIN

In addition to the angle of the original and that of the imagesetter, there is a third angle that must be accounted for: the angle of scan.

Scanners take their samples in a perfectly horizontal pattern, or, to make it consistent with previous terminology, at an angle of 0°. They are not exempt from the 30° rule. Just throwing prescreened art into the scanner, as I did with the Albright image, is highly inferior. For optimum reproduction, the scan must be angled as well. If the original is mounted straight up and down, there will be an unacceptable 45° angle between its screen pattern and the scan pattern. We therefore rotate the original by 15°. Whether the rotation is clockwise or counterclockwise is irrelevant in a B/W image; either way the scan angle will be off by 30°, which is just what we want.

Angling the scan is one of the more common magic bullets being offered for your use by various authorities, most of whom recommend trial and error. If the original is as bad as it can possibly be, angling it can't make it any worse, I would have to agree. But why guess? Why choose a random angle, when the 30° rule suggests there is one that is better than all others?

Instead of popping the original into the scanner at an angle chosen by providence because you are desperate, pop it in at 15°, because you are confident.

All this horsing around with angles and frequencies will solve most of your B/W descreening problems. These easy steps may give you all the quality you require out of a prescreened original. If so, there is no need for you to read further. The rest is for the folks who have time to spare and need to make rescreened images look not just OK, but pretty good.

RULES AND EXCEPTIONS

Any attempt at further improvement starts with the realization that the dot pattern is a two-edged sword. On the one hand, it prevents us from adding contrast to the image by threatening us with a ruinous moiré if we try. On the other, it holds all the detail. We don't need to eliminate it, just subdue it somewhat as we add range overall.

Exactly how much to play down the dot pattern is an image-by-image decision. I'll give you a recipe that will work pretty well, but you may have to modify it in certain cases.

Nevertheless, there are certain practices that are *always* correct, namely:

- Always scan prescreened art at

Finding the screen angles can be tough, especially in a color image. Below is an enlarged scan of a printed image; above is the original digital image with a perfect screen imposed. To find the cyan angle, for example, imagine an L-shape and angle it until the lines of cyan dots follow it both up and down. The smaller insets show two cyan plates: above is the original digital file, and below is a printed and rescanned version—showing how much detail is lost.



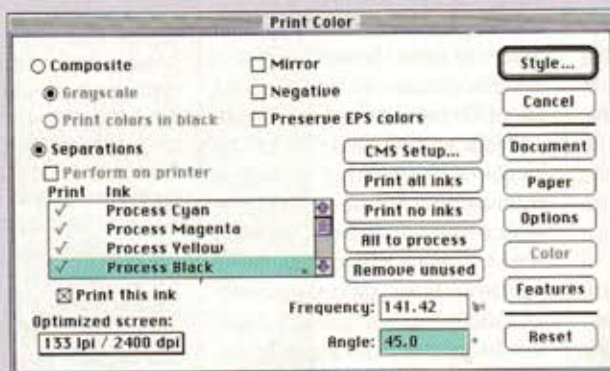
A PageMaker Powerhouse, Better Late Than Never

The ability to override screen angles (below) is one of many sophisticated print controls incorporated in Adobe PageMaker 6.5, which finally shipped for Macintosh in February, two months after Wintel users got it.

The new version has some maddening changes to the traditional interface, but important new capabilities that in most respects completely blow away its competitor, QuarkXPress, which has not had a major upgrade since 1990 and whose ability to deliver one prior to the scheduled overhaul of the Mac operating system next year is, to put it mildly, questionable.

The new PageMaker's gaudiest new features are full layering à la Illustrator and Photoshop, plus a robust scripting capability. It can export HTML files, and it can import them directly from the Web (just enter the URL, and the program does the rest), as well as from our hard disks. It can place virtually any kind of graphic in a document, from native, non-EPS Illustrator files to JPEGged RGBs to raw Photo CD images. It is highly Acrobat-friendly. And for once, this update appears to be fairly compatible with files prepared in previous versions of PageMaker.

This upgrade makes little secret of its desire to woo Quark users. We can now assemble pages using "frames", or text and picture boxes, almost exactly as in QXP. A utility is provided that



the highest possible resolution, then resample it down. Very high scan resolutions are usually bad because they make images overly soft, but if the original has a pattern, softness is just fine, thank you.

- Learn to read the angles of the original. This takes practice, especially when dealing with color. Examining the original under a loupe, imagine a box, or an L-shape, as shown on the previous page. Rotate it until straight rows of dots match its sides, and you'll know the angle. With few exceptions, you'll find that black is at 45° and that magenta and cyan are at 15 and 75, respectively. But it isn't always so, particularly in older publications or those

printed in Europe. Once you have verified the angle, use the 30° rule in both scanning and imaging.

- Build yourself a scanner template, with a line showing you where 15° is. Admittedly, you will never angle perfectly in a scanner, but why be off by 5°?

- Don't use a sharpening filter The whole problem with prescreened originals is they are too sharp. Generally we want to blur them to some extent and it is possible, nay likely, that we may want to go into local areas with the sharpening tool thereafter. For example, a person's eyes or jewelry will lose their sparkle during the blurring. This should be attacked with the tool,

but not an overall filter. If you blur so much that you have to sharpen globally, the sharpening is a bandage to put over the magic-bullet wound in your foot.

- Don't use an automated descreening package. Some, like the Linotype-Hell routine illustrated in the Clinton example, are pretty good, but all obliterate detail and none will give the same quality as careful human intervention. Eskofot, a manufacturer of very expensive scanners, has a successful descreening algorithm for film, but once ink hits paper, there are enough variables to make automated descreening mediocre at best.

And now, the recipe. First, go

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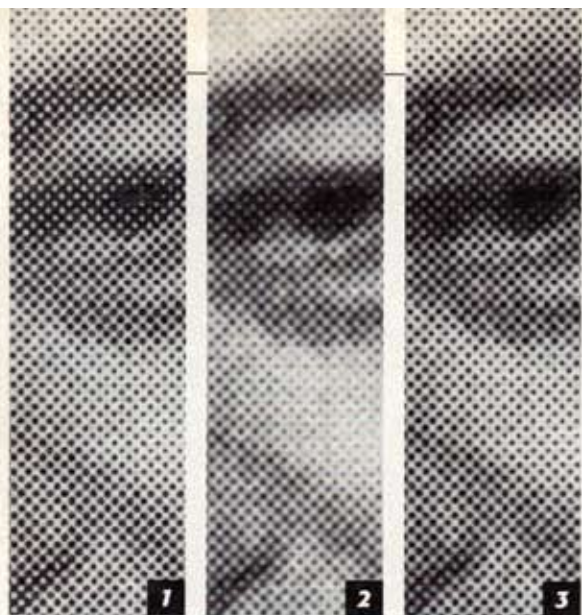
OK
Cancel

opens QXP files, with varying degrees of success, in PM format. If that fails, we can always export our QXP text using the XPress Tags format—which PageMaker now reads.

PageMaker also includes a nifty preflighting utility, which does a very strange thing. It neatly copies and assembles into a folder, so that we may hand them over to our service bureau, the very fonts that Adobe has for many years said we are not allowed to copy and hand over to our service bureau. The above notice appears, telling us not to give the fonts to any service provider that doesn't own them already. This is a little like the vendors of cable descramblers who make us sign documents saying we don't intend to descramble cable signals with them.

Some bad failings have not been corrected. Although PageMaker's automated trapping routine is in principle better than Quark's, it omits the absolutely critical ability to override the document's settings for a certain object. Our inability to control the number of letters before and after a hyphenation is inexcusably cheesy for a program of this sophistication. And the library of plug-in additions, though nice, by no means matches the variety and quality of XTensions available for QXP.

It remains easier to troubleshoot somebody's QXP document than one prepared in PageMaker, which is one reason, if I owned a service bureau, I'd rather have clients who used QXP. A more practical reason is, QXP has dominated the high end for so long that the average QXP user is, at present, more sophisticated than those who use PageMaker. Based on this upgrade, I wonder how long that situation is going to last. —DM



De-emphasizing the dots is best done in separate lightening and darkening steps. As described in the text: (1) a blowup of part of the original Clinton image; (2) a Gaussian Blur on a copy of the original; (3) the second, blurred version applied, Darken mode, to the first; (4) a Dust and Scratches filter run on a copy of the original; (5) the fourth version applied, Lighten mode, to the third.

back to the Albright moiré, and convince yourself that it isn't as bad as you first thought. Her jewelry is fine as is. Her dark dress and the background are also more or less acceptable. The really disgusting moiré happens only in the face. That is very typical. It's the middle range of the picture we need to worry about, not the two ends.

Second, break the image into two parts in your mind: on the one hand, the dots, which have detail, on

the other, the white space between them, which does not. We definitely have to reduce the difference between the two, but doesn't it make sense to handle these two hugely different phenomena in two different ways, rather than with a single cataclysm?

With these thoughts in mind,

- Take your properly sized and rotated grayscale scan and increase its contrast to your taste, ignoring the fact that this makes the dot pattern worse.
- Make two duplicates of the resulting image, which I will refer to as Copy A and Copy B.
- Going to Copy A, apply a Gaussian Blur filter at radius 1.0. This will fill up the white space, which we want. It will also badly damage the dots,

which we don't. Not to worry.

- Back to the original. With Image > Apply Image, apply Copy A in darken mode. This will not affect the dots, which will necessarily be lighter in Copy A than the original.

- Trash Copy A, and turn to Copy B. Apply a curves or levels command that brings up the highlight to a minimum of a 20 percent dot.

- With the newly darkened Copy B, apply Photoshop's Dust & Scratches filter, radius 1. This will diminish the dots but hold their shape more or less, except for the lightest dots, which will be history.

- Back to the original. Apply Copy B, this time in lighten mode. The point of the earlier darkening of Copy B now becomes clear. The lightest fifth of the original will be unaffected by this move—Copy B is guaranteed darker. The big action will be in the midtone. Copy A will have brought up the background, and Copy B subdues the dot pattern without killing it altogether.

- If it seems appropriate, increase contrast again.

If you can proof the image before actually going to press with it, be conservative with the above recipe. It's a lot easier to reduce moiré on the second pass than to restore detail.

A SELF-FULFILLING PROPHECY

If the 200-line screen, which we know to be ridiculous, is even close, that's a strong vote in favor of using 150 or even 175. This is a fairly risk-free technique with B/W originals, less so with color, which we'll explore next time. Prescreened color originals are easier, in the sense that the dot pattern is not so pronounced, but they are also harder, in that we have to spend a lot of time worrying about weird color creeping in.

The age of Photoshop has given us so many advantages over traditional methods that it is somewhat sobering to hear that the old way was better. Our forefathers would merely stick the prescreened original into a process camera and "fine-line" it. The result would then be merged by hand into the final film for the job. In other words, they

would be letting the original screen also be the final screen. We, having no choice but to screen the original again when we place it in our pages, are not so lucky.

That camera method doesn't work if the original screen is drastically different from the final desired one, as in the Clinton image, which was originally 65lpi yet needs to match the 133 of the rest of the magazine. In such a case, the traditional high-end method is to scan at an extremely high resolution, which we can do to some extent with our desktop scanners, and to scan just slightly out of focus, which we can't. We can never equal the quality of starting with a continuous-tone original, true. But *acceptable* quality? I think so. The Clinton series, remember, is done at the same size from an original printed in a 65lpi newspaper. That's about as bad as it gets. How unreasonable is the corrected version?

It would be nice never to have to work with prescreened art, but it sometimes can't be avoided. Original photographs get lost or damaged; historical photos are only available in printed form, and so forth. It would also be nice to have some of the high-end tools of the past to deal with them. But we *can* make do.

A number of practitioners assure us that adequate results from such originals are impossible using desktop methods. They proceed to make this a self-fulfilling prophecy by scanning at the wrong angle and then outputting at the wrong angle, when they don't obliterate the dots altogether.

Those dots are your friend. They only become your enemy if you allow them to moiré. Remember the 30° rule, and they won't.

Dan Margulis, a Computer Artist contributing editor, has recently published his latest book, *MakeReady, A Prepress Resource (MIS:Press)*, which features expanded versions of many of his *MakeReady* columns. Dan can be reached by e-mail at 76270.1033@compuserve.com or by fax at 201/763-2835. For information on the author's three-day, small-group color-correction tutorials, offered in Atlanta, contact Judy Starkweather of PrimeSource at 800/992-4897.