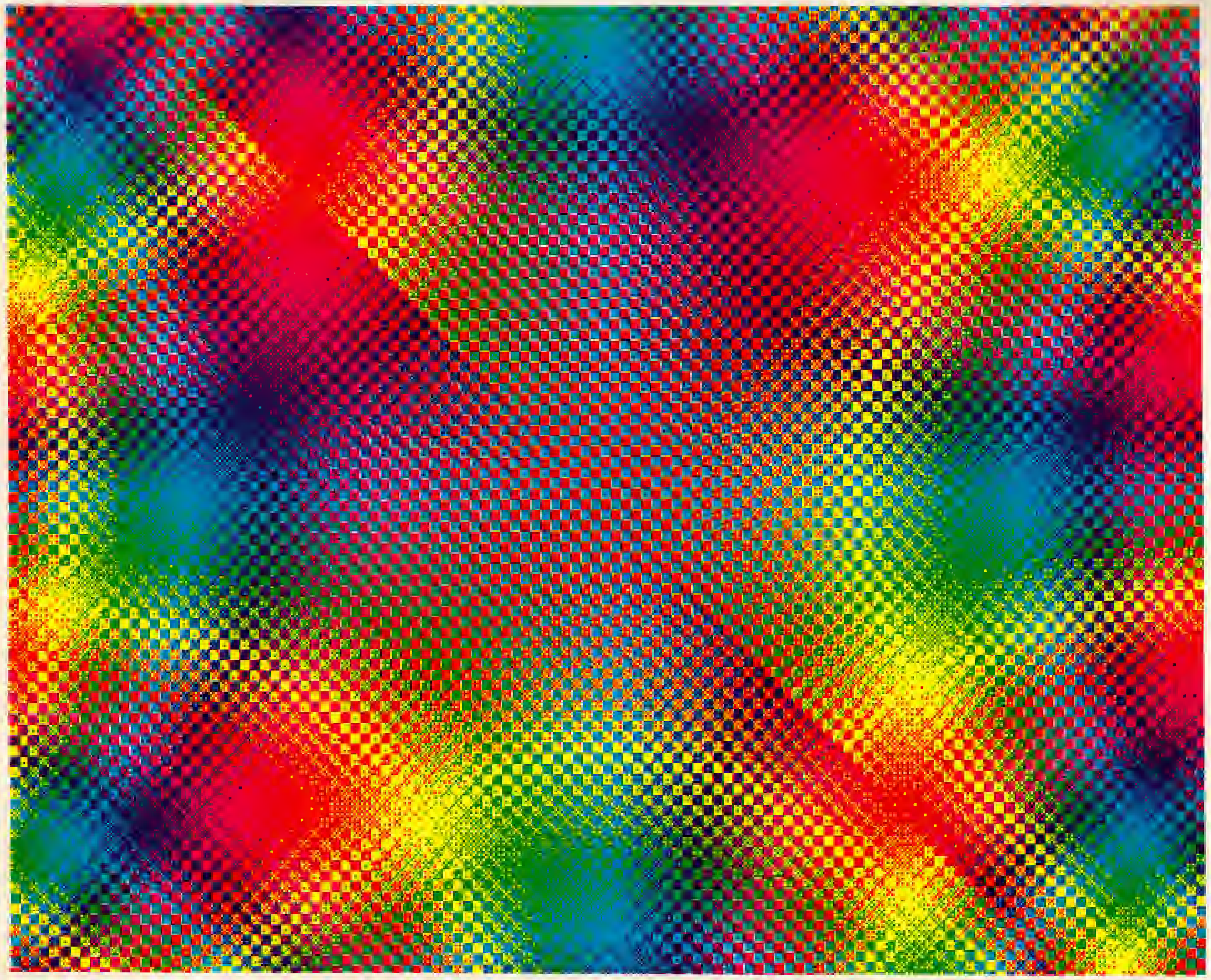


THE BEAUTIES OF MATHEMATICS V

1986 Planning Calendar featuring Colorgraphic Art

Charles and Jeanette Muench Center for Color Graphics
Florida State University

The Beauties of Mathematics Calendars

A Colorful Marriage of Science and Art

View of Cooperating Vendors

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 textile design, advertising, interior design, landscaping, architecture, communications, etc. Just as art can be an inspiration to the scientist, Dr. Miles has shown that science can inspire the artist.

Both Intelligent Systems Corporation 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 .pastandard 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. Intecolor Corporation, the original operating company of Intelligent Systems, has expanded into office and engineering markets, using new lines of color terminals. Intecolor has recently expanded its popular line of industrial control terminals. Also, its ColorTrend DEC compatible terminals feature ColorKey which automatically adds color to monochrome software. PrintaColor has developed a completely new line of color printers at a surprisingly low cost.

Editor's Note :

Intecolor equipment has produced almost all of our monthly Beauties. For Calendars I and II, Intecolor funded all printing costs and made overrun copies available for non-profit educational distribution or fundraising purposes. The independently owned PrintaColor Corporation was welcomed as a co-sponsor for Calendars III and IV, since PrintaColor/Intecolor workstations produced the separation images used. Since Calendars IV and V reflect the enhanced artist-support systems developed at Florida State University using Intecolor workstations supported by controllers from Datavue, this division of Intelligent Systems became a Calendar co-sponsor. We are pleased with the continuing support of these vendors.

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

Printacolor Corporation 2830 Peterson Place Norcross, GA 30071 (404) 448-2675	Intecolor Corporation 225 Technology Park Norcross, GA 30092 (404) 449-5961	Datavue Corporation 225 Technology Park Norcross, GA 30092 (404) 449-5961

BEAUTIES OF MATHEMATICS CALENDAR V

1986

This calendar honors able mathematicians of all countries, creeds, and cultures who have made key contributions to our common mathematical heritage. The primary dedication (see August) is to our recently deceased colleague, Nobel Laureate mathematical physicist Paul A. M. Dirac. Testimonials which followed Dirac's death here in 1984 spoke of his love for mathematics and its usefulness in understanding all physical phenomena. Dirac's anti-matter theory is often explained using a model which involves quarks with red, green, and blue component vectors and anti-quarks involving cyan, magenta, and yellow components. The duality in his quantum mechanics model is similar to that involved in developing the Digital FACSIMILES patented process used to produce these calendars.

Tallahassee and Florida State University were honored when the Dirac family chose for his burial to be here rather than at Westminster Abbey and when his widow Margit, sister of Hungarian Nobel Laureate Eugene Wigner, continued her residence here.

Dirac, at age thirty, was named to the distinguished Lucasian Chair of Mathematics at Cambridge University. The first holder of that chair (1664-1669), Isaac Barrow, a mathematician who helped develop calculus and the theory of optics, resigned in favor of Sir Isaac Newton who assumed the chair at age twenty-seven. Newton's first Lucasian lectures, in 1670, were concerned with color theory, based upon his spectral decomposition of white light.

We again thank Charles and Jeanette Muench of Norcross, Georgia, and their various color graphic companies. Their 1984 donations of forty Intecolor 2427 workstations supported by Datavue 3000 controllers, Printacolor ink jet printers, and Siemens black and white printers added to our five previously donated Intecolor 8000 series work stations made it possible for us to support computer programming and art courses with enrollments up to thirty. 1985 donations of two Intecolor VHR-19 terminals enable us to continue state of the art research.

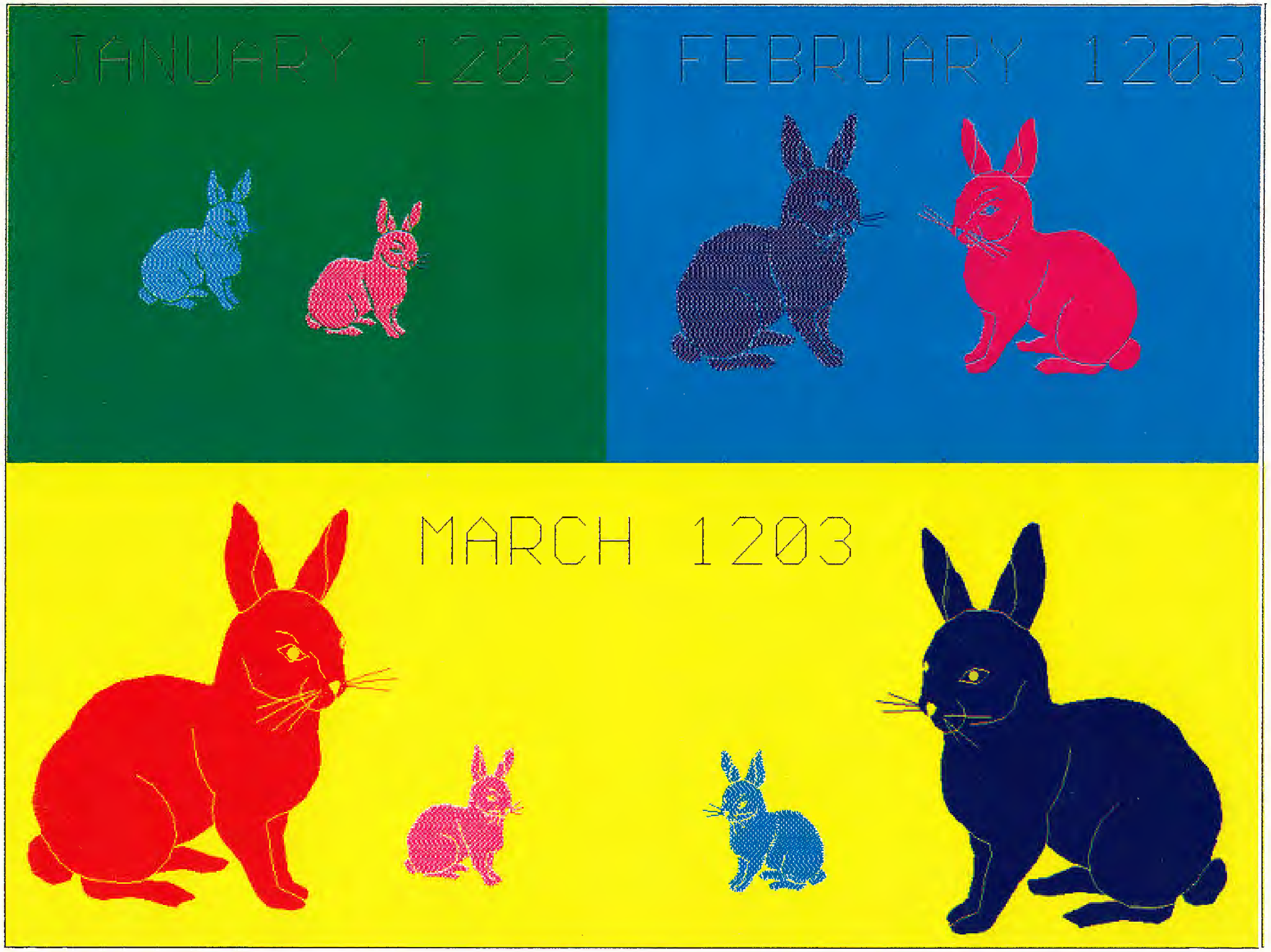
All five calendars have been created as a non-profit educational project of Miles Color Art in cooperation with Florida State University and participating vendors. Artwork, production time, and use of the patented separation process have been donated. Sales of calendars donated or sold at overrun cost have benefited many organizations. This year, additional distribution is expected to raise funds to broaden attendance at World Congress of Mathematics at Berkeley and IFIP-86 in Dublin next summer.

The author's 1955 paper "Functional Design or Colorful Mathematics" was part of a plan to improve precollege science and mathematics instruction of the Auburn Chapter of Sigma Xi in response to a national challenge by Sigma Xi president Joe Barker. The 1955 algorithm suddenly became very useful in 1977 for computer-generated educational modules being developed under NSF CAUSE and LOCI grants. Using our first Intecolor 8001G terminal, we found many uses of color to improve instructional modules. When our computer graphics were featured in a campus science display, Art Education, Textile Design, and Visual Art faculty saw a medium which would also revolutionize creative art and design. Their interest led to the founding of our center and the development of artist support programs.

The author chaired a CBMS Task Force (1977-1982) on precollege science and mathematics which chose three major goals: 1) Expanded enrichment opportunities for gifted students; 2) Improved curricular materials to modernize course offerings; and 3) The training of math and science teachers in the new instructional materials and other technological advances. Since 1978, he has served on the ACM Lectureship Panel to discuss educational uses of computers and a spectrum of color graphics applications. Our Muench Center efforts have made progress in all three areas and the ACM lectureship provides a medium to share our efforts with, and learn from, others active in color graphics and education.

Key gifted students helping to develop our image files and artist support programs in improving color palette environments since 1977 are: Phillip Jensen, Scott Rimbey, Laura Rimbey, William Jasiniecki, Eric Chamberlain, Raymond Curci, Doug Martin, Mark Schendel, Michael Sumner, Tracy Hamilton, and Don Pace. The five "Beauties" calendars show our progress in creating color graphics and their separations using U.S. Patent 4,430,668, a Digital FACSIMILES (Digital East Additive Color Separation Internegatives MILES) process which makes thirty percent savings in printing costs possible. Since Calendar III, separation images have been printed on a color printer attached to the generating computer.

We now create and separate designs in the 8, 27, 125, 729, and 4913 color palettes explicitly described in our 1981 patent application, and in other self dual palettes such as the 96 pure colors of the superpixel color wheel. Camera ready copy of the text portion of Calendar IV was for the first time created using the word processing and symbol generation capacity of our various Intecolor terminals. We thus illustrated preparation at one station of all pre-press elements of books, manuals, brochures, reports, etc. i.e. text, color graphs, art work, and color separations. In this calendar a laser printer has added better quality print as well.



RAPID RABBIT RECURSION RELATIONS

Miles Color Art V-1

January 1986: An Italian mathematician, Fibonacci, Leonardo de Pisa, solved this problem about 1203. " In January, a pair of baby rabbits was placed in an ideal hare haven. All such baby pairs become young a month later and mature pairs the following month which produced then, and each month thereafter, a similar baby pair. If all survived, what would be the December pair count? " Our artist in residence, Tracy Hamilton, shows the pair count for the first three months to be 1, 1, and 2. Can you project to December without peeking? Fibonacci, through travel and study abroad, learned alternate number systems which helped the Italians break away from Roman numerals to symbols embracing the place position concepts of the Arabs or Hindus. Our December entry contains more about Fibonacci numbers in nature and art.

Produced at the Muench Center for Color Graphics, on an InteColor VHR-19, Datavue 3000, 4000, and PrintaColor GP1024.

MCMLXXXVI **JANUARY** MCMLXXXVI

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			I	II	III	IV
V	VI	VII	VIII	IX	X	XI
XII	XIII	XIV	XV	XVI	XVII	XVIII
XIX	XX	XXI	XXII	XXIII	XIV	XXV
XXVI	XXVII	XXVIII	XXIX	XXX	XXXI	

世界和平

乙丑
↓
丙寅

A CLOSER ENCOUNTER OF THE INFINITE KIND

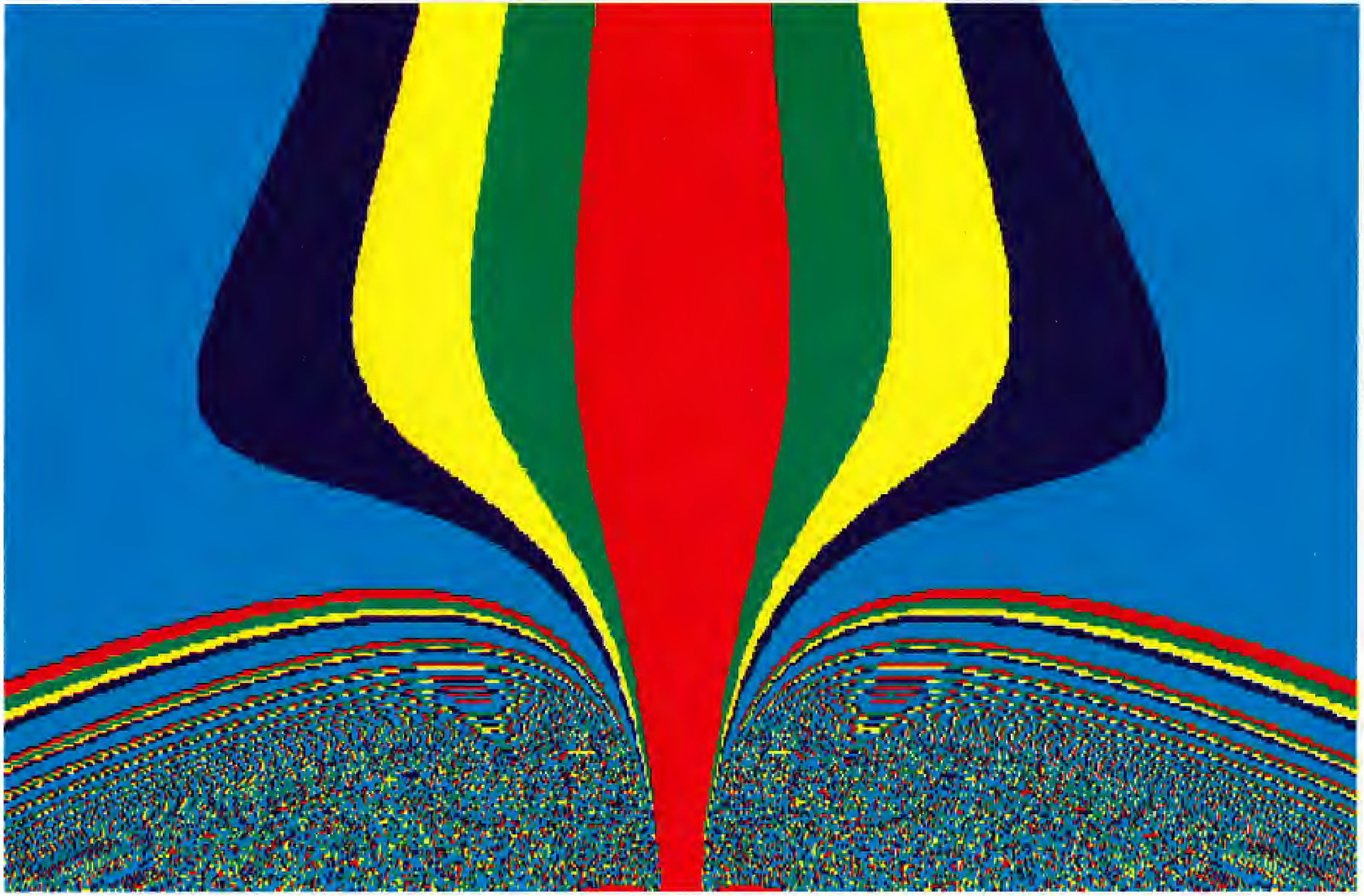
Miles Color Art V-2

February 1986: This Chinese New Year month, we honor Chinese contributions to our cultural heritage. We wish for peace on Earth as we pass from the year of the ox to that of the tiger. Our original Close Encounter is now in high resolution, using colors magenta, red and yellow only. The resulting mask emphasizes Chinese red and related colors. The graph illustrates Picard's theorem, applied to the real part of EXP(100/z). Near the essential singularity at the origin (located at the center of the left side) the function comes close to all real numbers in a symmetric fashion. When the low resolution pattern, appeared on the cover of ACM Southeast 1980 Proceedings, the separation costs were $230. By using our patented method, we have virtually eliminated such costs. Nearly 4,000 years ago, the Chinese used binary numbers, a key factor in electronic computers and in our color theory.

Produced at the Muench Center for Color Graphics on an InteColor 2427, VAX 780, Datavue 3000, and PrinaColor GP1024.

1986 FEBRUARY 1986

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



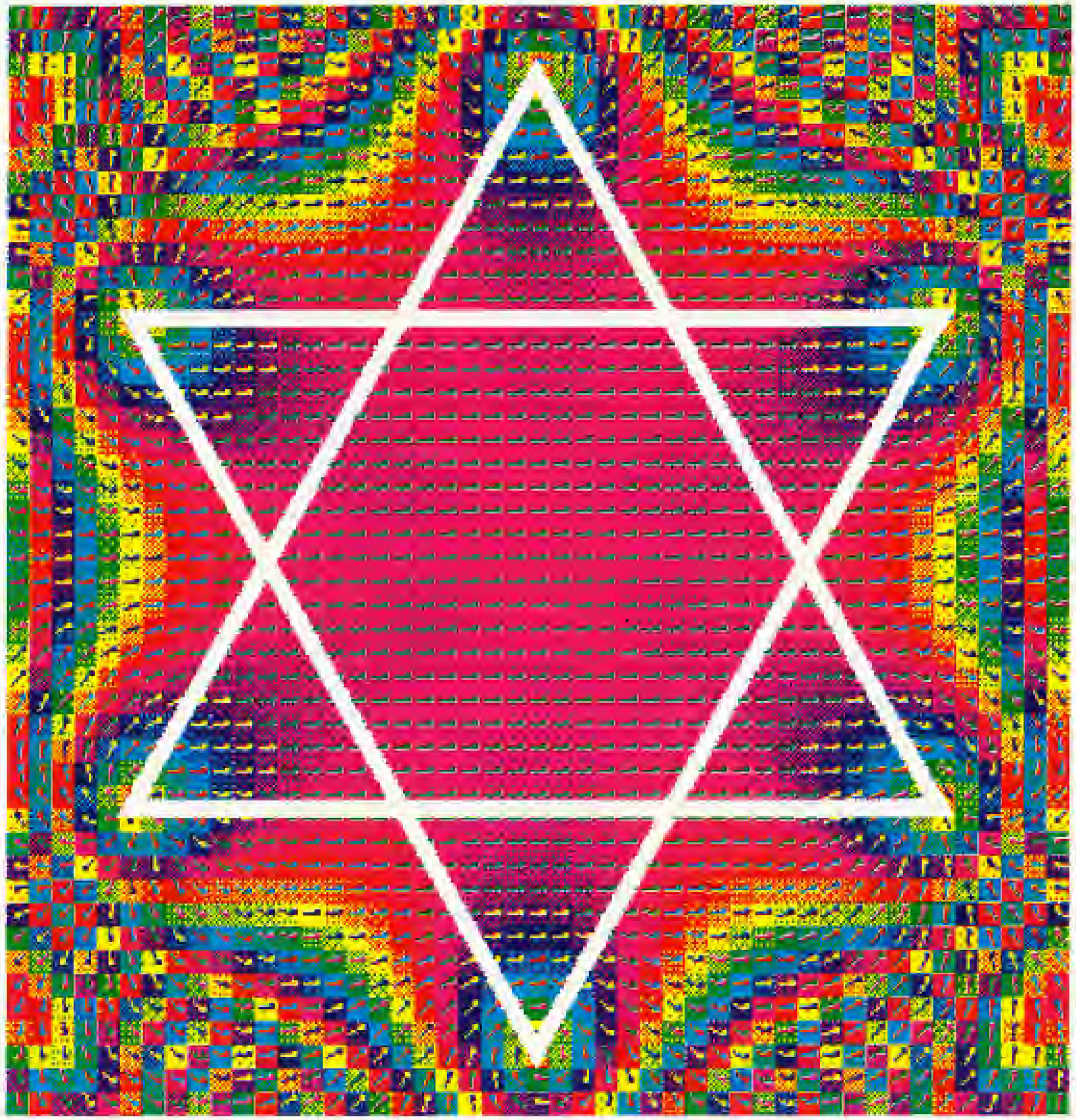
HIGH RESOLUTION TULIP

Miles Color Art V-3

March 1986: Our first test of the Digital FACSIMILES separation process involved the low resolution version of this tulip pattern. Rose Printing conducted the test for us using the marginal trim space on a limited edition print. The success of this trial led to the production of our first Beauties of Mathematics Calendar where we saved over 3000 dollars by doing our own separations on the Intecolor units producing the graphs. In 1984, the low resolution tulip was one of ten selected full color prints featured in invited exhibits at the LeMoyne Art Museum, the Tallahassee Junior Museum, and the Gulf Coast Community College. Savings of 40 percent in producing those prints resulted from our patented separation process. The function graphed is ((Y/4)*ABS(X)+ABS(X)**(100/(ABS(X)+ABS(Y)+.5)))/100.

Produced at the Muench Center for Color Graphics, on an InteColor 2427, SUN 170, Datavue 3000, and PrintaColor GP1024.

1986			MARCH			1986
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 / 30	24 / 31	25	26	27	28	29



MAGENTA MAGEN DAVID

Miles Color Art V-4

April 1986: The Old Testament is an important part of the sacred literature and history of Christians, Jews, and Muslims alike. Each study David, the national hero born 3000 years ago and the sparing of the Hebrews in Egypt. For this Passover month, our design is offered as a message of Peace (Shalom) to all Bible, Koran, or Talmud readers. Except for the interlocking equilateral triangles superimposed using our artist support program, this is a color block graph of a complex function of type AZ**6 - B scaled so the six symmetric zeros are appropriately placed. Over the centuries, migrating or refugee mathematicians and scientists of Mid-Eastern ethnic origin have made major contributions to the advancement of science and culture.

Produced at the Muench Center for Color Graphics on an InteColor 8064R and PrintaColor TC1040.

1986 APRIL 1986

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		1	2	3	4	5
6	7	8	9	10	11	12
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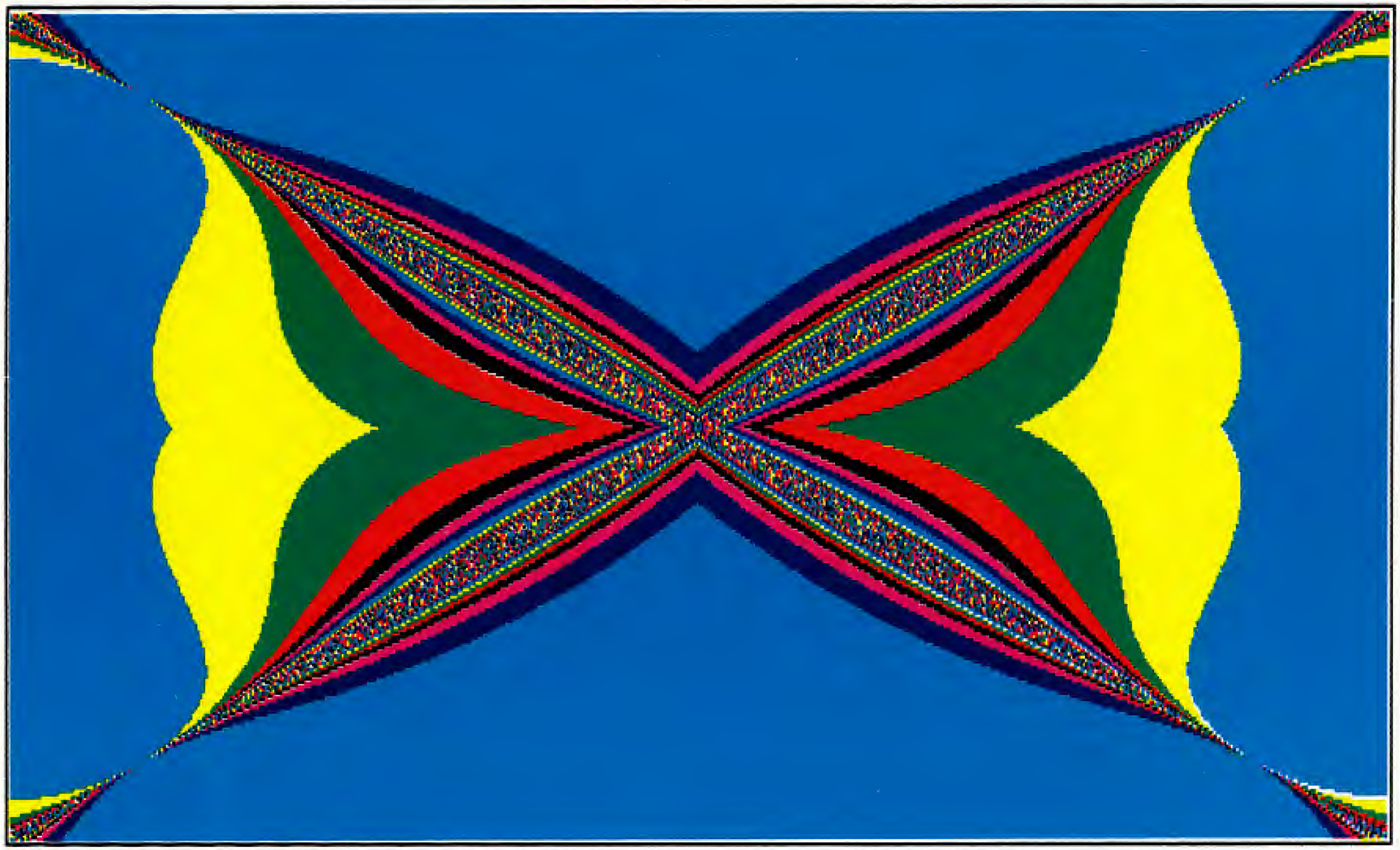
20	21	22	23	24	25	26
27	28	29	30			



X-values are -38 to 38   Y-values are -38 to 38   Colors are 43210564
((3*SIN(ABS(X/13))+3*COS(Y/13))^2)/(ABS(X)-ABS(Y)+.03)

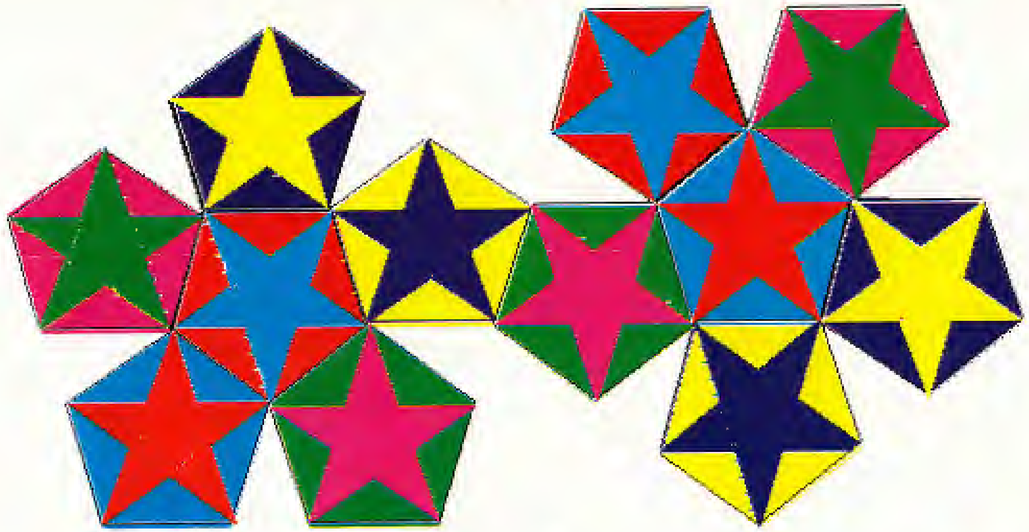
A BETTER BUTTERFLY BEAUTY

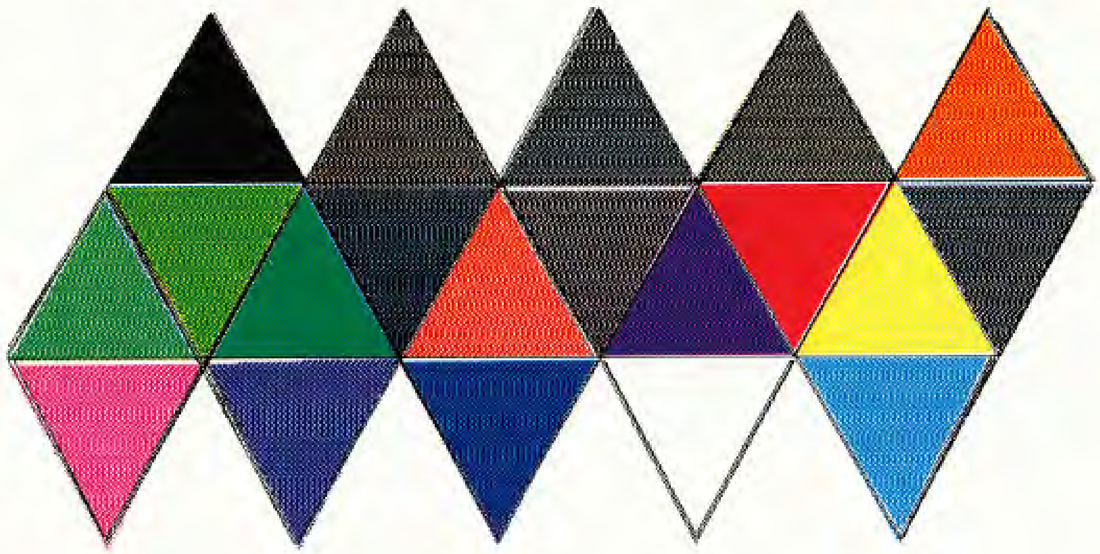
Miles Color Art V-5

May 1986: Perhaps more people have seen more versions of our butterfly pattern than of any other of our works. Tours of our center or live demonstrations given elsewhere frequently include permutations of the colors in this pattern at the rate of one per second. In the eight color state, there are more than 16 million variations. To see them all would take more than seven months. We frequently demonstrate derived versions of this graph on Apple II+, TRS-80 COCO, and Commodore 64 computers and share them with schools having such equipment. Even the beginning algebra student can see the denominator is very small near the diagonal lines Y=X and Y=-X causing the quotient values to change rapidly there and the associated color as well. The function is: ((3*sin(abs(x/13))+3*cos(y/13))^2)/(abs(x)-abs(y)+.03)

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

1986			MAY			1986
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





SYMMETRIC PLATONIC SOLID CUTOUTS

Miles Color Art V-6

June 1985: We salute the ancient Greek philosophers and mathematicians such as Pythagoras, Archimedes, Socrates, Euclid, and Plato. The Platonic solids have been involved heavily in our models approximating the color continuum especially the cube using regular coordinates and the pyramid using homogeneous coordinates. Here we show six symmetric stars with their duals on the twelve pentagonal faces of a dodecahedron. Here the null set, black, and the universal set, white, are omitted. To have symmetric distribution of a subset of our 27 pointillism colors on the twenty triangular faces of the icosahedron we include black and white but omit self dual gray and the additive and subtractive primaries. Opposite each colored face, we have placed its complementary color. We could elaborate using inscribed triangles on each face.

Produced at the Muench Center for Color Graphics on an InteColor 2427, VHR-19, Datavue 3000, and PrintaColor GP1024.

1986 **JUNE** 1986

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					

HOMAGE TO THE SQUARE, AUSTIN-2 (4913)

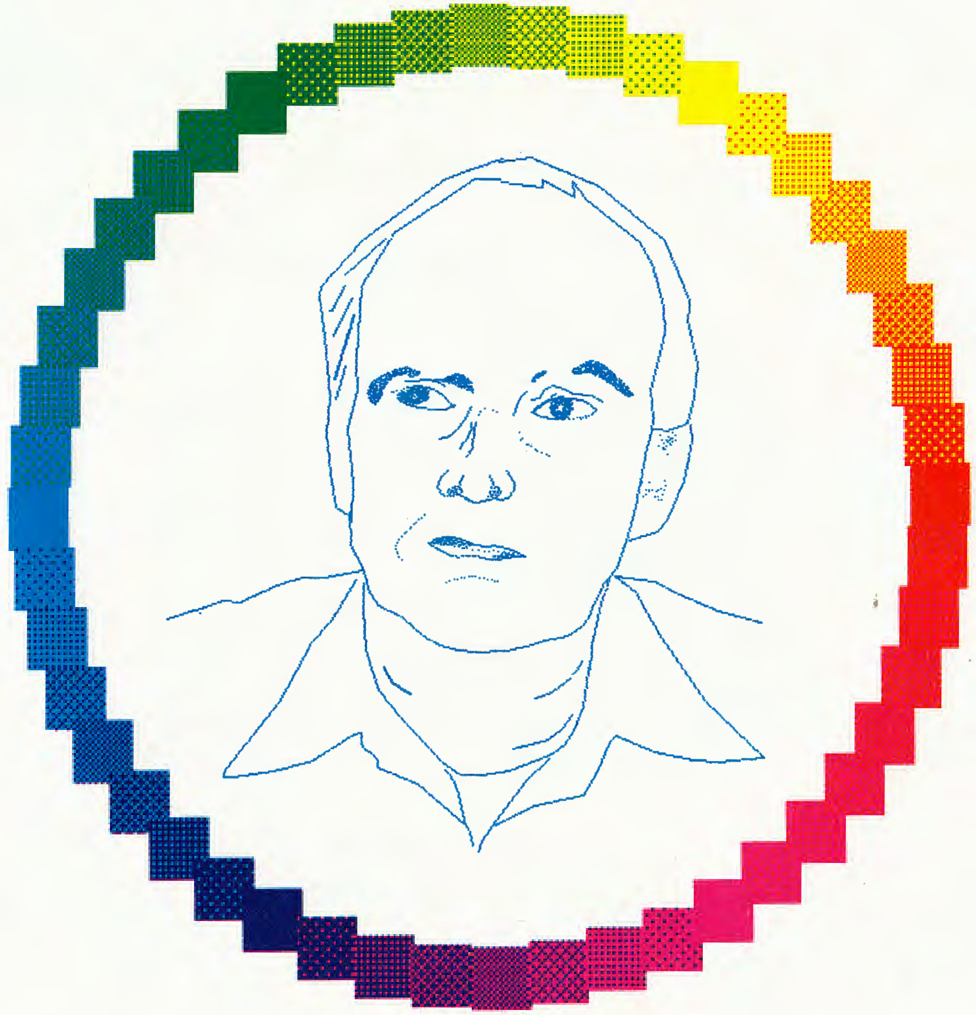
Miles Color Art V-7

July 1986: In Calendar IV, grandson Austin Brantley Miles, birthday 7/29, was honored by a square arrangement of the 729 (9 cubed) color mixes in our palette created by eight levels of red, green, and blue lights as printed using eight levels of cyan, magenta, and yellow pigment. Our version of that model with sixteen times more dots per square inch appears in the July 1985 PrintaColor ad on the inside back cover of Computer Graphics World. Here we have 4913 (17 cubed) color mixes using sixteen levels of each color. We have expanded the 289 color mixes with blue=0 nine fold and keep the square format for our full display. Again the color separations used our digital FACSIMILES process. Austin will be much more interested in the January bunnies when he sees this calendar.

Produced at the Muench Center for Color Graphics on an InteColor VHR-19, Datavue 3000, and PrintaColor GP1024.

1986 JULY 1986

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		



PAUL A. M. DIRAC

August 8, 1902 - October 20, 1984

August 1986: Paul Dirac received his PhD from Cambridge University in 1926, became a fellow of St. John's College in 1927, and was named Lucasian Professor of Mathematics at Cambridge in 1932. In 1933, he shared the Nobel Prize for physics with E. Schrodinger. After his retirement at Cambridge in 1969, he joined our physics faculty at Florida State University and continued his studies to seek mathematical models embracing all physical phenomena. Because of the charm of the man and the effective use of color terminology in discussing the quirks of the quarks and anti-quarks in his theory of matter and anti-matter, we have surrounded an artist's sketch of his memorial photograph with a color wheel halo showing the complementary quark and anti-quark colors opposite each other and intermediate colors between. We think this would appeal to Dirac's long interest in the beauties of mathematics.

Produced at the Muench Center for Color Graphics on an InteColor VHR-19, 8064R, Datavue 3000, and PrintaColor GP1024.

1986 AUGUST 1986

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 / 31	25	26	27	28	29	30

X-values are -38 to 38   Y-values are -38 to 38   Colors are 46321570
3*(X**3 - Y**2) * SIN((X+Y)/20)/(X**2 + Y**2 + .3)

REFINED BLUE LADY DANCING

Miles Color Art V-9

September 1986: This lady in low resolution was selected from twelve of our unpublished color block graphs, considered by the editors and publishers of IEEE Computer Graphics and Applications for the cover story of their May 1982 issue. Since that issue contained five of our graphics printed by traditional separations in an article on uses of color graphics to display scientific data and five graphics separated by our digital FACSIMILES process in the cover story, we had our first opportunity for readers to judge the effectiveness of our process. At that time, our color choices and resolution were quite limited. We are glad to present a refined and more resolute version of the blue lady at this time.

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

1986 **SEPTEMBER** 1986

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				

COMPUTER AIDED FASHION DESIGN

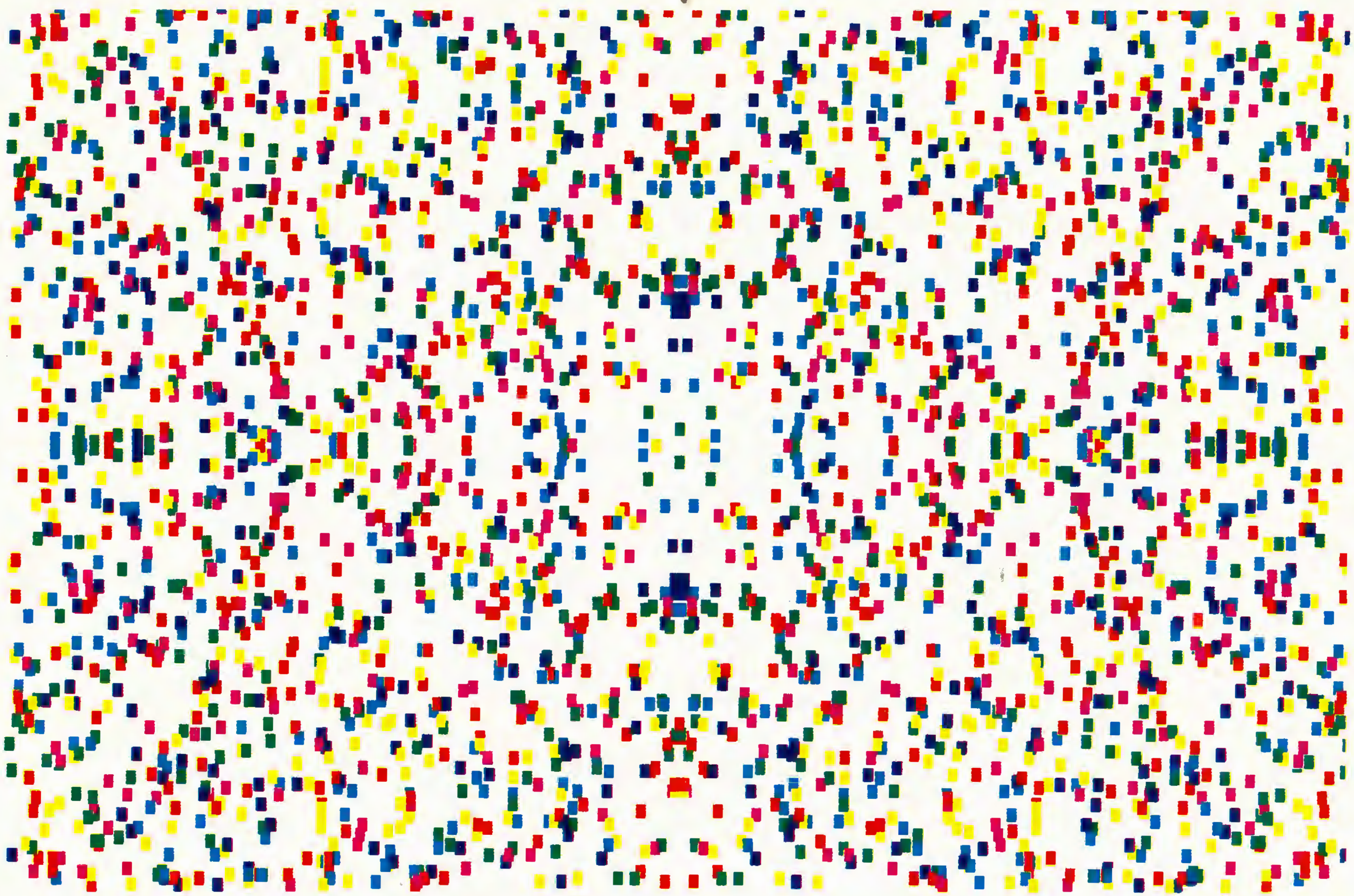
Miles Color Art V-10

October 1986: As our color palettes expanded and our software developed, creative artists from many university departments began using our equipment and guidance in directed individual study projects. Textiles, art education, interior design, communications, and core art students with the participation of their faculty appeared in that order. Here we show designs by Judy Grossbard created in 1985 as part of her doctoral program in fashion design at FSU. Here we have used our latest very high resolution equipment to provide sufficiently detailed design for producing the costume or supporting elements. The musical comedy costume depicted above was constructed within a week of its design using patterns generated by computer. Attendees at SIGGRAPH 85 saw the completed costume modeled live and digital camera photos of it distributed at the PrintaColor and InteColor booths.

Produced at the Muench Center for Color Graphics on an InteColor 2427, VHR-19, Datavue 3000, and PrintaColor GP1024.

1986 OCTOBER 1986

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	



FESTIVAL OF LIGHTS

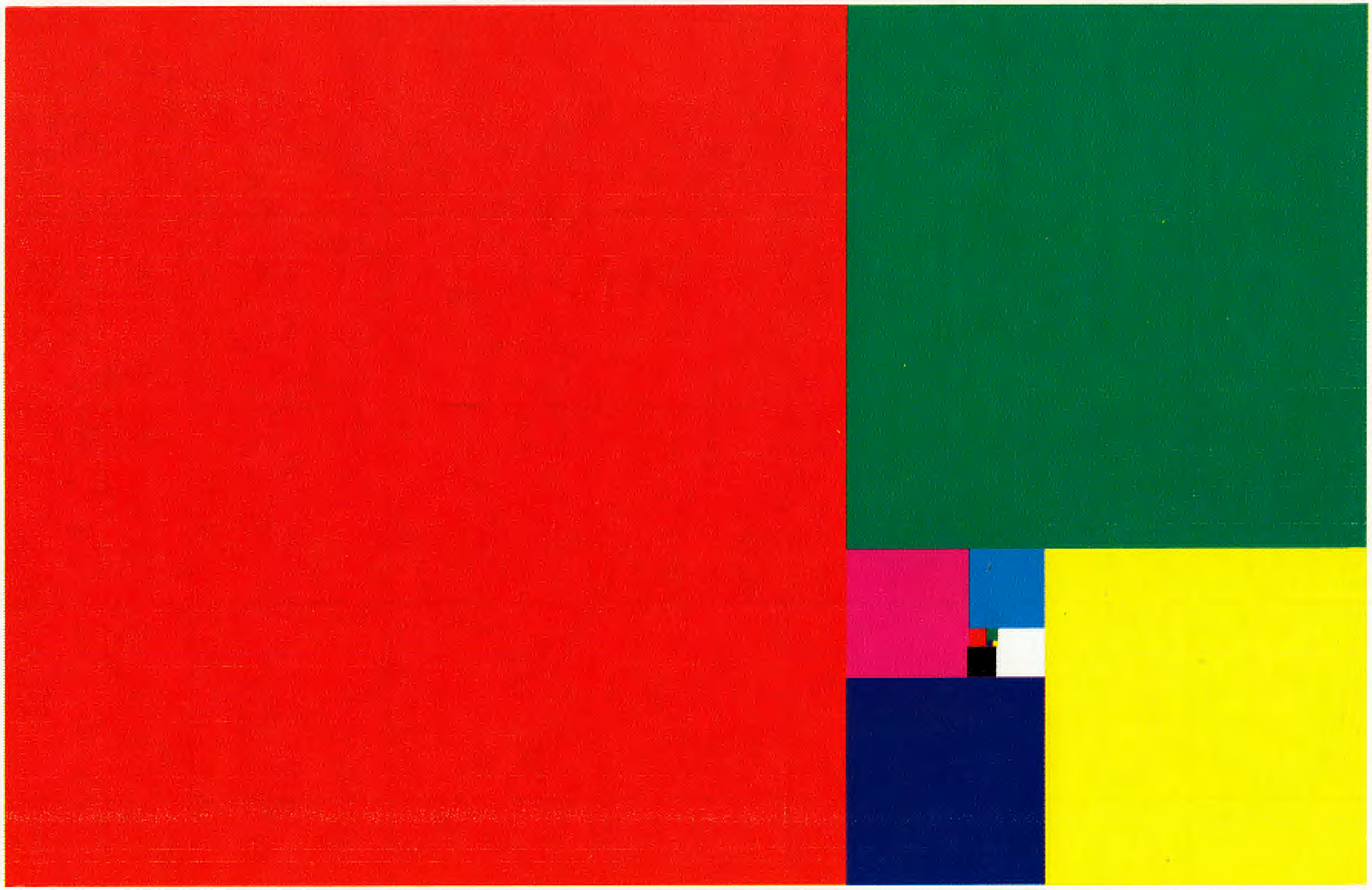
Miles Color Art V-11

November 1986: We dedicate our November space to the Hindus. The Hindu religion which dates back 3000 years has been modified in many subgroups by influence of other religious groups especially those formed about 500 years later by Buddha and Confucius, but we are told that all Hindus celebrate the Festival of Light which falls this year on November 2nd. Many who had opportunities to attend the Indian special exhibits in the summer and fall of 1985 at the Chicago Museum of Science and Industry learned the advanced state of Indian knowledge of number systems and geometry comparable to that in Greece and the Arabic countries five centuries before Christ. Arithmetic algorithms involved the place position concept, but the most significant integers were to the right instead of the left. A liquid filled model showed by rotation that the pentagon on a right triangle hypotenuse was the sum of the pentagons on the legs.

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

1986 NOVEMBER 1986

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 / 30	24	25	26	27	28	29



FIBONACCI NUMBERS IN ART AND NATURE

Miles Color Art V-12

December 1986: The rabbit pair count asked for in January was 144 in December 1203. The count for successive months was: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, where each number after the second is the sum of the two preceding. The spiral graph above started with two units, each two pixels square, side by side, joined spirally by squares whose edges are Fibonacci number multiples of the unit. The twelve squares form rectangles whose successive dimension ratios approach the golden sector ratio of art. This model approximates exponential growth and occurs in such plant and animal spiral designs such as the pineapple, the sunflower, and the chambered nautilus.

Produced at the Muench Center for Color Graphics on an InteColor 8001R, SUN 170, and PrintaColor TC1040.

1986 DECEMBER 1986

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			

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