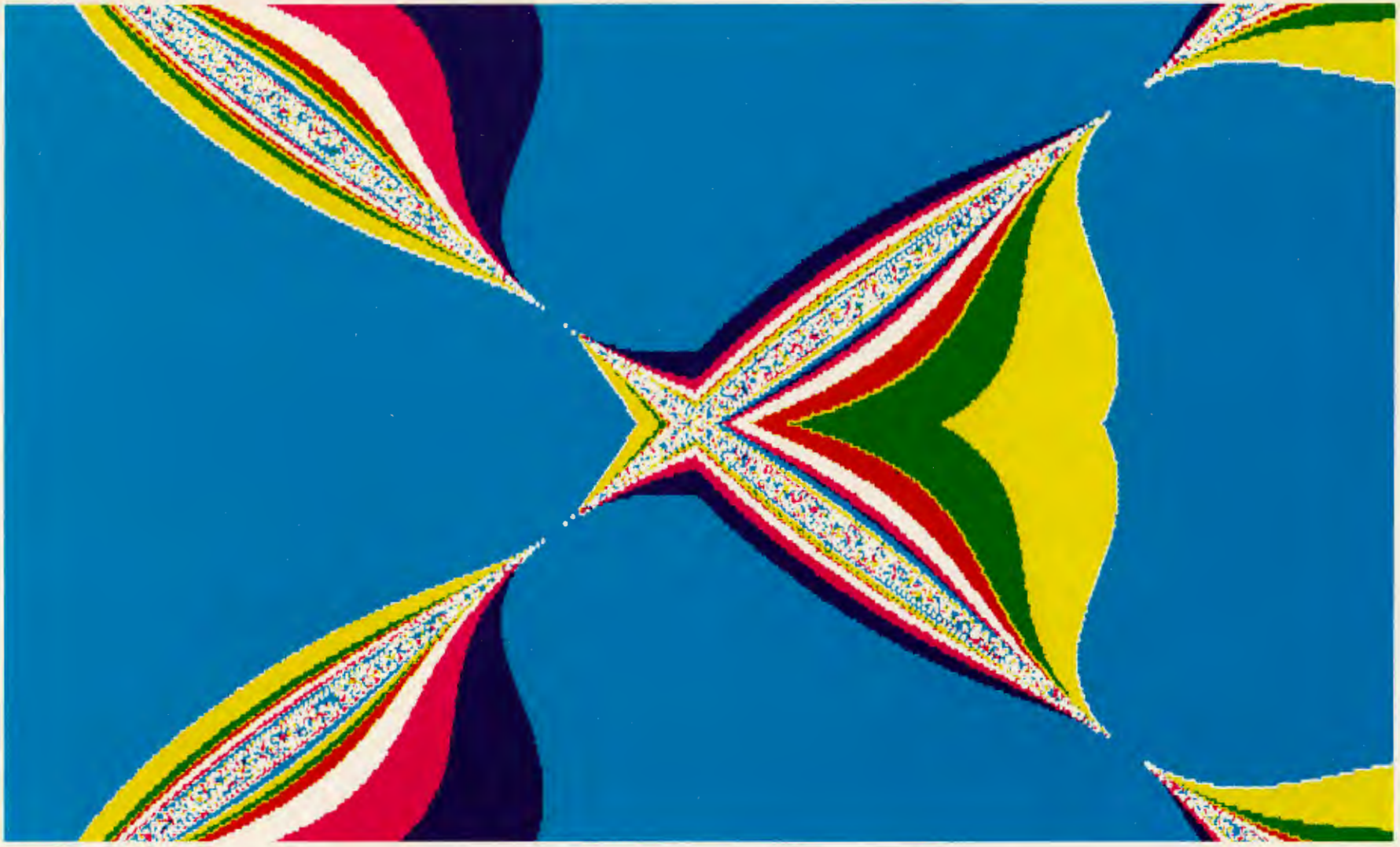

# THE BEAUTIES OF MATHEMATICS IV

## 1985 Planning Calendar featuring Colorgraphic Art

Charles and Jeanette Muench Center for Color Graphics
Florida State University

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000, and PrintaColor GP1024.

# Computerized Graphics Calendar:
# The Colorful Marriage of Science and Art

The family of Intelligent Systems companies, including Intecolor Corporation, Quadram Corporation, Princeton Graphics Corporation and Datavue Corporation, and the Printacolor Corporation proudly present this colorful calendar to our customers and friends throughout the world.

The beauty and mystery of colorful abstract art are evident in these calendar pictures. Not so evident is the manner in which they were produced. Each monthly abstract was generated via mathematical formula on a desktop computer by Dr. E.P. Miles, who heads the Charles and Jeanette Muench Center for Color Graphics at Florida State University. By making slight changes in the formulas, the patterns can be enhanced, producing different shapes and colorations. Dr. Miles experimented with hundreds of complex formulas and tried thousands of variations before creating the art used in this calendar. Once the images were created on the computer, color separations for volume printing were produced on a Printacolor ink-jet printer.

While color graphics has been appreciated in science and in business for years, its value in the arts has received less recognition. The pictures reproduced here are the result of a merger of art and science. Combining the aesthetics of art with the precision of science, Dr. Miles has demonstrated the value of color graphics in fields where art plays a major role -- including advertising, interior design, landscaping, architecture, packaging, etc. Just as art can be an inspiration to the scientist, Dr. Miles has shown that science can inspire the artist.

Both Intelligent Systems Corp. and Printacolor Corporation were inspired by and have prospered from a basic scientific principle: color communicates better. Intelligent Systems in 1974 introduced the first color terminal to use a microprocessor. That terminal, the model 8000, has become the standard in the process control industry and widely used in hundreds of colorful applications throughout the business world. In 1980, Printacolor became the first company to manufacture a desktop, color ink-jet printer. The phenomenal growth of both companies is a tribute to the growing importance of color.

Today both companies remain in leadership roles in their respective markets. Intelligent Systems now includes Quadram, the largest supplier of computer enhancement products in the world. And Princeton Graphics, manufacturer of brilliant, color monitors for personal computers. Intecolor Corporation, the original operating company of Intelligent Systems, has expanded into office and engineering markets, using two new lines of color terminals. Printacolor has developed a completely new line of color printers at a surprisingly low cost.

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Enjoy the marriage of science and art on the following pages. For more information, contact:


Intelligent Systems
20 Technology Parkway, Suite 160
Norcross, Ga. 30092
(404) 441-0611

Intecolor Corporation
225 Technology Park
Norcross, Ga. 30092
(404) 449-5961

Princeton Graphics Systems
1101 State Road
Princeton, N.J. 08540
(609) 683-1660

Printacolor Corporation
5965 Peachtree Corners East
Norcross, Ga. 30071
**(404) 448-2675**

Quadram Corporation
4355 International Blvd.
Norcross, Ga. 30093
**(404) 923-6666**

Datavue Corporation
225 Technology Park
Norcross, Ga. 30092
**(404) 449-5961**

# Beauties of Mathematics Calendar IV

## 1985

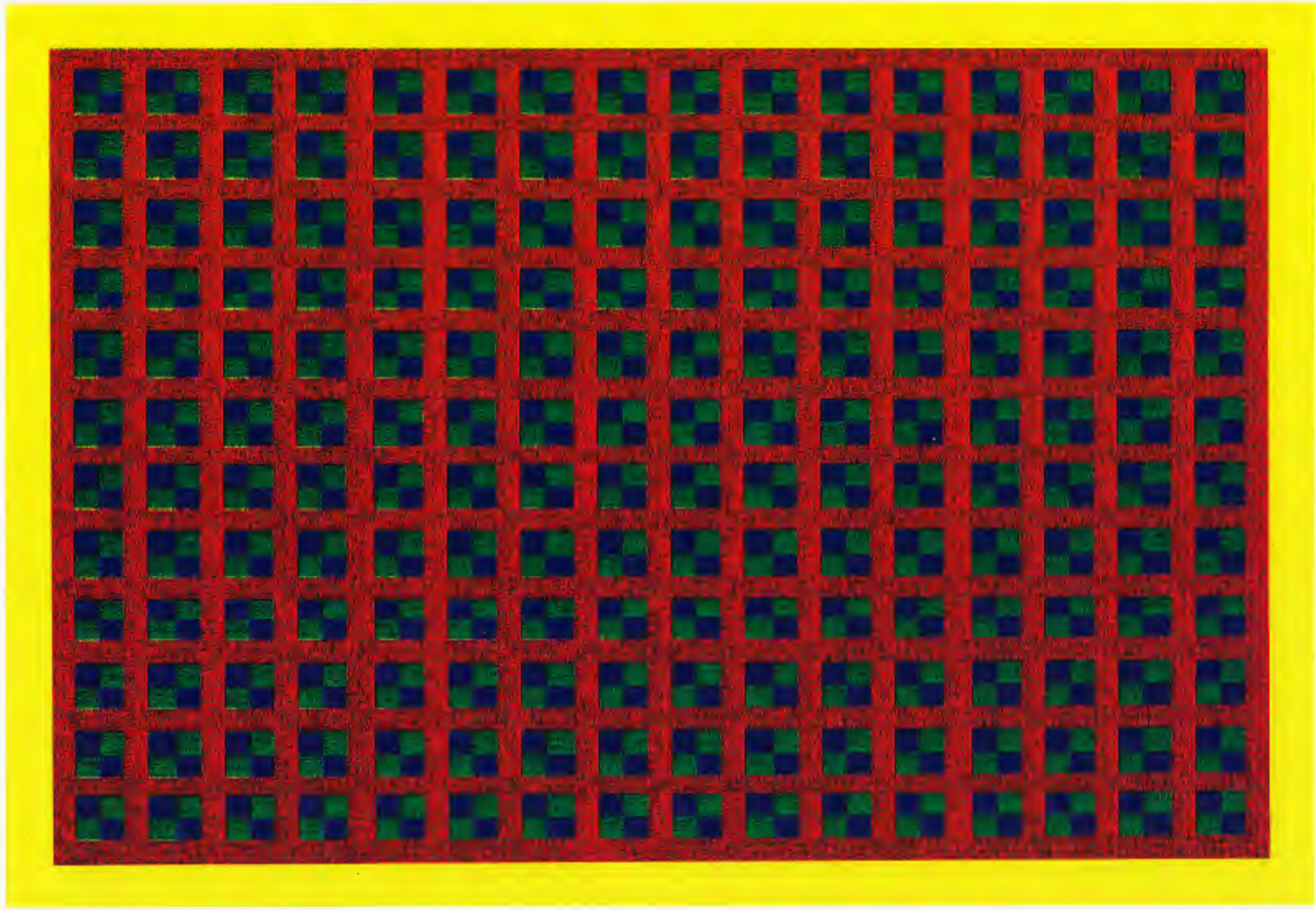
The mathematical beauties of the month for Calendars I through IV were produced, with the help of many gifted students, by Dr. E.P. Miles Jr., Service Professor of Mathematics and Computer Science at Florida State University, using various donated computers in the Charles and Jeanette Muench Center for Color Graphics. Students playing major roles in developing our graphic image files and artist support programs in each new hardware, software, language and color palette environment listed in chronological order since 1977 are : Peter Jensen, Scott Rimbey, Laura Rimbey, William Jasiniecki, Eric Chamberlain, Ray Curci, Doug Martin, Mark Schendel, Michael Sumner, Tracy Hamilton, and Don Pace. The four "Beauties" calendars outline the progress at FSU since 1980 in creating device-independent graphics in special color sets suitable for digital separation for substantial cost savings when printed on a four color press.

Miles has just received U.S. Patent 4,430,668 for the Digital FACSIMILES (Digital Fast Additve Color Separation Internegatives MILES) process which makes these savings possible. This process was applied in calendars I and II by photographing computer separation images from Intecolor 8000 screens. Calendar III used separation images printed on a PrintaColor GP1024 attached to the Intecolor 8064R computer which produced the low and high resolution graphics selected for printing.

For this calendar we have adapted our methods to recent Muench gifts of new model equipment providing a ten fold expansion of color graphics work stations based on 40 Intecolor 2427 high resolution units and five Datavue 3000 control units. Included are: PrintaColor TC1040, Siemens PT80, and Quadram QuadJet 9000 printers; also various Quadram interface units and related software for the IBM PC. Our four current student assistants, Curci, Sumner, Hamilton and Pace have developed software for this new equipment to create designs in the 8, 27, 125, 729 and 4913 color palettes using methods described in Miles' 1981 patent application. Camera ready copy of the text portion of this calendar was for the first time created using the word processing and symbol generation capacity of various Intecolor terminals to illustrate preparation at a single work station of all pre-press elements of books, manuals, brochures, reports, etc. i.e. text, color graphs, art work, and color separations.

Most "Beauties of Mathematics" displays are color block graphs of mathematical functions generated by using an algorithm described by Miles' 1955 paper "Functional Design or Colorful Mathematics". That paper used hand-created color patterns to attract junior high students with mathematical abilities who saw no need for mathematics in their future. Then, as now, many able students closed doorways to future technical, scientific, and non-technical careers by declining to study mathematics prerequisite for entry level jobs or advanced study in such areas. These calendars and related activities have provided outreach to many gifted precollege students in recent years. Two days after our forty new work stations were installed they began serving as a laboratory for fifty gifted high school students, chosen state-wide, for a six-weeks residential camp. Support for a three-week art teacher short course and demonstrations for an NSF Institute for Florida's outstanding science teachers overlapped support for the 1894 summer camp. We have adapted many of our programs to the APPLE II, TRS-80, COMMODORE VIC-20 or 64, and IBM PC computers to share with students or teachers having access to those machines.

Special credit is due to Doug Eason, then at Rose Printing, who cooperated in pre-testing our separation process and guiding its use for the first calendars, ICCGC '83 brochures, etc. and to Bruce Leinaar, Rose's production coordinator for most of our process color printing projects. Finally, appreciation is expressed to Vicki Miles for the help given her husband in evaluating, sorting, and selecting from thousands of images these past seven years those appropriate for various publications, museum displays, the ACM lecture slide tray, etc. and for thirty-nine years of loyal marital support in all categories.



**MODULAR MULTIPLICATION TABLE**

Miles Color Art B-108

JANUARY 1985: FOR THE FIRST MONTH WE SHOW OUR FIRST DESIGN ON THE IBM PC. AS X AND Y RANGE THROUGH THE INTEGERS FROM 0 TO 48 AND 0 TO 36 RESPECTIVELY, THE PRODUCT X*Y IS COMPUTED MODULO 3 FOR EACH BLOCK (X,Y). EACH RESULTING INTEGER PRODUCT, [0,1,2] IS REPRESENTED BY THE INTECOLOR COLORS [1,2,4]. THESE ARE IBM COLORS [4,2,1]. THE COMPUTATION IS SIMPLE ENOUGH, BUT MANIPULATING THE COLOR APPLICATIONS CORRECTLY WOULD BE QUITE TEDIOUS AND BORING FOR THIRTY-SEVEN ROWS OF FORTY-NINE BLOCKS. THE CYAN, MAGENTA, AND YELLOW CONTROL PLATES FOR PRINTING THIS DESIGN WERE CREATED AND PRINTED USING THE DIGITAL FACSIMILES (U.S. PATENT 4,430,668) PROCESS (DIGITAL FAST ADDITIVE COLOR SEPARATION INTERNEGATIVES - MILES) APPLIED THROUGHOUT THIS CALENDAR.

Produced at the Muench Center for Color Graphics, FSU, on an IBM PC, Quadram interface and QuadJet 9000.

1985 **JANUARY** 1985

| SUNDAY | MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY |
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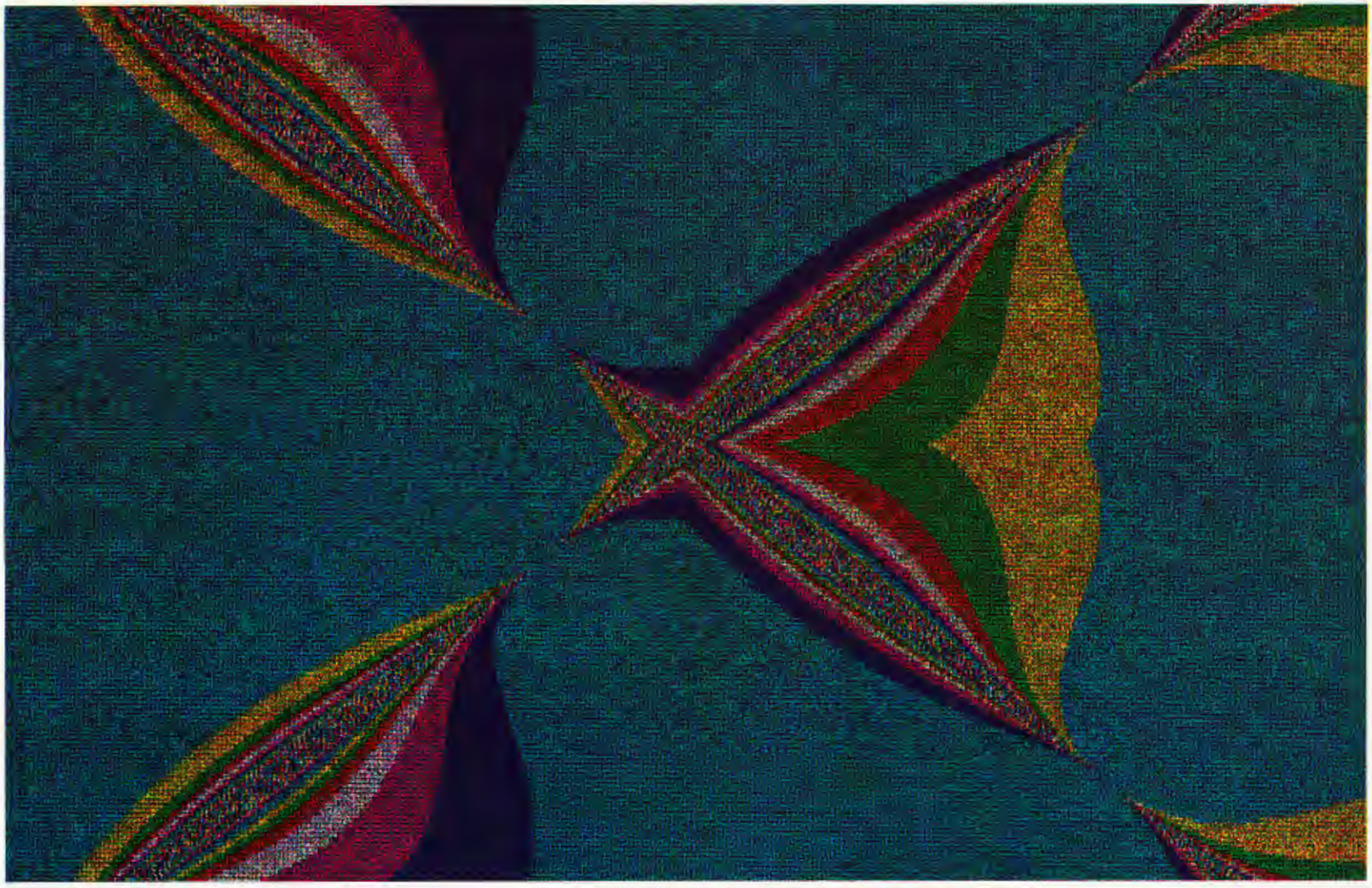

**FLAMBOYANT FLOUNDER FOOLISHLY FLIRTING**

Miles Color Art A-5

FEBRUARY 1985: THIS COLOR BLOCK GRAPH IS KNOWN TO READERS OF THE COVER STORY "SOME HIGHLIGHTS ON LOW-RESOLUTION COLOR GRAPHICS, IEEE COMPUTER GRAPHICS AND APPLICATIONS (MAY 1982)" AS THE FLOUNDER WHICH TRANSFORMS INTO A BUTTERFLY WITH A MINOR FUNCTION CHANGE. THE GENERATING FUNCTION F(X,Y)=((3*SIN(X/13)+3*COS(Y/13))**2)/(ABS(X)-ABS(Y)+.03), ALMOST INVOLVES DIVISION BY ZERO ON THE LINES Y=X AND Y=-X. VALUES OF THE FUNCTION GROW LARGE AND CHANGE RAPIDLY NEAR THOSE DIAGONAL LINES. FOR THIS CALENDAR THE GENERATING FUNCTION HAS BEEN SCALED AND RE-COMPUTED IN HIGH RESOLUTION. FOR THE COVER VERSION, SEPARATIONS WERE PRINTED ON THE PRINTACOLOR GP1024. HERE THE QUADJET 9000 WAS USED. THE SAME SOURCE IMAGE ON THE INTECOLOR 2427 WAS USED FOR BOTH SEPARATIONS. x:[-50,50] y:[-40,40]

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000, and Quadram QJ9000.

1985 # FEBRUARY 1985

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**COLORFUL CANAL SCENE**

Miles Color Art B-77

MARCH 1985: OUR GENERATING FUNCTION IS (X-10*SIN(Y**2/25+X/4))/(Y+ABS(X)+.001), WHICH HAS NEAR SINGULARITIES ON THE PARTS OF LINES Y=X AND Y=-X AT OR BELOW THEIR INTERSECTION AT THE ORIGIN. OUR PLOT MOVES THE ORIGIN JUST FIVE BLOCKS BELOW THE CENTER OF THE UPPER BOUNDARY. THIS IS A TYPICAL PRE-1980 LOW RESOLUTION GRAPH IN HALF CHARACTER BLOCKS. RANGES AND COLOR CODES ARE: x:[-39,39] y:[-70,5] code:63210576

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 8001G and PrintaColor GP1024.

1985 **MARCH** 1985

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**SHOCK WAVES FROM THE BUG OF PARADISE**

Miles Color Art B-83

APRIL 1985: IF YOUR APRIL PICNIC ATTRACTS BUGS, MAY THEY BE AS COLORFUL AND HARMLESS AS THE ONE PRODUCED HERE BY THE GENERATING FUNCTION, (X**3-Y**3-30*X*Y)/(3*(X**2+Y**2)+.03). THE ORIGIN IS FIFTEEN UNITS ACROSS AND DOWN FROM THE UPPER LEFT CORNER. YOU MIGHT LEARN MORE ABOUT THIS FUNCTION BY NEGLECTING THE .03 AND CONVERTING THE QUOTIENT TO POLAR COORDINATES. x:[-15,61] y:[-61,15] code:61230547

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000, and PrintaColor GP1024.

1985 **APRIL** 1985

| SUNDAY | MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY |
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**HOUND OF HEAVEN**

Miles Color Art B-35R

MAY 1985: THE LOW RESOLUTION VERSION OF THE GREEN AND YELLOW PUPPY DOG FEATURED AT OUR LEMOYNE FOUNDATION AND JUNIOR MUSEUM SHOWS HAS BEEN REDONE IN HIGH RESOLUTION WITH ALTERED BACKGROUND COLORS AND AN IMPROVED GALACTIC NECKTIE. OUR FUNCTION IS (X*EXP(SIN(Y/4))+Y*EXP(COS(X/5)))/(Y-ABS(X)+.001) WITH NEAR SINGULARITIES AT OR ABOVE THE INTERSECTION OF Y=X AND Y=-X. THE RAPID VALUE CHANGES THERE PRODUCE THE VARIEGATED COLORING FOR THE COLLAR AND THE BOW TIE OF THE PUPPY. x:[-39,39] y:[-37,37] code:63210576

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000, and PrintaColor GP1024.

1985 MAY 1985

| SUNDAY | MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY |
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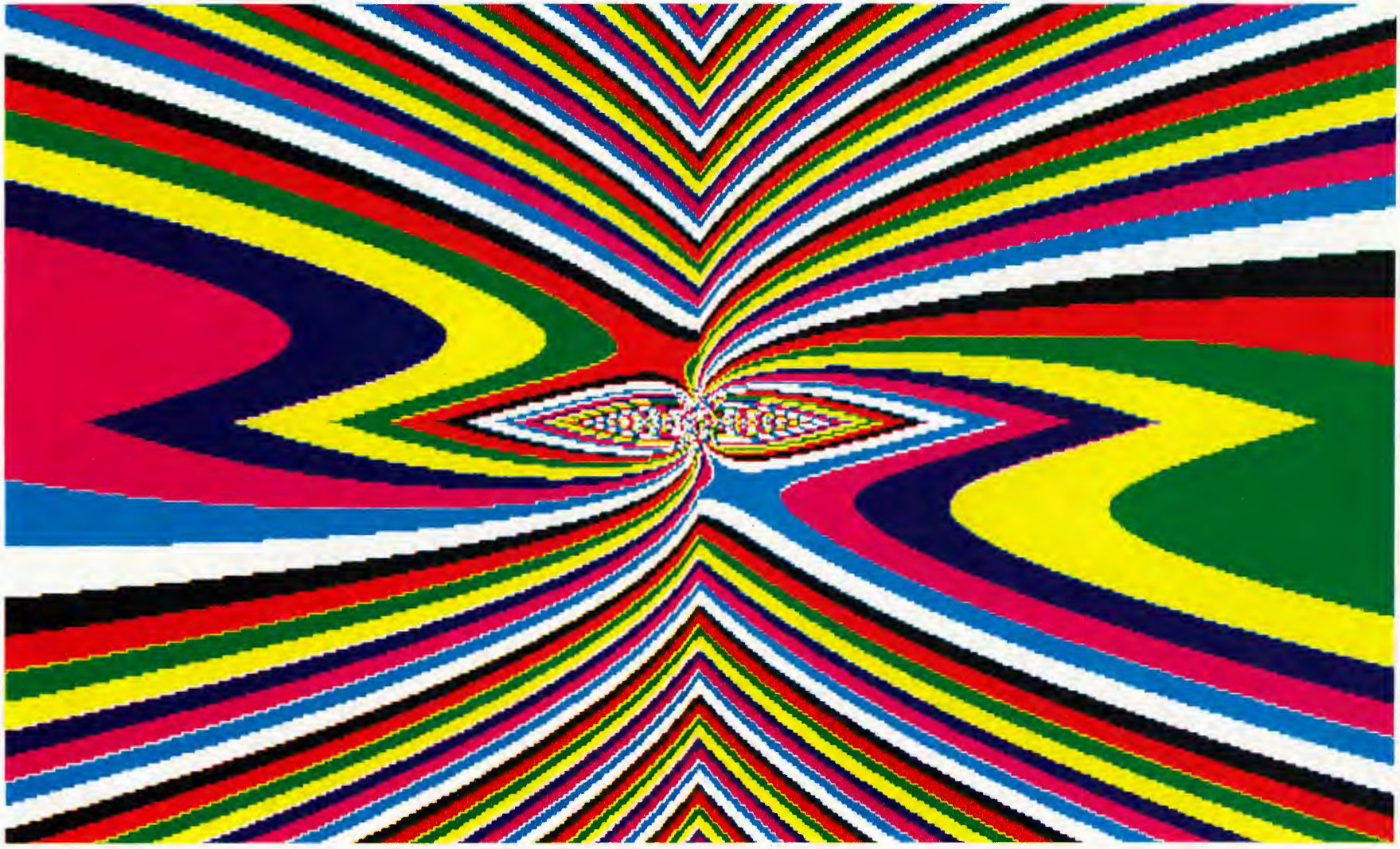

**VARIEGATED VORTICES REVISITED**

Miles Color Art B-95 (556*250)

JUNE 1985: OUR FUNCTION IS DEFINED SUCH THAT F(X,Y)=(100*X-Y**3)/((ABS(X)+ABS(Y))**2+.3)=-F(-X,-Y), THUS INEQUALITY BAND WIDTHS OF THE SAME SIZE, BUT COMPLEMENTARY COLORS, ARE ACROSS THE ORIGIN FROM EACH OTHER. COLOR CHOICES ARE IN THE DEFAULT ORDER 01234567: BLACK, RED, GREEN, YELLOW, BLUE, MAGENTA, CYAN, AND WHITE. THE FUNCTION Y=ABS(X) IS CONTINUOUS EVERYWHERE BUT HAS A DISCONTINUITY OF THE DERIVATIVE AT X=0. THUS THE BOUNDARIES OF THE INEQUALITY ZONES CHANGE RADICALLY AT THE Y-AXIS. FOR X=0, THE FUNCTION IS APPROXIMATELY -Y, FOR MOST Y, CAUSING THE COLORS TO GO THROUGH THE DEFAULT SET IN REVERSE ORDER ON THE Y-AXIS. THIS IS A HIGH RESOLUTION VERSION OF AN OLD FRIEND.

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000, and PrintaColor GP1024.

1985 **JUNE** 1985

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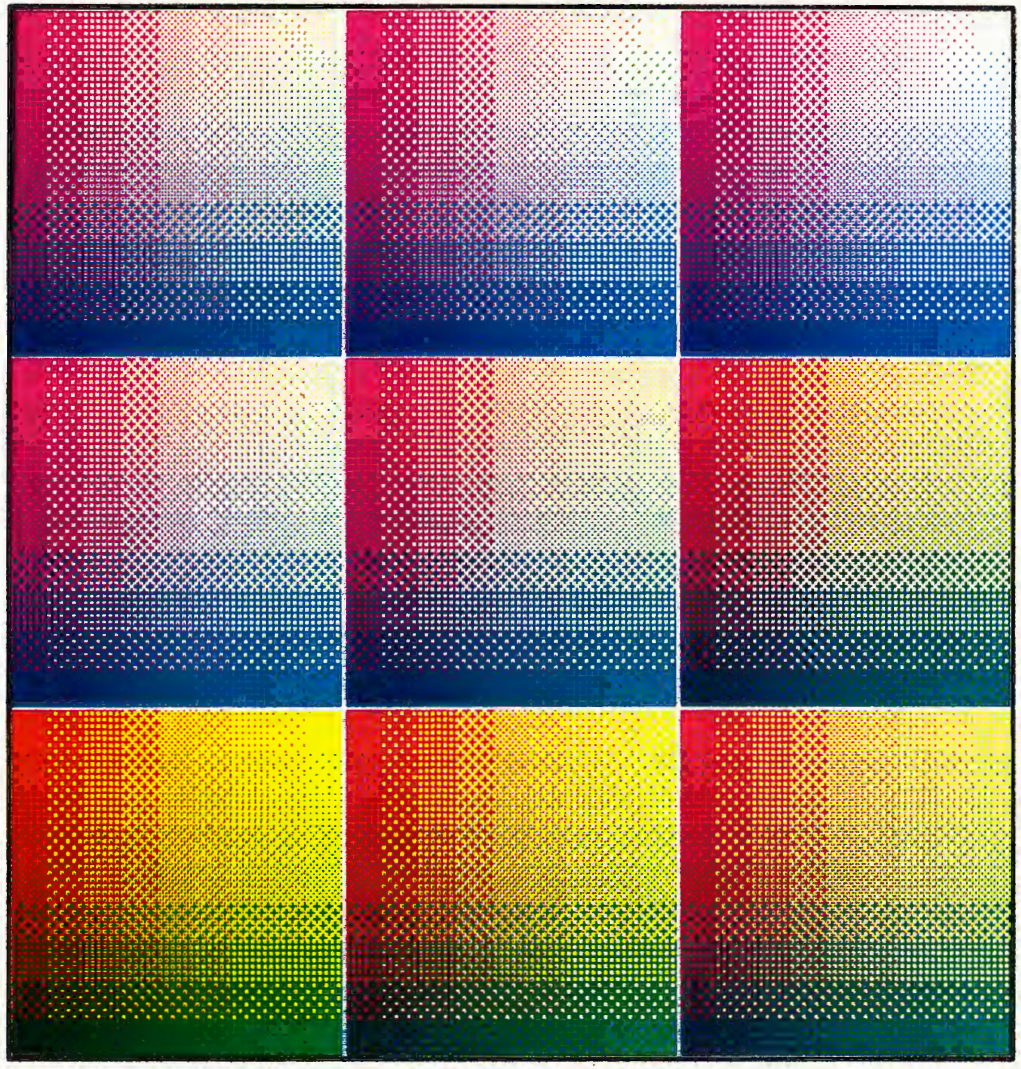

**CUBIC "HOMAGE TO THE SQUARE" AUSTIN 729**

Miles Color Art AUSTIN-1

JULY 1985: ON JULY 29TH, (7-29) 1983, GRANDSON AUSTIN BRANTLEY MILES ARRIVED. IN OUR DIGITAL SEPARATION PROCESS WE WORK WITH CUBIC COLOR SETS OF 8, 27, 125, 729, AND 4913 ELEMENTS. THE ONLY SQUARE IN THIS SET OF CUBES IS 729. WITHIN 24 HOURS OF AUSTIN'S BIRTH WE HAD SQUARED THE CUBE ON THE PRINTACOLOR GP1024 SHOWING THE NINE LEVELS OF BLUE IN THIS 'S' SHAPED ARRANGEMENT OF 81 SET ELEMENTS. A BETTER POINTILLISM COLOR MIX (DITHERING) CAN BE ACHIEVED WITH A ONE COLOR DOT FOR ONE PIXEL REPRESENTATION NOT AVAILABLE AT THE TIME, BUT THIS MODEL FOR THE 729 COLOR STATES HAS SENTIMENTAL VALUE.

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 8064R and PrintaColor GP1024.

1985 **JULY** 1985

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**STYLIZED SINUSOIDAL SEASHORE SANDS**

Miles Color Art B115-S (556x250)

AUGUST 1985: HERE OUR GENERATING FUNCTION IS EXP((Y-7*SIN(X/6))/17). CYAN IS USED FOR THE SEAWATER AND INLAND WATERWAYS, YELLOW FOR SANDS, GREEN FOR VEGETATION, AND RED FOR ROADS AND CONSTRUCTION. TO DATE OUR HIGH RESOLUTION GRAPHICS ON THE INTECOLOR 2427 USE THE TEKTRONIX 4027 EMULATION MODE AND OUR OWN PRINTER DRIVERS SINCE NONE WERE AVAILABLE FROM THE DONORS. FORTUNATELY, WE HAD ALREADY CONVERTED OUR INTECOLOR 8064R/PRINTACOLOR GP1024 WORKSTATION LIBRARY TO TEKTRONIX/TRILOG WORKSTATIONS. FOR THIS SIZE PRINT WE CHOSE THE FOUR COLOR DOT TO ONE PIXEL RATIO OPTION IN OUR TC1040 DRIVER. BY USING THE ONE TO ONE RATIO, WE COULD PRINT THE COLOR IMAGE AND ITS THREE SEPARATIONS ON A SINGLE SHEET. x:[-60,60] y:[-40,40] code:63216321

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000, and PrintaColor TC1040.

1985 # AUGUST 1985

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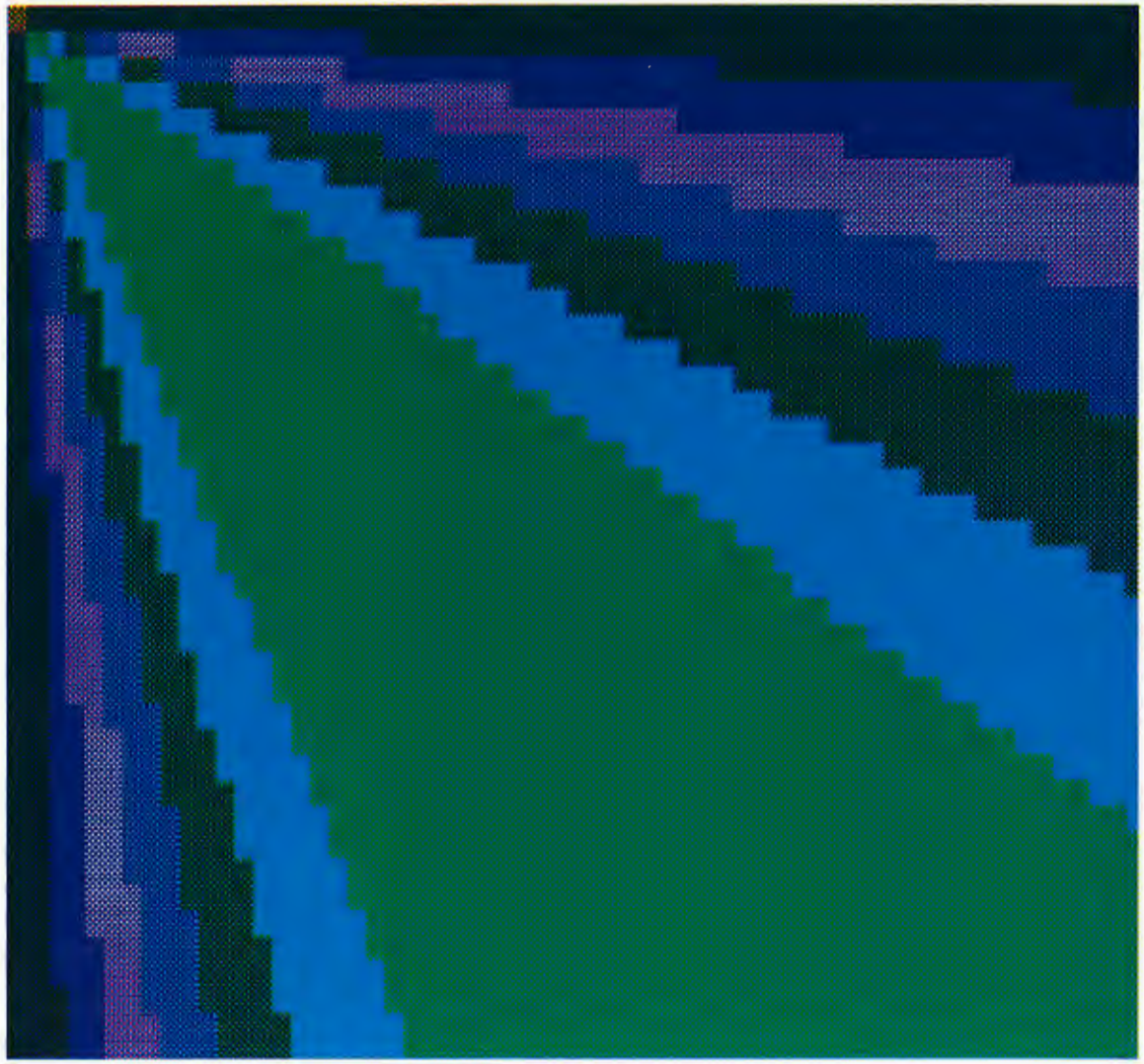

**SOMBER SEPTEMBER SCENE**

Miles Color Art B-41

SEPTEMBER 1985: DEPICTS IN LOW RESOLUTION POINTILLISM CHARACTERS THE GENERATING FUNCTION 10*LN(ABS((X**2+Y**2+.001)/((X-Y+.001)**2)))+16. IF THE TERMS .001 ARE OMITTED, THE SLIGHTLY MODIFIED FUNCTION WHICH IS UNDEFINED AT THE ORIGIN APPROACHES A DIFFERENT LIMIT AS ONE GOES TO THE ORIGIN ON LINES OF SLOPE Y/X FROM POINTS (X,Y). HERE WE HAVE PLACED THE ORIGIN AT THE UPPER LEFT CORNER OF THE DISPLAY FIELD, AND CAN NOTE THAT THERE IS NO WAY TO DEFINE FUNCTION LIMIT AT THE ORIGIN, SO AS TO BE CONTINUOUS THERE. THE DARK SHADES IN OUR 27 COLOR POINTILLISM SET ARE PREFERRED BY MANY ARTISTS AND ART LOVERS.

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 8001G and PrintaColor GP1024.

1985 # SEPTEMBER 1985

| SUNDAY | MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY |
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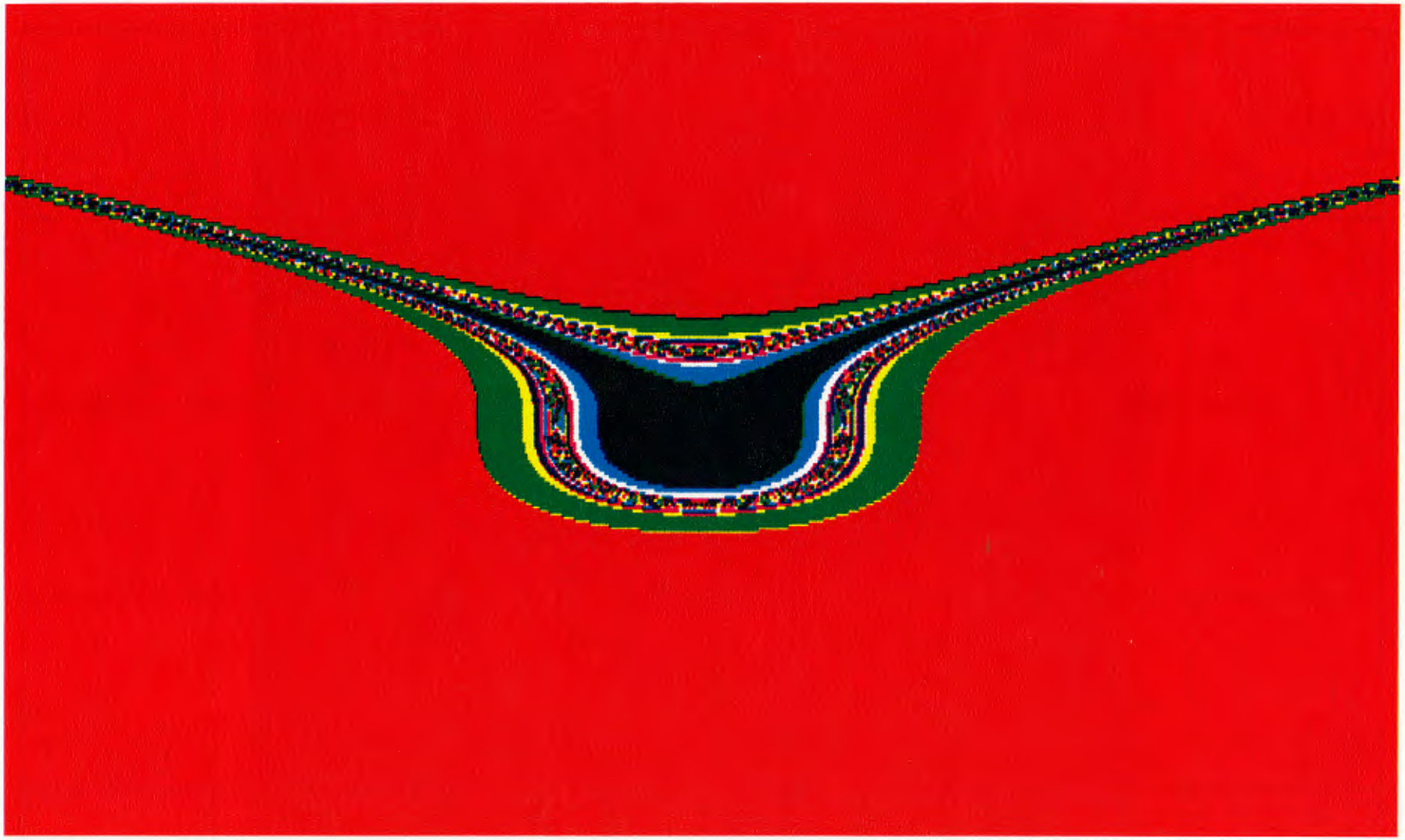

**GREAT LONGHORN IN THE SKY**

Miles Color Art A-13R (556x250)

OCTOBER 1985: WE HAVE GENERATED MANY VARIANTS OF THIS COLOR BLOCK GRAPH FOR THE FUNCTION 1/LN(ABS((Y/7)**3-(X/7)**2+.25)). WITHOUT THE .25, ANY ZEROES OF Y**3-7*X**2 WOULD CAUSE THE LOG (LN) FUNCTION TO BLOW UP. OTHER FUNCTIONS OF THE SAME CUBIC GIVE RECOGNIZABLE, LONGHORN SILHOUETTES.

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000 and Siemens PT80 b/w printer.

1985 # OCTOBER 1985

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**VIOLATED VIOLINS VARIATION**

Miles Color Art B110-R (554x250)

NOVEMBER 1985: IN ITS LOW RESOLUTION FORM, VICKI AND LEMOYNE ART DIRECTOR RON YRABEDRA MADE THIS GRAPH A UNANIMOUS CHOICE FOR INCLUSION IN OUR SET OF LIMITED EDITION COLOR PRINTS FIRST EXHIBITED AT THE APRIL 1984 LEMOYNE ART FOUNDATION SHOW. WE HOPE THIS HIGH RESOLUTION VERSION WHICH SMOOTHS OUT MANY JAGS WILL PLEASE THEM EVEN MORE. HAPPY BIRTHDAY VICKI. IF YOU ARE CURIOUS, THE GENERATING FUNCTION IS F(X,Y)=LN(ABS((X**3+Y**3+.001)**2/(ABS(X**3)-ABS(Y**3)+.01)))

Produced at the Muench Center for Color Graphics, FSU, on an Intecolor 2427, Datavue 3000, and PrintaColor GP1024.

1985 # NOVEMBER 1985

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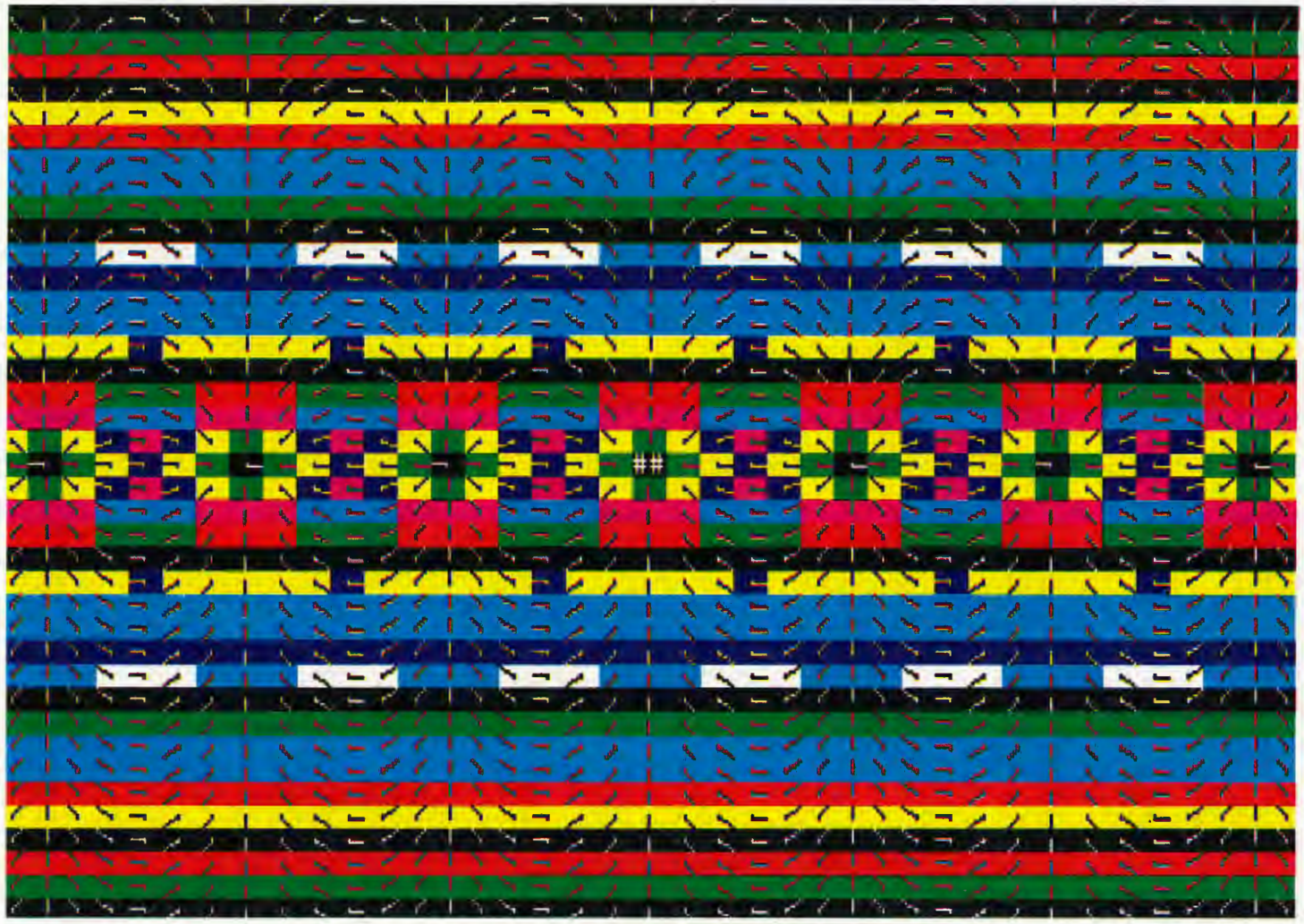

**DECEMBER FRIEZE DESIGN**

Miles Color Art D-128

DECEMBER 1985: OUR YEAR, WHICH BEGAN WITH A SIMPLE MULTIPLICATION TABLE, ENDS WITH A COMPLEX GRAPH OF THE FUNCTION 4*SIN(PI*Z/6). THE ABILITY TO REPRESENT THE MAGNITUDE AND DIRECTION FOR A COMPLEX VARIABLE F(X+I*Y) OR OTHER VECTOR TYPE FUNCTION IS A UNIQUE CONTRIBUTION OF OUR CENTER. THE CENTRAL TWO CHARACTER BLOCK WITH WHITE CROSS-HATCHES REPRESENTS THE MAGNITUDE OF THE FUNCTION AT Z = 0. THE X-AXIS ROW SHOWS THE VALUES OF 4*SIN(PI*X/6), FROM X = -19 TO X = +19. THE DIRECTIONS ARE EITHER ZERO OR PI, ACCORDING TO THE SIGN OF THE SINE. ON THE PURE IMAGINARY (X=0) AXIS, THE SINE FUNCTION IS IMAGINARY WITH ANGLE PI/2 OR 3*PI/2. THIRTY-TWO SPECIAL CHARACTERS MADE TO OUR DESIGN SPECIFICATIONS ARE USED TO APPROXIMATE ANGLES FROM 0 TO 2*PI.

Produced at the Muench Center for Color Graphics, F.S.U., on an Intecolor 8001G and a PrintaColor GP1024.

1985 # DECEMBER 1985

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PrintaColor

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VIRES ARTES MORES
1857

Muench Center for Color Graphics
Florida State University
Tallahassee, Florida 32306
(904) 644-1587 or 644-2058

COLOR MILES ART

Rose Printing Company
Tallahassee, Florida