Chairman’s Message

Time has passed quickly since my decision to enter into the Executive Committee positions four years ago. One certainly learns a great deal about our organization as the moves up to the Chairman progresses.

Our Division has undergone some changes and more are on the way. We recently switched to our new “logo” which you have now seen on the RETEC brochure that went out recently. Our Newsletter is also sporting the logo. Though I have not heard many complaints from members about the CAD Web-site, for those who have visited over the past year(s) have not seen a whole lot of change, especially with current activities. This was particularly troublesome last year when Katrina devastated the New Orleans area. One major problem was our web-master was affected by the storm and had limited internet and phone access. At the directive of the Executive Committee under Sandy Davis, the CAD Board created a Web-Site Committee under Joe Cameron to investigate our options and it spent a good deal of time discussing what could be done and, having pursued options and costs, then presented to the entire Board.

The result of this Committee’ work is a new web-site which should be operational by the time you get this newsletter. *(Of course, this timing is always subject to change).* The CAD bought the domain rights to specad.org, as well as several others of similar names, which will direct you to the correct site. Our new web-site will operate under the Web-Site Committee and, from what I have seen, will be easier to navigate and have pertinent information in it. The plan is to include our best papers from both RETECs and ANTECs.

Our Division has reached it goal for the Endowment Fund. The CAD is now offering scholarships for college. More information and forms can be obtained from Johnny Suthers, contact info on the back of the newsletter.

Our Annual RETEC Color Conference is coming up in Mid-September in Cincinnati, OH. Theme is “Back to the Basics”. The papers look interesting to me and I would urge you to consider allowing your color technicians to attend. As for myself, for the first time in many years I will not be in attendance, but in Colorado with my daughter at her marriage. So, though I will not be physically in Cincinnati, I will be thinking about the RETEC.

In conjunction with the RETEC this year, we have a “Tag Line” contest. The RETEC brochure explains what it is and that is to add a “tag line” to our logo to enhance our Divisions identity. Top Prize is a free attendance at an upcoming CAD RETEC Conference.

As Chairman, I would enjoy any thoughts or feed back you have on CAD Division operations. You can e-mail me at johnsond@Ferro.com.

Regards,

Dave Johnson
CAD Chairperson
EDITOR'S NOTE

You will notice a new but familiar face in a new place in this issue. Dave Johnson is now gracing our front cover as the CAD chairman. I look forward to working with Dave on future issues.

This newsletter continues to be full of great articles and other pertinent information. This is the final installment of the multi-part article on the History of Pigment Use in Western Art. Also in this issue are two brief technical issues, one covering new color measurement technology and the other - synesthesia.

Please take the time to peruse through our advertising pages. Besides providing support to help offset the cost of the newsletter production, these folks bring a wealth of knowledge and information to the table. Just tell them you saw their ad in the CAD Newsletter!

I would like to take this opportunity to solicit the membership for articles of interest in the area of color. If you have read a really good piece in a technical journal or found an interesting site on the web that you would like to share, please forward the information onto me at barbara.parker@jdsu.com.

I personally am looking forward to the upcoming RETEC meeting, September 17-19 in beautiful Cincinnati, Ohio. The program topics look to be extremely interesting. Bob Charvat will be holding a series of talks entitled Back to Basics, covering color perception, color measurement and color theory. Let's not forget there will also be a riverboat cruise, an evening reception featuring Color Eye Blind, table top exhibits and the New Technology Forum to round out the conference.

Hope to see you all at Oktoberfest in Cincinnati!

Barb Parker
EDITOR

UPCOMING RETECS

2006 RETEC CINCINNATI
Venue: Hilton Cincinnati Netherland Plaza
Dates: September 17-19, 2006
Chair: Bruce Mulholland, Scott Heitzman

2007 RETEC SAN ANTONIO
Venue: Hyatt Regency
Dates: October 1-2, 2007
Chair: Tim Reilly
Quality Pigments Producer In China

CINIC Chemicals (Shanghai) Co., Ltd. is located in Shanghai, China. The company is ISO 9001 certified. It develops, manufactures and markets organic pigments for the applications in the industries of paints & coatings, plastics and inks.

Currently its product range includes DPP series high performance organic pigments.

Cinilex® DPP Red SR2P (Pigment Red 254)

- Standard red pigment for plastics
- Brilliant shade with excellent all-around properties
- For polyolefins, PVC, PUR and many other polymers
- Cost effective

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OPENING/WELCOME (SANDY DAVIS)
The meeting commenced at 8:45 am with a welcome from Sandy Davis. There were no visitors. All board members introduced themselves.
Bob Trinklein was welcomed back. Bob expressed his appreciation to be back and to have served on the board.
Roger passed around a suspended membership list for review and to identify people that need to be contacted again.

SECRETARY’S REPORT (TRACY PHILLIPS)
Trinklein made a motion to accept the minutes as written. Balthazar seconded the motion. Minutes of the last meeting of 9/28/05 were approved.

TREASURER’S REPORT (BRUCE MULHOLLAND)
Bruce presented the treasurer's report. The beginning balance as of 8/31/2005 was $44,852.71. Income of $77.45 was from interest earned. Total expenses were $8,380.39 with no pending expenses. The ending balance was $36,549.78. A motion was made to accept the treasurer's report, second motion was made, and all in favor passed it. Income tax was filed on time. Receivables and expenses increased vs prior years because of our method of handling proceeds changed (combined instead of split). Bruce attached an explanation to the file that went to the IRS.

COUNCILOR’S REPORT (AUSTIN REID)
There was no Councilor's meeting since the September CAD BOD meeting. There will be a meeting in Albuquerque on Jan 21st. The matrix meeting is on that Thursday.

ANTEC TECHNICAL PROGRAM COMMITTEE
ANTEC 2006 (Charlotte, NC) - Sharyl Reid and Steve Goldstein
Eight (8) papers have been submitted. Seven (7) have been reviewed. A keynote speaker and a business meeting will be added to have at least 10 items.
Matrix meeting-there are problems with the electronic paper submission process. It is hard to get papers into the ANTEC system. The system was not working correctly if you are both a reviewer and a submitter.
Sharyl motioned for $2000 for ANTEC reception. Motion was seconded and passed.
A motion to donate $2000 for student travel and $1000 to endowment fund to be distributed at Antec 2005 in Charlotte, NC was made, seconded, and passed.

ANTEC 2007 (Cincinnati, OH) - Scott Heitzman and Kathryn Brannon
ANTEC 2008 (Milwaukee, WI)-Ann Smeltzer and Marty Paisner
ANTEC 2009 (San Antonio, TX)
ANTEC 2010 (Orlando, FL)
ANTEC 2011 (Boston, MA)-Robert Butts

RETEC TECHNICAL PROGRAM COMMITTEE
SANDRA DA VIS
RETEC 2005 (New Orleans, LA) - Earl Balthazar - Sept. 25-27
Earl Balthazar thanked everyone for the help in pulling off the "miracle." Charlotte was a great venue even though a little squeezed at the Awards luncheon. All applauded Earl in appreciation for a job well done.
Preliminary numbers:
Overall comments have been good. Bob Charvat's Tutorial had 15 attendees.
We are still missing proceeds from a couple of sponsorships. The New Orleans Fairmont may need to return $5000 in deposit.
25 papers: Best paper will be awarded to Ciba Specialty Chemicals.
ISPE was instrumental in getting the conference moved (Lesley Kyle). Lesley said that the CAD group was one that could handle the difficult task of moving the conference at the last minute. Joe Cameron proposed recognition
Charvat asked if money was available for the Terra Tech foundation. Some will go to Endowment fund. Chuck Swearingen passed away on Dec 12. Charvat proposed $5000 into Terra Foundation to be in memorial of Chuck. A motion was made and seconded. The motion was passed.

RETEC 2006 (Cincinnati, OH) - Scott Heitzman/Bruce Mulholland - Sept. 17-19
Scott Heitzman asked for help and ideas. The new CAD logo will be the RETEC logo this year.
Tech Program-sessions will be split with a basic focus to get entry level people involved. Bob Charvat's seminar will be imbedded in the program.
Fee structure will be designed to motivate to send first timers. Idea; Howard suggested sending first time passes. Another idea is to color code name badges for first timers.
Sandy gave an example of hosting a special reception for first time attendees. Bob T. recommended continued on page 6
doing it one time to try it and assess the results. Another idea was to offer free SPE membership to new attendees. Bruce needs a way to track first timers on the registration such as a check box to trigger a special name badge holder or new member ribbon. New was defined as having not attended in last 5 years or SPE members that have never attended RETEC.

Travel costs are more the issue than the registration fees. We’ve addressed this by having this in Cincinnati. Needs coupons/flyers to promote to attendee. Bruce, Dave, and Scott to discuss logistics and work through it. Oktoberfest is this same weekend. WWW.oktoberfest-Zinzinnati.com Lunch cruise-2hours at $30ish/person on Sunday. Reception: 6:30pm on Sunday. Color Eye Blind will play.
TAPPI conference is also going on at the same time. It may be possible to pull attendees from TAPPI conference. Processing papers are needed and a paper on dyes. Approx. 5 more papers are needed. Differentiate between non-member w and w/o SPE membership option. Declining SPE membership will be $25.00.

RETEC 2007 (San Antonio, TX) - Tim Reilly, Jim Figaniak - Oct. 1-2
· There will be a New Technology Forum.
· Slogan ideas were solicited: "Remember the Color, Walking the River of Color, ColorWalk, Color RoundUp, Riding Herd on Colors, Color Reflections, Plastic Expressions" were some of the ideas.

STRATEGIC PLANNING - ARAM TERZIAN
The mission statement developed by the committee was reviewed: The Color and Appearance Division of SPE strives to educate, train, inform and to provide professional interaction opportunities to the global community involved in visual performance and aesthetics of plastics. The mission statement will be used by committee chairs to cascade down their long term objectives.
A strategic planning workshop will be held at each summer and Winter BOD meeting. Strategic Planning will report through Pride committee.
The first action item to come out of the strategic planning meeting was the need to develop a tagline to go with our logo. The tag line should support our image and objectives. A motion was seconded and passed for $2000 to get the project started.

EDUCATION COMMITTEE
BOB CHARVAT & JAMIE PRZBYLSKI
Bob asked for emails of papers that would be good for publication. Bob is compiling articles for a magazine for JVAT, published by SPE through Wiley. Terra would like to have a table top at RETEC 2006.

ELECTION OF NEXT SECRETARY (ALL)
Sandy reminded the board that being elected to the secretary position is a 5 year commitment to go through the offices (secretary, finance, chair-elect, chair, immediate past chair). Election is done by secret ballot.
The floor was opened for nominations. Sharyl Reid nominated Tim Reilly. Tim accepted the nomination. Bob Trinklein nominated Howard Kennedy. Howard accepted the nomination. The nominations were moved to close and seconded. All passed to close the nominations with no objections. Tim Reilly was elected to serve as secretary for the 2006-2007 term.

RETEC PAPER ARCHIVE (TRACY PHILLIPS)
Tracy presented a comparison of Omnipress and X-CD quotes. Upon further questioning, it was determined that Omnipress would be the recommended choice. Omnipress seems to offer more of the options we need for this project. Motion to allocate $15,000 for the project was made, discussed, and withdrawn. Tracy will head a committee to manage this project with expenditures to happen after July 1st of 2006 so that RETEC 2006 proceeds can be used to fund the project.
The committee's first action is to obtain a firm proposal from Omnipress for the project and present it at the Summer BOD meeting. Funding will be requested then. The committee will need to conference in with the web designers and Omnipress to determine options in hosting the archive on the web site (fee or free). (Committee is part of the website committee). The Linda Hall Library service should also be investigated.

SITE AND THEME (SANDY DAVIS)
Motion made and passed for 2009 RETEC to be held in Savannah. Motion made and passed for 2010 RETEC to be held in Nashville. Motion made and passed for 2011 RETEC to be held in Chicago. 2012 will be the 50th anniversary. Las Vegas is a proposed site since it is a special occasion. ANTECS showed record attendance, but attendance at papers was very low. This site is still up for debate. Chairs for these RETECs will be assigned at Summer Board Meeting.

NEWSLETTER COMMITTEE (BARB PARKER/SHARYL REID)
Invoicing will be switched to end of year. Electronic newsletter vs hard copy was discussed. Most sponsors did not care if the newsletter was electronically distributed. We are not ready to make a decision yet. Barb needs to be present to discuss. Gary Conrad reviewed the RETEC survey results: 53 for electronic via email l vs 28 for paper. The Newsletter and Web-Site Committees need to coordinate and perhaps merge.

continued on page 7
CAD WEB-SITE (JOE CAMERON)
Joe reviewed the proposal from e-XYN. Quote is Canadian dollars. The proposal is to have everything we currently have on the web page. Selected individuals would have the ability to post (treasurer’s report, etc.). Profilers would be sent to contributors for input. Payments would be handled by link, rather than direct. We assume the current voting algorithm will be obtained from Reggie Dawes.

Joe and Tracy to update RETEC 2006 info as soon as possible. We need to run an election in 4 weeks. We should be able to run with existing algorithm.

Joe moved that the board approve going with e-XYN with allocation of $5000 to set up the website and $3000 to maintain it. Timing is 6 weeks to set up the new web site. e-XYN has at least 2 employees. New features will need to prioritized and quoted separately, based on profilers input. Motion was seconded and passed with a majority vote.

ENDOWMENT COMMITTEE
JOHNNY SUTHERS
The endowment fund has accumulated earnings of $227,864. We are over the $250,000 mark and will give 5 scholarships at $4000 each in 2006. We’ve identified 11 schools to send our documentation so they can submit applications. Scholarships will be paid direct to the university. The schools identified are: RIT, Ga Tech, Clemson, Auburn, Case Western, University of Akron, Pittsburgh State, Ferris State, U Mass Lowell, Penn State, and So. Miss. We want 3 of the 5 scholarships to be named after Jack Graff, Gary Beebe and Bob Charvat. Motion was seconded and passed for $20,000 for 2005 scholarships be given to the endowment fund for these scholarships.

AWARDS COMMITTEE (TERRY GOLDFING)
Steve G. will take over as committee chair after ANTEC. Awards not given out will be mailed. We need nominees for honored service member and fellow of society. We will also need a 2006 outstanding achievement award nomination.

PUBLIC INTEREST COMMITTEE (GARY CONRAD)
Gary thanked Jamie for the Terra student’s participation and manning the survey booth. It is a win-win.
Gary provided a summary of the RETEC 2006 survey responses: Comments were generally positive. New Technology formula was received favorable. Job function spread: 35 technical, 24 sales, 16 tech mgr 12 sales mgr 6 gen mgr

PREFFERED FORMAT: SunMonTue (30)
MonTueWed (38)

EXPERIENCE LEVELS:
1-5 years 21 6-10 years 19
>10 years 51

BEST CITIES:
Las Vegas (15) Chicago (11)

25 of 94 joined just for RETEC

MEMBERSHIP COMMITTEE (ROGER REINICKER)
Roger will contact Sandy about membership status for Pinnacle award. We are about 50 short in membership vs this time last year. There are about 250 attendees who attend RETEC - no matter the location.

DIVISION/SECTION TECHNICAL RESOURCE COMMITTEE (STEVE GOLDSTEIN)
4 slides have not been sent out yet:: Carbon black slide, particle size pigments, attractive force of pigments, pigment comparison. Steve needs feedback on pigment and use in polymer from non-Clariant suppliers. The goal is to have it all approved by ANTEC. Committee will coordinate to decide how the presentation should be managed once it is complete and offer a proposal at ANTEC BOD meeting.

OLD BUSINESS (ALL)
Reviewed and updated existing action item list.

NEW BUSINESS (ALL)
Joe Cameron proposed a membership outreach committee. We need to better utilize the Newsletter and Website to better promote membership. Joe Cameron to prepare a proposal. To be discussed at ANTEC BOD. NEW SPE CAD LOGO: Design 4 was chosen as logo. Color of swoosh: RGB change was voted on and passed because it will look good on a black or white background. Background of image must be transparent. SPE shield must have a ®. Sandy to work with designer to get the logo digitized. Motion to have the secretary order shirts for BOD was tabled until the logo is digitized.

2006 ELECTIONS: 9 members are up for re-election. Dave to get election ballots out by mid Feb. A Motion was made for officer progression and was passed. Summer Board Meeting will be Aug 7 and 8 in Detroit--Dearborn. Plastics Museum will be a good locale for a BOD meeting in the future. Honored Service Nominations: Terry Golding was nominated. Bruce and Austin will be sponsors. Terry will review to make sure he meets the requirements.

UPCOMING BOARD MEETINGS:
2006 SPRING Charlotte, NC May 9, 2006
SUMMER: Detroit (Dearborn), MI Aug 7-8,2006
FALL: Cincinnati, OH Sep 20, 2006
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**Bruce Muller**

**Plastics Consulting, Inc.**

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PlasticsC@aol.com

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[www.spectradyes.com](http://www.spectradyes.com)
INTERNET COURSES FOR PLASTIC PROCESSORS THIS FALL

Terra Community College's Coloring of Plastics Program will be offering three internet based courses in the Fall 2006 Semester. All of these courses will be offered in a completely distance format, meaning there is no lab time involved and a student can complete any of the courses from any computer that is connected to the internet anywhere in the world at a reasonable cost.

These courses are an excellent opportunity for your quality control technicians, production technicians, or yourself to learn more about the coloring of the plastics products. These courses are designed for students that find it difficult to attend regularly scheduled classes in Fremont, Ohio because of distance or time constraints.

To address the need for color education in the plastic's industry Terra Community College has founded the International Institute for the Coloring of Plastics, which offers certificates and associate degrees in the coloring of plastics and plastics processing. The goal for the Institute is to become the world's number one source for education and information about the coloring of plastics.

COURSES OFFERED IN FALL SEMESTER (BEGINS AUGUST 21, 2006)

Section VL  PET 1100  Introduction to Plastics  (3 Credits)
Fees: $400 Ohio students  $600 out of state  Books: approximately $200

Section VL  PET 1240  Introduction to Color  (3 Credits)
Fees: $400 Ohio students  $600 out of state  Books: approximately $200

Section VL  PET 2320  Colorants for Plastics  (4 Credits)
Fees: $520 Ohio students  $790 out of state  Books: approximately $150

COLOR FOR PROCESSORS CERTIFICATE

The three courses above can be taken to complete a certificate program designed to give processors valuable color knowledge. Processors are experts on producing the parts that they make, however they often do not have the knowledge necessary to prevent potentially expensive color problems from occurring. These courses are designed to provide this valuable color knowledge to QC technicians, operators, production engineers, or anyone else that needs to work with the coloring of plastic parts.

FOR FURTHER INFORMATION SEE TERRA COMMUNITY COLLEGE'S WEB SITE: WWW.TERRA.EDU OR CONTACT:

Program Professor
Jamie Przybylski
419-559-2459
jprzybylski@terra.edu

Dean of Engineering
Tom Kissell
419-559-2410
tkissell@terra.edu
An Invitation from the Chairperson

We welcome you to the CAD RETEC 2006! The Color and Appearance Division presents “Back To Basics” in Cincinnati, Ohio. This centrally located venue provides a perfect spot for “THE” color related plastics conference of the year.

Our Goal is to meet the high standard of previous RETEC’s while making some changes to the program to encourage new attendees and members. The program offers:

- Papers covering new technology related to coloring, testing, and processing
- The New Technology Forum. A commercial period of our session offering the podium to our tabletop exhibitors.
- The Basics Seminar covering colorants, processing and testing (value of $450 alone) embedded in our sessions. This seminar is perfect for the entry level technician or anyone wanting a refresher.
- Excellent social activities and an abundance of networking opportunities.
- Exhibitors- up to 60 tabletops of relevant products and services. (see the website for a list of the exhibitors to date).

This is a strong program! Be sure to bring several of your Sales Personnel, Technicians and Customer Service Representatives along.

Summary of Conference Events (see website for details)

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Advanced Registration
Deadline: August 18, 2006.
Register early to save $100 off the on-site registration fee.

Where to register or get more Info:
www.4SPE.org
http://4spe.org/conf/cad06/0609cad.php

CAD RETEC 2006 Sponsors as of July 10, 2006:

- Clariant
- BASF
- Engelhard
- DuPont Titanium Technologies
- EMD Chemicals
- Sun Chemical Colors
- Tronox
- Dominion Colour
- Ferro Corp
- Lanxess
- Standridge Color
- Cinic
- Shepherd Color
- A. Schulman
- Konica Minolta
- Ciba Specialty Chemicals
- LTL Custom Compounders

Some Conference Contacts:
- Scott Heitzman-Conference Chair 800-543-2323 ext. 553
- Bruce Mulholland-Registration 859-525-4756
- Brian West-Tabletop Exhibits 865-457-6700
- Sharyl Reid-Sponsorships 864-968-2426
- Gary Conrad-Riverboat Lunch Cruise 513-874-0714
- Howard Kennedy-5K Fun Run/Walk 416-791-4239

Also, Don’t forget to Enter our Tag Line Contest

Entry Deadline: September 19, 2006
Mission Statement
The Color and Appearance Division of SPE strives to educate, train, inform and to provide professional interaction opportunities to the global community involved in visual performance and aesthetics of plastics.

CASH AND PRIZES!!!
YOU COULD BE THE WINNER!

Society of Plastics Engineers
Color & Appearance Division (SPE CAD)
TAG LINE CONTEST

SPE CAD is getting a make-over! We’ve already redesigned our logo and composed our mission statement (see left). Our website (www.specad.org) is being revamped, too.

Now we need a great tag line to go with all of this updating. So, put on your creative thinking cap and help us come up with a tag line that concisely and creatively summarizes the mission and goals of our organization and makes our organization more memorable.

What’s in it for you, you ask? Well, if your tag line is selected, you get the great prizes (an $840 value) listed below plus the pride in knowing your tag line was chosen from all of the entries.

Don’t wait! Submit your tag line today!

Contest Prizes (valued at $840 US Dollars)
1 free CAD RETEC 2007 Conference Registration (up to a $540 value)
$250 American Express Gift Card
CAD SPE Logo shirt (a $50 value)

How to Enter
1. Think of a great tag line that communicates the SPE CAD mission in a clever way.
2. Email your tag line to hal@lancerdispersions.com. SUBJECT LINE: “SPECAD TAG LINE CONTEST”
3. Include your contact information in the email.
5. Deadline for entry: September 20, 2006

Contest Rules and Information
1. Tag Line should be concise—no longer than 10 words, but preferable less than 5 words.
2. Tag Line should directly or indirectly reference “Color” and/or “Plastic” and should help support the mission statement of CAD or the visual of the logo (3 swooshes-3 elements).
3. Tag Line can be clever, inspiring, humorous, serious, or a combination. The goal of the tag line is to get our mission and purpose across in a memorable way.
4. Tag Line must be unique – it cannot be in use by a company or other organization.
5. Number of entries per person: unlimited
6. Eligibility: Anyone involved the plastics industry including non-SPE members
7. Deadline for Entry: September 20, 2006
8. Submit your entry by email to hal@lancerdispersions.com with the following information: Tag Line, Full Name, Company, Address, Daytime Phone Number, Email Address
9. Due to the potentially large number of entries, email entries are preferred.
10. SPE CAD may slightly modify the chosen winner’s Tag Line to refine it.
11. If a single tag line is submitted by multiple contestants, the contestant who submitted it first will be entered.
12. Winner will be contacted directly by the SPE CAD Tag Line Contest committee.
13. Winner will be announced at the SPE CAD RETEC 2007 Awards Luncheon and on the specad.org website.

Contest Questions?
Call or Email one of us: Tracy Phillips (770-995-0887, tracy.phillips@cibasc.com)
Hal Button (330.794.6147, hal@lancerdispersions.com)
Sharon Ehr (815.759.2130. sehr@chromacolors.com)
**Tool Tackles Translucence and Other Color Challenges**

**SOURCE:** SCIENCE DAILY / NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

Plain old colors are passé. Complex visual effects, such as pearlescence, translucence, iridescence and glitter, help sell many products, including cars, cosmetics, pharmaceuticals and military hardware. A new instrument at the National Institute of Standards and Technology (NIST) makes comprehensive measurements of such appearance properties to help companies calibrate their own tools and control product quality.

Exotic surfaces and coatings may look different depending on illumination or viewing angles, subtleties that cannot be accounted for by traditional characterization methods. Many consumers are familiar with automobile paints that appear to change color with viewing direction. The new NIST device, called a goniospectrometer, automatically measures the color of light reflected from a surface as well as its dependence on the directions of illumination and observation. The device is described in a recent publication.*

NIST already offers a heavily used calibration service making less sophisticated measurements with another instrument. The new goniospectrometer will provide more complete data on the reflection of light from a color surface, and will be used for calibrating similar instruments and for research on exotic-appearing materials and coatings. NIST scientists also hope to create a database of measurements of different materials that could be used for modeling surfaces that have complex visual effects. The work is part of a NIST effort to develop accurate measurement methods for reproduction and quality control of appearance attributes, including color matching, by determining the minimum set of illumination and viewing geometries needed to accurately characterize the perceived color.

The goniospectrometer, housed in a clean room, illuminates a sample with a range of wavelengths of visible light, every 5 nanometers (nm) from 360 nm to 780 nm, i.e. from the near ultraviolet/deep blue to red/infrared. The sample and detector are rotated around three axes, allowing illumination and viewing in any direction within a hemisphere around the sample (see graphic). The intensity of the reflected beam is measured at several hundred locations on a sample surface. Based on these measurements, computer software assigns a numerical value to the color of the reflected light.


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**What Color Is That Sound?**

**Source:** SCIENCE DAILY / McMaster University

Imagine being able to see or taste sounds, as well as hearing them. Sound like science fiction? For some people, it's reality. This blending of the senses occurs in a rare condition called "synesthesia." In this condition, a stimulus, such as sound, creates a reaction in another sense, as well as the expected sense.

Now, professor Daphne Maurer of McMaster University's department of psychology has found that at one time we all lived in a world in which sights had sounds and feelings had taste. Although synesthesia is thought to occur in just 1 per cent of all adults, in her keynote address at the annual meeting of the American Synesthesia Association November 6, Maurer discussed evidence that all infants are synesthetic.

"Toddlers perceive higher pitched sounds to come from white balls and lower pitched sounds to come from black balls, just like adults with synesthesia," explains Maurer. "With development, the connections underlying synesthesia are inhibited in most individuals." People with synesthesia grow up thinking everyone perceives the world the same way they do. They discover their perception is different when they make a comment such as "she's the one with the orange name."
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Twentieth Century Art
The artists of the 20th century had to become pioneers, explorers and inventors. The most successful of these experiments formed a new art genre. One of the first groups in this new art world was expressionism, which began before the First World War in Germany and was strongly influenced by Van Gogh's work. Expressionism tried to show feelings and emotions by deliberate manipulation of artistic form and style. An early painter of this group was the Norwegian Edvard Munch (1863-1944), who painted the famous picture The Scream. In this painting reality is distorted by the use of harsh lines and perspective to make an unsettling image of a screaming figure. Expressionism often upsets people by its refusal to depict pretty, harmonious scenes. It concentrated instead on gritty, real life images of suffering, agony and social truth, which took a decided political aspect after the First World War. The art style was banned by Hitler when the Nazis came to power in 1933, and many of the expressionist artists were exiled or persecuted. Famous artists of this period include Otto Dix (1891-1969) and Käthe Kollwitz (1867-1945), who produced many bitter, haunting images.

Colour Classification
With the vast amounts of new colorants being produced, the requirement for some type of colorant indexing system was recognized. The German chemists and colour makers were the first to identify this need, and one early classification system was a publication by Schultz and Julius in 1888. This publication ran to several editions in the years up to 1914, reflecting the increase in the number of colorant products from 278 to 1001 over this time span. At this time the majority of all colorant production was carried out in Germany, and it seemed only natural that any colour classification system would be German in origin, but in 1914 political circumstances changed the balance of technological power in Europe. The First World War (1914-1918) stifled the flow of innovation, chemicals, colorants and trade with Germany and the need for an English language colour indexing system was recognised as being highly important.

During the First World War there was a huge expansion of research and manufacture in colorants by the British and also by the Americans, initially to aid the production of uniforms and equipment for the armed forces but also to develop technology comparable to that held by the Germans. From 1920 the Society of Dyers and Colourists began trying to devise 'some means or other to systematize the nomenclature of the colours'. The first Colour Index was published in 1924, followed by the second edition in 1956 in which the now well-established system of colorant nomenclature appeared. In 1998 an edition designed explicitly for the pigment industry was published. The Colour Index is still the only colour classification system that attempts to categorize all known colorants, and is invaluable to anyone with an interest in dyes and pigments. Most recently it has been released on CD-ROM. The development of a comprehensive colorants indexing system allowed chemical producers, dyers, researchers and artists to identify exactly what substances they were using.

Important Discoveries
Early in the 20th century two new pigments were discovered that would again revolutionize the colour industry. As often seems to happen, one of these pigments was actually discovered accidentally as an impurity. The pigment in question was blue phthalocyanine, first reported as a blue impurity by Braun and Tchernaik in 1907, although they failed to recognize the potential of their observation. The real discovery of phthalocyanine occurred at an ICI plant in Scotland in 1928, where a stable, insoluble blue impurity was found in reaction vessels. The blue compound was analyzed by Linstead at the Imperial College of Science and Technology in London and found to be iron phthalocyanine. The structure was identified and a method of synthesis formulated. Eventually the more intense blue copper phthalocyanine was synthesized. A viable manufacturing method for the pigment was patented in 1932.
ICI began production of its new colorant in 1935 under the trade name of Monastral Fast Blue BS, and later introduced a green halogenated copper phthalocyanine to the range.

The phthalocyanines were the first class of organic colorants to be introduced directly to the market as 'true' pigments, without initially being developed as dyes or lakes. They were a new class of super pigments with incredibly high performance in terms of tinting strength, fastness and chemical resistance; thus they quickly came to dominate the blue and green pigment markets in all applications. In a very short time they had all but replaced the synthetic indigo lake pigment over which there had been so much political and economic turmoil only 20 years earlier. The phthalocyanines are immensely popular as artists' pigments and are used in nearly all pigment applications today.273 Indeed they are the most widely selling organic pigments at the present time.

The second important pigment to be discovered in the 1920s was white titanium dioxide.59 The white mineral rutile had been known for some time, but it was not until 1795 that German chemist Klaproth identified it as the oxide of a new element, which he named titanium.17,162 Naturally occurring titanium dioxide was not used as a pigment because it was too highly contaminated with iron and a suitable purification method had not been worked out. In the 1920s a suitable method of producing white titanium dioxide pigment was developed, known as the sulphate process.274 Natural titanium minerals are treated with sulphuric acid at about 200 °C to form a sulphate solution, which is then hydrolyzed to form a white precipitate of hydrated titanium dioxide. The precipitate is calcined in a furnace to form the white pigment with the correct properties. Titanium dioxide is nowadays often manufactured by another method called the chloride process and it is the most widely used pigment of all time. It is very safe to use, has the highest hiding power of all the white pigments, has excellent light fastness and is very popular in modern artists’ colours, in addition to being very widely used in decorative paints, plastics, printing inks and many other applications.30

Modern Art

The style of art that was influenced by the work of Cézanne was called cubism and was developed in Paris at the dawn of the 20th century.275,276 It has been described as the most influential style in modern art. Cubism was developed partly by the Spanish painter Pablo Picasso (1881-1973), and it is concerned with the analysis of form in painting. These painters created familiar objects from flat building blocks of simple units, often using many angles and views to do so. Cubist painters were concerned with form first and subject matter second.279

The cubist style was crucial to the development of a new movement of abstract art. Abstract artists were interested solely in the form of a painting and abolished reliance on subject matter altogether.280 Painters were free to study pure colours and our psychological responses to them. They began by looking at the human visual system and thought processes through experiments in art.281,282 The first abstract painter is considered to be Russian-born Wassily Kandinsky (1866-1944), who lived and worked in Munich. The scientific experimentation of cubism and abstract art were in some ways combined by artists such as Piet Mondrian (1872-1944). He built abstract pictures but out of solid forms, blocks of bright, primary colours and bold outlines, which probed the laws of vision and colour.287

Modern art tried to create new forms and to explore new ideas that had not previously been considered. In order to facilitate this creative process, many artists took a lead from Gaugin's primitive paintings of Tahiti and tried to return to a naive state from which to begin their work. Gaugin's work sparked a cascade of naive, childlike paintings and a great interest in folk art and the art of 'primitive' cultures from the countries of the European empires. Naive artists, unlike the expressionists, were widely supported by both Nazi Germany and later by the Soviet Union. The concepts of naive art were absorbed and developed to found the Dada movement. This took the idea of returning to a childlike, primitive state to an extreme by rejecting all aspects of Western culture and conventional art. Many Dadaists used new materials such as discarded rubbish and waste paper in order to create their work, and many set out to shock the public out of their bourgeois art tastes. A leading Dadaist named Marcel Duchamp (1887-1968) became famous for exhibiting ready-made sculptures, which were commercially produced items, such as in one instance a urinal. Many of Duchamp's works were interactive with moving parts, and the public was invited to touch and feel the works in galleries. This began a trend for art being incorporated into everyday life, reducing some of the taboos and restrictions associated with attending exhibition halls.
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an art gallery. The public was encouraged to obey their childlike instincts and investigate what they could see. Being deliberately naive obviously caused problems, because it was not possible for any painter to adopt a primitive viewpoint all of the time or 'unlearn' all of their knowledge and preconceptions. Naive art and Dada began to become increasingly fantastic and based less in reality.\(^{291}\) Many artists had been strongly impressed by the ideas of Sigmund Freud and investigated the concept that art cannot be created by waking reason. Painters deliberately set out to paint their subconscious thought; these artists became known as the surrealists.\(^{294}\) Perhaps the most famous surrealist painter was Salvador Dali (1904-1989)\(^{295}\), who tried to reproduce a dream world in his work. Dali's paintings are a confused mix of images, which cleverly blend into one another to form new images.\(^{296}\) Some objects in his paintings are illustrated with extraordinary clarity while some are deliberately vague and cannot quite be made out, like memories of a dream.

The American Art Scene
The Second World War was to have a deep impact on the art communities of Europe and on the world perception of art generally.\(^{297}\) Britain and France entered the war in September 1939, and intellectuals from all disciplines began fleeing European countries for the haven of America.\(^{258}\) The Parisian art scene in between the wars had been dominated by the surrealists, cubists and abstract artists, and many of the individuals involved in these scenes went to New York. Artists such as Dali, Max Ernst (1891-1976)\(^{298}\) and Mondrian all took part in this exodus. Only a few of the major artists, including Picasso and Kandinsky, were to remain.

Before the Second World War the American artists of New York had taken great inspiration from the European art schools. Other influence came from the leftist revolution of Mexico (1911-20). In Mexico a great tradition of Socialist mural painting had been created that was sustained by state sponsorship.\(^{299}\) Famous fresco artists such as Diego Rivera (1886-1957)\(^{300}\) and David Siqueiros\(^{301}\) won international acclaim for their socially realistic work and even obtained commissions for large fresco works in America. Siqueiros set up a workshop near Union Square in New York. He introduced many young artists to his experimental painting techniques and to the use of new media such as industrial paints. The American stock market crashed in 1929 causing the great depression, and the artists of the day felt this intensification of social pressures, tending to become very politically minded.\(^{302}\) During the 1930s the Union Square area of New York became a hive of artistic activity reflecting these social issues, and a federal art project was set up. Thousands of artists were involved in this project and were paid a basic subsistence allowance to work and paint. The project generated hundreds of thousands of art works, and many of the young painters involved went on to form the New York art school. Such painters included Stuart Davis\(^{302}\), Jackson Pollock \(^{303}\), Willem de Kooning \(^{304}\), Lee Krasner\(^{302}\) and Mark Rothko\(^{305}\), who were all to become very famous during their lifetimes.

The New York School
The New York artists became more heavily influenced by European modern art in the 1930s after the opening of several new art museums in the city.\(^{306}\) New York artists had their first chance to study the works of European art face to face, to view the actual paintings from which they had taken inspiration. Paintings by Picasso and the surrealists provided a particularly strong influence; the flat cubist figures of Picasso are much in evidence in American art of the time. The influence of European art intensified still further with the arrival of the artists themselves after 1939. The surrealist and Dada artists stepped into the New York limelight and brought with them a strong sense of community, which was something lacking amongst the American painters.\(^{307}\) In Paris the art communities had been settled in established areas of the city, with members frequenting certain cafes, taking part in lively discussions and debate. The upheaval to America meant that new meeting places needed to be established and frequently these places became the art galleries. One of the most important galleries was a privately run exhibition area belonging to Peggy Guggenheim\(^{308}\), who called her gallery 'Art of this Century'. A profusion of small magazines and art-criticism journals also began to appear to give the artists a voice to communicate with each other across the
city. These changes due to the exodus from Europe are still in existence to this day. The art galleries all over the world are always the focal point for people to meet and discuss art, with most galleries running extensive lecture and information programmes for the public.

The mingling of artistic and political influences caused the emergence of a new art movement that was centered in New York. In 1945 Peggy Guggenheim's gallery hosted an exhibition called 'A Problem for Critics', where the art critics were challenged to identify the new style. The show featured works by many American artists including Hans Hofmann, Jackson Pollock, Arshile Gorky and Mark Rothko. These artists collectively became known as the abstract expressionists, or the New York School, and for the first time American art led the world. The abstract expressionists were a group of individuals who had a great deal in common. They generally came from similar cultural and political backgrounds, and were all influenced by European modernism and the surrealists with an interest in the unconscious mind. They all believed strongly in individuality and denied being part of a group at all; they also objected strongly to the term abstract expressionism.

**New Techniques**

Jackson Pollock (1912-56) was a particularly prolific painter of the New York group; he was involved in the New York art scene from his youth and painted in many styles. His mature works, for which he is most famous, were particularly innovative and have greatly influenced many subsequent artists. Pollock created 'action paintings', where he would take huge canvases, place them on the floor and drip, pour or splash the paint across them to make textured images. There was no actual subject matter involved in the paintings but the whole canvas was covered with paint and itself became the subject matter. Pollock redefined our ideas of painting. He often used novel materials in his compositions, including enamel paints, household decorative paints and industrial paints.

The American painter Mark Rothko carried out another novel investigation in art but this time with his use of colour. Rothko also had many different styles of painting until he settled on his mature style, which was often called colour field painting, which consisted of using large canvases filled with rectangles of colour painted in many layers to produce shimmering and glowing colour effects. Rothko did not title many of his paintings but simply gave them exhibition numbers or names such as 'Composition in red and black'. The ideas behind these paintings were central to the abstract expressionists. It was felt to be important to remove the barriers of the conscious mind to allow art and free thought to come entirely from the subconscious, with a new perspective.

During the explosion of American art there were also a great many new pigments that were introduced by science and industry. The new artists took advantage of these new materials and often used them in interesting forms. The new organic pigments were bright, attractive and had good properties so were quickly adopted by the artists of the New York School. Many new painting materials were also developed after the introduction of novel synthetic-polymer systems and other technologies. In addition to the more traditional painting styles of fresco, watercolours, egg tempera, oils and chalks, the modern artists could choose from printing inks, emulsion paints, oil pastels, acrylic paints, coloured pencils, wax crayons, enamel paints, aerosol spray paints, etc. From this large selection of styles modern artists began creating collages or sculptures, and experimenting with art media using just about any material in their work.

**Modern Pigments**

Two more classes of organic pigments that have been more recently developed and used as artists' materials deserve specific mention. The first of these are the quinacridone pigments, which like the phthalocyanines are polycyclic in nature. Quinacridones are very highly coloured, ranging from yellowish-red through to violet hues. They have excellent fastness and resistance properties and have been used in high-quality artists' materials.

Evidence of the quinacridone structure was first uncovered in 1896 but a linear quinacridone suitable for use as a pigment was not synthesized until Liebermann began work in 1935. He failed to recognize the potential use of this structure as a pigment, and it was not until 20 years later that any industrial progress was made. In 1955 Struve began investigating commercially viable synthetic routes to quinacridone pigments for the DuPont Company. The pigmentary potential of quinacridones was uncovered once it was realized that the quinacridone structure could exist in several crystal forms. The standard quinacridone could be converted to a very stable, highly coloured form, ideal for pigmentary applications. It took
several years to perfect a synthesis, and in 1958 a new class of pigments was introduced into the market place.\textsuperscript{317} A wide range of quinacridone pigments are commercially available, but CI Pigment Violet 19 and CI Pigment Red 252 are two of the most important.

The last group of pigments to be introduced in recent times are the diketopyrrolopyrrole (DPP) pigments.\textsuperscript{314} These are ranges of organic pigments that are based on a specific type of heterocyclic chromophore discovered after a series of experiments carried out in 1974.\textsuperscript{315} The unusual heterocyclic compound produced was investigated by Iqbal at Ciba and eventually yielded an entirely new class of colorant, the DPP pigment.\textsuperscript{319} The exact date of Iqbal's discovery is not known since the work was carried out with great secrecy, but the new pigments were patented in 1983 when a synthetic production route had already been established commercially. Diketopyrrolopyrrole pigments are red and orange in hue and have all a-round excellent pigment properties, which makes them desirable despite their high price. They have been used in some good-quality artists' materials and it is likely that their use may increase. Commercially, the most important DPP pigment is CI Pigment Red 254.\textsuperscript{320}

Conclusions

Art is continuing to develop and grow, tackling new ideas and themes. At any one point in history, it is difficult for the observer to evaluate what is and what is not significant in the field of contemporary art. It will be the job of the art historians of the future to analyze the trends of the late 20th century. Nevertheless, this paper has attempted to review the history of pigments in art from cave paintings of 40,000 BC to the art works of today. The progression from primitive man creating paintings with animal fat and crushed earth to the complex industrial synthesis of organic pigments and careful formulation of high-quality artists' materials has been outlined. The developments in art and science through the centuries appear to have been a series of diversifications, expansions and experiments, which have run very much parallel to one another. As the number of art styles has developed, so too has the artists' palette and the variety of painting techniques available. It is hoped that this review has provided an insight into the long history of pigments and art, and also inspired the reader to look at painting in a new light.
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