

# THE COUNCIL FOR NEAR-INFRARED SPECTROSCOPY

NEWSLETTER issue #3

September 1987

## AT THE EASTERN ANALYTICAL SYMPOSIUM:

**ASTM E13.03.03 NIR TASK GROUP MEETING**, Monday, September 14, 7:00-10:00 PM,  
5th floor Hilton Hotel All are invited to attend

**COUNCIL FOR NEAR INFRARED SPECTROSCOPY - OPEN MEETING:** Tuesday, September 15, 7:00-10:00 PM,  
Room 534; All are invited to attend

## NEAR INFRARED BIBLIOGRAPHY

A bibliographical compilation of near-infrared research is a service offered by the Council. While a knowledge of prior art is important in almost every scientific field, it has traditionally been more difficult to search for and find articles pertaining to near-infrared analysis. This is because near-infrared spectroscopy has been used in several diverse fields of study, astronomy, physics, electrical engineering, optics and communication, statistics, chemistry, and agriculture. No single computerized library of articles spans the entire range of interest. This is compounded by the unfortunate fact that important articles in near-infrared have appeared in journals with relatively limited circulation. As a final difficulty there is no single keyword which adequately describes the field. For example, if one were to conduct a computerized search of some of the more standard commercial reference sources using the name near-infrared spectroscopy, relatively few citations would appear. If the search title were changed to near-infrared, a very large number of articles would be found, but few would actually be pertinent to chemical analyses. Thus, a significant number of important documents would be missed.

To alleviate this problem and better serve the NIR community the Council has established a bibliographical service to identify the location of previous and current studies. This service consists of:

1. computerized reference library base,
2. data searching software,
3. quarterly updates.

Currently, the foundation library consists of 710 references to journal articles, books, and patents pertinent to near-infrared studies, covering the years from 1950 to 1986. Each entry includes the full title, author list, journal, issue, date, and page number of the article. More than 150 of the citations also include an abstract of the article. New entries with abstracts are being added constantly. Abstracts on earlier articles will be added as they become available.

PCFILE a popular, relatively low priced but sophisticated data base was used to write and access the organizational program. Using it is possible to construct simple or complex search patterns using exact matches, wildcard matches, or Boolean logic searches. The program even provides a soundex search which can find words sounding like the target word. This is an especially useful function when one is searching for authors or other names where the spelling isn't certain. PCFILE is a menu driven program with its own book and on-line documentation. The program can be used to add data files to customize your references, find references by searching, and sort references by author, title,

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date, or journal, write letters, generate reference statistics. It can even be used to transfer the data into different file formats including: dBASE, PC-CALC, DIP (Visicalc), PRN (Lotus), Mail-merge, Peachtext, Word Perfect, Microsoft Multiplan, or any of a number of user defined styles.

To illustrate the use of the database, consider the following example. A colleague's question illustrates the use of the bibliography search. He wanted to use Near-Infrared to monitor fermentation, so we searched the database for these words and fragments: brew, ferment, and beer in the title of an article. Four pertinent articles were located.

Under brew,

Halsey, Shellagh A.  
Application of NIRA in brewing.  
Anal. Proc. (London)  
23(4), pg. 126-127, 1986.

Under ferment,

R.W. Silman, LT. Black, K. Morris  
Assay of Solid Substrate Fermentation by means  
of Reflectance Infrared Analysis.  
Biotechnol. and Bioengr.  
25, pg.603, 1983.

Under beer, the program found:

Halsey, S.A.; Buckee, G.K.  
NIRA applied to Malts, Wort, and Beers.  
Proc. Congr - Eur. Brew. Conv.  
20th volume, pg. 523-530, 1985 and

A.G. Coventry and M.T. Hunston  
Application of Near-Infrared Spectroscopy to the  
Analysis of Beer Samples.  
Cereal Foods World  
29, pg 715, 1984.

Note the variety in the pertinent journals and books. It should be pointed out that talks and abstracts of talks are not indexed in the library. Nor are proceedings of conferences that were distributed only to the attendees catalogued. The bibliography is currently available from the Council. The price of the initial library, which includes all current references, source disks for PCFILE and the PCFILE manual, is \$150 for Council members and \$200 for non-members. Those who already possess a copy of PCFILE can receive the bibliographic database for \$50 less. After the initial references data base, updates are available every three months for \$10 for members, \$15 for non-members. We anticipate that each

update will add a minimum of 30 new citations. An annual update service is also available which would provide four quarterly updates for the price of \$40 for members, \$60 for non-members. These fees are to cover the costs of recording the references, shipping, handling, and the magnetic media involved in this effort. The actual bibliographic search of the literature is being provided by the Council and its volunteers free of charge as a service to promote the technology of near-infrared spectroscopy. Orders for the bibliography should be addressed to: Council for Near Infrared Spectroscopy

Attn. Dr. David Honigs  
Dept. of Chemistry, BG-10  
University of Washington  
Seattle, WA 98195

Checks should be made payable to the Council for Near Infrared Spectroscopy. Payment must accompany orders.

Finally, for this bibliography to be successful we need your participation. If you have additional references to add or notice a mistake in an entry please send a note to the above address. If we are to keep this bibliography up to date, it is imperative that authors send us notification of upcoming publications. Finally, we are open to comments about the organization, content, or style of the bibliography. *David Honigs*

### **Report on JCAMP**

JCAMP-DX committee is considerably more than a committee on data-transfer standards as indicated by its full name "The Joint Committee on Atomic and Molecular Physical data". It is a continuing committee of all subdisciplines of spectroscopy, including IR, FTIR, NMR, mass spectroscopy, various X-ray spectroscopies, line spectra of the elements, Raman, and others. Periodically, the committee takes on needed projects, such as providing IR spectra to the Coblenz society, and their current project of formulating a data transfer standard which is nearly complete. The status of the Council for NIRS was reported to the JCAMP executive committee, which met at Pittcon, March 10, 1987. They then voted to accept the Council as a sponsoring organization, contingent upon the Council's affirmation. Bob McDonald reported on the JCAMP-DX data transfer standard project (which is almost ready for submission to Applied Spectroscopy for publication) as regards its extension to other spectroscopies and non-spectroscopic analytical methodologies. Copies are available from Robert McDonald, 9 Woodside Drive, Burnt Hills, N.Y. 12027. In a second JCAMP-DX meeting we reported that

the NIR community found the proposed JCAMP-DX data transfer standard almost completely satisfactory with the inclusion of just a few changes. We scheduled an ad hoc meeting for the next morning, attended by D. Hopkins, M. Lovik, H. Mark, B. McDonald, and E. Stark. The major change suggested was the inclusion of a specification for a standard method of describing the constituent composition in the form of ##Concentration=<constitname#1; constit-value#1 ;units><constitname#2; constit-value#2;units>...

The standard is general enough to accommodate a wide variety of situations. One problem is to assure that, within the confines of the standard, different people using the standard to do the same thing use the standard the same way. To this end, there must be agreement within the NIR community on how to use the standard. A second problem unfortunately already exists between NIR users in the form of the number of data points utilized per spectrum for different existing file formats. Bob was adamant in insisting that problems of this nature were up to the recipient of the data to deal with. The only requirement of the sender is that the recipient should be able to read the data according to the standard. This will require further consideration and assistance from the instrument manufacturers or third party software people.

Bob McDonald is preparing a test disk containing data written in JCAMP-DX format, which will allow users to test the software designed to read data. This disk will be sold with the proceeds divided between JCAMP and him. Bob is also writing subroutines for the IBM-PC in PASCAL, C, AND BASIC (possibly FORTRAN) to read JCAMP-DX formatted data. These subroutines will be released as public domain software.

John Coates volunteered to act as liaison between the ASTM committee E13, Molecular Spectroscopy (the parent committee of our near infrared ASTM task group E13.03.03) and JCAMP. Howard Mark and Rob Lodder were made liaison between the Council and JCAMP-DX.

It is recommended that the Council for Near-Infrared Spectroscopy support JCAMP-DX and this project. This and associated recommendations and specifics will be voted on at the Tuesday Sept. 15 meeting at EAS.

*Dr. Howard Mark, Bran+Luebbe, Technicon Industrial Systems, Tarrytown, N. Y. 10591*

## NEAR INFRARED COURSES

**EAS - NIRS Workshop; Hilton Hotel, Tuesday morning, Sept. 15,1987, director Dr. F. DeThomas**  
Bran & Luebbe (Technicon), Dickey John, Pacific Scientific and KES Analysis will present talks on NIR theory, Quantitative and Qualitative Analysis, Bias and Slope Corrections as a Calibration Technique, Food Applications, and Industrial Applications. There is no charge for this workshop.

**Pittsburgh Conference, New Orleans, LA, Friday, February 26,1988, faculty E. Stark, K. Luchter**  
This one day survey will give an overview of vibrational Spectroscopy, NIR instrumentation, method development, and applications with an emphasis on industrial uses. For further information contact Alma Johnson at (412) 795-7110.

**Jointly sponsored by Council for Near Infrared Spectroscopy and American Association of Cereal Chemists (AACC) May 10,11,12 1988, St. Louis MO, director E. Stark, faculty K. Norris, W. Hruschka**  
This three day course will cover in more depth than a survey course: the physics and chemistry of NIR, instrumentation, sample preparation and presentation, spectroscopy, mathematics, statistics, method development, applications, questions and discussion on participant applications, and instrument demonstrations. Further information may be obtained by calling Dottie Ginsburg at (612)454-7250.

**Univ. of Washington, Seattle; Aug.28 - Sept.2, 1988, faculty Dr. D. Honigs**  
A week long course in Near Infrared Spectroscopy, analysis, and correlation techniques, offered by the University of Washington, the week of August 28th to September 2nd 1988. Led by Dr. Honigs, who received his PhD in Near Infrared Analysis, this course will be an intensive study with both a theoretical and practical emphasis. Morning lectures will cover spectral interpretation, selection rules, hydrogen bonding, regression analysis, experimental design, pattern recognition, and limits of confidence. Afternoon/Evening sessions will emphasize hands-on training with practical applications, sample preparation, instrumental considerations, fiber optics, FT-NIR, and direct comparison of several software and instrument packages. Specific time and services will be provided so that the attenders can investigate the University, our Center for Process Analytical Chemistry, Downtown Seattle, or the natural beauty of the Pacific Northwest. A Sunday evening cocktail hour and a Thursday evening banquet will provide further time for social and scientific exchange.

The cost for this course is \$1195 for the week, which includes room (single occupancy), meals for the week and all course materials. Spouse and family accommodations are available upon request. The course is limited in size to 30 participants, and is expected to fill rapidly. For further information on Seattle, the course, or registration, please contact David Honigs at: 1988 NIR Short Course, Attn. Dr. David Honigs, Dept. of Chemistry, BG-10, University of Washington, Seattle, WA 98195

**4th INTERNATIONAL DIFFUSE REFLECTANCE CONFERENCE: CHAMBERSBURG, Pennsylvania: Aug.12-18,1988**

The 4th International Diffuse Reflectance Conference the "Chambersburg Conference", as it is often called, will be held August 14-19, 1988 at Wilson College, Chambersburg, Pennsylvania, USA. Initially patterned after the Gordon Conferences, the International Diffuse Reflectance Conference has become a forum for researchers confronted with problems on diffuse reflectance. The 1988 Conference will convene researchers from all over the world to exchange technical information and experiences in near infrared spectroscopy as well as ultraviolet, visible, infrared, fluorescence, and remote sensing.

This coming year's Conference, as always, will convene as one session in the morning and one session in the evening. The afternoon is set aside for poster sessions, exhibits, committee meetings, and physical exercise (jogging, volleyball, golf, tennis, swimming, etc.) A hospitality suite will be provided following the evening sessions, an excellent time to clarify questions with the session speakers and to further fellowship with old friends. Thursday evening will be devoted solely to the banquet and speaker.

For the first time we will have a short course on "Statistics in Diffuse Reflectance Spectroscopy" which will be held prior to the actual conference. For further information contact Dr. W.F. McClure, Conference Chairman, 4th International Diffuse Reflectance Conference, North Carolina State University, Box 7625, Raleigh, NC 27695-7625. CONTRIBUTIONS FOR POSTER SESSIONS ARE REQUESTED. Conference enrollment is limited, so early registration is recommended. Mailing for registration will follow shortly.

WHERE WE MEET - Nestled in the foothills of the Appalachian Mountains, Chambersburg is near the center of the turning point of the Civil War. The Battlefields of Gettysburg (30 miles away) and Antietam (45 miles away), the Pennsylvania Dutch country, and the chocolate town of Hershey PA

make nice side trips. Chambersburg is approximately 88 miles from Washington, DC and 76 miles from Baltimore, MD; both cultural centers for eastern USA.

WILSON COLLEGE - Wilson College, a private 4 year college for women, has roots going back 118 years, to 1869, the year it was established. Located on a beautiful 300 acre campus in the heart of the lush Cumberland Valley it provides an excellent setting for our conference.

HOUSING - You are encouraged to live in the Wilson College dormitories, as their convenience adds to the time available for scientific and social interactions with the other conference participants. However, for those who wish more lavish accommodations and can afford it, a block of rooms will be set aside at the Chambersburg Holiday Inn. The cost for registration and a dormitory room for the week of Aug. 12 through Aug. 18 and for three meals a day during that period is \$275.

PRELIMINARY PROGRAM 4TH INTERNATIONAL DIFFUSE REFLECTANCE CONFERENCE CHAMBERSBURG.PA  
DATES DAY ACTIVITY

|                |  |
|----------------|--|
| Aug 14 Sun,    | Short Course: Statistics   |
| Starts 12 Noon | Diff. Refl. Spec.  |
| Aug 15, Mon.   | Registration for Conference<br>Dinner and Reception 6 PM   |
| Aug. 15 Mon.   | AM Interaction of Light and Matter<br>PM1 Poster, Exhibit, Discussion, Sports<br>PM2 Spectroscopies of Water         |
| Aug. 16 Tues.  | AM Fluorescence of Turbids & Solids<br>PM1 Poster, Exhibit, Discussion, Sports<br>PM2 Standardization of Instruments |
| Aug. 17 Wed.   | AM Remote Sensing Spectroscopy<br>PM1 Poster, Exhibit, Discussion, Sports<br>PM2 On-Line Spectroscopies              |
| Aug. 18 Thurs. | AM NIR Band Assignments<br>PM1 Poster Exhibit, Discussion, Sports<br>PM2 Banquet, Awards, Speaker                    |
| Aug. 19 Fri.   | AM Diffuse Reflectance Infrared<br>Fourier Transform Spectroscopy<br>(DRIFTS) <i>Fred McClure</i>                    |

ASTM TASK FORCE E13.03.03 excerpt of minutes from March 9, 1987 meeting at Pittsburgh conference

**A selection of STANDARD DEFINITIONS for TERMS AND SYMBOLS RELATING TO NIR SPECTROSCOPY**

From the report of committee E-13.03.03; these and additional definitions were submitted for balloting.

**A. STANDARD ERROR OF CALIBRATION (SEC)** - a measure of calibration accuracy determined by the equation:

$$SEC = \left( \frac{1}{n-p-1} \sum_{i=1}^n e_i^2 \right)^{1/2}$$

where n is the number of observations in the calibration data set, p is the number of independent variables in the calibration and  $e_i$  is the difference between a measured value of property and its accepted reference value.

**B. STANDARD ERROR OF PERFORMANCE (SEP)** - a measure of accuracy determined by the equation:

$$SEP = \left\{ \frac{1}{n-1} \sum_{i=1}^n (e_i - \bar{e})^2 \right\}^{1/2}$$

where n is the number of observations for which the accuracy is determined,  $e_i$  is the difference between a measured value of a property and its accepted reference value and  $\bar{e}$  is the mean of all the  $e_i$ .

**C. BIAS** - The definition of ASTM Standard E456 was adopted with the following note: BIAS is determined by the equation:

$$BIAS = \bar{e} = \frac{1}{n} \sum_{i=1}^n e_i$$

where n is the number of observations for which the accuracy is determined,  $e_i$  is the difference between a measured value of a property and its accepted reference value and  $\bar{e}$  is the mean of all the  $e_i$ .

**D. Multiple Linear Regression** - a statistical method of relating the values to a set of variables,  $X_1, X_2, \dots, X_k, \dots, X_K$  to the values of another variable Y, by a linear model

$$Y = b_0 + b_1X_1 + \dots + b_kX_k + \dots + b_KX_K + \varepsilon$$

Note: The  $X_k$  are called independent variables and are measured data. Y is called the dependent variable and corresponds to a measurement of a property of interest by a reference method. The constants  $b_0, b_1, \dots, b_k, \dots, b_K$  are the regression coefficients and  $\varepsilon$  is the residual error.

**E. Principal Component Analysis** - a mathematical procedure for resolving sets of spectra into orthogonal components whose linear combinations approximate the original spectra to any desired degree of accuracy.

Note: the number of components is smaller than or equal to the number of variables or the number of spectra, whichever is less. As successive components are calculated, each component accounts for the maximum possible amount of residual variance in the set of spectra.

**F. Calibration** - a mathematical procedure for relating measurements (or their transformations) obtained from a set of specimens to the accepted reference values of a property of those specimens. Note: Multiple Linear Regression is one method used to determine this relationship.

**THE INTERNATIONAL COMMITTEE FOR NEAR INFRARED SPECTROSCOPY** July 13, 1987, Univ. of East Anglia

The International Committee for Near Infrared Spectroscopy (ICNIRS) was formed in Budapest in May 1986 at the suggestion of Professor V.P. Krischenko that some form of international

collaboration was required if we were to organize Near Infrared Spectroscopy on an international basis. An ad hoc committee was agreed upon in which Professor V.P. Krischenko (Moscow) and E.W. Stark (New York) were elected co-chairmen. It was further agreed that the first international meeting under the aegis of the ICNIRS should be held in Norwich in July 1987 with A.M.C. Davies

as the organizer. Additional meetings of the organizing committee were held during the Chambersburg Conference Diffuse Reflectance Conference (August 1986 and Pacific Scientific NIRS Users Conference in Maryland (May 1987).

24 interested NIRS delegates, who were not otherwise engaged in a winery visit, attended the International Committee meeting held during the Norwich Conference at the AFRC Institute of Food Research. The differences between this Committee and the Council for Near Infrared Spectroscopy were spelt out. The Council is based in North America and is affiliated to the Society for Applied Spectroscopy. The nature of the International Committee was discussed and agreed that the Committee should be composed of up to three delegates from any one country but all meetings of the Committee would be an open forum. It was further decided that the main areas of interest for the International Committee were:-

- 1 Co-ordination of International NIRS Conferences.
- 2 The maintenance of mailing lists.
- 3 The establishment of data bases of published NIRS research.
- 4 The promotion of a standard for transfer the of NIRS spectral data between different computers and instruments.

Decisions in accordance with these subjects were taken as follows:- It was agreed that while the Chambersburg Conference was an independent biennial meeting, it would be publicized by the International Committee. This Committee would then arrange international conferences for the alternate years. Subject to approval from their respective national authorities, international Conferences will be arranged by Dr. Iwamoto in Japan in 1989 and by Professor Krischenko in the USSR in 1991. It was hoped that the instrument manufacturers would keep these arrangements in mind when organizing their own meetings.

Mailing lists will be maintained by Professor Fred McClure for America and A.M.C. Davies for Western Europe. Further mailing lists are maintained by Dr. Kaffka in Budapest and the individual instrument companies. One company indicated they would be willing to distribute material from the International Committee, A.M.C. Davies reported that he had received very generous assistance with publicity and distribution from two major NIRS instrument manufacturers.

It was agreed that the JCAMP-DX protocol was suitable for Near Infrared Spectroscopy and that the Committee should support a proposal for this

to become the standard for NIRS data. It was hoped that the instrument manufacturers would write procedures for formatting to and from the JCAMP-DX standard.

A.M.C. Davies reported that the NIRS Conference was part of the Royal Society of Chemistry's "Spectroscopy Across the Spectrum" Conference. In view of the large number of delegates attracted to the conference by the NIRS meeting, the "SAS" Conference organizers have donated L 2,000 to the International Committee. In addition to this success a small profit is expected from the independent part of the NIRS Conference held on Thursday and Friday. It was agreed that these funds would be used for postal expenses and funding the next international Conference. Professor Krischenko and E.W. Stark were re-elected as co-Chairman and A.M.C. Davies was elected secretary and treasurer. *A.M.C. Davies, Institute of Food Research, Norwich, UK*

**THE ROYAL SOCIETY OF CHEMISTRY:  
Analytical Division joined with the  
INTERNATIONAL COMMITTEE FOR NEAR  
INFRARED SPECTROSCOPY to present  
"Spectroscopy Across the Spectrum" July 12-17  
1987**

The campus of the University of East Anglia on the outskirts of Norwich UK served as a pretty and comfortable site for "Spectroscopy Across the Spectrum: Analytical Applications of Spectroscopy". The first three days of this conference were a multi-disciplinary series of shared morning and parallel afternoon sessions, initiated on Sunday evening by the inauguration of the Molecular Spectroscopy Group of the Royal Society of Chemistry by Messrs D.C.M. Squirrel, President of the RSC Analytical Division and A. Townshend, Chairman of the new Group. V.P. Krischenko and E.W. Stark, co-Chairmen of the International Committee for Near Infrared Spectroscopy (ICNIRS) then opened the "First ICNIRS Near Infrared Spectroscopy Conference." The plenary lecture for the combined conference was presented by Karl Norris, "History, Present Status, and Future Prospects for NIRS."

"Combined Techniques", "Fourier Transform Spectroscopy", and "Data Analysis" provided the themes for the three joint morning sessions which were followed each day by separate parallel sessions devoted to specific spectroscopic areas: Near Infrared, UV/Vis, Infrared, Atomic Spectroscopy, Mass Spectroscopy, NMR, Process Control and Chemometrics. The "First ICNIRS Near Infrared Spectroscopy Conference" continued on Thursday with morning and afternoon presentations and workshops on sample preparation and calibration techniques. Coffee breaks and free time were utilized for

poster sessions and hands-on displays by instrument manufacturers who occupied booths set up in the coffee break common room of University House.

The conference was well attended with over half the attenders particularly interested in the Near Infrared sessions. Not only did the UK and western Europe contribute their share of participants, but both the US and Canada, as well as Japan, the Soviet Union and Hungary were represented. Evenings were occupied by demonstrations of data analysis software, meetings of the International Committee for Near Infrared Spectroscopy, boat trips down the Wensum River, (the water thoroughfare through the beautiful

town of Norwich) and of course the scientific and social conversation so admirable fostered by English pubs and beer. Housing attenders on campus, with the use of the university dining halls, coffee shops, pub, banks, post office and stores helped free more time for person to person exchange. This was truly a conference intended to foster sharing and communication between related disciplines. Abstracts of the 89 presented papers and 20 poster session papers are available from A.M.C. Davies, Institute of Food Research, Norwich Laboratory, Colney Lane NR4 7UA, UK. A book of the written version of presented papers is also being prepared.

*K. Luchter, KES Analysis, NY, NY*



5 NIR Oldtimers  
from left to right

- PHIL WILLIAMS
- ED STARK
- KARLNORRIS
- FRED McCLURE
- IAN MURRAY

for information or  
contributions  
contact:  
Emil Ciurczak  
6 Riverside Drive  
Denville, NJ 07834  
(201)292-6339

**COUNCIL MEMBERSHIP APPLICATION:**

Because the Council For Near Infrared Spectroscopy is now affiliated with the Society of Applied Spectroscopy, SAS, the Council is providing a \$5.00 discount for combined Council and SAS membership fee. SAS membership includes a year's subscription to the Journal of Applied Spectroscopy, as well as the SAS news bulletin published 4 times a year. Please check the appropriate category:

- Regular Membership - Council only [\$25 N.Amer./\$40 other] (  ) discounted Council/SAS combined Membership [\$50 N.Amer./\$65 other] (  )
- Student Membership - Council only [\$10] (  ) discounted Council/SAS combined Membership [\$15] (  )
- Sponsoring Membership [\$250] (  )

Name

Mailing Address,

Company/School,

Area of Interest

please return this to: Patrick Cooper (treasurer), Pacific Scientific, 2431 Linden Lane, Silver Spring MD 20910

-ZIP-

We wish to thank Pacific Scientific and Technicon for their generous assistance in printing this newsletter.

PAPERS OF INTEREST:

EASTERN ANALYTICAL SYMPOSIUM  
September 13th to 18th, 1987  
New York City, NY

- 018 BASELINE AND SCATTER CORRECTION BY A QUANTUM MECHANICAL FILTER: C. Miller and D. Honigs, Dept. of Chemistry, Univ. of Washington, Seattle, WA
- 019 REFERENCE SPECTRA IN THE NIR: E. Stark, KES Analysis, New York, NY
- 020 ANALYSIS OF POLYMERS BY NIR SPECTROSCOPY: F. DeThomas, Pacific Scientific, Silver Spring, MD
- 021 ANALYSIS OF PARENTERAL DOSAGE FORMS BY NIR: E. Ciurczak, College of St. Elizabeth, Dept. of Chemistry, Convent Station, NJ
- 059 THE FAR-VISIBLE AND WHAT IT CAN DO FOR YOU: J.B. Callis, C.H. Barlow, and J.J. Kelly, Dept. of Chemistry, Univ. of Washington, Seattle, WA
- 060 PROGRAMMED RANDOM ACCESS NIR SPECTROSCOPY WITH AN ACOUSTO-OPTIC TUNABLE FILTER: D.L. Wetzal, A.J. Eilert, and G.J. Kemeny, Kansas State Univ., Manhattan, KS
- 061 NEAR INFRARED (NIR) FIBER OPTIC SAMPLING PROBES: P. Cooper and D. Webster, Pacific Scientific, Silver Spring, MD
- 062 THEORETICAL AND EXPERIMENTAL DEVELOPMENT OF THE NIR LAPLACE TRANSFORM SPECTROMETER: J. Perkins and D. Honigs, Dept. of Chemistry, Univ. of Washington, Seattle, WA

FACSS XIV ANNUAL  
MEETING October 4-9,  
1987 Detroit, Michigan

- A STUDY OF THE DISTRIBUTION OF RADIATION IN A DIFFUSELY REFLECTING MEDIUM: Gerald S. Birth, Russell Research Center
- INTERPRETATION OF SPECTRA OF CORRELATION COEFFICIENTS: K.H. Norris, U.S. Dept. of Agriculture, BARC-East
- PATHLENGTH CONSIDERATIONS FOR WATER-BASED SAMPLES IN TRANSFLECTANCE MODE: Pricilla M. Walling, Jaquelyn Dabney, Helene Curtis
- COLLECTION AND INTERPRETATION OF NIR REFERENCE SPECTRA: Edward Stark, KES Analysis, NY
- A BEAST TO BATTLE ANALYTICAL APPARITIONS: Robert A. Lodder, Gary A. Hieftje
- TRANSMISSION NIR SPECTROSCOPY OF AQUEOUS SUSPENSIONS: Lloyd E. Fox, The Upjohn Company
- A STUDY OF THE DISTRIBUTION OF RADIATION IN A DIFFUSELY REFLECTING MEDIUM: Gerald S. Birth, Russell Research Center
- DATA TREATMENT IN THE NEAR INFRARED: LA. Carreria, F.E. Barton, J. Griffen, University of Georgia
- UNIQUE APPLICATIONS OF FOURIER TRANSFORM SPECTROSCOPY IN THE NEAR INFRARED: Robert Klebba, Nicolet Analytical Instruments, Spectroscopy Research Center
- RESOLUTION ENHANCEMENT OF NEAR-INFRARED (NIR) SPECTRA: Patrick J. Cooper, Pacific Scientific, Instrument Division
- NEAR INFRARED (NIR) ANALYSES OF PHARMACEUTICAL PRODUCTS: F.A. DeThomas, Pacific Scientific, Instrument Division
- FUNDAMENTALS OF MEASURING THE MERCURIZATION OF COTTON USING NIR SPECTROSCOPY: Subhas Ghosh, Donna Dilanni, Institute of Textile Technology
- SIMULTANEOUS QUANTITATIVE AND QUALITATIVE ANALYSES USING NEAR-INFRARED SPECTROSCOPY AND DISCRIMINANT ANALYSIS: Jerry Workman Jr., Howard Mark, Technicon Instrument Corp.
- NOISE IN NIRS - SOURCES AND SOLUTIONS: David B. Funk, Dickey-John Corporation
- NEAR-INFRARED ANALYSIS WITH A HIGH DUTY CYCLE ACOUSTO-OPTIC TUNABLE FILTER RANDOM WAVELENGTH ACCESS SYSTEM: David B. Wetzal, A.J. Eilert, Kansas State University
- APPLICATIONS OF NEAR-IR FT-IR SPECTROSCOPY: HARNESSING AND APPLYING HIGH OPTICAL THROUGHPUT: D.A.C. Compton, S.L Hill, Bio-Rad Laboratories, Digilab Division
- REMOTE NEAR INFRARED MEASUREMENTS USING FIBER OPTICS AND A BROAD BAND SOURCE: Stanley M. Angel, Lawrence Livermore National Lab, Environmental Sciences Division