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Contents

General Articles

- 149 **Structure Visualization in Biochemistry Education**—Robert C. Bateman, Jr.
- 153 **Breast Cancer Among Women in Mississippi: A Preliminary Report of Excess Mortality in African Americans**—Mary H. Hill

Research Article

- 158 **Chiller Water Treatment from Channel Catfish (*Ictalurus punctatus*) Processing Plants with Ultrasound, Ozone, and Pulsed-light**—Roberto S. Chamul, Miranda Reed, and Juan L. Silva

Departments

- 146 **Editorial**—Ken Curry
- 147 **Election Results; Annual Meeting Announcement; New Division**
- 165 **President's Column**—Robert C. Bateman, Jr.
- 165 **Executive Officer's Column**—John Boyle
- 165 **Divisional Report**—Alan Shiller
- 166 **2003 Annual Meeting Abstract Form and Instructions**

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Editorial

Laws, theories, and hypotheses. I am teaching biological evolution this semester, and my students have made me particularly aware of the use and misuse of the word theory. Many of them refer to evolution with one popular sense of the word theory as something unsubstantiated when they say “it’s only a theory.” So much of the business of science is tied to the concept of laws, theories, and hypotheses, and yet when I think of the number of textbooks that I have used for various biological courses, only the introductory texts devote any significant portion of their books to explaining these concepts. And even the introductory texts do not follow through using the terms as they have defined them throughout their chapters. To make matters worse, the definitions offered are not consistent among all the texts. Apparently we do not have a strong common sense of what is meant by law, theory, and hypothesis.

Frequently hypothesis is defined as an educated guess or reasonable explanation as to why a phenomenon occurs. The creation of a hypothesis requires familiarity and experience with phenomena related to the one which the hypothesis purports to explain. The process of choosing the most reasonable explanation from a field of explanations that might be offered is what philosophers call abductive reasoning. Inductive reasoning has sometimes been associated with the creation of hypotheses. I can appreciate that inductive reasoning will lead to inductive generalizations, but I believe inductive generalizations fall short of hypotheses and that the difference is abductive reasoning, that creative leap that gets us from generalization to explanation. Once the hypothesis is created, it becomes the premise for deductive reasoning. True predictions made from deductive reasoning substantiate the hypothesis while false predictions require further explanation or modification of the hypothesis. Truth in science is embodied in those hypotheses which have great predictive value.

Theories are defined in a number of introductory biology textbooks as hypotheses with great predictive value. These same authors will go on to discuss the theory of spontaneous generation which was discarded many years ago. I suggest that the way we actually use the word theory is to mean a collection of related hypotheses. Hence we can talk about atomic theory or the theory of evolution or the theory of spontaneous generation. Atomic theory have a theory of evolution embrace collections of related hypotheses with high predictive value. The theory of spontaneous generation embraces a collection of related hypotheses with poor predictive value. We would do well to teach our students the difference between a scientific theory as a collection of related hypotheses and a popular use of theory as that which is unsubstantiated by empirical evidence.

The concept of law has given me quite a bit of trouble. I have seen suggestions to avoid using the word in science, and at the other extreme, to define science as only including those things which are governed by laws. The concept of law is rarely applied in biological sciences. The two examples that come readily to mind are the Hardy-Weinberg law that applies to ratios of genes in a population under particular conditions and the law of independent assortment of chromosomes applied to the partitioning of chromosomes during meiosis. In both cases these laws apply to stochastic events. Other laws, such as the law of gravity, or for mathematical description of a specific phenomenon. My sense of the concept of law is that we apply it to what appear to be irrefutable descriptions of natural phenomena. Laws, been allow us to predict what will happen in a given circumstance, but do not explain why it will happen which is the business of hypotheses and theories.

Comments on the basic concepts of hypotheses, theories, and laws are welcome.—Ken Curry

Election Results

We are pleased to announce that our President-elect for 2002-2003 is **Hamed Benghuzzi**. The President-elect will serve as principal organizer for the 2004 Annual Meeting, become President automatically during the summer of 2003 and preside at the 2004 meeting, and serve as Past President for one year following his presidential term.

We are pleased to announce that **Sarah Lea McGuire** has been elected to serve as a member of the Board of Directors. We are also pleased to announce that **Dick Highfill** will be filling the term of Director vacated by Hamed Benghuzzi.

The Board of Directors comprises three people that deliberate and vote on matters of importance to the Academy and its membership. Members of the Board serve a three-year term, with one member elected each year to replace the member rotating off.

The sixty-seventh annual meeting of the
Mississippi Academy of Sciences
will be held on
Thursday and Friday, February 13 and 14, 2003
Hattiesburg, Mississippi,
at the Hattiesburg Convention Center.

Accommodations will be across the street (Hwy 49) at the Cabot Lodge.
(601-264-1881; \$55 single for MAS meeting)

New Division! ECOLOGY AND EVOLUTIONARY BIOLOGY

The Mississippi Academy of Sciences is pleased to announce the formation of a new division, effective immediately, in Ecology and Evolutionary Biology. The Division of Ecology and Evolutionary Biology encourages submission of papers in these areas to the Journal of the Mississippi Academy of Sciences, and for presentation at next year's annual meeting of MAS in Hattiesburg. Papers appropriate to this division may come from researchers conducting studies in ecology and evolution in terrestrial, wetlands, or aquatic environments, involving organisms of any kind, or be strictly theoretical in content. Dr. Clifford Ochs of the University of Mississippi (byochs@olemiss.edu) and Dr. David Beckett of the University of Southern Mississippi (david.beckett@usm.edu) are the chair and vice-chair of the division for the coming year.—Cliff Ochs

[insert Ohaus advertisement here]

Structure Visualization in Biochemistry Education

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Modern biochemistry and the other molecular biosciences have been fundamentally changed by the sequencing of the genomes of numerous organisms including humans. This genomic sequence information has led to structural genomics, which attempts to understand the function (or malfunction) of a protein from its predicted structure. Scientific journals and popular literature abound with illustrations of macromolecular structures illustrating these rapid advances. Today's students in widely diverse fields ranging from medicine to research (e.g. drug design) to teaching must therefore understand the relationship between structure and function, a relationship that has been called molecular 3D literacy (Richardson and Richardson, 2002).

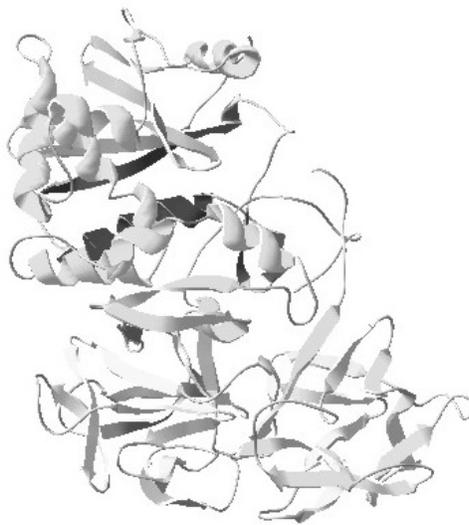
Historically, chemists have used models of various types to render models of "invisible" molecules visible so that structural features can be analyzed and stereochemistry can be communicated. For example, in general chemistry and sophomore organic chemistry an understanding of the three dimensional nature of molecular structure can be obtained with hand models such as wire frame or hard sphere because the molecules are small enough to easily see, build, and manipulate. In the classroom and on examinations, the instructor typically asks students to draw 3D structures on paper using wedges, dotted lines, etc. to illustrate dimensionality. Some students can do this, but some have difficulty.

As structures get larger (> 500 Daltons), hand models and hand drawings become cumbersome, and for large macromolecules hand models are primarily of historic value or for illustrating small pieces of structure. There are a small number of free graphics programs in common use in biochemistry education to fill this gap. With ubiquitous laptop computers

and data projectors, these programs can be used in lecture or laboratory, as well as in homework and online tutorials. I would like to briefly review these programs¹, discuss their features, their strengths and limitations, and make some suggestions about how to use these programs most effectively in teaching biochemistry.

CHEMSCAPE CHIME

Today's biochemistry textbooks have illustrations of macromolecules often comprised of ribbon drawings to illustrate patterns of secondary and tertiary structure, or spacefilling models to illustrate shape and fit. Those textbooks also come with CDs and websites, which have interactive computer illustrations of these same molecules. These usually use Chime, a free Java-based web browser plug-in from MDL Systems (www.mdl.com), and the illustration is often imbedded in a webpage describing the illustration and providing buttons allowing specific changes to the graphic rendering. Likewise, when browsing the Protein Data Bank (Berman et al., 2000), Chime is the primary viewer for rendering the PDB files "visible" although there are other viewers available. Chime allows a certain amount of manipulation such as rotation, zooming and switching from ball and stick to spacefilling rendering. Many general and organic chemistry teachers also use Chime because it is very good at rendering small molecules and has almost no learning curve for simple rendering. As a web-based



Ribbon diagram of ricin, a castor bean toxin, illustrated with Deep View.

¹All programs in this article are linked to <http://ocean.otr.usm.edu/~rbateman/hotlist.htm>

program, Chime is not platform dependent. However, it is dependent on both browser type and version, with Netscape 4.7 being the most reliable of these. The next Chime release (version 2.6 SP4) should be fully compatible with Internet Explorer 6.0.

As mentioned above, there are a number of Chime-based macromolecular structure tutorials and many small molecule libraries available. Making your own Chime-based instructional tools is not trivial because one needs to be fairly proficient in HTML coding. Other limitations of Chime are that it is not open source and the graphics are only adequate for large structures, certainly not publication quality.

RASMOL

Chime is based on the stand-alone program Rasmol (RAsTer MOLeCules), written by Roger Sayle in his spare time as he worked on his doctoral thesis in computer science at the University of Edinburgh. He made it public domain in June 1993 and it has gained a large following (Sayle and Milner-White, 1995; Bernstein, 2000). Rasmol has menu commands, but also has a command line interface, which allows much more manipulation of the image than Chime. It also has the nice feature of allowing images to be saved in a variety of formats suitable for presentations. Like Chime, Rasmol has almost no learning curve for simple rendering. For instructor or student to select features in Rasmol the user must learn the command line codes. These commands can be saved as scripts. Most students are not enthusiastic about using a command line and the scripts have the file paths embedded, making them difficult to transport to a different machine. In addition, Rasmol does not have depth cueing or the ability to load multiple molecules. An experimental Windows interface written by Philippe Valadon called RASTOP is designed to overcome these latter deficiencies.

PROTEIN EXPLORER

Protein Explorer (PE) is a web-based interface to Chime that, as the name says, encourages exploration of the structure (Martz, 2000). It was developed and championed by Eric Martz at University of Mass Amherst with NSF support. PE has lots of explanatory helps and there are good teaching ideas on the PE website (www.proteinexplorer.org). The interface

also provides additional functionality such as a multiple sequence alignment coupled to structure overlay. PE is subject to the same browser limitations as Chime and tends to be limited by connection speed. The PE interface is powerful and provides a great deal of useful information, but the button interface can be very confusing. Finally, PE is in a constant state of revision, which is good for addition of new features but bad for stability.

DEEP VIEW

Swiss PDB Viewer, now called Deep View, is a stand-alone program that was developed by Nicholas Guex and coworkers at SmithKlineBeecham in Geneva, Switzerland (Guex et al., 1999) and championed as an educational tool by Gale Rhodes at the University of Southern Maine. This is an excellent graphics program for those destined for graduate school in biochemistry or related fields. Deep View serves as the graphics interface to the EXPaSY Swiss Model server where one can submit sequences for automated homology modeling. Deep View will load multiple structures, superimpose structures, do energy minimizations, and show a variety of surfaces and other renderings. It currently does not have depth cueing and the graphics are adequate, but they can be enhanced by exporting the image to PovRay. Deep View is more capable than the other programs reviewed, but also has a steeper learning curve than the other programs and so is not as widely used in education. Future versions of Deep View are planned with depth cueing and better scripting capability.

KINEMAGES

Kinemages and their associated programs, originated and maintained by David and Jane Richardson at Duke, constitute the original molecular graphics freeware. Written in 1992 for distribution with the journal Protein Science (Richardson and Richardson, 1992, 1994, 2002; Bateman et al., 2002), kinemages ("kinetic images") are plain text scripts which produce images when viewed with Mage, the kinemage viewing program. Kinemage scripts may be generated or "authored" with any text editor if the author follows the proper formatting but, for generating molecular kinemages from coordinate files such as Protein Data Bank files, there is a menu-driven authoring program called Prekin. The Prekin user interface is not particularly intuitive but is currently

being rewritten to make it more user friendly. Kinemages have an extensive color palette and good depth cueing, so they lend themselves to artistic expression. Since they were designed to illustrate the viewpoint of the author, they are an excellent 3D communication tool. Kinemages are not limited to molecules and have been used for illustrations from geologic faults to architectural drawings to population data.

In addition to the programs briefly reviewed here there are other freeware graphics programs, which the reader might find useful. These include Echem, a simple program useful for high school and freshman college chemistry (Wu et al., 2001), MolMol (Koradi et al., 1996), and Cn3D (Wang et al., 2001), the graphics program available at the NCBI molecular modeling database.

EFFECTIVE USE OF MOLECULAR GRAPHICS

Educators must remember that factors other than biochemistry content are at work when using computer-generated molecular models. These other factors include the basic curiosity of the student when exploring a structure on their own, the difficulty experienced by the student in learning the software, and the spatial abilities and learning style of the students. For example, a visual learner may

find molecular graphics more interesting than a student who has traditionally learned by reading the text.

My own experience in using molecular visualizations in lecture can be summarized in the following bullets:

- Use motion to give 3D effect (rock the image gently).
- Teach the basics of the software while you are using it.
- Make the images you use in class available outside of class.
- Give follow-up homework (graded!).
- Don't overdo it. Never spend more than 5-10 minutes on visualizations in lecture.
- Point out relevance of molecular structure to the function of the molecule.
- Use computer models jointly with solid models for small molecules.
- Keep the structure in overall context, i.e. together with sequence, physical properties, experimental data, biological role, etc.

Final Take home lesson: Make the students do some work. Active learning is essential. Passively watching colorful animated tutorials is little better than Saturday morning cartoons.

Summary Table

Graphics Program	Strengths	Limitations
Chime	Online tutorials, platform-independent	Browser-dependent, relatively low quality images
Protein Explorer	Chime + extra helps	Same as Chime + always in beta state
RasMol	Structure browsing & exploration	Single structure, command line interface
Deep View	Excellent analysis tools	Steep learning curve

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Breast Cancer Among Women in Mississippi: A Preliminary Report of Excess Mortality in African Americans

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Breast cancer, a major contributor to morbidity and mortality among women, occurs more frequently in the United States than any other type of cancer. Breast cancer incidence and mortality rates vary among racial and ethnic groups in the United States. Increased mortality is associated with many factors including lack of access to health care services, lack of screening, advanced stage at diagnosis, socioeconomic conditions, poorer treatment, and limited preventive services. The purpose of this paper is to examine data on breast cancer in Mississippi women. Data sources include the Surveillance, Epidemiology and End Results Program, the American Cancer Society, and the Mississippi Central Cancer Registry. African American women in Mississippi have an excess breast cancer mortality rate and data from a recent publication, *Cancer in Mississippi: An Annual Report 1996*, suggest that it may be higher than previously recognized. These observations signal a need for more diligent surveillance of the trends in breast cancer as well as public health programs directed toward cancer prevention, treatment and control. Therefore, it is imperative that research be done to determine the relationships among socioeconomic and cultural factors, access to health care and preventive services, and attitudes about seeking treatment for breast cancer. Additionally, to effectively implement legislation for breast health, there must be increased education of consumers and health care providers of resources available.

Breast cancer, a major contributor to morbidity and mortality among women, occurs more frequently in women in the United States than does any other type of cancer. During 2001 the American Cancer Society (ACS) estimates that 192,000 women in the United States will be diagnosed with breast cancer and 40,200 women will die from the disease (Greenlee et al., 2001). Within the state of Mississippi, however, it is estimated that in the year 2001 there will be 2000 new cases of breast cancer diagnosed among women and 400 women will die from the disease (American Cancer Society, 2001a).

BREAST CANCER STATISTICS

Breast cancer incidence and mortality rates vary among racial and ethnic groups in the United States. Nationally, data from the National Cancer Institute's (NCI) Surveillance, Epidemiology and End Results (SEER) Program for 1992–1996 show the age-adjusted incidence rate of breast cancer in women was 110.6/100,000 for all races, 113.9/100,000 for whites, and 101.5/100,000 for African Americans (Ries et al., 1999). The age-adjusted mortality rate of breast cancer in women for 1992–1996 was 25.4/100,000 for all races, 25.1/100,000 for whites, and 31.3/100,000 for African Americans—the highest breast cancer mortality rate among United

States racial and ethnic groups. During 1992–1996, the average annual age-adjusted cancer mortality rate of breast cancer for all women in Mississippi was 23.8/100,000 (Reis et al., 1999). The state of Mississippi ranked 39th among the 50 states and the District of Columbia in breast cancer mortality and is one of the states with a lower rate (Ries et al., 1999). Few studies, however, have examined breast cancer among African American women in Mississippi. In this report data on breast cancer in Mississippi women are examined. Underlying factors that may contribute to differences in the mortality rate between blacks and whites and policy issues related to breast cancer are discussed.

Data from the SEER, the ACS, and the Mississippi Central Cancer Registry were reviewed. Incidence data are from the SEER program. The ACS and SEER mortality data are from the National Center of Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC). Death rates were calculated using data on cancer deaths compiled by NCHS and population data collected by the U.S. Bureau of the Census. All SEER incidence and mortality rates are age-adjusted to the 1970 United States standard population. The Mississippi Central Cancer Registry (CCR), a population-based cancer registry within the Mississippi State Department of Health and established by the 1993 Legislature,

began collecting data in 1996. Data sources include: (a) population data from the Surveillance, Epidemiology, and End Results Program (SEER) population files (December, 1998); (b) incidence data from the Mississippi State Department of Health Central Cancer Registry; and (c) mortality data from the Mississippi State Department of Health Division of Vital Statistics (Mississippi State Department of Health, 1996). Mammography and clinical breast examination data are from the Behavioral Risk Factor Surveillance System, NCHS (American Cancer Society, 1996).

Table 1 shows a summary of data from SEER, the ACS, and the Mississippi CCR on breast cancer incidence and mortality rates for women in the United States and in Mississippi. Nationally, breast cancer incidence rate in whites is higher than in blacks. Incidence data for the Mississippi CCR for 1996 (its first year of operation) is estimated to be only 80% complete, and is therefore not shown (Mississippi State Department of Health, 1996). National and state data show the age-adjusted mortality rate of breast cancer to be higher in blacks than in whites. Black/white mortality rate ratios were calculated and the percentages of excess mortality for blacks were determined. During 1990–1996, SEER data show that blacks had a 22% greater risk of dying from breast cancer than whites. Data for Mississippi during a similar time period (1991–1995) show a slightly higher percentage of excess mortality at 29%. Data for the year 1996 show a higher rate of excess mortality nationally (28%) than seen for the 1990–1996 period. Preliminary data from the Mississippi CCR for 1996 suggest that the excess breast cancer mortality among blacks may be even greater than previously recognized, up to 55% (Mississippi State Department of Health, 1996). However, there are limitations to these data: (1) only data for 1996 are presented and (2) age-adjustment and standardization were made to the U.S. 2000 population in Mississippi, and not to the 1970 United States standard population used in SEER. Accordingly, these data are preliminary and must be interpreted with caution. Increased breast cancer mortality

is associated with many factors including a lack of access to health care services, lack of screening, advanced stage at diagnosis, socioeconomic conditions, poorer treatment, and limited preventive services. In order to determine the behavioral pattern of women in Mississippi related to mammography screening, state-specific data on screening practices were reviewed using state survey data from the Behavioral Risk Factor Surveillance System. As shown in Table 2, women in Mississippi are involved less often in breast cancer screening prevention

Table 1. Age-adjusted Breast Cancer Incidence and Mortality Rates* in Females.

	Incidence Rate	Mortality Rate	% Excess Black/White Mortality
1990–1996: United States, SEER			
All races	109.1	25.9	
White	113.2	25.7	
Black	113.2	31.4	22%
1991–1995: Mississippi**			
All races	n/a	23.6	
Whites	n/a	21.9	
Blacks	n/a	28.2	29%
Year 1996: United States, SEER			
All races	110.7	24.3	
Whites	113.3	24.0	
Blacks	100.3	30.8	28%
Mississippi Cancer Registry***			
All races	n/a	30.1	
Whites	n/a	26.1	
Blacks	n/a	40.4	55%

*Age-adjusted per 100,000 to the 1970 U.S. standard population.

**Source: American Cancer Society (2001b). Based on data from the National Center for Health Statistics.

***Cancer in Mississippi: Annual Report, 1996, Mississippi State Department of Health.

Table 2. Mammography and Clinical Breast Examination for Women 40 and Older, 1996.

	% Ever Had Mammogram	% Ever Had Mammogram & Clinical Breast Examination	% Had Recent Mammogram		
			40–49	50 % Over	65 & Over
Years:	40 & Older	40 & Older			
United States	84.1	79.5	65.4	56.9	54.1
Mississippi	76.3	71.9	66.1	41.8	38.3

Recent mammograms: Women 40–49 within the last two years; women 50 and older within the last year. Behavioral Risk Factor Surveillance System CD-ROM, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention Source: 1996.

practices than women nationally. Only 76.3% of women age 40 and older in Mississippi reported they ever had a mammogram compared to 84.1% of women nationally. Only three other states had a lower percentage of women who had ever had a mammogram. Between ages 40–49 years, the percentages of women who had a recent mammogram are similar at nearly 65%. However, fewer women in Mississippi age 50 years and older report having had a recent mammogram (approximately 40%) compared to mammogram use by women nationally, nearly 55% (American Cancer Society, 1996).

UNDERLYING FACTORS

Differences in race-specific and state-specific incidence and death rates for breast cancer may be attributed to differences in factors such as socioeconomic status, access to delivery of medical care, lifestyle, and specific biological risk factors for disease (Centers for Disease Control, 1992b; Miller et al., 1995). A major factor contributing to higher breast cancer mortality among black women is that they often do not seek prevention and treatment services until the disease has advanced. They are less likely than white women to be screened for breast cancer through such measures as clinical breast examination and mammography because of a lack of knowledge about prevention services and less access to health care (Blendon et al., 1989; Fletcher et al., 1993). Consequently, a diagnosis of breast cancer in black women occurs when the disease is in a less

treatable stage.

Underlying reasons that may explain why black women do not seek treatment until the disease is advanced are also related to socioeconomic factors coupled with beliefs and attitudes regarding breast cancer's disease process, treatment, and the impact of treatment on a woman's relationship with the significant other. In a study by Lannin et al. (1998) of the economic factors and cultural beliefs influencing the reporting of breast cancer, they found that: (a) African American women had a more advanced-stage disease at diagnosis, (b) socioeconomic factors and cultural beliefs strongly influence the stage at which the patient seeks treatment after a diagnosis of a breast lump, and (c) the combination of the two factors provide an explanation of the racial difference (Lannin et al., 1998). Specific demographic and socioeconomic factors, which are listed as they were presented in the survey forms, that were identified as significant predictors of advanced-stage breast cancer include: (a) being an African American, (b) low income, (c) never having been married, (d) no private health insurance, and (e) delay in seeing a physician due to lack of money or lack of transportation. Cultural beliefs were also identified as significant predictors of women presenting with advanced-stage breast cancer. Medically invalid cultural beliefs that were reported include: (a) air causes a cancer to spread, (b) the devil can cause a person to get cancer, (c) women who have breast surgery are no longer attractive to men, and (d) chiropractic is an effective treatment for breast cancer. Most recent research

indicates that socioeconomic variables alone do not account for observed differences in breast cancer between African American and white women. Cultural factors such as beliefs, attitudes and knowledge about cancer vary among races and could be underlying contributors to the disparities in breast cancer incidence and mortality between African American women and white women (Lannin et al., 1998).

Mississippi is one of many states with large rural populations. Compared to other states, its economic base is depressed. Pockets of poverty and lack of access to quality health care in largely poor and rural areas contribute to its low ranking as the unhealthiest state in the Nation (Kanengiser, 2000). In a study by Amey et al. (1997), the role of race and residence in determining stage at the diagnosis of breast cancer was examined in 79,946 women from the state of Florida between 1981–1989. With the exception of age, race was the most influential individual characteristic. When race and residence were entered into the logistic regression equation, rural black women from remote areas of the state were diagnosed with breast cancer much later than other women (Amey et al., 1997). However, rural white women demonstrated no significant disadvantage from residence. An unanswered question is why the most rural of white women suffered no significant disadvantage from residence (Amey et al., 1997). Further research is needed to better understand the relationship between socioeconomic and cultural factors, and geographic barriers to screening and healthcare services.

POLICY ISSUES

Recognizing the value of screening and early detection for breast cancer, Congress passed the Breast and Cervical Cancer Mortality Prevention Act of 1990 (Centers for Disease Control and Prevention, 2000). This act is responsible for the establishing the CDC's National Breast and Cervical Cancer Early Detection Program (NBCCEDP). The program targets underserved women, including those who are older, have low incomes or are members of racial and ethnic minority groups and provides breast and cervical cancer screening exams. It provides grants to states for program implementation and includes education and outreach programs for women and health care providers, improving quality assurance measures for screening and improving access to

screening and follow-up services (Centers for Disease Control and Prevention, 2000). By 1992, 12 states had received funding and technical assistance in program implementation (Centers for Disease Control, 1992a). In 1996 the program was implemented nation-wide.

As a result of NBCCEDP, the state of Mississippi offers breast screening and mammograms for women 50 years of age or older who have no Medicaid, private insurance, Medicare or other third-party payment. In addition to screening, the program provides diagnostic services, public information and educational programs, and training to improve the skills of health professionals in detection and control of breast cancer (Centers for Disease Control and Prevention, 2000). The NBCCEDP, however, did not provide free treatment for women too poor to afford insurance but not poor enough to qualify for Medicaid. Consequently, in October 2000 the Breast and Cervical Cancer Prevention and Treatment Act of 2000 was signed into law. This law authorizes states to provide Medicaid coverage for women who are diagnosed with breast or cervical cancer, but have no way to pay for treatment (Pear, 2000). Prior to this law, women with an abnormal screening result, received diagnostic evaluation and treatment referral, but no resources were made available to pay for the treatment.

African American women in Mississippi have excess breast cancer mortality. Recent data from the Mississippi Central Cancer Registry suggest that it may be higher than previously recognized. These observations signal a need for more diligent surveillance of the trends in breast cancer as well as public health programs directed towards cancer prevention, treatment and control. Comparatively, Mississippi women participate in breast cancer screening services less frequently than women in most other states, and nationally. Therefore, it is imperative that research be done to determine the relationships among socioeconomic and cultural factors, access to health care and preventive services, and attitudes about seeking treatment for breast cancer. Additionally, to effectively implement policies legislated for breast health, there must be increased education of consumers and health care providers of resources available to improve breast cancer screening and thereby decrease mortality.

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Chiller Water Treatment from Channel Catfish (*Ictalurus punctatus*) Processing Plants with Ultrasound, Ozone, and Pulsed-light

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High-frequency ultrasound, ozone, and pulsed-light were studied as alternative disinfecting treatments for catfish chiller water. Chlorination of process water is done on site, by processors, or by municipalities. However, contaminated water may reach the product/process if water is not adequately treated. Incoming quality (both fresh and recycled), and discharge water streams of two channel catfish processing plants was determined. Quality of incoming fresh water was better than recycled chiller water, which was similar to discharge water. High-frequency ultrasound (850 MHz) had no effect on microbial reduction of chiller water. Ozone at 7.68 ppm and 5 min contact time killed *Listeria* spp. and reduced heterotrophs and coliforms by 1 log CFU/mL. Of the Gram-negative microorganisms, *Acinetobacter baumannii* was found to be one of the most resistant to ozone at low concentrations (3 ppm). Pulsed white light reduced heterotrophs and coliform counts by more than 4 log CFU/mL in recycled chiller water. Thus, pulsed-light showed the best results for treatment of catfish processing water, followed by ozone (> 5 ppm) while high-frequency ultrasound had no effect.

KEY WORDS: Water, quality, chiller, catfish, disinfection

Channel catfish (*Ictalurus punctatus*) is one of the most popular/eaten finfish in the United States. Most channel catfish production takes place in the southeastern part (Mississippi and adjoining states) of the United States (TCI, 2001). The water used in the chiller, to lower the temperature of the fish, must “be safe and of adequate sanitary quality” (21 CFR 110.37, FR 1995). The quality of the water determines the overall quality of the product itself during processing. The chiller is used to cool the end product and may aid in surface cleaning (dilution) before product is packaged. In the southeastern part of the United States (SE U.S.), rain recharges the aquifers. Also, the SE U.S. has an abundance of poultry, cattle, hogs, sheep, catfish, and horse farms. These animals may carry many microorganisms, which are discharged in their feces and become part of the agricultural run-offs that pollute the water (Gray, 1994). The temperature of the water in the chiller (< 5°C) must be monitored and controlled at all times. The chiller is usually the final wash that

the catfish goes through before packaging, so the water in the chiller should be as sanitary as possible.

There are many new uses of ultrasound and more to come in the near future. Some of the uses of ultrasound now include acoustical agglomeration and treatment of water and wastewater (Crum, 1992; Mason, 1993). Phull et al. (1997) conducted an experiment on the effects of ultrasound on the biocidal treatment of water and its effect on microorganisms such as *Escherichia coli*. The results showed that ultrasound could be used to kill microorganisms. Furthermore, high frequency ultrasound was suggested to be more beneficial than low frequency ultrasound.

Ozone has been used in potable water treatment since 1856 (Langlais, 1990). The United States Food and Drug Administration (USFDA) has authorized the use of ozone as Generally Recognized as Safe (GRAS) (66 FR 33829, 2001). Ozone is now used in the bottled water industry, soft drink industry, and beer and wine industry. In the bottled water industry,

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ozone is applied to water just before bottling.

The FDA has approved pulsed light (PureBright® Technologies, San Diego, CA) to reduce microbial contamination in water. This technology works by storing electrical energy in a capacitor and releasing it in short, high intensity light pulses (Barbosa-Canovas et al., 1998). These pulses cause a lamp to produce short light flashes (< 1 μs) and these short-duration flashes inactivate microorganisms. The PureBright® process uses a pulsed power system to drive an inert gas lamp that emits broadband light pulses approximately 20,000 times more intense than sunlight. PureBright® is comprised of light wavelengths between 200 and 300 nm in the ultraviolet (UV), visible, and near infrared (IR) parts of the spectrum. The process produces no significant heat rise in the product (PurePulse Technologies, 2002; Figueroa et al., 2002).

The objectives of this research were to explore disinfection of chiller water by alternate technologies, in order to recycle it and decrease the likelihood of microbial cross-contamination. The specific objectives included: (1) evaluating water and recycled chiller water quality of two catfish processing plants, (2) studying the possible effect of ultrasound and ozone alone and in combination in disinfecting chiller water, and (3) studying the effect of pulsed-light technology on microbial load and waterborne pathogens of chiller water.

MATERIALS AND METHODS

Quality of Chiller Water—Catfish chiller water was collected in the summer and fall 2000 from two different catfish processing plants in Mississippi. One plant was located in northwest Mississippi (NW) and the other one was located in northeast Mississippi (NE). Water from the chiller was sampled. For the NW plant, the incoming chilled water was “fresh” or “clean” water, whereas for the NE plant, the incoming water was recycled water. Chiller discharge water was also sampled at both plants. For both, incoming and discharge water, samples were taken every 15 min for a period of 45 min.

Samples were placed in sterile bottles and packed with ice in an ice chest for transportation. Upon arrival at the laboratory, a composite sample was prepared by mixing samples taken at different time intervals. The physical and chemical characteristics of the chiller water were analyzed: pH, turbidity,

hardness, total solids, and settleable solids by the method of APHA (1998). Total coliform counts were also performed as suggested by APHA (1992).

Disinfection Trials—An ultrasonic K80 generator (Meinhardt, Germany), with 100 W maximum power output was used in combination with a static ultrasonic chamber. The reaction chamber has 346 mL of useful volume. A water column of 2.0 cm corresponding to 77 mL was used in this section (Chamul, 2000). Constant for each treatment was a frequency of 850 MHz and amplitude of 580 mV. Contact times were 0, 10, and 15 min. Discharged recycled chiller water from the northeast Mississippi plant was used in this part of the study.

Ozone was produced from purified, extra dry oxygen by using a Welsbach Model T-816 Ozonator (Welsbach Ozone Systems Corporation, Philadelphia, PA) set at 60 Hz and 29.58 kPa (8 psig) dry oxygen pressure. The flow of ozone was set at 2 L/min (S.L.P.M.). The produced ozone gas was dispersed through a diffuser (average pore size 60 μm, Fisher Scientific, Houston, TX) into the chiller water for 30 sec to identify possible resistant bacteria to ozone, and for 0, 5, or 10 min for the disinfection trial. Ozone concentration was measured using an iodometric method (Stephens, 1984) and results were expressed as mg/L or ppm O₃. The surviving Gram-negative microorganisms were isolated on Eosin Methylene Blue Agar. After isolation, API 20E biochemical tests, from bioMerieux (Hazelwood, MO) were performed in order to identify the surviving microorganisms.

Chiller water from the catfish processing plant in northeast Mississippi was collected in 18 L (5 gallon) buckets, transported to the laboratory at room temperature and treated within 2 h. Water was passed through a PureBright® Water Purification System Model PBW-4 (Maxwell Technologies, San Diego, CA) and samples collected once steady flow was achieved. The flow rate was 2.21 L/min (0.584 gal/min). For the detection of *Listeria* spp. (tested on disinfection trials with ozone and ultrasound), the TECRA *Listeria* Visual Immunoassay Kit (TECRA DIAGNOSTICS, Australia) was used. The water sample was added to 225 mL of Modified *Listeria* Enrichment Broth (LEB) (Difco Laboratories, Detroit, MI) and incubated for 24 h at 30°C. After 24 h, 0.1 mL of the LEB culture was transferred to a tube of Fraser Broth (Difco Laboratories, Detroit, MI). Before transferring, 50 μL/10 mL 0.5%

acriflavin, 40 µL/10 mL 0.5% nalidixic acid in 0.1 M NaOH, and 0.1 mL 5% ferric ammonium citrate were added to the Fraser broth. The tubes were then incubated for 22–24 h at 30°C. After incubation, 1 mL was transferred from the enrichment broth to a labeled tube and then the TECRA kit was used. Results were read and expressed as positive or negative.

Statistical Design—The survey of the chiller water was set as a randomized complete block (RCB) design with two factors: plant (2) and sampling month (4), with 2 replications (blocks). The replicates were composite from three samples taken every 15 minutes for 45 minutes. Analysis of data was performed using PROC ANOVA (SAS, 1997). When there was a significant difference (P # 0.05), means were separated by Fisher’s protected LSD (Dowdy and Wearden, 1985).

RESULTS AND DISCUSSION

Quality of Chiller Water—For the incoming chiller water, there was a difference (P # 0.05) in temperature by sampling month (data not shown).

For the plant in NW Mississippi, the temperature of water in the chiller ranged from 8°C to 12°C during the sampling period. The temperatures for the water in the chiller in the plant in NE Mississippi ranged from 6°C to 9°C. Ambient temperatures ranged from 31.1 to 31.4°C in west Mississippi and from 31.4 to 30.3°C in east Mississippi. The ambient temperature affects the temperature of the ground water. Although the water is being chilled before it goes into the chiller, the outside temperature could still affect the temperature of the water going into the chiller. If warmer water is coming into the plant, it will take more energy to chill that water to the desired temperature.

Means for the physical and chemical parameters of the incoming water, by plant location, are summarized in Table 1. The mean pH values were 7.3 and 6.9 for fresh and recycled water, respectively. These pH values fall into the range (6.5–8.5) of the primary standards set by the EPA (2001). Turbidity for fresh water ranged from 0.066–0.300 NTU, with a mean value of 0.14. For recycled water the turbidity values were higher (P # 0.05) ranging from 14.93–51.30 NTU, with a mean value of 28.71, these

values are higher than the maximum level (5 NTU) stated by the World Health Organization (WHO, 1985) for processing water. Because turbidity is a measure of the presence of suspended solids, it may be an indication of concentration of microorganisms present (McGhee, 1991). Therefore, the higher the turbidity, the higher the microbial load. The recycled water had higher turbidity (P # 0.05) and a higher (P # 0.05) bacterial count. This indicates that the water was not being properly treated (Gray, 1994) prior to recycling. Water hardness was lower (P # 0.05) for fresh water (0.18 mg CaCO₃/L) than for recycled water (0.35 mg CaCO₃/L). Total solids were higher (P # 0.05) for recycled water (265–635 mg/L) than fresh water (160–350 mg/L).

There was a significant difference in heterotrophic plate counts (HPC) and total coliform counts (TCC) by plant (Table 1). Fresh water had an HPC density of 0.2 log CFU/mL

Table 1. Mean of all parameters of the incoming freshwater and recycled chiller water from two catfish processing plants.

Parameter	Water Source		LSD ¹	C.V. ²
	Fresh	Recycled		
Temperature (EC)	9.5 ^{ns}	9.4	1.80	25.94
pH	7.3 ^a	6.9 ^b	0.16	3.10
Turbidity (NTU)	0.1 ^b	28.7 ^a	4.67	44.17
Hardness (mg CaCO ₃ /L)	0.2 ^b	0.3 ^a	0.05	27.70
Total Solids (mg/L)	228.8 ^b	488.1 ^a	43.27	16.51
HPC (log CFU/mL)	0.2 ^b	4.4 ^a	0.29	17.54
TCC (log CFU/mL)	0.1 ^b	3.4 ^a	0.20	15.98

ns—Means within a row are not significantly different

ab—Means within a row not followed by the same letter differ (P # 0.05)

¹Fisher’s Protected Least Significant Difference (P # 0.05)

²Coefficient of variation

while the recycled water had 4.4 log CFU/mL. This difference in microbial load could be attributed to the fact that the plant in east Mississippi recycles the water used in the chiller. Chamul (2000) found that the microbial load of the ground water in east Mississippi had values that ranged from 0.7 to 3.2 log CFU/mL for HPC and 0.0 to 3.0 log CFU/mL for TCC. The quality of the ground water for the plant in east Mississippi fell into the normal range of HPC, which may vary from 1 to 5 log CFU/mL. Once more, the recycled water had a higher microbial count than the fresh water. Total Coliform counts were 0.1 and 3.4 log CFU/mL for fresh and recycled water, respectively. These levels exceeded those of the EPA (2001), thus calling for better monitoring and treatment of raw (incoming) water.

Temperature of discharge water in the chiller (Table 2) ranged from 8°C for fresh water to 10°C for the recycled discharge water. The tendencies in temperature were about the same for both plants, but the temperature was always higher for the plant in NE Mississippi. Means for the physical and chemical parameters of the outgoing chiller water, by plant location, are summarized in Table 2. There was a significant difference in turbidity between plants, with mean values of 16.6 NTU for fresh water and 33.7 NTU for recycled water. For both plants, the water leaving the chiller had higher turbidity values than the incoming or recycled water. This is expected because the water “picks-up” solids from the fish. This water is now considered to be wastewater. Water hardness was 0.23 mg CaCO₃/L for fresh water and 0.44 mg CaCO₃/L for recycled water. Settleable solids were 0 mg/L for recycled water and 0.63 mg/L for fresh water. There was also a significant difference in total

Table 2. Mean of all the parameters of the discharge chiller water from two catfish processing plants.

Parameter	Water Source		LSD ¹	C.V. ²
	Fresh	Recycled		
Temp (EC)	7.7 ^b	10.1 ^a	1.34	20.62
pH	7.1 ^{ns}	7.0	0.09	1.81
Turbidity (NTU)	16.6 ^b	33.7 ^a	6.40	34.84
Hardness (mg CaCO ₃ /L)	0.18 ^b	0.35 ^a	0.08	32.28
Settleable Solids (mg/L)	0.6 ^{ns}	0.0	0.66	290.84
Total Solids (mg/L)	990.3 ^a	503.1 ^b	173.9	31.84
HPC (log CFU/mL)	3.6 ^b	4.3 ^a	0.28	9.83
TCC (log CFU/mL)	2.6 ^b	3.4 ^a	0.50	22.65

ns—Means within a row are not significantly different

ab—Means within a row not followed by the same letter differ (P # 0.05)

¹Fisher’s Protected Least Significant Difference (P # 0.05)

²Coefficient of variation

Table 3. Percent survival of identified Gram negative microorganisms in chiller water after 30 seconds of treatment with 3 ppm ozone.

MICROORGANISM	# ISOLATED	PERCENT (%)
<i>Aeromonas hydrophilia</i>	2	8.33
<i>Providencia alcalifaciens</i>	2	8.33
<i>Acinetobacter baumannii</i>	4	16.67
Unidentified Gram Negative Rods	15	66.67
Total	23	100.00

solids, with values of 503 mg/L for recycled water and 990 mg/L for fresh water.

Both HPC and TCC were higher (P # 0.05) for the recycled water (at discharge) by about 0.7 to 0.8 log CFU/mL compared to the fresh water at discharge (Table 2). Nunez (1995) and Fernandes et al. (1997) have shown that summer fish have higher

TCC than in other seasons. Therefore temperatures higher than 4°C should be avoided during the chilling process.

Disinfection Trials—Recycled chiller water was exposed to ozone to discern its antimicrobial effects. Survival of Gram-negative microorganisms was also isolated and identified. The most common identified surviving microorganisms, after 30 sec of treatment (no residual ozone) of chiller water, was *Acinetobacter baumannii* (Table 3). Kim et al. (2000) reported that *Acinetobacter* spp. in channel catfish fillets was resistant to ozone and hydrogen peroxide treatments. Other resistant bacteria identified were *Aeromonas hydrophilia* and *Providencia alcalifaciens* (Table 3) which have been reported as normal flora in catfish processing plants (Wachalatone, 1996). Exposure of chiller water to over 60 sec (6.0 ppm O₃) and 120 sec (7.0 ppm O₃) resulted in no surviving microorganisms.

Samples of chiller water from a catfish processing plant were treated with ultrasound, ozone, and a combination of ultrasound and ozone. The results from this experiment are summarized in Table 4. All samples of both incoming and outgoing water were positive for *Listeria* spp. High frequency ultrasound (HFU) was not effective in reducing heterotrophic plate count (HPC), total coliform count (TCC), or *Listeria* spp. Ozone killed *Listeria* spp. and reduced HPC and TCC by about 1 log CFU/mL. There was no synergistic effect between HFU and ozone. The results of ozone treatment indicated that a longer contact time is needed to reduce the number of TCC, than the time needed to reduce the number of HPC. According to Langlais et al. (1990), *Escherichia coli* is one of the most sensitive organisms to ozone treatment, while the Gram-

Table 4. Mean heterotrophic plate count (HPC) and total coliform count (TCC) loads of recycled chiller water after treatment with high frequency ultrasound (HFU) and ozone.

Treatment	Contact Time (min)	Conc. (ppm)	HPC (log CFU/mL)	TCC (log CFU/mL)	<i>Listeria</i> spp. presence ²
HFU	0		4.4 ^{ns}	2.8 ^{ns}	+
	10		4.3	2.8	+
	15		4.2	3.1	+
LSD ¹			0.24	0.85	
OZONE	0	0	4.4 ^a	3.3 ^{ns}	+
	5	7.68	3.0 ^b	2.9	-
	10	7.68	2.7 ^b	2.5	-
LSD ¹			0.24	0.85	
HFU + OZONE	10 + 5		2.8 ^{ns}	2.5 ^a	-
	10 + 10		2.8	2.5 ^a	-
	15 + 5		2.9	3.5 ^b	-
	15 + 10		2.9	2.6 ^a	-
LSD ¹			0.24	0.85	

ns—Means within a row are not significantly different

ab—Means within a row not followed by the same letter differ (P # 0.05)

¹Fisher's Protected Least Significant Difference (P # 0.05)

²*Listeria* spp. presence: +present, -absent

positive cocci, Gram-positive bacillae, and the mycobacteria are the most resistant.

Catfish chiller water samples were passed through the PureBright® Water Purification System. A flow rate of 2.21 L/min (0.58 gal/min) was used. At this flow rate the microbial load was reduced from 4 to 0 log CFU/mL (Table 5). Several authors have reported successful reduction microbial populations with light pulses (BarbosaCanovas et al., 1998; MacGregor et al., 1998; Rowan et al., 1999), reporting reductions of cell populations of 6 and 7 log orders in *E. coli* 0157:H7 and *Listeria monocytogenes*.

The pH of the water, after treatment, remained the same value as the pH of the water before treatment (Table 5). The pH values ranged from 6.8 before treatment to 7.4 after treatment. The turbidity of the chiller water decreased as it passed through the system, from 20.3 NTU to 10 NTU after treatment (Table 5). One of the specifications for the PureBright® Water Purification System is that the turbidity of the water leaving the system will be below 10 NTU. This is because high turbidity will impede penetration of the PureBright®, a combination of UV, visible, and infrared spectrum.

CONCLUSIONS

The water used in catfish processing plants in Mississippi is of good quality, but if a processing plant intends on recycling the water in the chiller, a secondary treatment may be necessary. After evaluation of the chiller water samples, it was concluded that all samples were positive for *Listeria* spp. High frequency ultrasound was not effective in reducing the heterotrophic plate count (HPC), total coliform count (TCC), or *Listeria* spp.

Ozone reduced HPC and TCC by 1 log, but killed *Listeria* spp. Surviving microorganisms from chiller water samples exposed to ozone were isolated and identified. The predominant Gram-negative microorganism was *Acinetobacter baumannii*.

Using the PureBright® Water Purification System, with a flow rate of 2.21 L/min, the microbial load HPC and TCC was reduced from 4 log CFU/mL to 0. The turbidity of the chiller water was lower after passing through the PureBright® System. Ozone and PureBright®, because of the antimicrobial properties they possess, could both be a secondary treatment in a catfish processing plant, if recycling is an option. These technologies may be accompanied

Table 5. Effect of pulsed light on pH, turbidity, and bacterial load of recycled catfish chiller water.

Parameter	Untreated	Treated
pH	7.1 ^a	7.4 ^b
Turbidity (NTU)	20.3 ^a	10.0 ^b
HPC (log CFU/mL)	3.91 ^a	0.0 ^b
TCC (log CFU/mL)	3.51 ^a	0.0 ^b

ab—Means within a row not followed by the same letter differ (P # 0.05)

by settling and filtration to reduce suspended solids, thus increasing treatment effectiveness.

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President's Column

It is with great enthusiasm that I write my first column as MAS President. For those of you who don't know me, I have been in the USM Department of Chemistry and Biochemistry for fourteen years. I am a biochemist, with research interests in protein structure and enzyme action. Another of my longtime interests is astrobiology, the study of life outside the earth. As you can see in another part of this journal, I was able to "scratch that itch" as MAS President by bringing in a prominent NASA astrobiologist, Dr. Chris McKay, as the 2003 Dodgen Lecturer. I believe all will find his presentation enjoyable and informative.

The MAS 2003 Annual Meeting will be here in Hattiesburg next year at the Lake Terrace Convention Center. My thanks to Dr. Aubrey Lucas, former USM President, and Dr. Robert Lochhead, Dean of the USM College of Science and Technology, for underwriting most of the cost of the facility. I am hoping that this will be our biggest meeting ever, so please come and encourage your colleagues to come as well! For academic exhibitors there will be a special graduate recruiting package offered as well as the standard exhibit arrangement. We will have a new division at the meeting as well, the Ecology and Evolutionary Biology Division. If you have other ideas for the annual meeting, feel free to email me at Robert.Bateman@usm.edu.

Although the annual meeting is the focus of my brief stint as president, I also intend to do what I can to get the Academy on a firmer financial footing. We have a small endowment to build upon, so please remember the Academy in your estate planning and charitable giving. Even a modest contribution would be very welcome as well as tax deductible. With additional funding we could do such things as fund a number of small travel awards to faculty and students who could not otherwise attend the annual meeting because of tight budgets. If you are aware of funding sources for the annual meeting, the journal, or the other activities of the Academy, please let me know.

Let me close by expressing my appreciation to my predecessor, Dr. Margot Hall, for her tireless work as President and her encouragement to me as her predecessor. I look forward to an exciting year as MAS President!—Bob Bateman

Executive Officer's Column

These are trying times in Mississippi. The colleges and universities in the state are experiencing sharp declines in their budgets. The students at these institutions are experiencing several years of continuing tuition increases. The economy in general seems to be improving; however, the war on terrorism always threatens to derail any substantial progress.

And yet... life will go on; students will still be taught (and, one hopes, will continue to learn); scientific research will proceed. It's important not to get caught up in the depressions of the moment but to recognize that the spirit of science is the spirit of optimism. We would not be scientists if we did not think that we could find answers to difficult questions; science demands a positive outlook. We can recognize that current times might be trying, but we can also recognize that times move on and things do get better. Science also demands a realistic outlook and we are realistic enough to recognize that low budgets mean low travel funding.

As we've said so often in the past, the Mississippi Academy of Sciences is an inexpensive way to present scientific findings. If the budget prevents travel to a national meeting, travel to Hattiesburg to speak with your colleagues. The 2003 Annual Meeting will be held in the beautiful new convention center there. This will be a first for the MAS but we are optimistic about our experiment. Come help us succeed in this endeavor.—John Boyle

Divisional Report

Marine and Atmospheric Sciences

The recent MAS annual meeting featured 20 oral and 7 poster presentations in our division on a wide variety of topics from fisheries to global ocean circulation. About half of the presentations were by students including several by undergraduates in the Cooperative Internship Program between Mississippi Gulf Coast Community College and USM. During the divisional business meeting Dr. Chet Rakocinski from the USM Dept. of Coastal Sciences was elected to the position of vice-chair of the division to assist Dr. Patricia Biesiot who moved up from vice-chair to division chair for the coming year.—Alan Shiller

MISSISSIPPI ACADEMY OF SCIENCES ABSTRACT FORM/MEMBERSHIP FORM

ABSTRACT INFORMATION

Abstract title _____

Name of presenting author(s) _____
(Presenter must be a current (i.e., 2003 membership dues must be paid) student member, regular member, or life member of the MAS)

Telephone _____ Email _____

Check the division in which you are presenting

- ___ Agriculture and Plant Science ___ Health Sciences ___ Physics and Engineering
___ Cellular, Molecular and Dev. Biol. ___ History and Philosophy of Science ___ Psychology and Social Sciences
___ Chemistry and Chem. Engineering ___ Math., Computer Sci. and Statistics ___ Science Education
___ Ecology and Evolutionary Biology ___ Marine and Atmospheric Sciences ___ Zoology and Entomology
___ Geology and Geography

Type of presentation

- ___ Poster presentation ___ Workshop
___ Lecture presentation ___ Invited symposium

If the presenting author for this paper is also presenting in another division, please list the other division: _____

Audio-visual equipment needs

- ___ 2" x 2" slide projector
___ Overhead projector

Other audio-visual equipment including computers and computer projection equipment must be provided by the speaker.

MEMBERSHIP INFORMATION

New ___ Renewal ___

Mr. Ms Dr. _____

Address _____

City, State, Zip _____

School or Firm _____

Telephone _____ Email address _____

PLEASE INDICATE DIVISION WITH WHICH YOU WISH TO BE AFFILIATED _____

Regular member \$25 Student member \$5 Life member \$ 250

Educational \$150 Corporate Patron \$1000 Corporate Donor \$500

CHECKLIST

The following MUST be DONE:

- ___ 1. Enclose copy of abstract (even if abstract has been submitted electronically)
___ 2. Complete and enclose abstract form /membership form(this form)
___ 3. Enclose the following payments (make check payable to Mississippi Academy of Sciences):
___ \$25 per abstract
___ \$25 regular membership fee OR \$5 student membership fee (2003 membership must be paid for abstract to be accepted)
___ 4. You must supply a check # _____ or P.O. # _____ (credit cards are not accepted)

In addition you MAY preregister at this time:

- ___ Enclose the following payments:
___ \$20 regular member (after 15 Jan.) ___ \$12 regular member (Preregistration before Jan. 15, 2003)
___ \$10 student member (after 15 Jan.) ___ \$ 5 student member (Preregistration before Jan. 15, 2003)
___ \$50 nonmember (after 15 Jan.) ___ \$40 nonmember (Preregistration before Jan. 15, 2003)

NOTE: Abstracts that are resubmitted for changes will incur a \$10 resubmission fee. Late abstracts will be accepted with a \$10 late fee during November increased to \$25 after that. Late abstracts will be accepted only if there is room in the appropriate division. They will be published in the April issue of the MAS JOURNAL.

MISSISSIPPI ACADEMY OF SCIENCES—ABSTRACT INSTRUCTIONS
PLEASE READ ALL INSTRUCTIONS BEFORE YOU SUBMIT YOUR ABSTRACT

- < Your paper may be presented orally or as a poster. Oral presentations are generally 15 minutes although some divisions allow more time. The speaker should limit a 15 minute presentation to 10–12 minutes to allow time for discussion; longer presentations should be limited accordingly. Instructions for poster presentations are given on the reverse side of this sheet.
- < Enclose a personal check, money order, institutional check, or purchase order for \$25 publication charge for each abstract to be published, payable to the Mississippi Academy of Sciences. The publication charge will be refunded if the abstract is not accepted.
- < The presenting author must be a member of the Academy at the time the paper/poster is presented. Payment for membership of the presenting author must accompany the abstract.
- < Attendance and participation at all sessions requires payment of registration.
- < Note that three separate fees are associated with submitting and presenting a paper at the annual meeting of the Mississippi Academy of Sciences. (1) An abstract fee is assessed to defray the cost of publishing abstracts and (2) a membership fee is assessed to defray the costs of running the Academy. (3) Preregistration payment (\$12 regular; \$5 student) may accompany the abstract, or you may elect to pay this fee before January 15th, or pay full registration fees at the meeting.
- < Abstracts may be submitted by e-mail or entered directly through the MAS website. The URL is <http://www.msacad.org>. This abstract submission form and the appropriate fees should be sent by US mail even if the abstract has been submitted electronically.
- < Abstracts may be submitted as a WordPerfect, Word, ASCII, ANSI, or .RTF file on a PC readable diskette. *Formatting should be minimal.* This abstract submission form and the appropriate fees should be sent by US mail even if a diskette is used for the abstract.
- < Abstracts may be submitted typed or printed on clean white paper. Abstracts received in this form will be scanned into a computer. Leave ample margins and use a sanserif type font to help minimize errors in scanning.
- < **Abstracts that are resubmitted for changes will incur a \$10 resubmission fee.**
- < **Late abstracts will be accepted with a \$10 late fee during November increased to \$25 after that. Late abstracts will be accepted only if there is room in the appropriate division.** They will be published in the April issue of the MAS JOURNAL.
- < Submit your abstract and appropriate fees to the Abstracts' Editor, John Boyle, **TO BE RECEIVED NO LATER THAN NOVEMBER 1, 2002.**
- < Late abstracts will be accepted with a \$10 late fee and only if there is room in the appropriate division. They will be published in the April issue of the MAS journal.

Dr. John Boyle
Mississippi State University
Dept. of Biochemistry
P.O. Drawer 9650
Mississippi State, MS 39762

FORMAT FOR ABSTRACT

- < Your abstract should be informative, containing: (a) a sentence statement of the study's specific objectives, unless this is given in the title; (b) brief statement of methods, if pertinent; (c) summary of the results obtained; (d) statement of the conclusions. It is not satisfactory to state, "The results will be discussed."
- < Your abstract, including a concise, descriptive title, author(s), location where work was done, text and acknowledgment, may not exceed 250 words. **Excessively long abstracts will be truncated.**
- < The title should be all capital letters. Use significant words descriptive of subject content.

- < Authors' names start a new line.
- < The institution where your research was done should include city, state, and zip code. Do not include institutional subdivisions such as department.
- < The abstract should be one paragraph, single spaced, starting with a 3-space indentation.
- < Use standard abbreviations for common units of measure. Other words to be abbreviated, such as chemical names, should be spelled out in full for the first use, followed by the abbreviation in parenthesis. Do not abbreviate in the abstract title.
- < Special symbols not on your printer or typewriter must be in black ink.
- < Use italics for scientific names of organisms.
- < Begin authors' names on a new line. Place an asterisk (*) after the presenter(s), if there are multiple authors.
- < Use superscripts for institutional affiliations where necessary to avoid ambiguity.
- < Refer to these examples as guides.

EXAMPLES OF TITLES AND AUTHORS:

[single author, no ambiguity about designated speaker or affiliation]

AN EXPERIMENTAL MODEL FOR CHEMOTHERAPY ON DORMANT TUBERCULOUS INFECTION WITH PARTICULAR REFERENCE TO RIFAMPICIN

Joe E. Jones, Mississippi State University, Mississippi State, MS 39762

Abstract body starts here . . .

[two authors, both designated as speakers, different affiliations, but no ambiguity]

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Joe E. Jones¹, Ralph A. Smith^{1*}, and Alice D. Doe², ¹Mississippi State University, Mississippi State, MS 39762 and ²University of Mississippi Medical Center, Jackson, MS 39216

Abstract body starts here . . .

GUIDELINES FOR POSTER PRESENTATIONS

- < The Academy provides poster backboards. Each backboard is 34" high by 5' wide. Mount the poster on the board assigned to you by your Division Chairperson. Please do not draw, write, or use adhesive material on the boards. You must provide your own thumb tacks.
- < Lettering for your poster title should be at least 1" high and follow the format for your abstract. Lettering for your poster text should be at least 3/8" high.
- < Posters should be on display during the entire day during which their divisional poster session is scheduled. They must be removed at the end of that day.

< Authors must be present with their poster to discuss their work at the time indicated in the program.