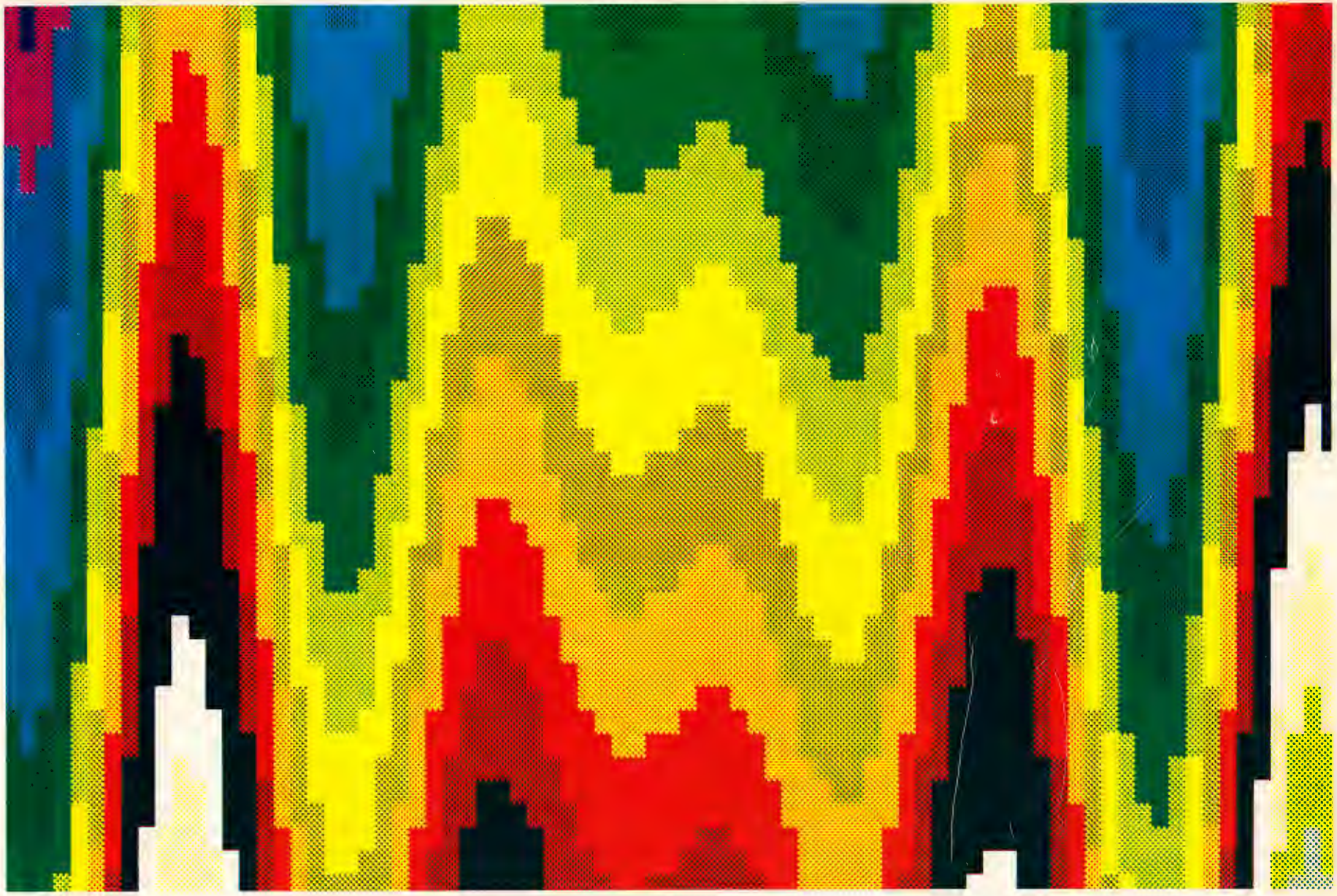


THE BEAUTIES OF MATHEMATICS III

1983-84 Planning Calendar featuring Colorgraphic Art

Center for Color Graphics, Florida State University

COLOR GRAPHICS COMMUNICATE BETTER—IN ART, SCIENCE AND BUSINESS

Since the inception of these calendars two years ago, Intecolor Corporation and its parent company, Intelligent Systems Corp., have been enthusiastic supporters. Naturally, part of our interest comes from the fact that all the artwork was created on Intecolor's color graphics computer equipment.

However, our commercial interest is only part of the story. The visual challenges and compelling attractions of the abstract art form are important factors, as is the fact that these striking images were generated via carefully calculated mathematical equations. Actually, the heart of the matter is that we are deeply involved with this project because of one person:

Dr. E. P. Miles, Jr., Director of the Center for Color Graphics at Florida State University.

A visionary in the use of color to create wider interest in mathematics, Dr. Miles wrote, "Functional Design or Colorful Mathematics" in 1955, when he struck upon the idea of using mathematical formulae to create color abstract art to dramatize the inner workings of mathematics. At that time, he had his students use graph paper and color pens to create the resultant abstracts. That was two years before he saw his first computer.

Some 22 years later, in 1977, Dr. Miles got the opportunity to demonstrate his 1955 work interactively using an Intecolor 8001 color graphics terminal. Since that time, he has been a world leader in promoting the use of color graphics computers in many fields of business where art plays a central role—including advertising, interior design, textiles, architecture and packaging.

Intecolor salutes Dr. Miles' extraordinary talents and his dedication to the marriage of color, mathematics and the computer. Our interest in color and graphics began when the company was founded in 1973. The Intecolor 8001 was the first color terminal to incorporate the then new microprocessor. We were the first firm to produce a desktop color graphics computer using an advanced programming language, and the first to produce a color-enhanced word processing system.

Intecolor was the first firm to manufacture and ship 30,000 color terminals and now we have the largest installed base in many industrial applications. We built our reputation in the demanding process control and scientific markets, and have since transferred that expertise into the office environment.

Today, we manufacture a complete line of color graphics terminals, from low resolution to very high resolution units, color graphics desktop computers, and multi-processor, multi-user computer systems. We produce units for use in management information systems, distributed data processing, presentation graphics, computer-aided design, energy and facilities management, plant automation and complete business systems.

We invite you to contact us for additional information on color graphics computer equipment at Intecolor Corporation, Intecolor Drive, 225 Technology Park, Norcross, GA 30092. Telephone 404/449-5961.

BEAUTIES OF MATHEMATICS III CALENDAR
Sept. 1983–Dec. 1984

The mathematical "Beauties of the Month" were created by Dr. E. P. Miles, Jr. and his students at Florida State University from 1977 to 1983 as displays on Intecolor 8000 screens from Intelligent Systems Corporation of Norcross, GA. The color separations were done in the FSU Center for Color Graphics on an Intecolor 8064R computer using the Digital FACSIMILES (Fast Additive Color Separation Internegatives—Miles) process covered by U.S. patent application #291,479, August 10, 1981 for which a Notice of Allowance was issued March 25, 1983. The 1982 and 1983 calendar separations used 35mm photographs of internegative images from the computer screen. However, production of this calendar bypassed photography completely by printing separation images directly on a Printacolor GP1024 under Intecolor control. Use of Miles's digital separation process on the 3 calendars cut production costs approximately $3,000 each year, a percentage saving in the 25% to 40% range compared with laser scan or direct processes.

We welcome Printacolor Corporation of Norcross, GA as a new calendar cosponsor with Intecolor, the Center for Color Graphics of Florida State University, and Miles Color Art. The calendar is being published again as a nonprofit educational project with Miles's artwork and separations donated and startup print costs shared by Intecolor and Printacolor. Thousands of these calendars printed at marginal overrun costs have been donated for educational purposes or sold by nonprofit groups to help fund educational, cultural, or humanitarian projects.

Most "Beauties of Mathematics" displays are color block graphs of mathematical functions generated by computer implementation of an algorithm described by Miles's 1955 paper "Functional Design or Colorful Mathematics". It was the intent of that paper to use hand-created color patterns to attract many students at the high-school entry level with mathematical abilities who saw no relevance of further study in mathematics to their likely career choices. Then, as at the present time, a large number of able students were closing doorways to future scientific careers or technical skills useful for non-scientific careers by declining to study mathematics prerequisite for studies in such areas.

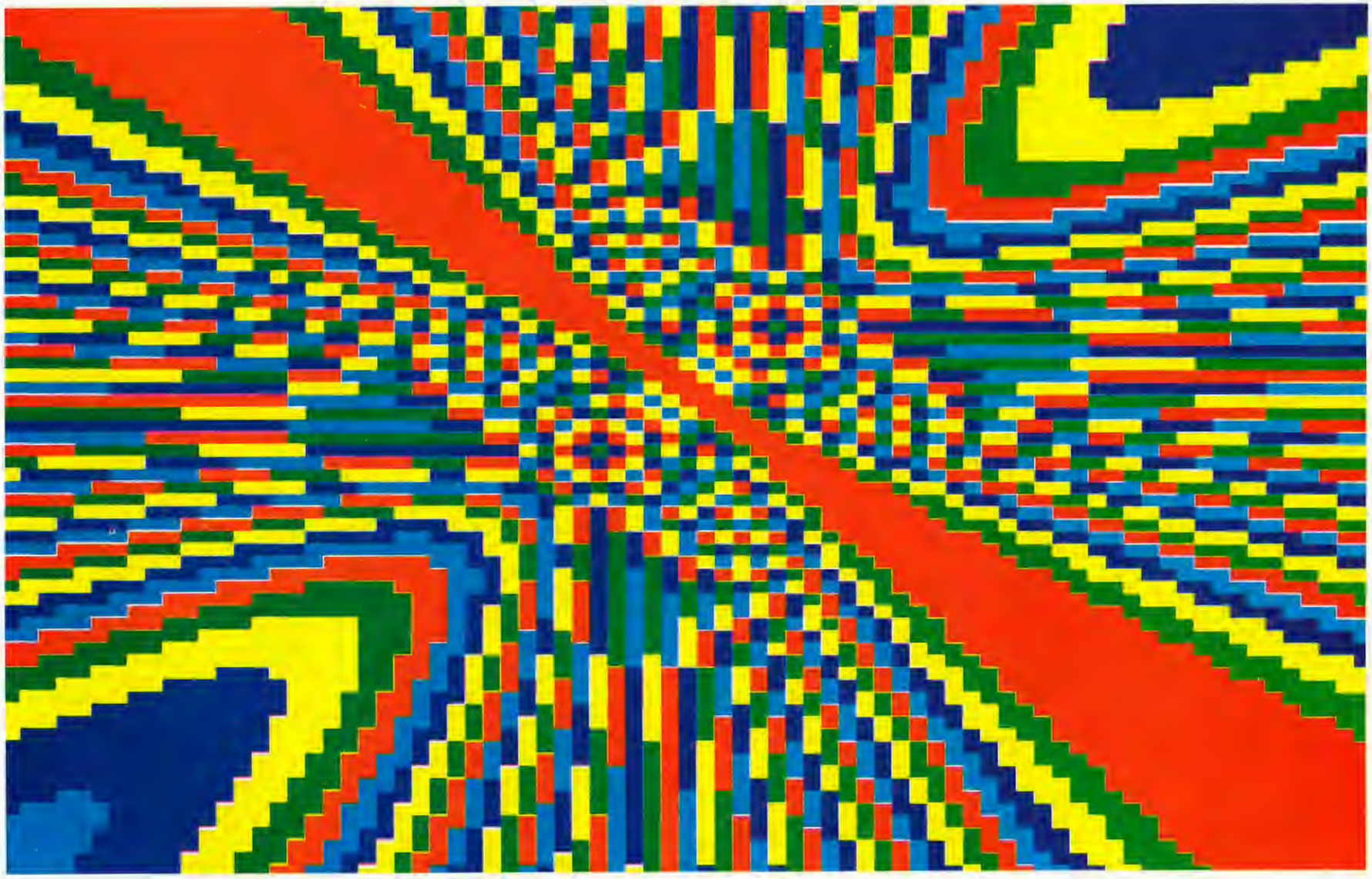
Current widespread use of color graphics makes it important for students in such non-science areas as art, advertising, interior design, architecture, business, communications, social science, etc., to continue studies of mathematics and computer science to levels which have become useful attributes to the practice of those fields. It is hoped that preparation of this calendar and its wide distribution may help acquaint the general public with both the beauty and utility of mathematics to help them convince students in their formative years that mathematics has much to offer people pursuing careers in both technical and non-technical areas.

The color block graphs of functions $z = f(x,y)$ are produced in a rectangular grid in which each block is assigned integer coordinates, x and y, over specified ranges. The function z is computed at each point (x,y) and its value converted into one of the integers $0, 1, \ldots, n-1$, if n colors are available for assignment. For each block the color is assigned which is associated with its value number by the input to the computer program generating the pattern.

The formation of the Center for Color Graphics in 1981 was made possible by the generosity of Charles A. Muench and Intelligent Systems Corporation, expressed in equipment gifts and software development grants. Since 1981 Muench's personal donations of state-of-the-art Intecolor and Printacolor equipment and approval of software grants and of support by the Mary Jeannette Muench Charitable Lead Trust have kept the Center alive in a period of extreme budgetary crisis at Florida State University.

All those who helped create the library of displays used in Miles's ACM lecture tours, his other professional presentations, his calendars, journal and book cover art, and who developed the Graphic Center's artist and instructional support systems were FSU students. Major contributions were made by: Peter Jensen, Scott Rimbey, Laura Rimbey, William Jasiniecki, Eric Chamberlain, Chelle Field, Ray Curci, Doug Martin, Mark Schendel, and Michael Sumner. Vicki Miles deserves great credit for her help in sorting, evaluating, labeling for copyright, screening for use, suggesting suitable color choices, etc. for the hundreds of pictures, slides, screen displays and Printacolor graphics which have followed her husband home and on their travels. Also to Ann Petty for typing of manuscript and Douglas Eason for the design.

Many of our graphs are in low resolution half character block mode using eight colors in a maximal 96×80 half character (24 Pixel) grid. The cover uses the special Miles pointillism character mode providing twenty-seven colors in a maximal 48×80 character grid. Separations performed for the "Gold in Them Thar Hills" cover require the equivalent of halftone photography for their generation. The April, 1984 heat data uses blocks of superpixels on the Intecolor 8064R display from the color wheel of "pure" colors. Separation images for this data display were then created in superpixel blocks and printed on the Printacolor GP1024. Of final interest, the graph "Fire and Ice Revisited" for August, 1984 is a display of maximal high resolution range on our present Intecolor 8064R. The generating function was evaluated at each of the 480×384 pixel positions of the display device with the eight colors determined independently at each position on the screen. Because the GP1024 has 1024 jet print positions per line, the color separation images were created in 2×2 print blocks across, using 960 of the available print spaces per line.

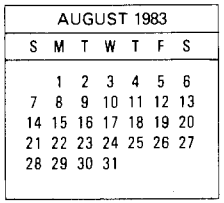
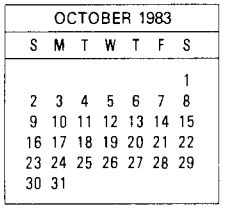


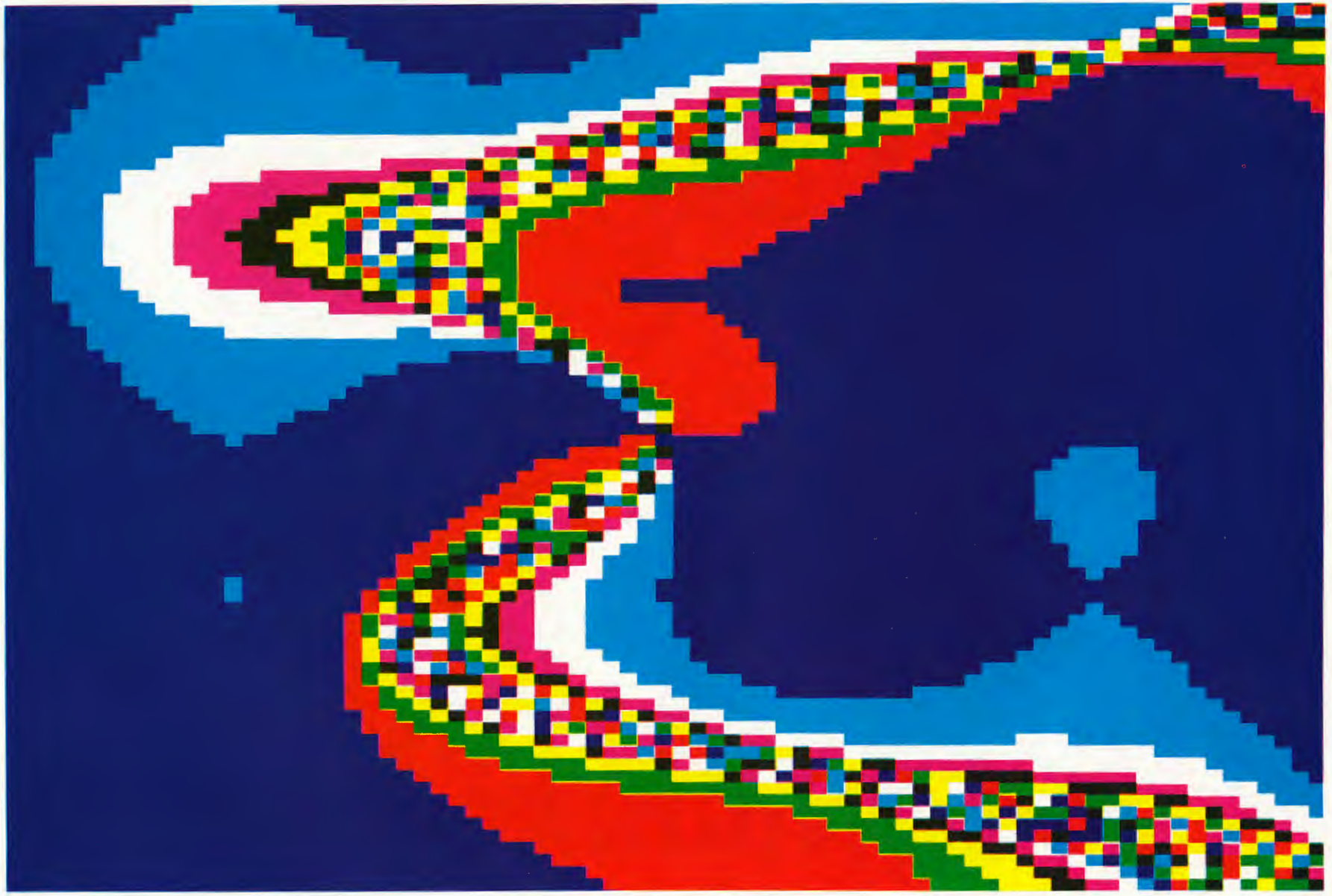
COLLISION COURSE

Miles Color Art A-21

September, 1983: This September scene, a 5-year veteran from the ACM lecture tour slide tray, has become more timely with presidential discussion of laser beam attacks on approaching missiles. The graph of the non-negative definite and bounded generating function, $(25(x + y)^2/(x^2 + y^2 + 45.11)) \bmod 5$, seems to depict two missiles near collision where the death rays are already meeting.

1983 SEPTEMBER 1983

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	2	3
4	Labor Day 5	6	7	Jewish New Year 8	9	10
11	12	13	14	15	16	Yom Kippur 17
18	19	20	21	22	23	24
25	26	27	28	29	30	September



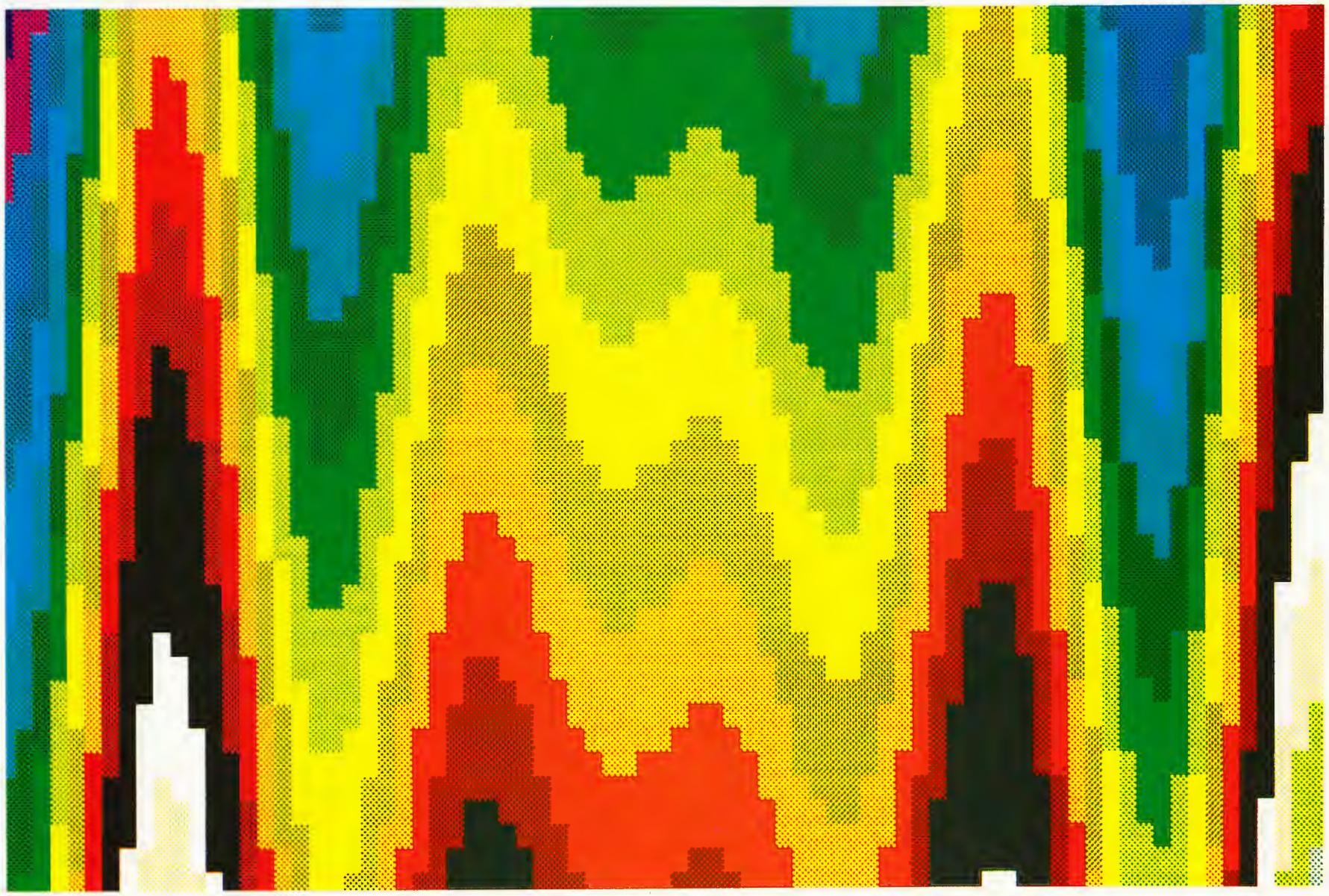
GHOUL/GOBLIN GET TOGETHER

Miles Color Art B-76

October, 1983: These weird creatures appear as if by magic for Halloween if you evaluate the function (y + xcos(x/8))/(x + ysin(y/8) + .1), color it as we did, 41230576, and give it a 90 degree twist.

1983 OCTOBER 1983

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
SEPTEMBER 1983 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	NOVEMBER 1983 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30					1
2	3	4	5	6	7	8
9	Columbus Day 10	11	12	13	14	15
16	17	18	19	20	21	22
23 30	24 Halloween 31	25	26	27	28	29 October

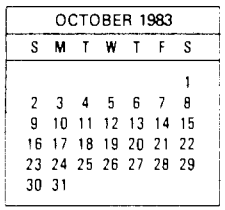
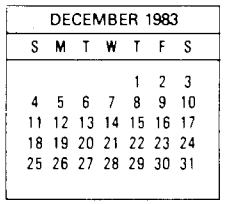


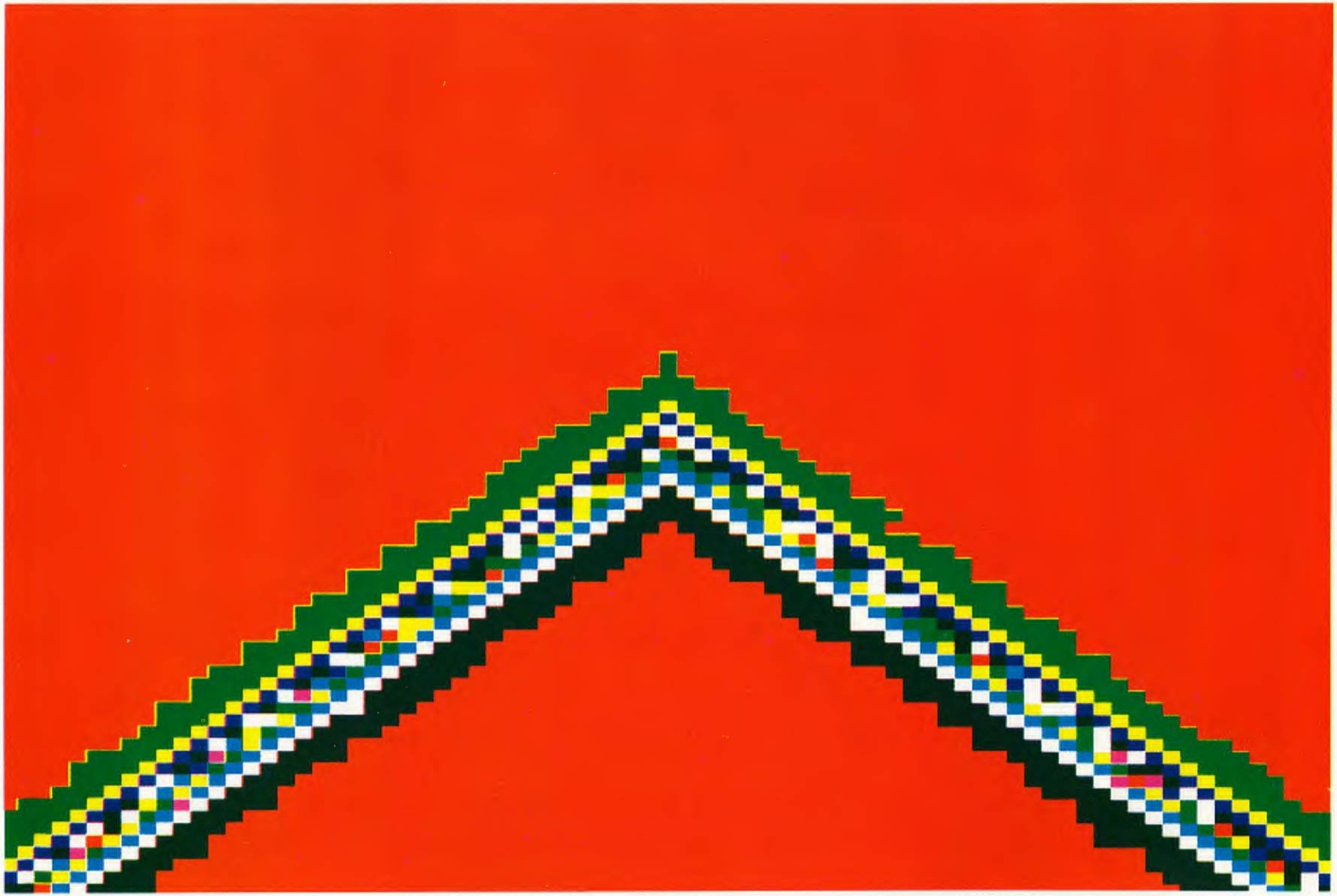
GOLD IN THEM THAR HILLS

Miles Color Art B-45

November, 1983: These colorful autumn mountains were produced using the 27 color pointillism set. The function determining the numbers to which the colors were assigned is $(y - x\cos(x/3))/6 + 5$. These Pointillism Peaks have become such a family favorite, they were chosen for the calendar cover by AVM. Other popular subtitles are MAJESTIC MONOGRAM MOUNTAINS or CHINA'S ICECONE (Guilin) MOUNTAINS.

1983 NOVEMBER 1983

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1	2	3	4	5
6	7	Election Day 8	9	10	Veteran's Day 11	12
13	14	15	16	17	18	19
20	21	22	23	Thanksgiving Day 24	25	26
27	28	29	30			November



CHRISTMAS ARCH

Miles Color Art A-47

December, 1983: This arch for the Christmas season was created using a function staying between zero and one throughout much of the range and oscillating wildly near the lower halves of the lines y=x and y=−x where the denominator (abs(x) + y + .001) is near zero. This is a color block graph of $(y - 7\sin((x + y^3)/14))((\text{abs}(x) + y + .001)$.

1983 DECEMBER 1983

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				Hanukkah 1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
Christmas Day 25	26	27	28	29	30	31 December

ANTI-CITY ACROSS THE BAY

Miles Color Art A-4

January, 1984: Here we can think of the inverted skyscrape in the upper left as representing the year just turned over, while coming in from the lower right we see the upright city representing the new year moving into focus. So it's out with the old and in with the new against a background that's cyan blue. The function graphed is $(x^3 - y^2)\sin(x + y/20)/(1000(x + y + .1))$.

1984 JANUARY 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
New Year's Day 1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

DECEMBER 1983

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEBRUARY 1984

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29			

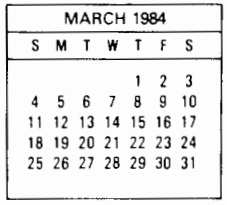
January

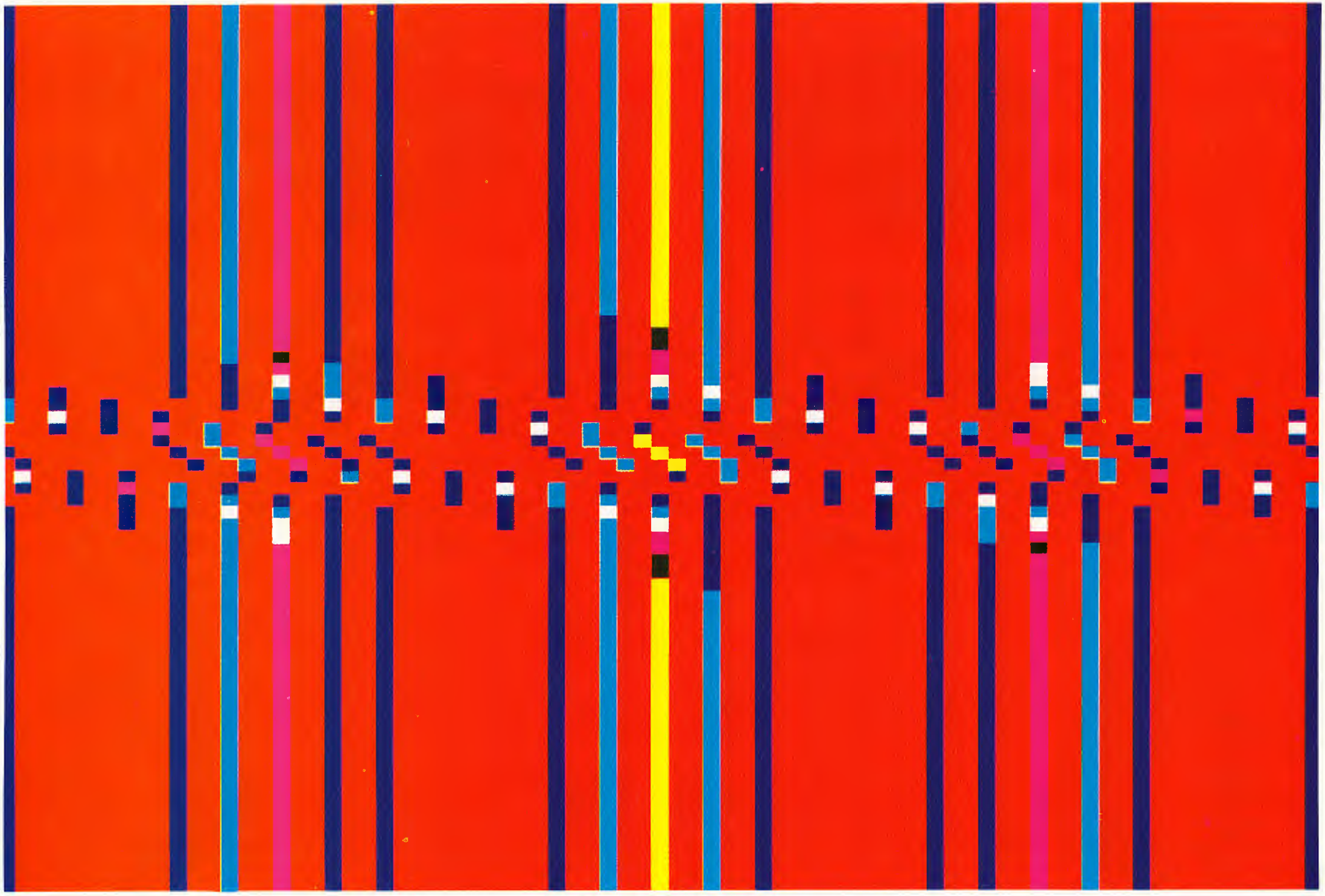
LOVEBIRDS LICKING/RORSCHACH RIDDLE

Miles Color Art B-61

February, 1984: For February we have chosen this comic Valentine cartoon riddle: Do you see lovebirds licking or chameleons kissing, and if so, what are their thoughts or words for the balloons above? Or do you see the upper torso of a sunburned red lady on red sand, so that only her eyeshades and bikini with matching accessories are visible? The generating function is $(\ln(\text{abs}(x^2 + .1)) + y\cos(y/9))/(y - x\sin(x/8) + .1)$.

1984 FEBRUARY 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8	9	10	11
Lincoln's Birthday 12	13	Valentine's Day 14	15	16	17	18
19	Legal Holiday Washington's Birthday 20	21	Washington's Birthday 22	23	24	25
26	27	28	29			February

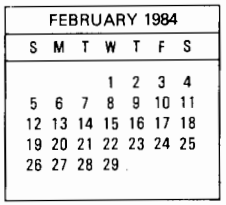
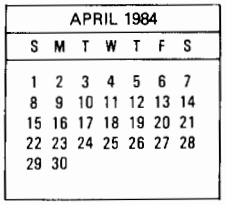


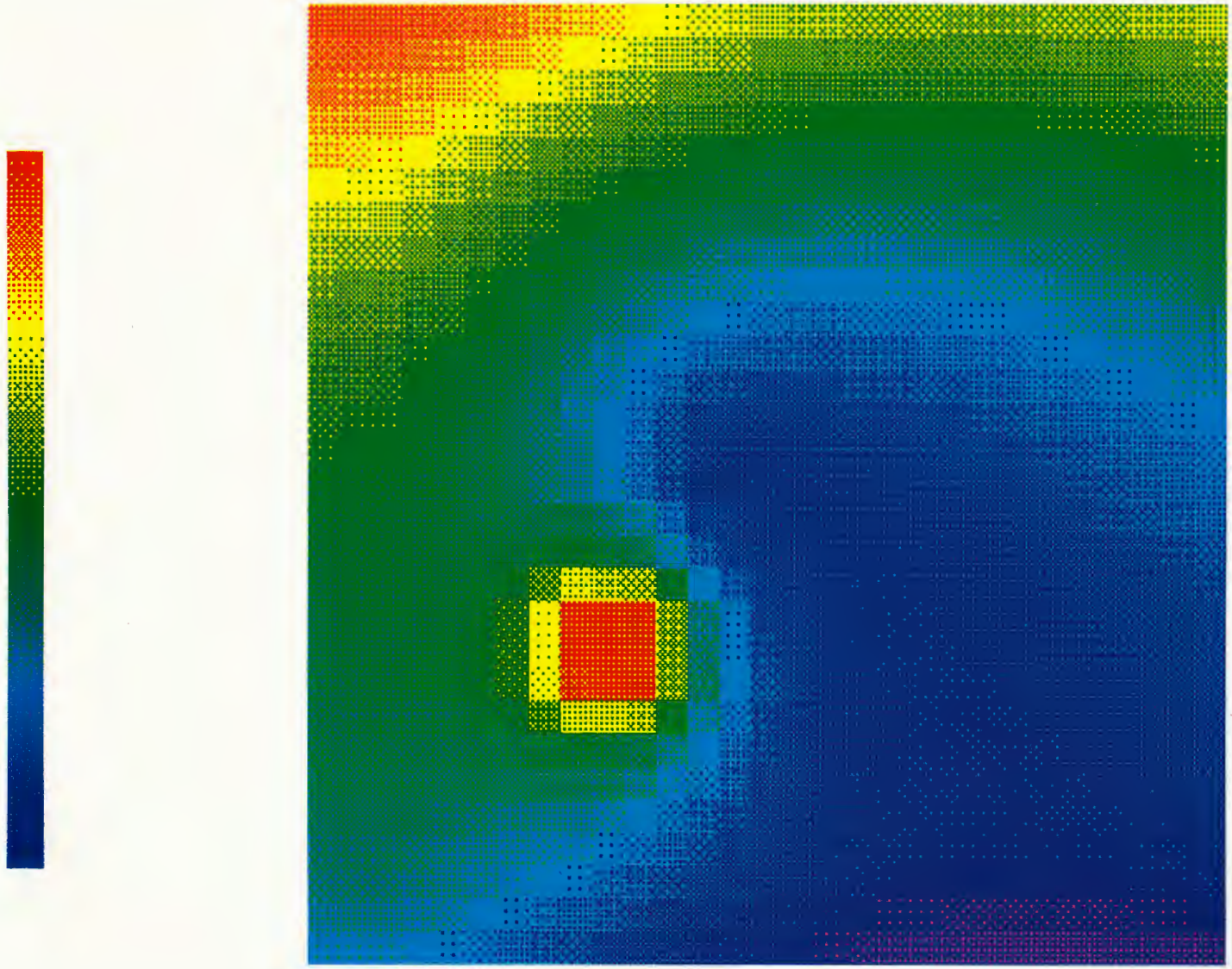
SHATTERED STRIPES

Miles Color Art B-62

March, 1984: This unusual pattern features parallel, vertical stripes which are disrupted near the center, when y is near ±1, to give us a March out of step. The bright colors and merry motions result from a block graph of ln(7abs(sin(x + yexp(1 − abs(y)))) + .01).

1984 MARCH 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
				1	2	3
4	5	6	Ash Wednesday 7	8	9	10
11	12	13	14	15	16	St. Patrick's Day 17
18	19	20	21	22	23	24
25	26	27	28	29	30	31 March



COORDINATED COLORS—COOL TO CALORIFIC

Miles Color Art E-0

April, 1984: This April graphic, with all its beauty and spring colors, displays temperature data from an IEEE COMPUTER GRAPHICS & APPLICATIONS 1981 article originally using only black and white graphics. Our May 1982 version in the same Journal uses pure colors in the Intelligent Systems R-series color wheel which increase in warmness from cold blues to warm reds through intermediate cyans, greens, yellows and oranges, as the temperature rises in the scale from 2.3 to 17.

1984 APRIL 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	Passover 17	18	19	Good Friday 20	21
Easter Sunday 22	23	24	25	26	27	28
29	30					

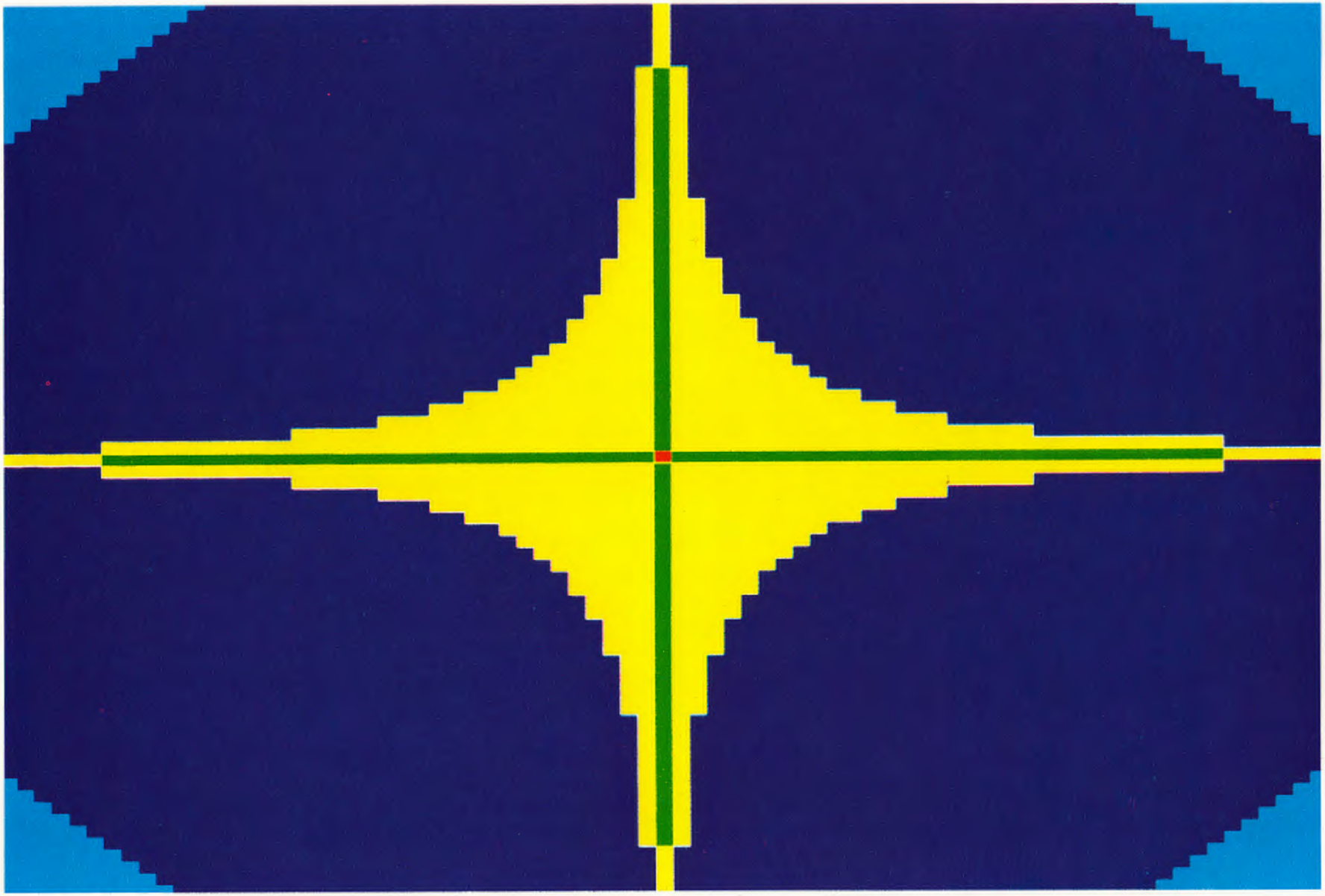
MARCH 1984

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

MAY 1984

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

April



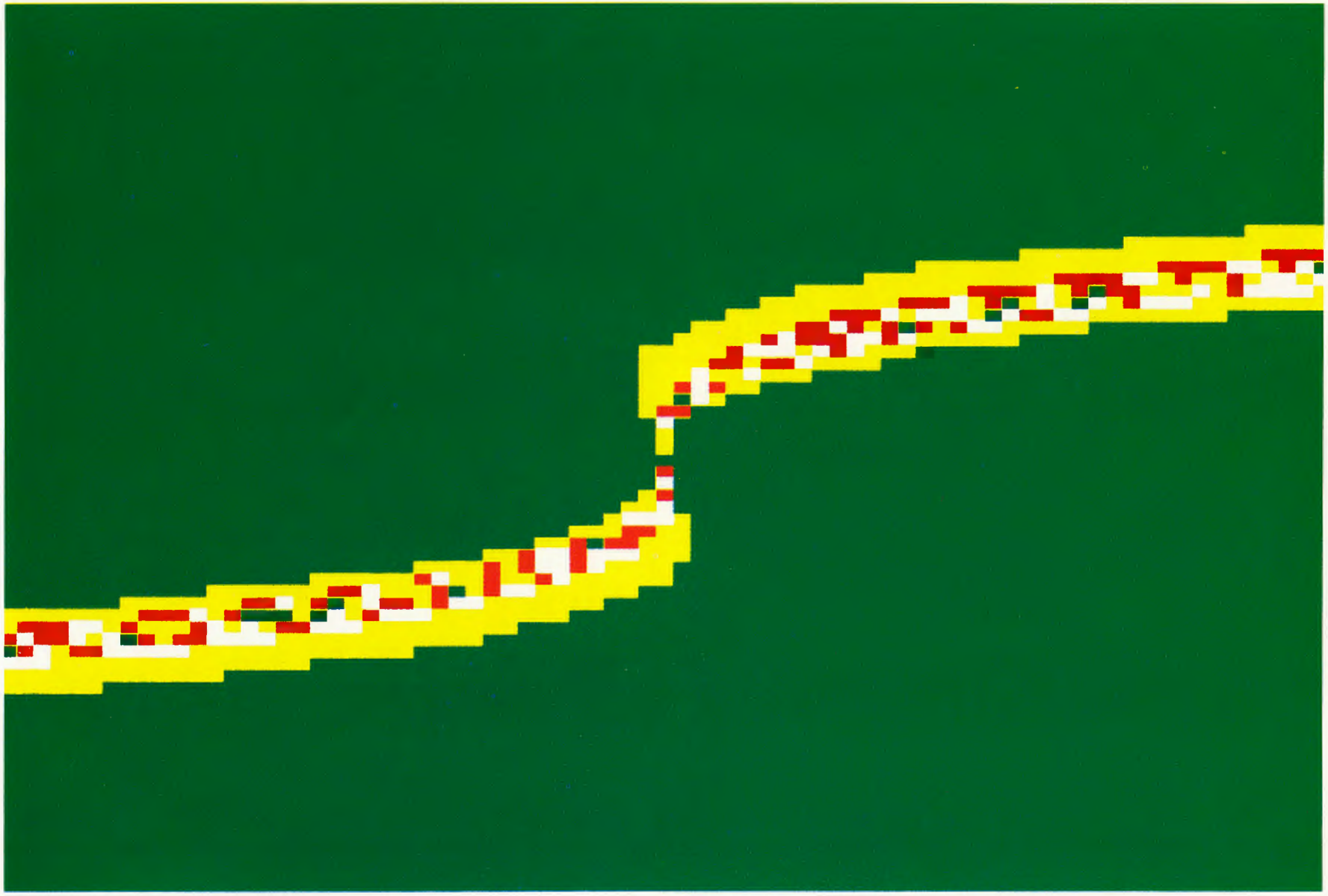
GOLDEN GATE TO BLUE HEAVEN

Miles Color Art A-27

May, 1984: May is a month of heavenly weather. The symmetry and slow growth of the function (abs($x^{(1/5)}$) + abs($y^{(1/5)}$)) Mod5 provides a startling complementary blue framing for the golden gate to heaven displayed here.

1984 MAY 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
APRIL 1984 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	JUNE 1984 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	1	2	3	4	5
6	7	8	9	10	11	12
Mother's Day 13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	Memorial Day 28	29	30	31		May



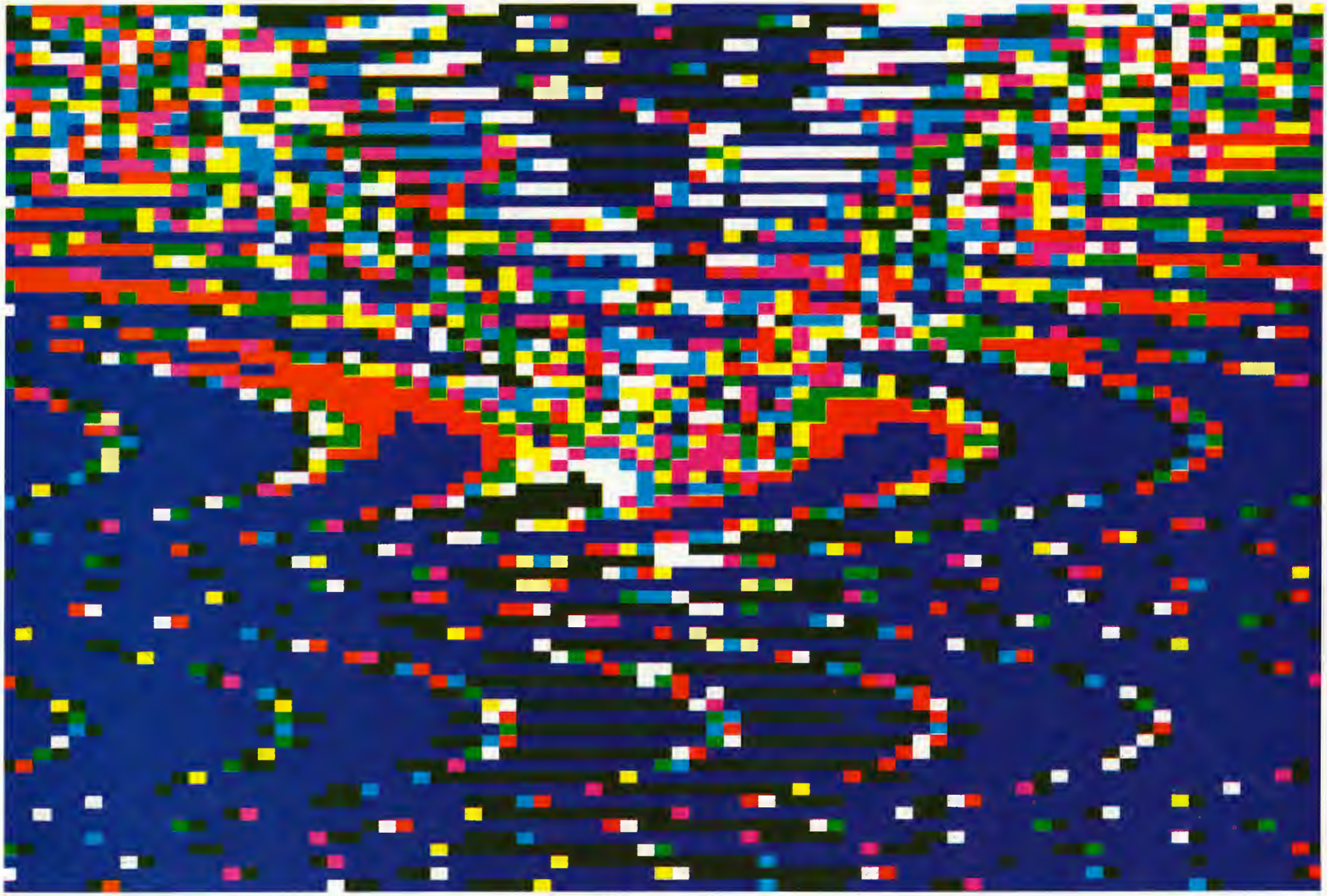
SERPENTINE SCREEN ADORNS GRETNA GREEN

Miles Color Art A-6, (revised)

June, 1984: June is ideal for art upon the green, as we see in this al fresco scene. Our generating function, $10(y^2 - y\sin(x/6 + xy/30))/(100x - y^3 \times .3)$, is small (green) except near the zero of its cubic denominator where the lazy S multicolor screen appears.

1984 JUNE 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
Father's Day 17	18	19	20	21	22	23
24	25	26	27	28	29	30 June



TECHNICOLOR TORNADO

Miles Color Art A-34

July, 1984: These turbulent, tornado-like waves of July color were produced by the generating function $(y - 10/(\cos(x/4 + y^2/15)))/(\text{abs}(x) - y + .1)$. The argument of the cosine function is parabolic. Near the zeros of that denominator function, the parallel parabolic color units appear. The rapid color changes on the upper halves of the lines $y=x$ and $y= -x$ occur because the denominator is also near zero on those two lines.

1984 JULY 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	Independence Day 4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

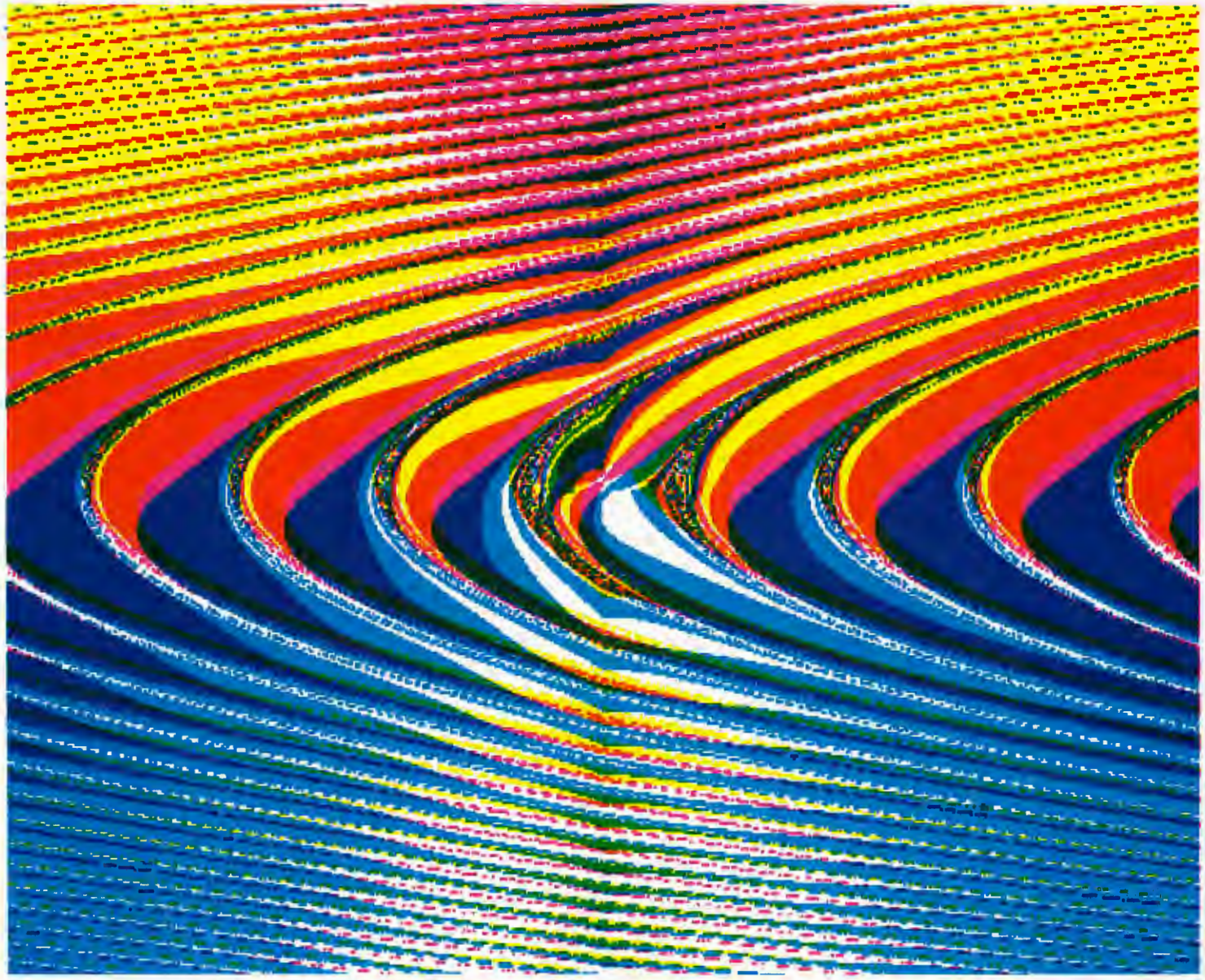
JUNE 1984

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

AUGUST 1984

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

July

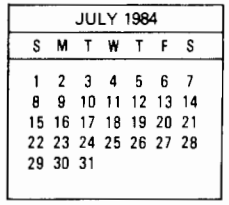
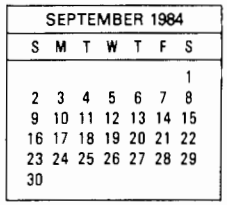


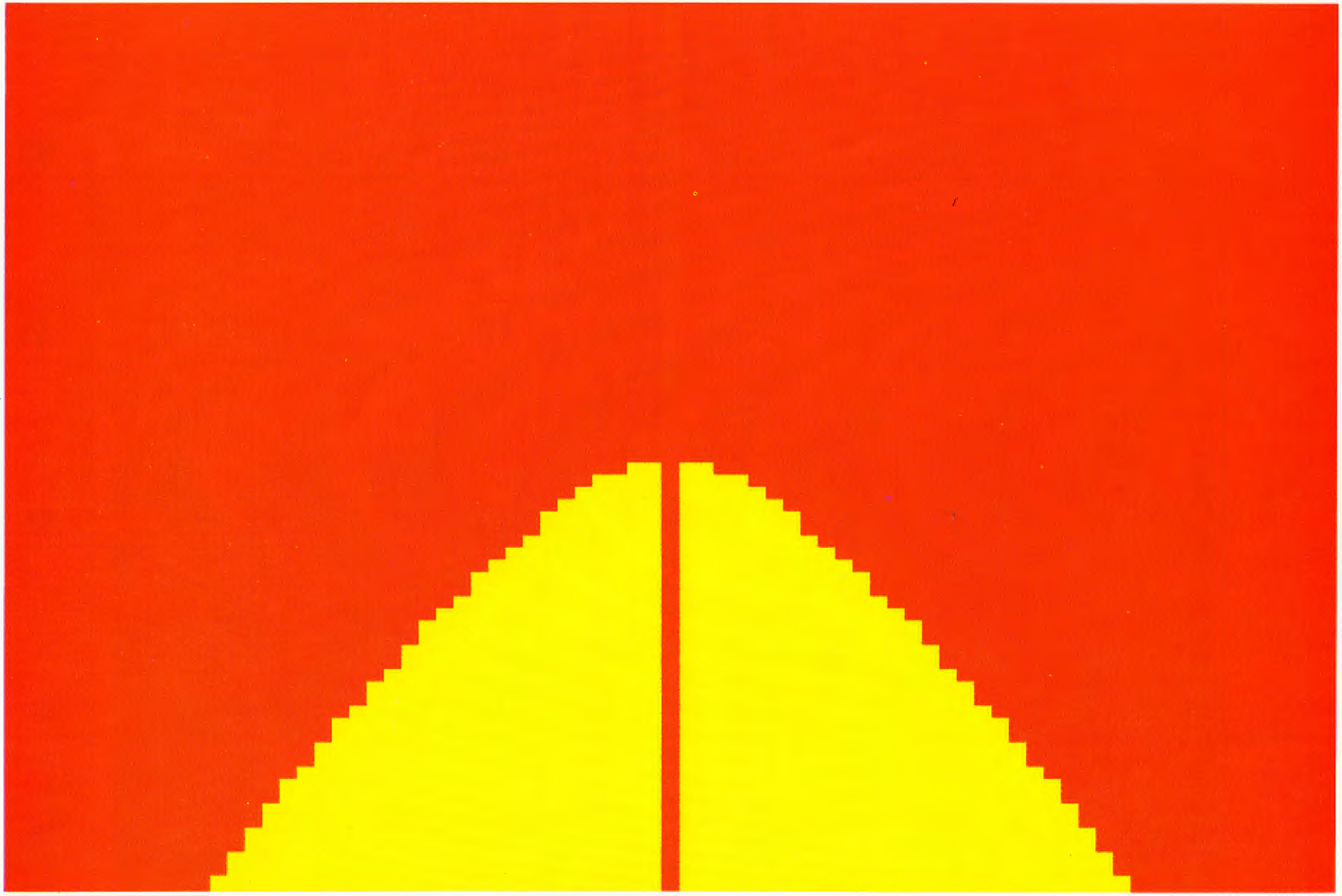
FIRE AND ICE REVISITED

Miles Color Art A-9 (revised)

August, 1984: This Beauty from the cover of calendar I was redone at 480 × 384 resolution and inverted. Warm colors now dominate the upper latitudes and cold colors the lower, typical for August on our planet.

1984 AUGUST 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	August



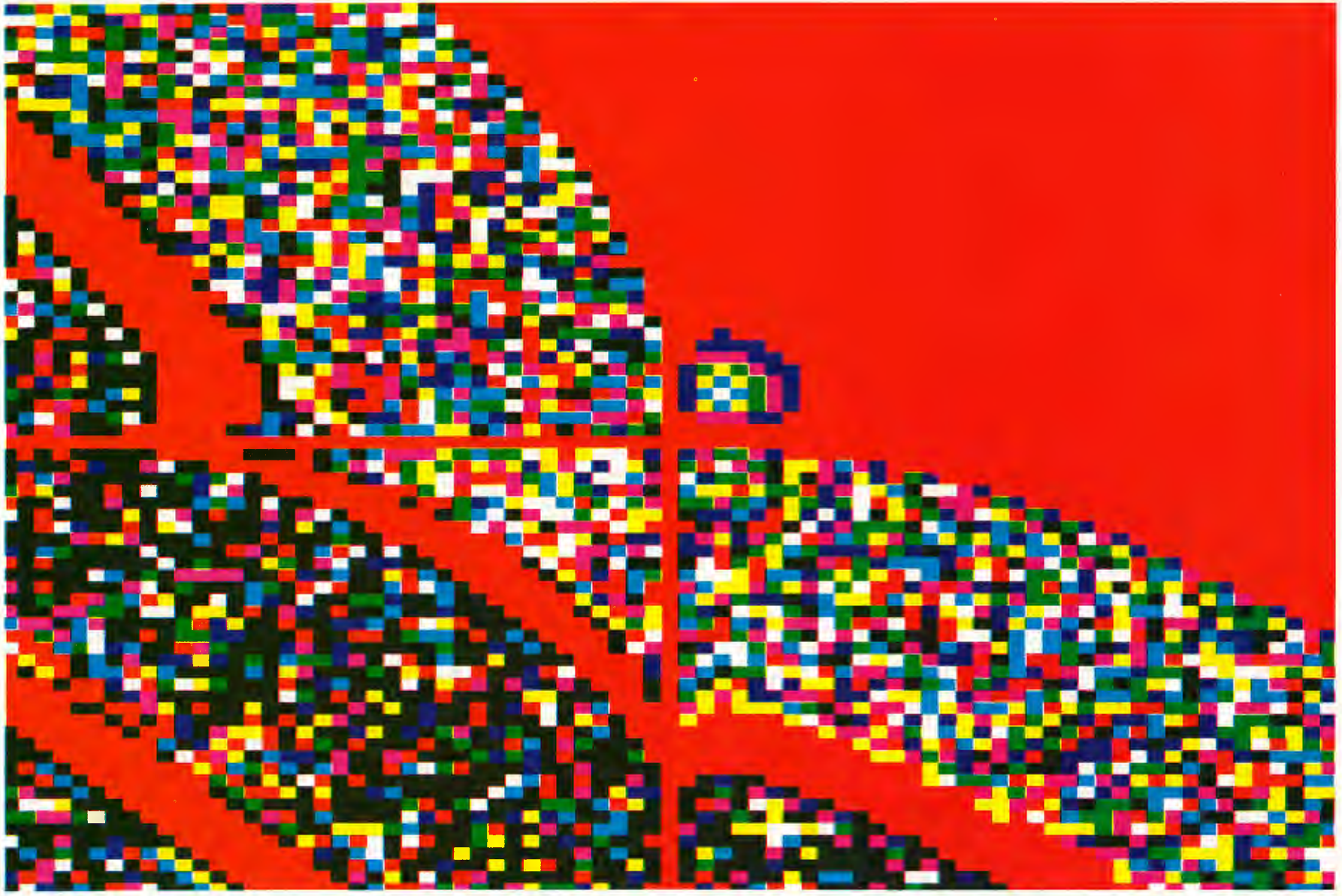
SUPER SEMINOLE ANTHILL

Miles Color Art A-58

September, 1984: This Seminole September pattern was produced from the function $((y - (\text{abs}(x))^{(2/3)})^2/(x^2 + y^2 + .3)$. The function never gets out of the [0,2) range to take on colors other than the red (1) and yellow (3) values for those first two intervals.

1984 SEPTEMBER 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	Labor Day 3	4	5	6	7	8
Grandparents' Day 9	10	11	12	13	14	15
16	17	18	19	20	21	22
23 30	24	25	26	Jewish New Year 27	28	29 September

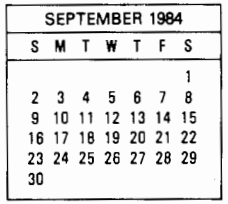


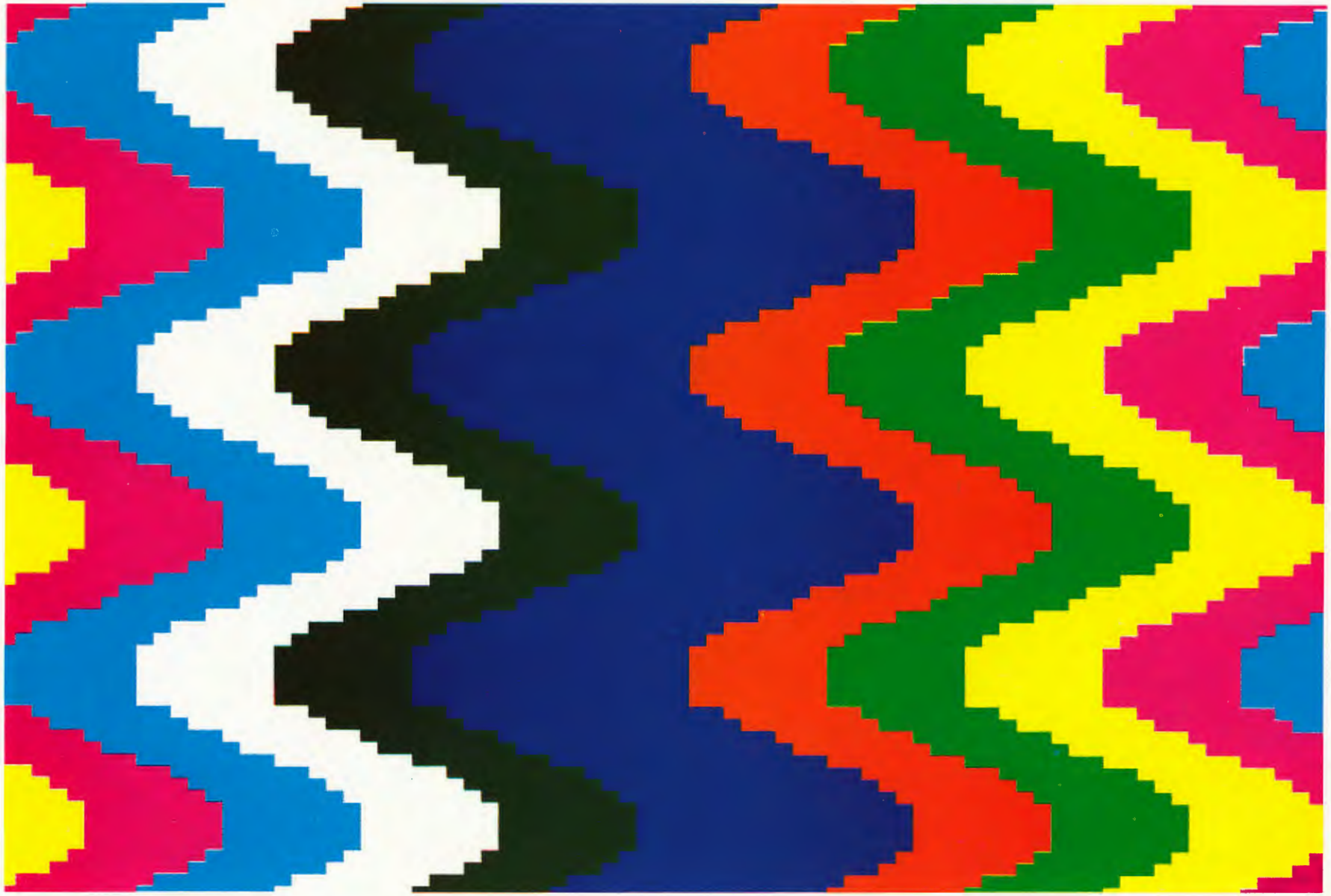
BAT OUT OF HELL

Miles Color Art A-43

October, 1984: This Halloween entry haunts Miles's ACM lecture tray as a horrible product of inadequately debugged software appropriate for the JOURNAL OF IRREPRODUCEABLE RESULTS. We defy you to generate it from $f = x^3y^4/e^{(x+y)}$ using red only where $0 \leq f < 1$.

1984 OCTOBER 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	Yom Kippur 6
7	Columbus Day 8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	Halloween 31			October



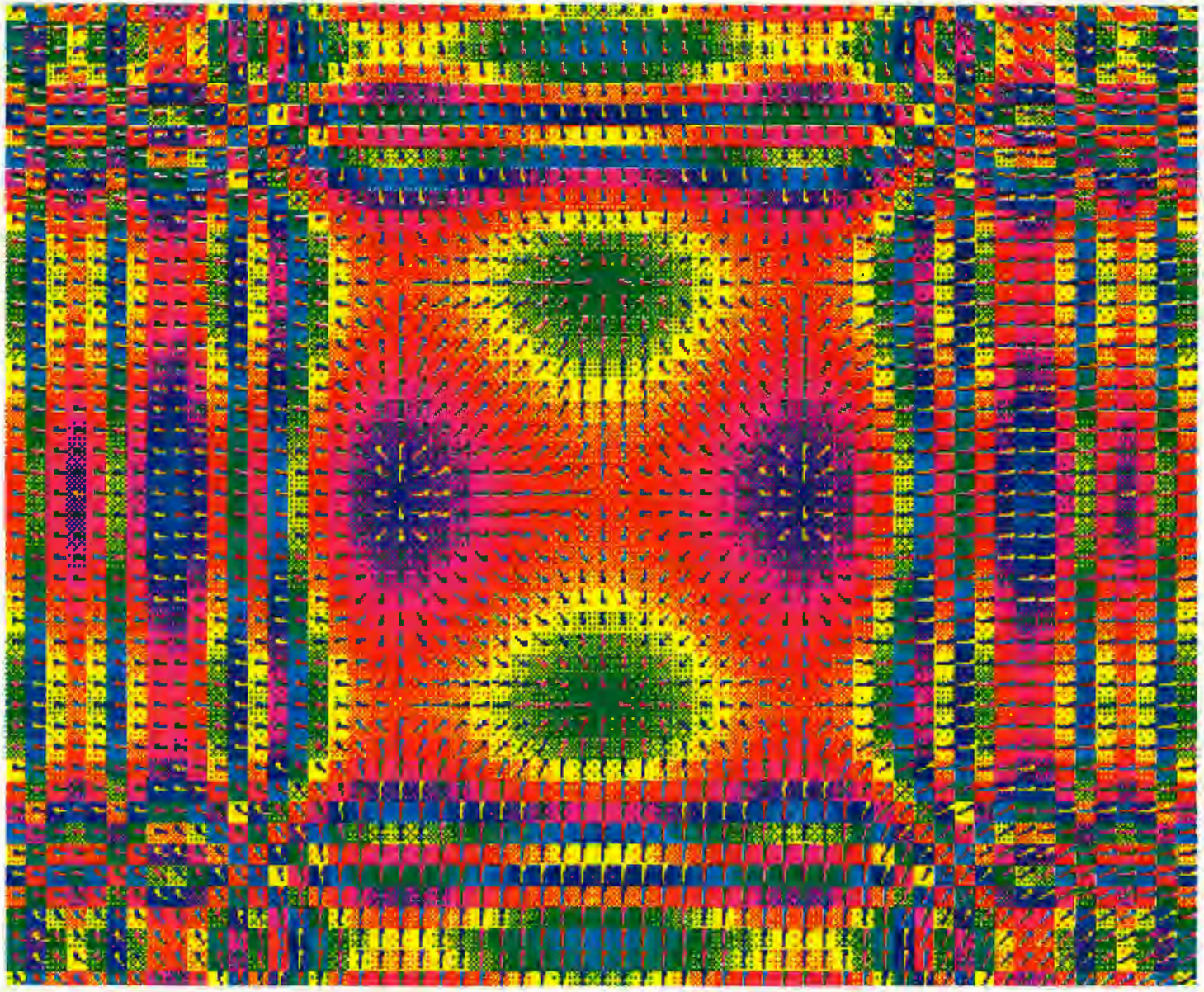
SINUSOIDAL SHAPES

Miles Color Art A-41

November, 1984: For national election month our function is (x + 7 sin (y/4))/8. Few issues are just black and white—individual candidates and voters waver; often tactics and positions at the far left and far right are similar, as with this design. The subtitle "Ric Rac" appeals to those seeing a fabric trim design.

1984 NOVEMBER 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
OCTOBER 1984 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	DECEMBER 1984 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			1	2	3
4	5	Election Day 6	7	8	9	10
Veteran's Day 11	12	13	14	15	16	17
18	19	20	21	Thanksgiving Day 22	23	24
25	26	27	28	29	30	November

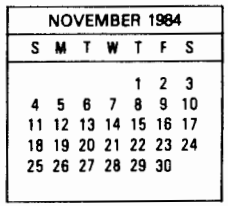
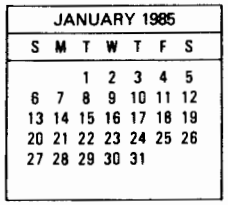


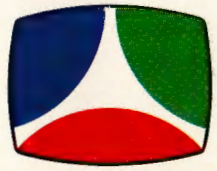
CHRISTMAS CRAZY QUILT

Miles Color Art E-2

December, 1984: Christmas colors dominate our graph of 32 $[(x/10^4 - (y/10)^4 - 2(x/10)^2 + 2(y/10)^2]$. The color in a block shows the function value there; the vector depicts its gradient (direction of greatest change). Note that vectors are perpendicular to boundaries of equi-color zones. Observe their behavior near relative maxima and minima at (± 10, ± 10).

1984 DECEMBER 1984

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	Hanukkah 19	20	21	22
23	24	Christmas Day 25	26	27	28	29
30	31					December



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