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Editorial

The Journal of the Mississippi Academy of Sciences is growing! You will notice that four new associate editors have been added to the list on the front page (Maureen Corcoran and John Boyle have been associated with the journal for a number of years). The new editorial board was formed over the past few months and formalized at the annual meeting in February. This will be rather different than the board I inherited. That board was basically a group of scientists available as reviewers. I have had excellent fortune in finding high quality and responsive reviewers for manuscripts. I needed help keeping up with the increase in manuscripts that have been arriving sporadically over the past year. The new editorial board will take over some of my duties by handling manuscripts. All manuscripts will still be sent to me, but I shall send them to the appropriate associate editor to find reviewers and move the manuscript through the review process. Manuscripts that have been accepted by the reviewers and the associate editor and have been revised as necessary by the author will finally be sent back to me from the

associate editor to put in camera ready form. Associate editors will also be responsible for soliciting manuscripts, soliciting additional abstracting services to index our journal, and address various policy issues.

The editorial board will consist ultimately of six members plus the abstracts editor rotating in pairs through three year terms. The Academy Board of Directors is charged with overseeing the composition and orderly rotation of the editorial board. I see the establishment of this board as an important step in the growth of the journal. Additional people associated with and working for the journal can attract more articles covering a broader area than I could by myself. Additional people familiar with the operation of the journal means an orderly rotation not only of associate editors, but also of the editor when that time comes. The strength of the journal is in its ability to continue as a viable voice for the Academy no matter who is editor, associate editor, or abstracts editor.—Ken Curry

The Mississippi Academy of Sciences gratefully acknowledges a grant from the Merck Human Health Division. Funds from this grant supported poster presentations of student members of the Academy which help their scientific development.

[insert Ohaus advertisement here.]

The 2000 Annual Meeting of the Mississippi Academy of Sciences
Photographs by Brian Tsang



Busloads of people come . . .



. . . stand in line,



. . . get registered,



. . . attend lectures,



. . . argue their points,



. . . have a great time and a group picture.



Posters are presented . . .



. . . viewed,



. . . enjoyed,



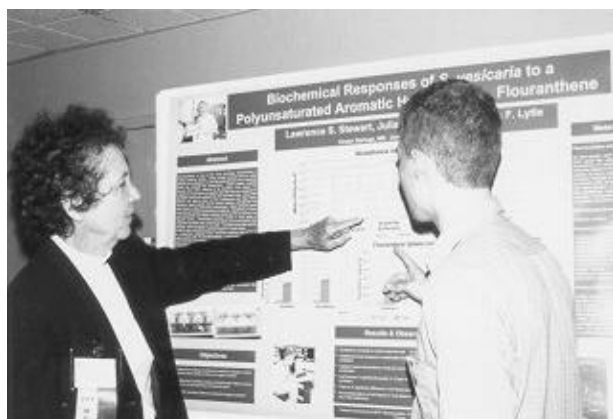
. . . photographed,



. . . and judged for awards.



The Poster Session Is One of the Most Active and Attractive Events





Exhibitors include institutions. . .



. . . software companies,



. . . and hardware companies.



Junior Academy Award winners are coached about manuscript preparation.



"Meet the Statistician" is a popular event at this meeting.



Philip Eichhorn receives the Junior Academy Clyde Sheeley Award from Dr. Joan Messer (left) and Dr. Steve Case (right).



Alexander Clark (center) receives the Junior Academy 2nd Place Award from Drs. Joan Messer and Steve Case.



Dr. Richard H. Sullivan receives the Outstanding Contributions to Sciences Award from Dr. Sarah Lea McGuire.



Daphanie D. Webster (UMMC) receives the Douglas Walker Award from overall best presentation from Dr. Zelma Cason, chair of Health Sciences Division.



Stephanie Misquitta (USM) receives the Best Graduate Student Presentation Award from Dr. David Carson, chair of Cellular, Molecular and Developmental Biology Division.



Ibrahim Makhadmeh (MSU) receives the Best Graduate Student Presentation Award from Dr. James Garner, chair of Agriculture and Plant Sciences Division.

[insert Howard Industries advertisement here.]

Internet Web Site Geographical Counter

Kenneth Davidson and James Etheredge¹

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The Internet provides many interesting challenges, as its usage becomes more common in the consumer marketplace. Most forms of media provide some means of obtaining profiles of the people using that media. The purpose of the project described in this paper was to develop an Internet web page counter that provides a geographical representation of the people visiting the site. This information can be useful to the businesses hosting the site as well as advertisers supporting the site. Very little information is available about the particular user downloading a web page. Hypertext Transfer Protocol (HTTP) provides a means of obtaining personal information about the user, such as their e-mail address, through the request header but for reasons of privacy, commercial programs generally do not implement those elements of the protocol. One piece of information, which is available, is the user's Internet domain. This is the piece of information used to determine the person's geographical location. For people using national domains, such as America On-Line and CompuServe, however, no information can be obtained regarding that particular person's location. This program will determine the person's location approximately 70% of the time, based on testing performed to date. The output of the program is a map of the United States showing the number of hits by state. In addition to the development of a new Internet application the project served as a vehicle for the exploration and utilization of complex and often poorly documented networking concepts.

Virtually every form of media has some means of obtaining information about the people viewing that media. The Internet provides some interesting challenges in this regard. As commercial interests on the Internet, such as advertising and electronic commerce, continue to increase, so does the demand to obtain information about the users of the media. Several mechanisms are available for obtaining user information, each with its advantages and disadvantages.

One method of tracking users is by using "cookies." A cookie is an ASCII text string, which is set in the user's computer. By using a Common Gateway Interface (CGI) program, the text string can be sent and stored on the client machine as well as retrieved from the client. The notion of allowing a server to install a file onto a user's computer, often times without the user's knowledge, has caused many debates between the government and the companies writing the commercial software. The two leading web browser developers, Netscape and Microsoft, claim it is not an invasion of privacy because the user has the option of not accepting cookies. The government's claim is that the user is not given any indica-

tion that the server is installing data onto their computer because the default setting in both browsers is to accept all cookies without warning. For security reasons, cookies have several restrictions:

- They can contain only ASCII text. This prevents the spread of viruses.
- Only one cookie may be installed from each domain.
- The size is limited to 4096 bytes.

Several types of information can be gathered using cookies, such as tracking how a user navigates through the web site and tracking how often the user visits the site. An advertiser or web developer may be more interested in the number of repeat visits to the site, instead of a raw count number.

Another method of tracking users is through a registration process. The user may be presented with an HTML form, which is used to gather information about the user. The form contents can be passed to a program on the server that assigns the user a password. Sometimes this can be effective if the informa-

¹Author for correspondence.

tion is of sufficient value that the user will register. Often times though, the user will go seek the information elsewhere or put invalid information into the form.

The project described in this paper is another means of obtaining information about the user. Geographical information can be used by web hosting companies and advertisers alike to better understand their audience.

OVERVIEW

The geographical counter is implemented as a CGI program. Several methods are available for calling CGI program. Felton (1997), Schwartz and Christiansen (1997), Wall et al. (1996), and Medinets (1996) provide detailed explanations and examples of different methods and techniques used in CGI programs. In this case, the program is called from an image tag on the web page such as:

```
<IMG SRC="http://www.domain.com/cgi-bin/geo">
```

The CGI program is started when the client browser requests the "Image" described in the tag. The path in the image tag is actually the path to a CGI program. Since the browser thinks it is retrieving an image, the CGI program has two methods of providing an appropriate response. The method used in this program is to open an image file and send it to the client once the connection is established. Another method is to return an HTTP redirection header. This type of header is used to redirect the client browser to an alternate location to obtain the information. The redirection header has the format:

Location: <http://www.hostdomain.com/image.gif>

The CGI program retrieves the user's Internet domain from the server environment. When the HTTP request is made from the client browser to the server, an environment variable called "REMOTE_HOST" is sent to the server. Retrieving this variable returns a string representing), the user's domain, for example, "datasync.com."

All domains on the Internet are registered and publicly available from the InterNIC, which is the organization in the United States responsible for domain registration. Each domain name must be unique in order to avoid conflicts. The program opens a socket to the appropriate InterNIC server to obtain

the registration information for the domain. The data received from InterNIC is parsed to obtain the state from which the domain is registered. The parser looks for the following sequence of characters:

```
<comma><space><2 uppercase letters><space><5 digits>
```

This would represent a sequence like ", VA 22089." The two uppercase letters represent the state and the five digits represent the zip code. A counter for the state is incremented in a local file. Figure 1 shows the response from the InterNIC server when it was queried with "datasync.com."

A separate utility program is used to display the counter results. This also runs as a CGI program and reads the count numbers for each state. A map of the United States is displayed to the user with dots representing the location and number of hits. The dots are sized according to the number of hits for that state. The map is displayed in a Java applet window to allow the dots to be dynamically drawn. Harold (1996) and Falnagan (1997) provide information on how Java applets execute within the context of a web browser. A table is also displayed giving the actual numbers. Refer to Figure 2 for a sample of the program output.

FUNCTIONAL DESCRIPTION

Refer to Figure 3 for the functional description of this program. This model assumes that the counter program and web site are running on different network servers. This model was chosen for practical reasons. Many commercial Internet Service Providers (ISP's) do not allow any type of customer installed executable, other than those that are made public by the system administrator. This model allows the program to be installed on one system, but can be accessed by any number of web sites. The name of the web site making the request can be passed to the program in the QUERY_STRING environment variable. Six steps are required to obtain the users location as follows:

(1) URL Entry: The process starts when the user enters a URL into the web browser or the user selects a hyperlink from another web page. The client browser sends a request for the HTML coded page.

(2) Server Response: The web site server responds by sending the HTML coding for the page. The HTML coding provides the web browser with the formatting information for the page. This will typi-

cally include such items as text, tables, frames, images, links, etc.

(3) Call CGI Program: Once the HTML coding is downloaded, the browser makes additional requests based on the coding. This will typically include items like images. If a web page has 10 different images, the browser must make 10 separate connections to the server to obtain the images (assuming they have not been previously downloaded). The images don't necessarily have to reside on the same server where the HTML coding originated. For this particular model, one of the image tags tells the browser to go to a different server to obtain the image. This causes the browser to make a request to the server where the geographical counter program resides. At this point,

the browser is simply making a request for an image, except the path provided by the image tag is actually to a CGI program, not an image file. This causes the CGI program to instantiate and the server will attach the standard output file handle of the CGI program to the socket connection back to the browser. The browser will receive the output of the CGI program.

(4) CGI Program Response: When the CGI program is instantiated, it retrieves the user's domain name from the environment. The domain name will be an ASCII string like "datasync.com." The server will set the domain as an environment variable when the connection is established. The client browser is waiting for the image file so the CGI program opens an image file and sends it to the client. The image is a

```
Registrant:
DataSync (DATASYNC-DOM)
  P.O. Box 1389
  Biloxi, MS 39533-1389
  US

Domain Name: DATASYNC.COM

Administrative Contact:
  Gehres, Mark (MG215) gehres@AMETRO.NET
  228-435-8888 x119 (FAX) 228-435-4388
Technical Contact, Zone Contact:
  Datasync Hostmaster (DH82-ORG) hostmaster@DATASYNC.COM
  601-435-8888
Fax- 601-435-4388
Billing Contact:
  Gehres, Mark (MG215) gehres@AMETRO.NET
  228-435-8888 x119 (FAX) 228-435-4388

Record last updated on 18-Dec-97.
Record created on 13-Jan-95.
Database last updated on 10-Jan-99 09:06:27 EST.

Domain servers in listed order:

NS.AMETRO.NET          205.216.82.1
NS.CW.NET              204.70.128.1
NS2.AMETRO.NET         205.216.82.2

The InterNIC Registration Services database contains ONLY
non-military and non-US Government Domains and contacts.
Other associated whois servers:
  American Registry for Internet Numbers - whois.arin.net
  European IP Address Allocations       - whois.ripe.net
  Asia Pacific IP Address Allocations    - whois.apnic.net
  US Military                           - whois.nic.mil
  US Government                         - whois.nic.gov
Connection closed by foreign host.
```

Figure 1. Information returned from the InterNIC server for domain "datasync.com."

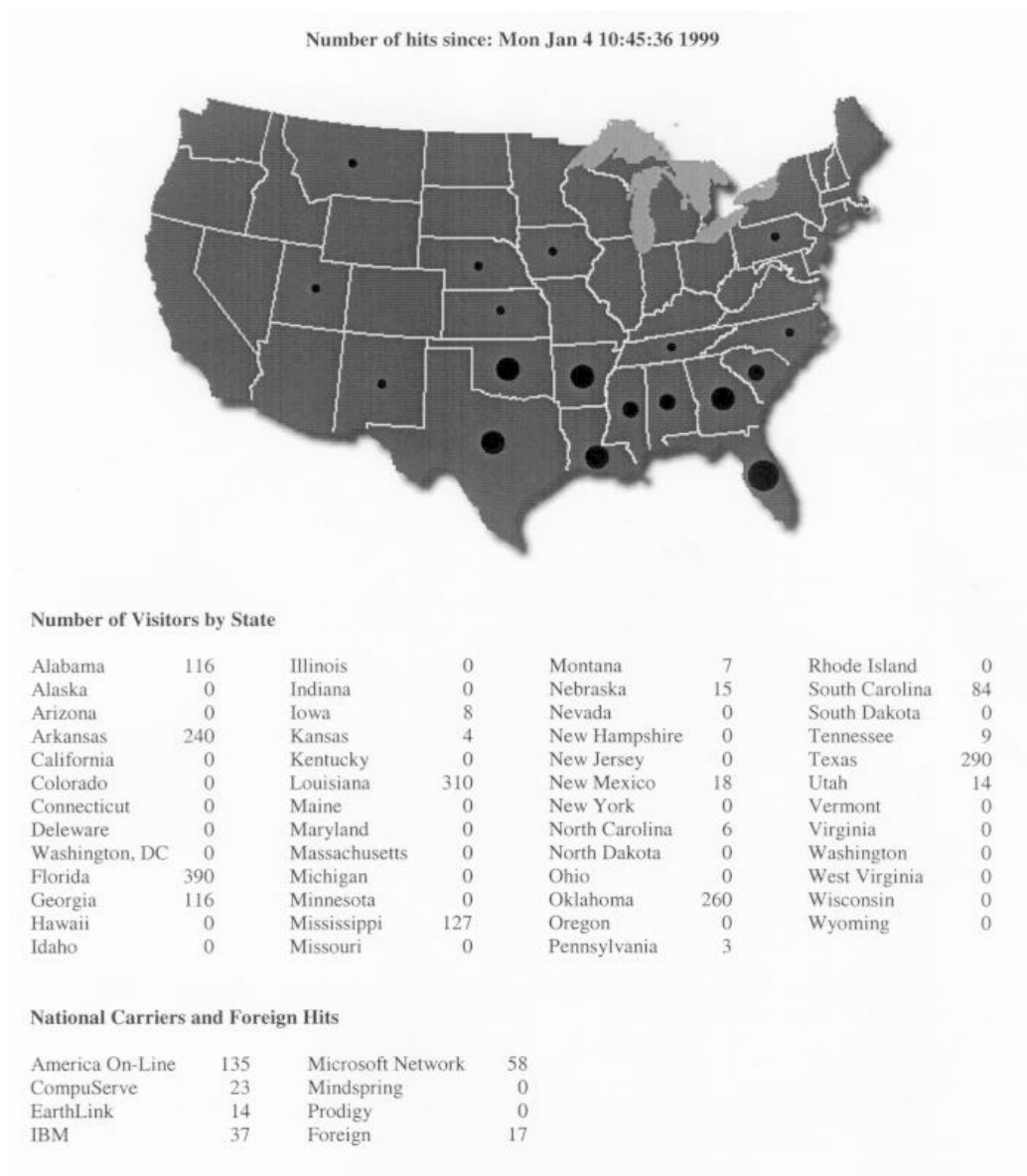


Figure 2. Program Output.

1 x 1 pixel, transparent bitmap. The image will not be visible in the client browser. The purpose of the image tag is to force a request to the server where the counter resides. If the server fails to return an image or a redirection, then the client machine will display an error to the user. Once the image data is returned to the client, the server can proceed to the next step, which is to check the user's geographical location.

(5) Query InterNIC: Once the CGI program is instantiated, the user's domain is retrieved from the local environment. The server places the domain string into the environmental variable "REMOTE_HOST," which can be retrieved by a call to the C language runtime function getenv(). The domain string will be of the form "datasync.com." The

program queries the InterNIC server with the domain name. A TCP socket is opened to port 43 on the InterNIC server, however, the appropriate server to query depends on the domain suffix.

(6) InterNIC Response: The InterNIC server responds with the registration information about the domain, including the city and state where it is registered. This should only be used for determining the general geographical area. Most ISP's operate in a region that may cover a 50 mile radius, with hubs located in various locations to provide local dial-up numbers. The query to InterNIC will only return the city and state where the company is registered. Refer to Figure 2 for a sample of the response from the InterNIC server. The program retrieves the first 255

bytes of data, then parses it to obtain the state where the domain is registered. The program opens a binary file and updates the count for that state. Since the CGI program is instantiated for each request, it is possible to have multiple instances updating the same file. If the data is considered critical, then file locking can be used to maintain data integrity. This introduces significant overhead and should only be used if necessary. Once the count file is incremented, the program terminates.

Several steps are involved in implementing the counter. It may appear somewhat cumbersome; however, the process is relatively quick. Typically, it will take about 2 seconds from the time the client obtains the HTML coding until the counter is incremented. Typically, the longest delay is waiting for the InterNIC server to respond.

The whole process is invisible to the user. The web server where the counter is located responds back to the client by sending a 1 x 1 pixel, transparent image. This is done prior to connecting to the InterNIC server to check the user's geographical location. With this method, the user would not experience any noticeable delay. The only purpose of the image is to provide a means of instantiating the CGI program. It should be noted that the process of connecting to the InterNIC could be performed off-line. Server logs could be used to obtain the domain information. Which method is best depends on the business application. Off-line processing could be done during non-peak hours at the expense of real-time data collection.

The program opens a socket to one of three InterNIC servers to obtain the registration information as follows:

| <u>Domain suffix</u> | <u>InterNIC server</u> |
|----------------------|------------------------|
| com, org, edu, net | whois.inter-nic.net |
| gov | whois.nic.gov |
| mil | whois.nic.mil |

Each server uses port 43 for the registration

information. The sockets used in this program are non-persistent. If an error occurs while connecting, sending or receiving information through the socket, then the socket is closed and the program terminates. Also, if the InterNIC server is busy at the time the query is made, the program aborts the attempt and terminates.

This program could be easily extended to determine international domain locations. At this time, however, all domains outside the United States are logged under one category called "foreign."

More persistent sockets can introduce large amounts of overhead, which is not necessary for this application. Any errors in connecting sockets are related to the host server talking to the InterNIC server and have nothing to do with the domain of the

user accessing the page. With this line of reasoning, making the sockets persistent will not provide any more accurate data on the physical location of users visiting the web site.

IMPLEMENTATION

Consideration has to be given to the load put on the server to run this type of counter. The purpose is primarily to provide a geographical representation. The total hit count can be obtained through a simple counter program and then compared to a geographical distribution. For a very busy site, the number of users checked can be reduced with some simple algorithms. One method is to use a time constant with the modulus operator to determine whether to check the user domain. In C code, the line of the code would look something like:

```

if( (t % 4) == 0) {
<check user domain>
}

```

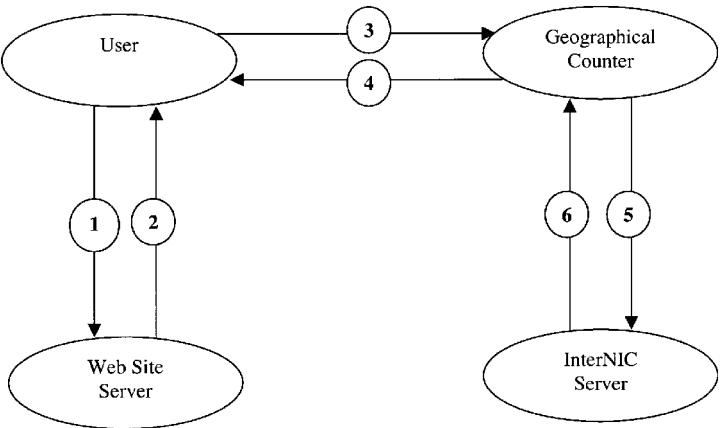


Figure 3. Functional Overview.

In this case, the statement will return true 25% of the time, so 25% of the user domains will be checked. t is the standard time constant representing the number of seconds passed since January 1, 1970.

The counter can be activated and de-activated quite easily by just changing the image tag in the HTML page.

LIMITATIONS

As with any image-based counter the CGI program will not be instantiated if the user is using a text-only browser or the user has set the browser to text-only mode. In order for the CGI program to instantiate, the client browser must make a request for the image. Other technologies are available which overcome this limitation. Active Server Pages or Java servlets could be used to deliver the page provided the Internet host allows such processes to be installed. The image should be placed near the top of the page. This gives it the best chance of being requested from the server. If the calling image is near the bottom of the page, the user may click the "stop" button in the browser before the page and all its components finish downloading.

An alternate method can be used to call the program. The entire web page can be the output of a CGI program. This is referred to as "through-put" mode. The CGI is called from a link to the page. This ensures that the program is always called. Maintenance can be a little more difficult with this approach.

The InterNIC server returns the registration information for the user's domain. In some cases, this does not represent the user's physical location. For this reason, users with national domains cannot be verified. Typical examples of national domains are America On-Line, Microsoft Network or Compu-Serve. These can be logged separately from the

geographical hits. In many circumstances, the number of users from national domains can be a very useful piece of information. People using these services tend to fit a particular demographic profile, which may be of interest to web developers or advertisers.

CONCLUSION

A geographical counter is a tool that can provide a representation of people visiting a web site. This information can be used to determine which geographic areas to target for other forms of media and advertising.

Inherent limitations in the network environment and practical considerations will prevent 100% of the users being checked for geographical location. The goal, however, is to produce a geographic distribution that approximates the location of the people visiting the web site.

The source code for this program may be viewed at <http://www.bestweb.net/~pywacket/>. The compiled code is not presently installed in a publicly accessible directory.

LITERATURE CITED

- Felton, M. 1997. CGI Internet Programming with C++ and C. Prentice Hall (ISBN 0-13-712358-2). 514 pp.
- Schwartz, R.L., and T. Christiansen. 1997. Learning Perl, 2nd ed. O'Reilly and Associates (ISBN 1-56592-284-0). 269 pp.
- Wall, L., T. Christiansen, and R.L. Schwartz. 1996. Programming Perl, 2nd ed. O'Reilly and Associates (ISBN 1-56592-149-6). 645 pp.
- Medinets, D. 1996. Perl by Example. Que Corporation (ISBN 0-7897-0866-3). 58 pp.
- Harold, E.R. 1996. Java Network Programming. O'Reilly and Associates (ISBN 1-56592-227-1). 422 pp.
- Falnagan, D. 1997. Java in a Nutshell, 2nd ed. O'Reilly and Associates (ISBN 0-56592-262-X). 610 pp.

Effects of NaCl and MgCl₂ on Physiological and Biochemical Changes in Osmoregulation of *Chlorococcum hypnosporum* L.

Mark G. Hardy¹, Sophia Sanders-Leggett and Gregorio B. Begonia

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This study investigated the physiological and biochemical changes in cellular osmoregulation when *Chlorococcum hypnosporum* (L.) was grown in high saline environments. A dramatic decrease in total growth occurred when *C. hypnosporum* was cultured in increasing concentrations of NaCl. When grown in increasing concentrations of MgCl₂, a significant decrease in growth of *C. hypnosporum* was observed only at 10 ppt. Percent sexuality increased at all concentrations of NaCl and MgCl₂ except at 0.1 ppt. When compared to controls, the amount of dissolved oxygen decreased in all saline concentrations. Growth medium pH of *C. hypnosporum* was not significantly affected by changes in MgCl₂ concentrations, with only marginal pH changes in medium containing various concentrations of NaCl. Nuclear magnetic resonance (NMR) analysis indicated that increasing MgCl₂ concentrations caused increases in cellular osmoregulation by *C. hypnosporum* resulting in increased production of intracellular ¹³C-labeled organic solutes. When *C. hypnosporum* was grown in increasing NaCl concentrations, similar results were observed only at 0.001 ppt.

Algae have been used as agricultural fertilizers by coastal farmers for a number of years (Booth, 1965). As early as 1980, researchers explored developing fertilizers that do not contaminate ground and surface waters or cause erosion (Waaland, 1981). Conventional fertilizers contain multiple nutrients, nitrogen, phosphate, potash, and secondary micronutrients that can cause degradation in surface water quality due to runoff from upland areas. Fertilizer runoff on the scale of major river drainage basins is thought to be involved in declining surface water quality (Justic et al., 1995).

According to the Association of American Plant Food Control Officials 1996 Annual Report, the United States consumed 50,744,419 tons of commercial fertilizers in 1995. Furthermore, as of June 1996 total usage increased to 53,439,634 tons. The prohibitive costs and environmental consequences of synthetic fertilizer use necessitate a need to investigate microalgae as a "biofertilizer." A potential source of organic nitrogen, microalgae degrade in the soil and drastically reduce the problem of leaching exhibited by other organic and some slow release fertilizers.

Algae are potentially excellent biofertilizers because they have sufficient amounts of nitrogen and potassium but are low in phosphate. If algae are used as alternative fertilizers, they must be supplemented

with phosphate for use with most crops. According to Waaland (1981), the advantages of algae as a biofertilizer are that they: (1) are free of weed seeds and fungal spores which can harm terrestrial crops, (2) are good sources of trace elements, and (3) can regulate crop growth and ripening because of the auxin, cytokinin, and gibberellin associated with them. Fertilization with algae may inhibit certain pathogens reducing harm to crops (Waaland, 1981). Deleterious effects of seaweed manures include excess manganese release in low pH soils, water-logging of soils fertilized with *Pachymenia*, inhibition of plant growth, and low nitrogen availability (Boney, 1965).

The purpose of this research is to investigate the feasibility of improving *C. hypnosporum* as a biofertilizer by increasing intracellular nitrogenous compounds. In aquatic environments, salinity is considered an important ecological variable, particularly in estuarine regions, salt water ponds, and shore areas where planktonic algae are often subjected to widely fluctuating salt concentrations (Guillard, 1962). Changes in the salinity of seawater usually affect the growth, metabolism, and survival of marine phytoplankton. Guillard (1962) also suggests that the osmoregulatory mechanisms of algae living in marine environments can tolerate a wide range of external salinities. Salinity changes have been

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explored in only a few microalgal species. Therefore, *C. hypnosporum* was exposed to five concentrations of two salts, NaCl and MgCl₂ respectively, to assess the physiological and biochemical changes that are involved in increased production of intracellular organic solutes of freshwater microalgae when grown in high salinities.

MATERIALS AND METHODS

Microalgae Culture—A stock culture of *C. hypnosporum* was maintained in 500-ml Erlenmeyer flasks containing 100 ml of a 1.5% semi-solid agar (FW1) medium (O'Kelley, 1983). Algal cell inoculum was prepared from stock cultures by aseptically washing cells from the semisolid agar medium using 5 ml of sterile FW1 medium and shaking flasks forcefully (Hardy and O'Kelley, 1986). The cell suspension was decanted into a 25 ml sterile beaker and diluted by adding 20 ml of fresh FW1. Transmittance readings of FW1 medium and inoculum (9:1, v/v) indicated that a 2 ml volume contained approximately 280,000 algal cells needed for optimal growth initiation.

Thirty-six 250-ml Erlenmeyer flasks containing 50 ml sterile FW1 medium and isotopically labeled NaH¹³CO₃ (10 μM) were aseptically inoculated with 2 ml of the algal suspension. The initial transmittance of the medium was 100%. The growth medium, initially adjusted to pH 6.8, also contained NaCl or MgCl₂ concentrations of 0.001, 0.01, 0.1, 1, and 10 ppt using 6 replications. Culture flasks were maintained for 21 days at 25 ± 1°C in a Mark III Environmental Growth Chamber. Light intensity was maintained at 13.36 μmol photons m⁻² s⁻¹ using Westinghouse cool-white fluorescent tubes. A day and night regime was set at 12:12 hour light/dark cycle. At the end of each culture period in medium allowing optimal growth, the final packed volume of algal cells was approximately 1.0 ml/L for each liter of culture.

Parameter Analysis and Algal Assessment—After the 21-day growth period, percent sexuality, amount of dissolved oxygen, total growth, pH and cellular osmoregulation by nuclear magnetic resonance (NMR) analysis (General Electric, GN 300 Mhz) was determined. Photosynthetic activity was determined using a YSI model 51B oxygen meter (YSI Inc., Yellow Springs, OH) to measure dissolved oxygen. An oxygen probe was placed in each algal sample and stirred for approximately 2 to 3 minutes.

The O₂ solubility factor was set at 25°C and dissolved oxygen content measured in mg/L. The probe was rinsed in distilled water and recalibrated after each measurement. Medium pH was determined for each culture using an Orion research digital Ionalyzer/501. Each dissolved oxygen measurement was taken at 9:00 a.m., while each measurement of pH was taken at 10:00 a.m.

Total growth assessments were obtained at 520 nm wavelength using a Baush and Lomb Spectronic 20D spectrophotometer. The spectrophotometer was calibrated to a transmittance reading of 100% using a culture tube containing 10 ml of FW1 medium. Medium (10 ml) containing algae from each experimental flask was placed in a culture tube and spectrophotometrically analyzed.

A Bright-Line hemacytometer and a demoscope, consisting of a light microscope connected to a 19" RCA television was used to determine the percent sexuality of *C. hypnosporum*. Percent sexuality was calculated by dividing the number of zygotes by the number of zygotes plus vegetative cells in a 1 ml sample, counting at least 150 cells per sample. Zygotes contained "spines" on their cell wall or the appearance of two or more cells in a parent cell wall. After a 21-day growth period, algal cells were collected by centrifugation using a Beckman Centrifuge model J21-B. Algal pellets were obtained after centrifugation at 20,000 rpm for 10 to 15 minutes. Pellets were resuspended in 3–5 ml FW1 medium and dispensed into 10 ml test tubes for NMR analysis of 13 C-labeled organic compounds.

Experimental Design—Experimental flasks were arranged in a 1 (inoculation treatment) x 5 (NaCl or MgCl₂ concentrations of 0.001 to 10 ppt) factorial arrangement in a completely randomized design (CRD) with 6 replications. Each identical 250-ml Erlenmeyer flask containing 2 ml inoculum in 50-ml FW1 medium constituted a treatment replicate. Algal cells were grown in batch culture for 21 days and manually shaken twice a day for adequate dispersal of nutrients.

RESULTS

Cell growth of *C. hypnosporum*, measured as transmittance, was 2 times greater in MgCl₂ compared to NaCl at all concentrations except 10 ppt (Table 1). Growth inhibition was highest in cultures grown at 10 ppt MgCl₂. Zygospore production in algal cells grown in NaCl increased as NaCl

increased, with the exception of cells grown in 0.1 ppt NaCl. All NaCl concentrations demonstrated significantly higher zygospore production than algal cells in controls. There was a significant difference in zygospore production of controls versus experimental cultures of *C. hypnosporum* at all MgCl₂ concentrations, with the exception of 0.1 ppt (Table 2). There was no significant difference in oxygen evolution of *C. hypnosporum* cultures grown in MgCl₂ when compared to NaCl. Oxygen evolution decreased in cells grown in MgCl₂ and NaCl at all concentrations tested, with the exception of 0.001 ppt MgCl₂ (Table 3). Medium pH in experimental cultures was significantly different at 0.001, 0.01, and 0.1 ppt NaCl. However, no differences in medium pH were observed in algal cells grown in all concentrations of MgCl₂ (Table 4).

NMR spectra of ¹³C-labeled *C. hypnosporum* indicated that the accumulation of organic solutes, although significantly higher than controls, was fairly constant at 0.001 to 1 ppt MgCl₂. However, there was a dramatic increase in organic solutes at 10 ppt

MgCl₂ (Table 5). Organic solute accumulation fluctuated in algal cells grown in increasing NaCl concentrations. The highest accumulation of organic solutes was observed at 0.001 ppt NaCl.

DISCUSSION

After 21 days of growth, *C. hypnosporum* grew significantly better in all MgCl₂ concentrations except at 10 ppt when compared to NaCl. Although algal cells grown in 10 ppt NaCl grew better than cells in 10 ppt MgCl₂ all other NaCl concentrations had a deleterious effect on algal growth with at least a two-fold decrease compared to cultures grown in MgCl₂. While NaCl exhibited the greatest inhibitory effect on growth, there was no significant difference in algal growth with increasing MgCl₂ concentrations compared to controls except at 10 ppt. In *Chlorella autotrophica*, the inhibition of growth at high salinities was associated with decline in turgor pressure (Ahmad and Hellebut, 1984). The decline in

Table 1. Effect of NaCl and MgCl₂ on total growth of *Chlorococcum hypnosporum* after 21 days.

| Salt | Concentration (ppt) | Total Growth (% Transmittance) |
|-------------------|---------------------|--------------------------------|
| NaCl | 0 | 8 a |
| | 0.001 | 18b |
| | 0.01 | 18b |
| | 0.1 | 17b |
| | 1 | 17b |
| | 10 | 20c |
| | | |
| MgCl ₂ | 0 | 8 A |
| | 0.001 | 6 A |
| | 0.01 | 8 A |
| | 0.1 | 6 A |
| | 1 | 6 A |
| | 10 | 22B |
| | | |

Means followed by the same lower case or upper case letters are not significantly different at the 0.05% level (Duncan Multiple Range Test). Transmittance at day 0 was 100%, which was equivalent to 280,000 algal cells/ml.

Table 2. Effect of NaCl and MgCl₂ on percent sexuality of *Chlorococcum hypnosporum* after 21 days.

| Salt | Concentration (ppt) | (% Sexuality) |
|-------------------|---------------------|---------------|
| NaCl | 0 | 13a |
| | 0.001 | 22b |
| | 0.01 | 24b |
| | 0.1 | 19b |
| | 1 | 54c |
| | 10 | 58c |
| | | |
| MgCl ₂ | 0 | 13A |
| | 0.001 | 21B |
| | 0.01 | 24B |
| | 0.1 | 19A |
| | 1 | 53C |
| | 10 | 56C |
| | | |

Means followed by the same lower case or upper case letters are not significantly different at the 0.05% level (Duncan Multiple Range Test). Percent sexuality was expressed as the number of zygotes divided by the number of zygotes plus the number of vegetative cells multiplied by 100.

Table 3. Effect of NaCl and MgCl₂ on amount of dissolved oxygen in cultures of *Chlorococcum hypnosporum* after 21 days.

| Salt | Concentration (ppt) | Oxygen evolution (mg/L) |
|-------------------|---------------------|-------------------------|
| NaCl | 0 | 4.60a |
| | 0.001 | 3.93b |
| | 0.01 | 4.00b |
| | 0.1 | 4.27c |
| | 1 | 3.83b |
| | 10 | 3.67b |
| MgCl ₂ | 0 | 4.60A |
| | 0.001 | 4.63A |
| | 0.01 | 4.36B |
| | 0.1 | 4.30B |
| | 1 | 4.20C |
| | 10 | 4.33B |

Means followed by the same lower case or upper case letters are not significantly different at the 0.05% level (Duncan Multiple Range Test).

total growth was due mainly to a decrease in vegetative cells with a corresponding increase in zygospores as salinity increased. These findings agree with the observations of Sze (1993) where sexual reproduction was often induced by stressful conditions.

Herbst and Bradley (1989) observed that growth and persistence of algae in a saline environment required physiological tolerance and/or resistance stages in the life cycle. *Chlorococcum hypnosporum* demonstrated a greater physiological tolerance to MgCl₂ than NaCl as indicated by higher growth measurements after 21 days. Increases in the number of zygospores with corresponding reductions of vegetative cells indicated that both salts promoted sexuality and persistence of *C. hypnosporum*. Thirteen percent zygospore production in controls was increased to over 50% in cultures grown in NaCl and MgCl₂. This demonstrated a dramatic shift in the life cycle of *C. hypnosporum*. Previous studies by Setter and Greenway (1983) showed evidence of osmotic regulation control in *Chlorella emersonii* using two endogenous osmotic solute concentrations of proline and sucrose which resulted in large changes

Table 4. Effect of NaCl and MgCl₂ on the pH of *Chlorococcum hypnosporum* after 21 days.

| Salt | Concentration (ppt) | Medium (pH) |
|-------------------|---------------------|-------------|
| NaCl | 0 | 8.11a |
| | 0.001 | 8.50b |
| | 0.01 | 8.51b |
| | 0.1 | 8.52b |
| | 1 | 8.17a |
| | 10 | 8.15a |
| MgCl ₂ | 0 | 8.11A |
| | 0.001 | 8.10A |
| | 0.01 | 8.00A |
| | 0.1 | 8.09A |
| | 1 | 8.05A |
| | 10 | 7.98A |

Means followed by the same lower case or upper case letters are not significantly different at the 0.05% level (Duncan Multiple Range Test).

in cell life cycle.

Both NaCl and MgCl₂ caused a decrease in oxygen evolution in *C. hypnosporum*. A significant decrease in oxygen was observed in all experimental flasks except 1 ppt MgCl₂ when compared to controls. The greatest reduction in oxygen production was in medium containing 10 ppt NaCl. In studies with *Chlamydomonas eugametos* and *Chlamydomonas moewusii*, Lewin (1956) found that production and maintenance of gametes in the light required the presence of oxygen, and that gametic activity is lost more rapidly in the dark under anaerobic conditions than in the presence of oxygen. Their findings could explain why we observed that as oxygen evolution decreased, zygospore production increased in NaCl. This inverse relationship between oxygen evolution and zygospore production was not distinctly demonstrated in cultures grown at various levels of MgCl₂. Stifer (1959) also suggested that the presence of oxygen affected mating in algal cultures.

After 21 days of growth, growth medium of *C. hypnosporum* increased from an initial pH of 6.80 to as high as 8.52 at 0.1 ppt NaCl compared to 8.11 in

Table 5. NMR spectra peak measurements of Carbon-13 labeled organic solutes in *Chlorococcum hypnosporum* after 21 days.

| Salt | Concentration (ppt) | NMR peak (mm) |
|-------------------|---------------------|---------------|
| NaCl | 0 | 32b |
| | 0.001 | 52c |
| | 0.01 | 29b |
| | 0.1 | 18a |
| | 1 | 37b |
| | 10 | 36b |
| MgCl ₂ | 0 | 32A |
| | 0.001 | 56B |
| | 0.01 | 55B |
| | 0.1 | 57B |
| | 1 | 57B |
| | 10 | 108C |

Means followed by the same lower case or upper case letters are not significantly different at the 0.05% level (Duncan Multiple Range Test).

controls. There was no significant difference in medium pH when algal cells were grown in various concentrations of MgCl₂. Since FW1 medium contains NaHCO₃ this carbonate salt and the production of CO₂ by *C. hypnosporum* and the resulting CO₂ equilibrium probably caused the pH changes. Coleman (1962) suggested that within the bounds of physiological neutrality, there were no striking effects of pH in the mating reactions of algal gametes. Mating has been reported in cultures ranging in pH from 4 to 8.5. In this experiment, medium pH as high as 8.52 had no appreciable effect on zygospore production in cultures containing NaCl or MgCl₂. There was no correlation between medium pH and zygospore production in cells grown in NaCl or MgCl₂. Biebi (1962) suggested that an increased zygote yield correlated with a slight rise in pH value of the medium, but the effect was rarely as much as twofold. According to Gerloff et al. (1952) growth and survival of many algae seemed to be endangered only at pH values exceeding 10.

Microalgae naturally accumulate a variety of

intracellular organic compounds. The halotolerant alga *Dunaliella baradawii* grown in NaCl medium contained glycerol, proteins, lipids, carbohydrates, carotene, and chlorophyll (Ben-Amotz and Avron, 1982). Avron (1986) found that *Dunaliella* osmoregulates by producing glycerol. NMR spectra peak measurements of *C. hypnosporum* indicated that it increased levels of ¹³C-labeled organic solutes when grown in medium containing increasing concentrations of NaCl or MgCl₂. Ben-Amotz and Avron (1982) suggested that an alga producing massive amounts of useful organic compounds by osmoregulation make it a natural organism for cultivation. These enhanced algal cells thus provided valuable products and a high protein-containing feed material (Ben-Amotz and Avron, 1983).

NMR spectra peak measurements increased from 32 mm in controls to 108 mm in cells grown in MgCl₂. Highest NMR spectra peak measurements was observed in 0.001 ppt NaCl. Based on these increases, *C. hypnosporum* is potentially a useful alga when employed as a biofertilizer. The presence of introduced ¹³C in all but one of our experimental flasks at levels much higher than the controls suggests that *C. hypnosporum* may be osmoregulating using carbon-containing compounds such as glycerol. However, further analyses must be done to determine if glycerol or other organic compounds were produced by *C. hypnosporum* in high salinities. Adverse changes in other parameters investigated also indicate that high concentrations of NaCl and MgCl₂ induced stress in *C. hypnosporum* resulting in osmoregulation. If *C. hypnosporum* is found to contain high quantities of nitrogenous compounds, it will be an excellent alternative to conventional fertilizers. If this alga could be grown economically and supplied to crops, eutrophication of lakes and streams could be drastically reduced and potential leachates from synthetic fertilizers would be virtually eliminated.

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LITERATURE CITED

- Ahmad, I., and J.A. Hellebust. 1984. Osmoregulation in the extremely euryhaline marine micro-alga *Chlorella autotrophica*. *Plant Physiol.* 74:1010–1015.
- Avron, M. 1986. The osmotic components of halotolerant algae. *Trends Biochem. Sci.* 11:5–6
- Ben-Amotz, A., and M. Avron. 1982. Accumulation of metabolites by halotolerant algae. *J. Phycol.* 18:529–537.
- Ben-Amotz, A., and M. Avron. 1983. Accumulation of metabolites by halotolerant algae and its industrial potential. *Annu. Rev. Microbiol.* 37:95–119.
- Biebi, R. 1962. Seaweeds. Pages 711–815 in R. Lewin, ed. *Physiology and biochemistry of algae*. Academic Press, New York.
- Boney, A.D. 1965. Aspects of the biology of the seaweeds of economic importance. *Adv. Mar. Biol.* 3:105–253.
- Booth, E. 1965. The manurial value of seaweed. *Bot. Mar.* 8:138–143.
- Coleman, D. 1962. Sexual isolation in *Pandorina morum*. *J. Protozool.* 6:249–264.
- Gerloff, G.C., G.P. Fitzgerald, and F. Skoog. 1952. The mineral nutrition of *Microcystis aeruginosa*. *Amer. J. Bot.* 39:26–32.
- Guillard, R.R.L. 1962. Salt and osmolyte balance. Pages 529–540 in R. Lewin, ed. *Physiology and biochemistry of algae*. Academic Press, New York.
- Hardy, M.G., and J.C. O'Kelley. 1986. Exogenous steroids and growth of *Neosporangiococcum* sp. (Chlorophyceae). *J. Phycol.* 22:564–566.
- Herbst, D.B., and T.J. Bradley. 1989. Salinity and nutrient limitations on growth of benthic algae from two alkaline salt lakes of the western great basin (USA). *J. Phycol.* 25:673–678.
- Justic, D., N.N. Rabalais, R.E. Turner, and Q. Dortch. 1995. Changes in nutrient structure of river-dominated coastal waters: Stoichiometric nutrient balance and its consequences. *Estuarine, Coastal and Shelf Science* 40:339–356.
- Lewin, R.A. 1956. Control of sexuality in *Chlamydomonas* by light. *J. Gen. Microbiol.* 15:170–185.
- O'Kelley, J.C. 1983. Environmental factors and sexual expression in *Chlorococcum echinozygotum* (Chlorophyceae). *J. Phycol.* 19:57–64.
- Setter, T.L., and H. Greenway. 1983. Changes in the proportion of endogenous osmotic solutes accumulated by *Chlorella emersonii* in the light and dark. *Plant Cell Environ.* 6:227–234.
- Stifer, A. 1959. Salt uptake in plants. *Biol. Revs. Cambridge Phil. Soc.* 34:159–220.
- Sze, P. 1993. *A biology of algae*, 2nd ed. William C. Brown Publisher, Dubuque, IA. 259 pp.
- Waaland, J.R. 1981. Commercial utilization. Pages 741–762 in C.S. Lobban and M.J. Wynne, eds. *The biology of seaweeds*. University of California Press, Berkeley, CA.

Plan to Attend
the 2001 Annual Meeting of the
Mississippi Academy of Sciences
in Tupelo, Mississippi
February 8 and 9



Swertia caroliniensis (Gentianaceae) in Pontotoc, Lee, and Chickasaw Counties in Mississippi

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Swertia caroliniensis (Walt.) Kuntze (Gentianaceae), commonly called American columbo (Hemerly, 1990), or columbo, is a robust, monocarpic, glabrous perennial with erect stems ranging from one to three meters tall and two to three centimeters in diameter. It has thick tuberous roots and leaves in whorls of three to nine. The inflorescence is a panicle of cymes. There are four calyx lobes. The four corolla lobes are separate nearly to the bases, rotate, yellowish to whitish, and streaked with green. Each corolla lobe has a prominent, elliptic to obovate, green gland toward the base. There are four stamens and the fruit is a capsule (Radford et al., 1968). A member of the Gentianaceae family, the genus *Swertia* L. includes numerous tall, showy herbs.

One population of 30–40 plants and a smaller population of 10–12 plants of *Swertia caroliniensis* were found in Trace State Park in Pontotoc County, Mississippi (Floyd, 1995). In Lee County one mile east of the Pontotoc-Lee County Line and within four and one half miles of Trace State Park a third population of several dozen plants was observed. Three additional populations were observed in Chickasaw County within the Tombigbee National Forest.

The larger population within Trace State Park was first observed in June, 1993, at the base of a calcareous slope. It was situated in an ecotone where the mixed forested habitat of the slope abruptly met a mowed meadow at its' base. At that time several plants had basal leaves and one plant retained an inflorescence in which the panicle of cymes had begun to deteriorate. The inflorescence, however, still presented a showy appearance. If not for this single plant in flower the entire population might have been overlooked.

We returned to the site in June, 1994, to once again discover a thriving population of 30–40 plants, which extended several meters upward from the base

of the slope. Numerous observations of the population were made between June and September, 1994. The basal leaves remained, yet none of the plants flowered during this period.

The smaller population was first observed in the spring of 1995. It contained 10–12 plants with only two plants showing indications of flowering.

The Lee County population was first observed by us in 1994. It consisted of several dozen plants in all states of development including at least nine in flower.

Two Chickasaw County populations within the Tombigbee National Forest were observed in the spring of 1995. One population was found on the south side of Davis Lake and another smaller population was found in dry deciduous woods off County Road #123. Both populations contained flowering and fruiting plants. The third and largest of the Chickasaw County populations was observed in June, 1997, in the Chuquatonchee Research Natural Area north of Davis Lake. McDaniel (1992) lists two sites for *Swertia caroliniensis* elsewhere in the Tombigbee National Forest with one consisting of over 8000 plants.

A further search of the literature revealed records of its occurrence in Monroe County (MacDonald, 1996). The IBE Collection at Mississippi State University Herbarium contains records from Chickasaw, Lee, Monroe, Noxubee, and Oktibbeha Counties (John MacDonald, graduate student, Mississippi State University, personal communication). The Mississippi Natural Heritage Program provided records of sites in five additional counties, not previously mentioned, including Hinds, Lowndes, Madison, Union, and Winston (Ron Wieland, ecologist, Mississippi Natural Heritage Program, personal communication).

Trace State Park along with our other sites is located within the Pontotoc Ridge Physiographic Region of the state (Fig. 1). The Pontotoc Ridge

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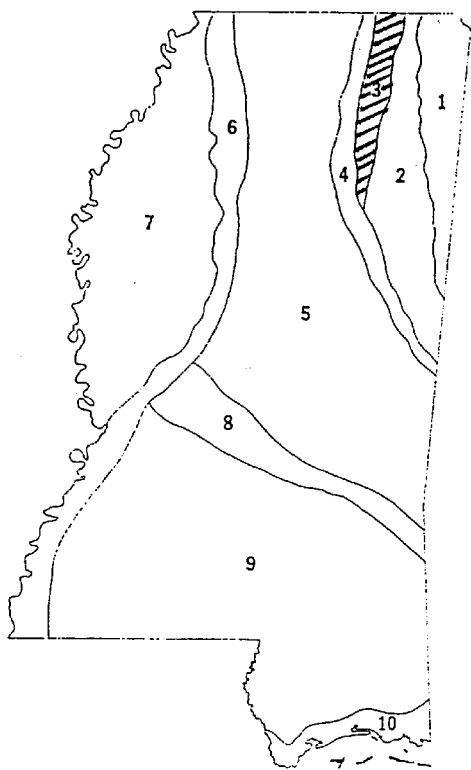


Figure 1. Physiographic regions of Mississippi (adapted from Lowe, 1921; Temple and Pullen, 1968). 1. Tennessee River Hills, 2. Northeast Prairie Belt, 3. Pontotoc Ridge, 4. Flatwoods, 5. North Central Plateau, 6. Loess Hills, 7. Yazoo-Mississippi Delta, 8. Jackson Prairie Belt, 9. Long Leaf Pine Region, 10. Coastal Pine Meadows.

Region consists of a series of parallel ridges twelve to fourteen miles wide. It occupies the western third of Alcorn County and the eastern half of Tippah County widening to the northern boundary of Union County. It passes east of Union County's center in a strip less than two townships wide and continues to narrow through Pontotoc and Chickasaw Counties terminating in a point near Houston, Mississippi (Lowe, 1919; Floyd, 1995).

All of our populations described here were found growing in soils underlain with calcareous materials leading us to assume that it grows in circumneutral soils. Steyermark (1963) indicates that in Missouri *Swertia caroliniensis* occurs in rich, low, or rocky open woods and thickets, often in ravine bottoms and wooded valleys along streams in acidic soils. Radford, Ahles, and Bell (1968) state simply that the species

grows in "woodlands." Lowe (1921) states that it occurs in rich upland forests.

According to Hemmerly (1990), *Swertia caroliniensis* is a triennial which produces a rosette of large smooth leaves for two growing seasons before producing a panicle in the third year. The failure of the plants to flower during the 1994 season may be attributed to this characteristic. However, Steyermark (1963) describes the plants as perennials that may live several years without flowering. Our observations agree with Steyermark's conclusion. We have noted basal rosettes more than three years old which showed no flower stalks in the third year.

Swertia caroliniensis is the only representative of the genus *Swertia* in the eastern United States (Hemmerly, 1990). It is considered secure globally, though possibly rare in some parts of the range (MNHP, 1992; MNHP, 1997). It is relatively rare, but widespread, in the eastern United States, preferring limestone soil (Hemmerly, 1990). *Swertia caroliniensis* is considered rare or uncommon and vulnerable to extinction within Mississippi (MNHP, 1992; MNHP 1997). The Thomas M. Pullen Herbarium (MISS) at the University of Mississippi had no specimens of *Swertia caroliniensis* prior to this collection. McDaniel (1992) indicates that a study of the biology of *Swertia caroliniensis* would be useful to determine factors including flowering and fruiting.

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The authors wish to thank the Mississippi Natural Heritage Program for funding the plant survey of Trace State Park. We also appreciate the cooperation and assistance of Mr. Jim Pickett, former manager of Trace State Park, and his staff. Thanks also to John MacDonald and Ron Wieland for providing data on additional sites.

LITERATURE CITED

- Floyd, M.D. 1995. The Vascular Flora of Trace State Park. M.S. Thesis. University of Mississippi, University, MS. 112 pp.
- Hemmerly, T.E. 1990. Wildflowers of the Central South. Vanderbilt University Press, Nashville, TN. 121 pp.
- Lowe, E.N. 1919. Mississippi, its geology, geography, soils and mineral resources. Mississippi State Geol. Surv. Bull. No. 14. 346 pp.
- Lowe, E.N. 1921. Plants of Mississippi: A list of flowering plants and ferns. Mississippi State Geol. Surv. Bull. No. 17. 292 pp.
- MacDonald, J. 1996. A survey of the flora of Monroe County, Mississippi. M.S. Thesis. Mississippi State University, Mississippi State, MS. 163 pp.

- Mississippi Natural Heritage Program (MNHP). 1992. Special Plant List. Museum of Natural Science, Mississippi Department of Wildlife, Fisheries & Parks. Jackson, MS. 7 pp.
- Mississippi Natural Heritage Program (MNHP). 1997. Special Plant List. Museum of Natural Science, Mississippi Department of Wildlife, Fisheries & Parks. Jackson, MS. 12 pp.
- McDaniel, S. 1992. Sensitive Plants of the Tombigbee National Forest (Tombigbee District). Institute for Botanical Exploration, Box EN, Mississippi State, MS 39762. 52 pp.
- Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. The University of North Carolina Press, Chapel Hill, N.C. 1183 pp.
- Steyermarck, J. A. 1963. Flora of Missouri. The Iowa State University Press, Ames. 1728 pp.
- Temple, L.C., and T.M. Pullen. 1968. A preliminary checklist of the Compositae of Mississippi. *Castanea* 33:106–115.



Marcie Floyd and *Swertia caroliniensis*.

The Mississippi Museum of Natural Science Is Open

The Mississippi Museum of Natural Science in Jackson opened its new facility on March 3rd to a crowd of 20,000 in the first week! The Museum serves as a permanent and significant symbol of the love and commitment the people of Mississippi hold for their land and wildlife. Natural objects and live animals tell the story of “Mississippi’s Web of Life” through exciting and educational exhibits, as visitors experience the beauty and diversity of nature.

The 73,000 square foot building is planned to draw connections between indoor exhibits and the surrounding outdoor environment. Long expanses of windows revealing boardwalks and nature trails invite visitors to spend time outside. A central, circular rotunda culminates in a dome shaped skylight in the upper lobby where a spectacular White-tailed Deer exhibit and soaring waterfowl introduce Mississippi wildlife. Impressive stairways lead down to more waterfowl and an entire wall of fossils. Two thousand five hundred square feet of space for changing exhibits can be easily and quickly altered to the specifications of each show. A giant tree house and delightful murals wrap young children in a habitat created just for them in the preschool room.

A floating Earth and oversized maps of Mississippi introduce the main exhibition hall and put our state in context with the rest of planet Earth. Visitors journey through the state, starting on the Gulf Coast, learning about the various habitats that comprise Mississippi. The exhibits reveal relationships between the land, flora, fauna, and the people of our state. An aquarium system containing nearly 100,000 gallons of water and housing over 200 species of native fishes, reptiles, amphibians, and aquatic invertebrates in 20 aquariums tells an ecological story of rivers, streams, lakes, ponds, marshes, and the Mississippi Sound. Life size habitat displays represent unique and exciting ecosystems, featuring hundreds of animals and plants. “The Swamp” is a 1,700 sq.ft. greenhouse containing a 20,000 gallon aquarium that is home to an assortment of alligators, turtles, and fish surrounded by a lush native plant garden.

In an effort to disturb as little natural habitat as possible, the Museum and new parking lot were built on previously cleared land, an old parking area. and

an old road bed. The building is nestled against the tree line of a 300 acre natural area. Over 3,000 native trees, shrubs, and vines have been planted to extend the natural area and restore wildlife habitat.

Fifteen million in funding, appropriated by the Mississippi Legislature, has been matched by over \$1.6 million from private sources to make this new super attraction possible in Jackson. The Mississippi Museum of Natural Science Foundation is looking for a few more corporate sponsors to reach our goal of \$2 million.

Mississippi Valley Gas, Bell South, Blue Cross Blue Shield, ERGON, Deposit Guaranty/First American Foundation, Mississippi Chemical Corp., Friede Goldman, Trustmark, Farm Bureau Federation, Mississippi Power, Delta and Pine Land Company, and Chevron have sponsored exhibits, along with several local and national foundations (Gertrude Ford Foundation, Walker Foundation, Tara Wildlife Foundation, and Phil Hardin Foundation). Benevolent individuals such as Dudley Hughes, Billy and Mollie Van Devender, Maggie Bryant, the Abe Rotwein family, the Richard McRae Family, and the Steve Zachow family have given generously to help provide this wonderful educational facility to the people of Mississippi.

The new facility will provide:

- An aquarium system 7 times larger than the old one on Jefferson Street
- A 200 seat auditorium
- Two classrooms
- A 2,500 sq. ft. library
- A Gift Shop
- An exhibit hall for temporary and traveling exhibits.
- Laboratories and Collection ranges to accommodate our present biological
- archives in a safe environment.
- Larger, more realistic habitat exhibits.
- More hands-on exhibits
- More than 2½ miles of nature trails
- 300 beautiful acres adjacent to the Pearl River
- Outdoor amphitheater

President's Column

Thanks to all who made the 64th Annual Meeting of the Academy such a success! First and foremost, the Academy wishes to recognize and thank the Institutions of Higher Learning (IHL) for sponsoring this year's conference. Over seven hundred participants were on hand to enjoy the paper and poster presentations, symposia, and exhibits.

Each conference is unique in its special highlights, and this year's conference in Biloxi was no exception. Two stimulating symposia, one on Remote Sensing, and another on Communicating Science Through the Media, are good examples of the scope of science topics addressed at this meeting. And of course, conferences are always remembered by the Dodgen Lecturer. Those who attended this year's presentation by Dr. David Orr from Oberlin College will not soon forget his insightful, challenging and inspiring lecture. I am sure that many who may not have read his books, *Ecological Sustainability* and *Earth in Mind*, which are often compared in impact to Rachel Carson's *Silent Spring*, have headed to their local bookstores (or more likely Amazon.com). The highlights wouldn't be complete without mentioning the award recipients. Preceding the Dodgen Lecture, the Academy traditionally takes the opportunity to recognize Junior and Senior Academy award winners. It is always with great pride that we speak of the Junior Academy program and the accomplishments of our young scientists. Dr. Joan Messer, the Youth Activities Chairperson, had the pleasure of awarding plaques to Philip Eichhorn from Jackson Prep (Clyde

Sheely Winner) and Alexander Clark from St. Andrew's in Jackson, the first and second place winners respectively from their paper competition held in January. Dr. Richard Sullivan from Jackson State University was recognized with the "Outstanding Contributions to Science" Award. In presenting the award, Dr. Sarah McGuire remarked that Dr. Sullivan was being recognized for a long career in which he consistently "exhibited a commitment to the acquisition, dissemination, and application of scientific knowledge."

As we look to the future, we realize we are facing unparalleled challenges, but also, unparalleled opportunities. David's presentation reminded us of that reality. What part will the Academy play in that future? To continue to be the vital organization we have been in the past, this question should keep calling us home to right and effective service. Knowing Dr. William Lushbaugh, our President-Elect, we will have the leadership to guide us in the right direction. In closing, as my tenure as President winds down, I would like to express my most heartfelt appreciation to all the members of the Academy for giving me the opportunity to serve as your president. I have always felt it to be a great honor. I wish in some measure I could convey to so many of you the depth of gratitude I feel for the generous and unfailing support I received. With all of you, I am eagerly looking forward to working together on the challenges and opportunities in our future.—Susan Nodurft

Executive Officer's Column

An Opinion about Public Concern over Genetically Modified Crops

The American public has become more aware of the existence of genetically modified crops as a result of several bits of negative publicity recently. One of the most widely disseminated is the case of genetically engineered corn killing caterpillars before they could develop into beautiful Monarch butterflies. Unfortunately, these days popularized science is commonly accepted without a complete presentation of all facts. In point of fact, science is always changing (as it should because our techniques and knowledge base changes) and scientists frequently disagree. That's the way science moves forward. The public may see disagreements as an indication of a

lack of real knowledge or a possible coverup by some group or other.

There is another side to the butterfly story. Many scientists with lots of experience in the area have been highly critical of the original work. Yet those scientists don't know how to get their message across. In fact, it is highly unlikely that, any butterflies will be harmed. Yet, the public is left with the image of dead butterflies. What needs to be emphasized is the positive aspect of the modification of crops and the fact that this is really nothing new.

Mankind has been modifying plants (and animals) since the beginning of agriculture thousands of years

ago. Selective breeding to incorporate or eliminate new traits has the same goals and almost the same methods as genetic engineering. A crop breeder moves genes around in an organism by deciding which plants to cross pollinate. It is a direct but time consuming process. A genetic engineer (I prefer to use the term molecular biologist) moves genes around in a more rapid fashion, but they still moving genes around to improve a crop.

The positive aspects of this more rapid alteration of crops needs to be featured. Modern agriculture has been enormously successful at feeding the world. However, it has become addicted to ever increasing needs for fertilizers, herbicides, and pesticides. In turn, this has begun to impact the environment negatively. Genetically modified crops give us a wonderful route to stopping this addiction. They are the ultimate environmentally friendly product because

they can be designed to drastically reduce the need for fertilizers, herbicides, and pesticides. They can also be designed to give better, more nutritious products. Modified crops can help to improve agricultural efficiency.

The public needs to be aware that genetic modification is not creating some chimeric monsters. We are still only moving DNA around just like crop and animal breeders. And just like breeders, we test the results of our experiments. We are just at the beginning of the Century of Biology. As with any new technology, there will be initial mistrust (consider the automobile—"Get yourself a horse, mister!"); but there will also be wonders that will truly serve mankind.— John A. Boyle

Mississippi Junior Academy of Sciences 2000 Research Paper Competition

The 2000 Mississippi Junior Academy of Sciences research paper competition was held at the Naval Research Laboratory, Stennis Space Center on the Mississippi Gulf Coast on February 11, 2000. This annual paper competition brought students from around the state to Stennis Space Center. Approximately fifty students represented the following schools, either as observers or competitors: St. Andrew's Episcopal School (Jackson), Cleveland High School, Morton High School, Weir Attendance Center, Jackson Academy (Jackson), Yazoo City High School, Jackson Preparatory School (Jackson), Mississippi School for Math & Science (Columbus), Poplarville High School, Hattiesburg High School, and Jim Hill High School (Jackson).

Six divisional competitions took place in the morning: Class I (9th & 10th grades) Biology, Class I Behavioral & Physical Sciences, Class II (11th & 12th grades) Computers, Mathematics & Physics, Class II Medicine & Health, Class II Behavior & Social Sciences, and Class II Biology. Thirty-two students competed in these categories.

Janaka Lagoo of St. Andrew's Episcopal School won the Class I Biology competition. Her research paper was titled "The Ability of Estrogen and Progesterone to Potentiate the Effect of Methotrexate and Vincristine on Human Leukemia Cells." Special Recognition was given to William F. Bryant, Jr., of

Yazoo City High School for his paper, "A Study on the Effects of Acidic Rainfall on the Development and Sex Ratio of Mosquito Larvae."

In Class I Behavioral & Social Sciences, a research team won the competition. Christi Coleman and Carlin Williams of Jackson Academy won with their paper, "The Testing of the Conductivity of Wet vs. Dry Wood Using Balsa, Oak and Pine Woods."

The win in Class II Computers, Mathematics & Physics went to Alexander Grant Clark of St. Andrew's Episcopal School. His research was titled "Dependence on Cutoff Distance in Protein Fold Recognition Scoring Functions." Special Recognition in this division went to Alan B. Powell of the Mississippi School for Math & Sciences. Alan's paper was titled "Low Speed Wind Tunnel Acoustic and Pressure Measurements."

"Suture/Eyelet Orientation Effectors on Bone Anchor Failure Strengths: Improving Orthopedic Surgical Repair of Tendons Torn off Bone" by Philip Eichhorn of Jackson Preparatory School won the Class II Medicine & Health division. Cleveland High School's Jessica Burgos received special recognition for her work "The Effects of a Heavy Backpack on Adolescent Students."

Class II Behavior & Social Sciences division was won by Lawren M. Wood of Cleveland High School. Lawren's work was titled "Effects of Extracurricular

Involvement on Stress Levels of Elementary Youth: A Comparative Study.” Derrick Spires of Jim Hill High School received special recognition with “Frequency and Type of Scent-marking in the Small-eared Bushbaby (*Otolemur garnettii*) in Response to Reproductive Condition of Female Conspecifics.”

A tie was the result of the Class II Biology competition. Annie Vaughan and Tara Rosenberg, both of Yazoo City High School, worked as a team on “A Comparative Study of the Effects of Tartrazine on the Cellular Processes of Selected Organisms,” while Adrienne Howse of the Mississippi School for Math & Science competed with her work “Where Have All the Frogs Gone? A Two-year Study.”

After the participants enjoyed the keynote address by Mr. Michael Harris, who spoke on mapping and charting research at the Naval Research Laboratory, the winners were announced. After lunch, the Class II divisional winners competed for the Clyde Sheely Award (overall winner) and the Second Place Award.

Officer and board elections were held at the annual business meeting. The 2000 Mississippi Junior Academy of Sciences Officers are: Philip Eichhorn (Jackson Preparatory School) president, Gita Subramony (St. Andrew’s Episcopal School) - Vice-president, Carlin Williams (Jackson Academy) - Secretary, LaTonya Little (Yazoo City High School) - Reporter. Board members include: Christi Coleman (Jackson Academy), Donyale Parker (Yazoo City High School), Farzad Sadjadi (Cleveland High School) and Paul Varnado (Hattiesburg High

School).

During the business meeting, Dr. Joan Messer officially announced her position as the new American National Junior Academy of Sciences director. She resigned as the director of the Mississippi Junior Academy of Sciences to accept this position,. Betsy Sullivan of the Mississippi Museum of Natural Science will replace Dr. Messer as director.

At the end of the business meeting the Clyde Sheely winner and Second Place winner were announced. Philip Eichhorn won the overall competition to become the Clyde Sheeley* Award winner. Alexander Clark won second place.

Special thanks go to all the teachers for their time and efforts in promoting scientific research in high school students. Also, the judges of the written and oral competitions must be thanked for their time. Their dedication to the young researchers was obvious. Ms. Becky Rotundo and Dr. Portia Harris did a wonderful job organizing the competition at the Naval Research Laboratory. Thank you, ladies, for the extra efforts you put in. Lastly, a sincere thank you to the Naval Research Laboratory of Stennis Space Center. With so many people attending the competition, the rooms and parking were appreciated.—Betsy Sullivan

*The Junior Academy award for first place had no formal name before 2000. The Clyde Sheeley award was the second place award. Last year the MAS Board of Directors voted to have the first place award designed as the Clyde Sheeley award. The second place award has no formal name.—ed.



Philip Eichhorn, Clyde Sheeley Winner, is congratulated by Dr. Joan Messer.



Alexander Clark, Second Place Winner Overall.



Year 2000 MJAS Officers and Board: 1st row (l-r): LaTonya Little, Carlin Williams, Janaka Lagoo. 2nd row: Philip Eichhorn, Donyale Parker, Farzad Sadjadi, Paul Varnado, Christi Coleman.



This year the Mississippi Junior Academy of Sciences delegation to the American Academy of Sciences included Dr. Joan Messer (left), Director of the Junior Academy; student competition winners (left to right) Amit Goel, Emily Almas, and Alexander Clark; and Dr. Steve Case, Mississippi Academy of Sciences representative to AAAS.

Divisional Reports

Cellular, Molecular and Developmental Biology

The Cellular, Molecular, and Developmental Biology Division had 21 platform presentations and 12 poster presentations this year at the Biloxi meeting of the Mississippi Academy of Sciences. Although the number of presenters was slightly decreased from last year's meeting in Tupelo, the overall participation appeared to have increased with approximately 30 in attendance at each of the three sessions. Representative subjects of research presented this year included: gene suppression in *Aspergillus nidulans*, physical properties of the amphipathic protein hydrophobin, heavy metals in hyperthermophilic archaea, heatshock response in wound healing, regulation of the cell signaling protein Janus kinase, and DNA binding proteins in chloroplast nucleoids. We hosted two invited speakers at our Thursday morning session this year. The first was Ross E. Whitwam (Mississippi University for Women) who presented work he performed at the Sloan-Kettering Cancer Center on "Cloning and Characterizing the Calicheamicin Self-resistance gene in *Micromonospora echinospora*." The second was Alexander Grant Clark, (St. Andrew's Episcopal School, Jackson) who presented his Mississippi Junior Academy of Sciences award winning work: "Dependence on Cutoff Distance in Protein Fold Recognition Scoring Functions."

Awards were presented for two student presentations. Wally Bugg won Outstanding Undergraduate Presentation award for his work on the "Isolation of a Catalytic RNA Capable of Coenzyme Synthesis" conducted under the direction of Faqing Huang (University of Southern Mississippi.) In addition to the certificate, Mr. Bugg received a \$50 cash award generously provided by Susie Emfinger of Fisher Scientific. Stephanie A. Misquitta won the Outstanding Graduate Presentation award for her work on the "Essential Residues in Glutaminyl Cyclase" she performed under the direction of Robert Bateman (University of Southern Mississippi.) Her certificate was also accompanied by a \$50 cash award provided by Rebecca Turnage of C²Corporation.

During the Divisional Business Meeting, Vice-chair Peter Butko (University of Southern Mississippi) was elected to Chair the Division for the

2001 Annual Meeting next spring. Roy J. Duhe (University of Mississippi Medical Center) was elected to the vice-chair position.—David D. Carson

Health Sciences

Fifty-five abstracts were submitted to the Health Sciences division at the sixty-fourth annual meeting of the Mississippi Academy of Sciences, February 2000. There were 43 student platform and poster presentations, as well, as 12-platform presentations by established investigators. The presentations included such diverse topics as sustained drug delivery systems, dental and orthopedic implants, clinical studies involving women with postmenopausal bleeding and cervical cancer research, and community based health projects. Platform and poster presentations involved an average of 40 attendees per session. We were very pleased that a large number of students submitted their work to the Academy for review. Thirty six entries were from the University of Mississippi Medical Center, three entries came from each of the following schools: Delta State University, Alcorn State University, Jackson State University and the University of Mississippi. Two entries from Millsaps College and one entry from each of the following schools: University of Southern Mississippi, Mississippi University for Women and Belhaven College. Also, there were a total of five high school students that submitted abstracts to the competition. This year we were fortunate to offer cash awards in addition to the certificate for the best papers in five different categories. The awards consisted of the Douglas Walker Award for best overall poster or platform presentation and first, second and third place in the categories of dental/medical, graduate, allied health, undergraduate and high school. A total of ten judges (two judges per category) evaluated the published abstracts, the platform presentations, and poster presentations by the students. The student awards were sponsored by the Douglas Walker endowment and Microtek Medical, Inc from Columbus, MS. As chair of this year's Health Sciences session, I would like personally to thank Mr. Lester J. Berry of Microtek Medical, Inc for the generous donation. This year the student presentations were

exceptionally good, as reflected by the closeness of the Judge's scores and the various comments made by the judges and attendees. The level of subject knowledge and professionalism displayed by each presenter was most notable, and I am pleased to report the award winners for the Health Sciences Division. The overall Douglas Walker Award was given to Ms. Daphanie D. Webster, an allied health student, from The School of Health Related Professions at UMC. The title of her presentation was **"The effect of polychlorinated biphenyl on RAW 264.7 cells."** Ms. Webster's research was performed under the mentorship of Dr. Hamed A. Benghuzzi. The winners of the dental/medical category were 1st place Brad Roberts, 2nd place Kendall P. Brown, and a two-way tie for 3rd place Ashley McArthur and Steve Arnold. The winners of the graduate category were 1st place Keith Stokes, 2nd place Melissa P. Daniel and 3rd place Kenneth Butler. The winners of the allied health category were 1st place Mi Jung, 2nd place Kevin Blake and 3rd place Marlene Harris. The winners of the undergraduate category were 1st place K. L. Alford, 2nd place Keyanna Mitchell, and 3rd place Kristi McGillivray. The winners of the high school category were 1st place Philip Eichhorn, 2nd place Ayesha Alam and a three way tie for 3rd place Robert Triplett, John Bullock and Kimberly Cornelius. The Health Sciences division will continue to foster and encourage research, especially at the different student levels. I hope the student participation at next year's meeting in Tupelo will be even better.

During the Health Sciences divisional meeting Dr. Aaron D. Puckett from UMC Dental School was elected as chair and Dr. I. O. Farah from JSU was elected as vice-chair. The divisional meeting resulted in one action item, the formation of a student competition committee, consisting of Dr. Margot Hall, Chair, Dr. Michelle Tucci, Dr. Larry S. McDaniel and Ms. Zelma Cason as members. The purpose of the committee is to establish permanent guidelines for the student competition and administrate the competition at future meetings. The chair, the vice chair and committee will be charged with soliciting donations to support the competition.

It was a pleasure to serve over the past two years in the capacity of chair and vice chair of the Health Sciences division of the MAS. Working with Dr. Aaron D. Puckett, this year's vice chair, and the former chair, Dr. John Piletz, to plan and carry out the divisional meeting and the research competition

for the students was a most enjoyable and memorable experience.—Zelma Cason

History and Philosophy of Science

The second meeting of the History and Philosophy of Science Division featured a diverse group of presentations. A mini symposium on biological species addressed current concepts as to the usefulness of different types of classification system and the reality of species as entities. The other main theme for philosophical presentations was definitions and perceptions of the reality assumed by science; the manner in which learning is actually achieved through science and the how new knowledge is communicated. Presentations in the area of the history of science included a review of the contributions of four generations of Whitfield women to chemistry in the State of Mississippi, the origin and development of the Polymer Science Department at the University of Southern Mississippi and an historical look at medical practices in India. There were two presentations focused on the issue of evolution, one reviewing the lack of validity to anti-evolution arguments and one reviewing the complexity of the living world and suggesting that such complexity is not possible without intelligent design. The business meeting was held following the final session. Rob Waltzer, the 1999–2000 co-chair, was elected chair for 2000–2001. Paula Smithka was elected co-chair.—Robert Hamilton

Mathematics, Computer Science and Statistics

Members of the Division of Mathematics, Computer Science and Statistics presented twelve papers at the sixty-fourth annual meeting of the Mississippi Academy of Sciences. Two additional papers were scheduled but not presented. At the business meeting between the morning and afternoon sessions, Dr. Dale Bowman was elected 2001 Chairperson and Dr. Joseph Kolibal was elected Vice Chair. Dr. Jeff Stuart volunteered to revive the "Transactions of the Division of Mathematics, Computer Science and Statistics." Each presenter at the annual meeting will be invited to submit an extended abstract of his or her presentation. These unrefereed, three to five-page manuscripts with perhaps one or two figures will not replace nor compete with submission to the Academy's **Journal**. The invitation to submit a "Transaction" will include

encouragement to submit a full paper, based on the presentation, to the **Journal**. Members present at the business meeting noticed that although the audience at the presentations was fairly representative of the three branches of the division, attendance at the business meeting was not. Ways to maximize participation in the business meeting and service as Division officers were discussed.

The Mississippi Chapter of the American Statistical Association is not affiliated with the Academy or Division but has overlapping membership. The Chapter met and elected officers following the last Division presentation.

On Friday morning the Division hosted its first "Meet the Statistician" workshop. Dr. Carolyn Boyle and Mr. Walt Brehm provided free statistical consultation for six researchers and instructors. They discussed experimental design, selection of appropriate statistical tests and automated calculation of classroom statistics.—Walter Brehm

Physics and Engineering

Participation of Engineers in the Division has been consistently low. Sustained efforts by the current and past officers will continue towards increasing the membership of Engineers in the Division.

Faculty participation has been declining over the past few years. Efforts will be made to involve junior faculty members.

Dr. S. Kant Vajpayee, Professor, University of Southern Mississippi, has been elected as the President of the Physics and Engineering Division for the year 2000-2001. He has been requested by the members to select an enthusiastic junior faculty member as the Vice Chair of the Division.

Dr. Amin Haque and Dr. T. M. Parchure have been successful last year in obtaining a grant of \$500 from the U. S. Army Engineer Waterways Experiment Station, Vicksburg. Dr. Parchure is continuing efforts in obtaining another \$500 from WES. The grant will be used for giving awards to students making excellent presentations at the Annual Meeting.

It has been decided that three Cash Awards will be given to students each year. These will be \$100, \$50 and \$25 in the order of merit. Since balance money will be available from the existing grant; the awards can be given on time each year. The present and past officers will continue their efforts in obtaining additional grants each year from other sources.

It is decided to search for at least one student representative from the University of Mississippi, Mississippi State University, and the University of Southern Mississippi who will serve as the points of contact for information dissemination and encouraging student participation.—Trimbak M. Parchure

Science Education

The Science Education Division of the Mississippi Academy of Sciences had 22 platform and five poster presentations at the meeting in Biloxi this year. The number of presentations increased slightly over last year while the number of posters remained unchanged. While a wide variety of topics were presented, many initiated continued discussions even through the break periods. Topics ranged from mentor programs between a university and a high school, to hands-on teaching techniques, to student learning devices, to teaching an online science course. Several presentations revolved around statistical analysis of the Performance Index of rural school districts with emphasis on math and science scores. Additional presentations included utilizing butterfly surveys as school activities, to Marine Biology presentation, to student research presentations. The total attendance was 333 attendees with an average of 15 per session (the range was from 6 to 29 attendees). All presenters generated interest and the comments and questions were positive and beneficial.

Mr. Willie Heard, J.L. Scott Marine Education Center and Aquarium will begin as the year 2000 Science Education Division Chair with Dr. Joyce Applegate, Pearl River Community College will serve as Chair-elect. No other business was discussed at the meeting.

It has been an honor and privilege to serve as both Chair-Elect and Chair of the Science Education Division within the MAS. John Ammons, Mississippi Delta Community College, Moorhead, MS.—John Ammons

Social Sciences

Social Sciences is in its third year as an official division in the Mississippi Academy of Sciences. The division held a small, but varied, session at this year's meeting. We had four papers in the areas of physical anthropology, cultural anthropology, archeology, and sociology of culture and the media. All of the papers

were presented by students—graduate (4) and undergraduate (1)—from the University of Southern Mississippi. Each student did a fine job in presenting their research.

As the division is still small and experiencing some problems in recruiting members and abstracts, the business meeting for the division was held this year together with the Division of Psychology and Behavioral Neuroscience. During the meeting we discussed the possibility of combining the two divisions into one larger division. The decision was made to remain officially separate for the next year, but to combine our sessions for the 2001 meeting. Dr. Ann Marie Kinnell, USM, was re-elected as Chair for Social Sciences and Dr. Emmanuel Nwagbosa, JSU, was re-elected as Vice-Chair.

After the meeting, we discussed some reasons for the lack of participation by social scientists. One difficulty may lie in the plethora of national, regional, and state meetings available to social scientists. We

discussed focusing our recruitment efforts on graduate and undergraduate students and the possibility of creating an award for best graduate paper and best undergraduate paper. It is our hope, of course, that if more students participate, the faculty will come to support them!—Ann Marie Kinnell

Zoology and Entomology

The Zoological/Entomological Division met on the morning of Friday, 25 February, 2000. Ten divisional talks and one poster were presented to an appreciative audience. Estimates of attendance over a 1 l exceeded one hundred individuals throughout the meeting. At the end of the divisional session, Tim Lockley of the U.S. Department of Agriculture and Alex D.W. Acholonu of Alcorn State University were re-elected to the positions of Chairman and Vice Chairman respectively. A fun time was had by all.—Tim Lockely

ABSTRACTS

These abstracts for presentations at the February 2000 annual meeting of the Mississippi Academy of Sciences were not included in the January abstract issue.

Agriculture and Plant Sciences—poster presentation
EARLY AND LATE PLANTING EFFECTS ON
LEAF AREA INDEX (LAI), BIOMASS AND
YIELD OF SNAP BEANS

A.H. Al-Humadi*, Girish K. Panicker, C. Sims, Liang C. Huam, and J. Harriess, Alcorn State University, Alcorn State, MS 39096

This field research was done on highly erodible Memphis Silt Loam Soil (Typic hapludalf, silty, mixed, thermic) in 1993 and 1994 to compare the LAI, biomass and yield of snap beans (*Phaseolus vulgaris* L. var. 'Provider') planted in late summer of 1993 and early summer of 1994. The density of planting for both crops was at 0.904 m x 0.152 m and they received the same cultural practices and fertilizers. Five destructive harvest studies were conducted in each season. Statistical analysis was performed at 0.05 level of probabilities to determine the significant effects of the leaf area index, biomass, and the yield for the two planting. Leaf area index (LAI), and upper and lower dry biomass were significantly lower in summer 1993 planting than summer 1994 planting. However, the yield in summer

1993 was higher than the yield of summer 1994. It was concluded that planting in late summer was more economical to the growers than planting in the early summer.

Cellular, Molecular and Developmental
Biology—oral presentation

DEPENDENCE ON CUTOFF DISTANCE IN
PROTEIN FOLD RECOGNITION SCORING
FUNCTIONS

Alexander Grant Clark, St. Andrew's Episcopal School, Ridgeland, MS 39157

In the protein fold recognition problem, one tries to recognize the correct (native) structure of a protein given its amino acid sequence. The native structure should have a better score than plausible decoy structures. After formulating a scoring function, and keeping that function static, cutoff distances, used in the generation of contact matrices, and protein database atom types were varied to determine the values needed to optimize the scoring function to return the best results. Data collected concluded that using a database of all-carbon atom proteins with a

cutoff distance of 4.0 Å returned the highest Z scores, a measure of a scoring function's ability to distinguish between native structures and decoys.

Chemistry and Chemical Engineering—oral presentation

IBOGAINE ANALOGS AS NOVEL AGENTS FOR ADDICTION THERAPY

Mark S. Levi^{1*}, C. Randall Clark², W. Marvin Davis^{1,5}, Cheryl L. Klein³, John C. Matthews^{1,5}, Harry J. Olverman⁴, Robert D. Sindelar^{1,5}, Norrie H. Wilson⁴, and Ronald F. Borne^{1,5}, ¹University of Mississippi, University, MS 38677; ²Auburn University, Auburn, AL 36849; ³Xavier University of Louisiana, New Orleans, LA 70125; ⁴University of Edinburgh Medical School, Edinburgh, Scotland; and ⁵Research Institute of Pharmaceutical Sciences, University, MS 38677

Currently, ibogaine, an indole alkaloid isolated from West African shrubs, appears to be the most novel lead to further new drug development for treatment of drug dependency. Surprisingly, few analogues of ibogaine have been synthesized and evaluated. Modifications of the structure offer not only opportunity to find an improved congener of ibogaine, but also to reach a better understanding of the mechanism(s) responsible for its desirable actions. That is because structural modifications may lead to changes in the neurochemical activity profile. Thus, inferences would become possible regarding neurochemical actions underlying the favorable neurobehavioral effects of ibogaine itself. Of particular interest have been recent reports that ibogaine binds to a number of receptor systems, most notably the NMDA receptor subtype, an area of special interest to this research. The brain NMDA receptor system has been implicated in the pathway of addiction. The overall goals of this research are to synthesize 2-azabicyclo[2.2.2]octane analogues of ibogaine to clarify SAR requirements at the NMDA receptor and to identify analogues more potent and less toxic than ibogaine or its metabolite as potentially

useful agents.

Marine and Atmospheric Sciences—poster presentation

A STUDY OF HURRICANE PREDICTIVE INDEX (HPI) FOR PREDICTING HURRICANE BRET OVER THE GULF OF MEXICO

R. Suseela Reddy¹, John L. Hurley^{1*}, and Richard L. Miller², ¹Jackson State University, Jackson, MS 39217 and ²NASA Earth System Science Office, Stennis Space Center, MS 39259

Under the NASA FAR Program, a study has been undertaken to investigate the ocean-atmosphere interactions over the Gulf of Mexico and their relation in the formation and development of tropical cyclones/hurricanes. Hurricane Predictive Index (HPI), a new method, has been developed for predicting the formation and development of land-falling tropical cyclones/hurricanes over the Gulf of Mexico. This index characterizes the ocean-atmosphere interactions over the Marine Boundary Layer (MBL) in terms of heat, momentum and latent heat fluxes, scale height, pressure tendency, kinetic energy, and instability. A positive index indicates no sign of formation of hurricanes. A negative index indicates a significant formation and development of hurricanes. The index has been tested for the hurricanes Opal and Roxanne, which formed over the Gulf of Mexico in October 1995 (Reddy and Miller 1998; Reddy and Miller 1999). In the present study, the index has been further tested for hurricane Bret which formed and developed on August 22, 1999 over the Gulf of Mexico. GOES (visible), AVHRR sea surface temperatures, and NOAA's buoy data from the National Data Buoy Center at Stennis were used in this study. The study has indicated a strong negative index (-0.5 to -5.0), 2–3 days prior to the formation and development of hurricane Bret. The results were in good agreement with those of previous studies. The method is useful to disaster relief agencies for reducing property damage and loss of life during these events.

A Science History Quiz

Here is a quiz of your knowledge of the great scientists and their writings. The six quotations below are reproduced from great works of science. See how many you can identify both as to the author and the work from which the quotation came. Answers are on the last page of this issue.

Quotation 1

The idols and false notions which have already preoccupied the human understanding, and are deeply rooted in it, not only so beset men's minds that they become difficult of access, but even when access is obtained will again meet and trouble us in the instauration of the sciences, unless mankind when forewarned guard themselves with all possible care against them.

Four species of idols beset the human mind, to which (for distinction's sake) we have assigned names, calling the first idols of the tribe, the second idols of the den, the third idols of the market, the fourth idols of the theatre.

The formation of notions and axioms on the foundation of true induction is the only fitting remedy by which we can ward off and expel these idols. It is, however, of great service to point them out; for the doctrine of idols bears the same relation to the interpretation of nature as that of the confutation of sophisms does to common logic.

Quotation 2

Revolutions of Heavenly Spheres

The argument which maintains that the Earth, as a part of the celestial sphere and as sharing in the same form and movement, moves very little because very near to its centre advances to the following position: therefore the Earth will move, as being a body and not a Centre, and will describe in the same time arcs similar to, but smaller than, the arcs of the celestial circle. It is clearer than daylight how false that is; for there would necessarily always be noon at one place and midnight at another, and so the daily risings and settings could not take place, since the movement of the whole and the part would be one and inseparable.

Quotation 3

It has been ten years since I published my Commentaries on the Movements of the Planet Mars. As only a few copies of the book were printed, and as it had so to speak hidden the teaching about celestial causes in thickets of calculations and the rest of the

astronomical apparatus, and since the more delicate matters were frightened away by the price of the book too; it seemed to my friends that I should be doing right and fulfilling my responsibilities, if I should write an epitome, wherein a summary of both the physical and astronomical teaching concerning the heavens would be set forth in plain and simple speech and with the boredom of the demonstrations alleviated. I did that before many years had passed. But meanwhile various delays came between the book and publication: the little book itself was not up to date in spots, and, unless I am mistaken, it was also incomplete in the form in which it was given, and even the plan of publication began to totter. For in the "doctrine concerning the sphere"—published before three years were up—I seemed to certain people to be more diffuse in arguing about the diurnal movement or repose of the earth than befitted the form of an epitome. Accordingly I reflected that if the readers had not digested that part, which was however absent from no epitome of astronomy, all the more strange to them would be this Fourth book, which airs so many new and unthought-of things concerning the whole nature of the heavens—so that you might doubt whether you were doing a part of physics or astronomy, unless you recognized that speculative astronomy is one whole part of physics.

Quotation 4

Axioms, or Laws of Motion

Law I. *Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it.*

Projectiles continue in their motions, so far as they are not retarded by the resistance of the air, or impelled downwards by the force of gravity. A top, whose parts by their cohesion are continually drawn aside from rectilinear motions, does not cease its rotation, otherwise than as it is retarded by the air. The greater bodies of the planets and comets, meeting with less resistance in freer spaces, preserve their motions both progressive and circular for a much longer time.

Quotation 5

Organs of Extreme Perfection and Complication

To suppose that the eye with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest degree. When it was first said that the sun stood still and the world turned round, the common sense of mankind declared the doctrine false; but the old saying of *Vox populi, vox Dei*, as every philosopher knows, cannot be trusted in science. Reason tells me, that if numerous gradations from a simple and imperfect eye to one complex and perfect can be shown to exist, each grade being useful to its possessor, as is certainly the case; if further, the eye ever varies and the variations be inherited, as is likewise certainly the case; and if such variations should be useful to any animal under changing conditions of life, then the difficulty of believing that a perfect and complex eye could be formed by natural selection, though insuperable by our imagination, should not be considered as subversive of the theory. How a nerve comes to be sensitive to light, hardly concerns us more than how life itself originated; but I may remark that, as some of the lowest organisms, in which nerves cannot be detected, are capable of perceiving light, it does not seem impossible that certain sensitive elements in their sarcoderm should become aggregated and developed into nerves, endowed with this special sensibility.

Quotation 6

Thus far I have spoken of the passage of the blood from the veins into the arteries, and of the

manner in which it is transmitted and distributed by the action of the heart; points to which we, moved either by the authority of Galen or Columbus, or the reasonings of others, will give in their adhesion. But what remains to be said upon the quantity and source of the blood which thus passes is of so novel and unheard-of-character, that I not only fear injury to myself from the envy of a few, but I tremble lest I have mankind at large for my enemies, so much doth wont and custom, that become as another nature, and doctrine once sown and that hath struck deep root, and respect for antiquity influence all men: still the dice is cast, and my trust is in my love of truth, and the candour that inheres in cultivated minds. And sooth to say when I surveyed my mass of evidence, whether derived from vivisections, and my various reflections on them, or from the ventricles of the heart and the vessels that enter into and issue from them, the symmetry and size of these conduits—for nature doing nothing in vain, would never have given them so large a relative size without a purpose—or from the arrangement and intimate structure of the valves in particular, and of the other parts of the heart in general, with many things besides, I frequently and seriously bethought me, and long revolved in my mind, what might be the quantity of blood which was transmitted, in how short a time its passage might be effected, and the like and not finding it possible that this could be supplied by the juices of the ingested aliment without the veins on the one hand becoming drained, and the arteries on the other getting ruptured through the excessive charge of blood, unless the blood should somehow find its way from the arteries into the veins, and so return to the right side of the heart; I began to think whether there might not be a MOTION, AS IT WERE, IN A CIRCLE.

Answers to the science history quiz: Q1. Francis Bacon, *Novum Organum*. Q2. Nicolaus Copernicus, *On the Revolutions of the Heavenly Spheres*. Q3. Johannes Kepler, *Epitome of Copernican Astronomy*. Q4. Isaac Newton, *Mathematical Principles of Natural Philosophy*. Q5. Charles Darwin, *The Origin of Species*. Q6. William Harvey.