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Many of you hold academic positions with responsibilities for training graduate and undergraduate students. Others of you are involved with student training indirectly through connections with academic colleagues. Each year the Academy serves as a place where some of those students present what is frequently their first formal presentation of research. Many of us had our first experience with a formal presentation of our research at a state academy of science and continue that tradition. State academies have been the launching ground for many young scientists.

State academy journals can serve an equally important role as the forum for publishing a student's first peer-reviewed paper. How many master's theses are never published because they just do not represent enough material or they represent a verification of somebody else's work or they are too local in nature to be published nationally? Yet the research it self is sound and worthy of publication. The student would benefit from the experience of submitting to a peer reviewed journal, and for a young person trying to compete in the job market a publication would be helpful.

The Journal of the Mississippi Academy of Sciences can serve you and your students as an outlet for research of limited or local nature. The journal is peer reviewed. The time frame for publication is usually less than six months. We accept articles describing original research, describing science education including laboratory experiments that you might suggest for high school or college teaching laboratories, science related news events of local interest, and descriptions of science institutions and missions in Mississippi. Articles addressing history and philosophy of science are also encouraged.

The Mississippi Academy of Sciences has maintained an office on Briarwood Drive in Jackson for many years. Recently an opportunity arose to move to a less expensive office. That move will take place this month (April). The new address is listed below with a postal box so that any future moves will not impact the flow of mail to the office. The street address for the office is 3000 Old Canton Road, Suite 405. A new telephone number will also be in place, but is not available at this writing.—Ken Curry

The Mississippi Academy of Sciences has a new address:

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The 2001 Annual Meeting of the Mississippi Academy of Sciences

Photographs by Ann Curry

Mississippi Academy of Science 2001 Award Winners. (left to right) Steven T. Case, Dudley F. Peeler Outstanding Contributions to the Mississippi Academy of Sciences Award; William M. Miles, Secondary Science Teacher Award; Robert C. Bateman, Jr., Outstanding Contributions to Science Award.

Three past presidents discuss Academy business. (left to right) Tom Lytle, Julia Lytle, and Steve Case.

Jim Heitz (right) has handled the Academy exhibits for many years.

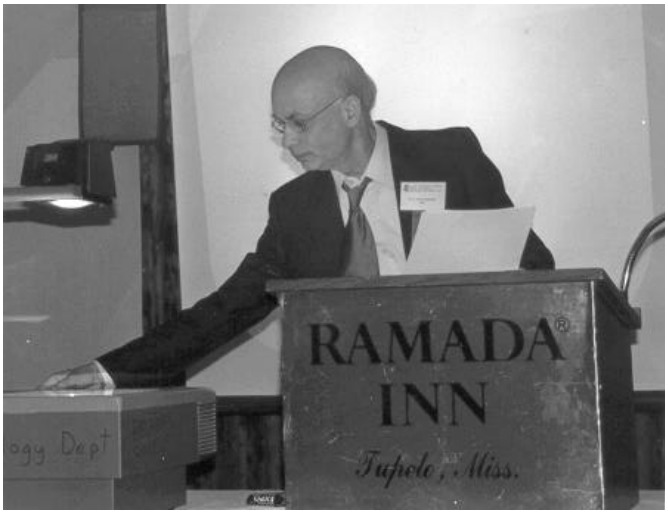
Academy Executive Officer John Boyle fields a telephone call at the registration desk.

Business is conducted at the Academy meeting.

Officers at the Academy business meeting. (seated left to right) Jim Heitz, exhibits coordinator; Ken Curry, journal editor; Marcy Petrini, exhibits coordinator; and John Boyle, executive officer.

Activity at the registration area. Cynthia Huff, 2nd from the right, is in charge of registration.

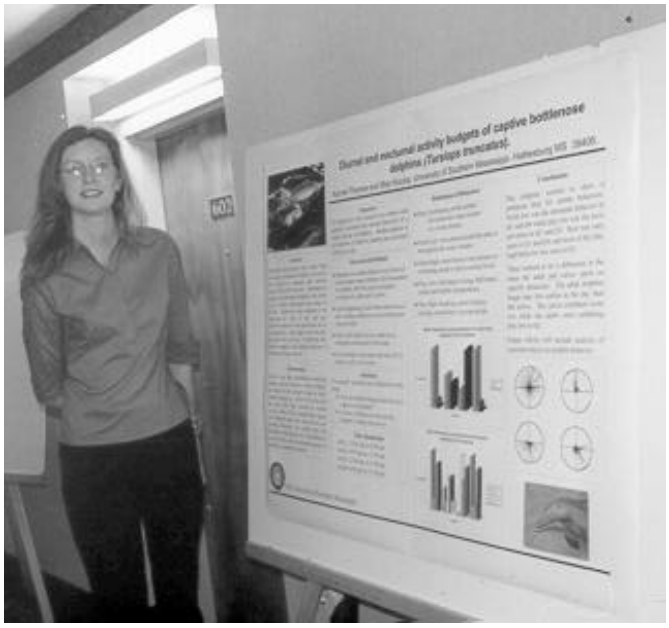
Lectures are delivered.



Kant Vajpayee, division chair for Physics and Engineering, delivers a lecture in History and Philosophy of Science.

Frank Gilmore delivers an invited lecture in the Sigma Xi symposium on ethics.

Poster session are popular.



[insert AcadSci advertisment here.]

Ticks and Tick Ecology in Mississippi: Implications for Human Disease Transmission

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Ticks are blood-sucking ectoparasites which may transmit a wide variety of disease organisms to humans. They feed exclusively on blood and have rather specific temperature and humidity requirements. Because of these requirements, as well as host availability, ticks tend to congregate in areas providing those factors. This leads to "clustering" of ticks in the environment. A field project was conducted at a wildlife management area to carefully document lone star tick (LST) clustering in relation to shade and soil moisture. Results of this study showed clear patterns of LST clustering, especially of nymphs, in association with shade and soil moisture. Ticks were only collected in areas with >23% soil moisture. Only three ticks out of 221 were collected in 10% or less shade. The average percent shade for areas where all adult LST's were caught was 63% in lane one and 43% in lane two. This study indicated that LST clustering in nature is real and somewhat predictable. The epidemiological implications of tick clustering are presented and discussed.
Key Words: ticks, tick-borne diseases, tick control

***Medical importance of ticks*—**Ticks are blood-sucking ectoparasites capable of transmitting a wide variety of disease organisms such as protozoa (babesiosis), viruses (encephalitis and Colorado tick fever), and bacteria (Rocky Mountain spotted fever, ehrlichiosis, Lyme disease, and tularemia) (Spach, 1993). They seem to especially be associated with spotted fever group rickettsial organisms (Burgdorfer, 1977). In addition, ticks may cause paralysis in humans and animals as a result of salivary toxins injected upon feeding. In Mississippi, there are approximately 30 cases of RMSF and 20 cases of Lyme disease (LD) reported each year (Personal Communication, Dr. Mary Currier, Mississippi Department of Health, October 5, 2000). Only rarely are cases of tick-borne tularemia or ehrlichiosis reported in Mississippi. Concerning Lyme disease, there is controversy as to whether or not Mississippi cases are actually LD or another, yet undescribed, Lyme-like illness.

***Tick biology*—**There are three families of ticks recognized in the world today: (1) Ixodidae (hard ticks), (2) Argasidae (soft ticks), and (3) Nuttalliellidae, a small, curious, little-known group with some characteristics of both hard and soft ticks (Varma, 1993). The terms hard and soft refer to the presence of a dorsal scutum or "plate" in the Ixodidae, which is absent in the Argasidae.

Hard ticks display sexual dimorphism, males and females look obviously different (Figure 1), and the blood-fed females are capable of enormous expansion. They have no true head, but their mouthparts are anteriorly attached and visible from dorsal view. If eyes are present, they are located dorsally on the sides of the scutum.

Soft ticks are leathery and nonscutate, without sexual dimorphism (Figure 2). Their mouthparts are subterminally attached in adult and nymphal stages and not visible from dorsal view. Eyes, if present, are located laterally in folds above the legs.

There are major differences in the biology of hard and soft ticks. Some hard ticks have a one-host life cycle, wherein engorged larvae and nymphs remain on the host after feeding; they then molt, and subsequent stages reattach and feed. Adults mate on the host, and only engorged females drop off to lay eggs on the ground. While some hard ticks complete their development on only one or two hosts, most commonly encountered ixodids have a three-host life cycle. In this case, adults mate on a host (except for some Ixodes spp.) and the fully fed female drops from the host animal to the ground and lays from 2,000 to 18,000 eggs, after which she dies. Eggs hatch in about 30 days into a six-legged seed tick (larval) stage, which feeds predominantly on small animals. The fully fed seed ticks drop to the ground and transform into eight-legged nymphs. These nymphs seek an animal host, feed, and drop to the ground. They then molt into adult ticks, thus completing the

Figure 1. Female and male hard ticks, showing obvious sexual dimorphism (U.S. Air Force photo).

life cycle.

Ticks feed exclusively on blood, and begin by cutting a small hole into the host epidermis with their chelicerae and inserting the hypostome into the cut, thereby attaching to the host. Blood flow is maintained with the aid of an anticoagulant from the salivary glands. Some hard ticks secure their attachment to the host by forming a cement cone around the mouthparts and surrounding skin. Two phases are recognized in the feeding of nymphal and female hard ticks: (1) a growth feeding stage characterized by slow continuous blood uptake and (2) a rapid engorgement phase occurring during the last 24 h or so of attachment.

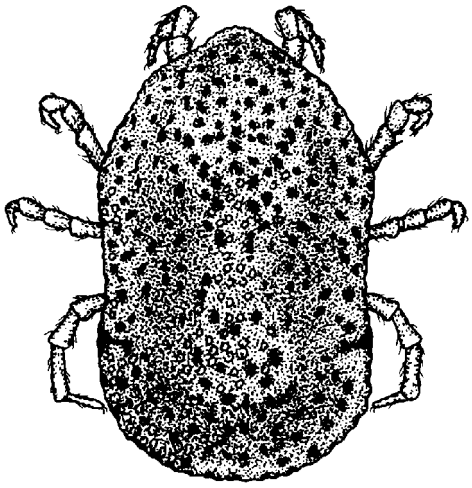

Figure 2. Typical soft tick (U.S. Air Force drawing).

The biology of soft ticks differs from hard ticks in several ways. Adult female soft ticks feed and lay eggs several times during their lifetime. Soft tick species may also undergo more than one nymphal molt before reaching the adult stage. With the exception of larval stages of some species, soft ticks do not firmly attach to their hosts for several days like the Ixodidae—they are adapted to feeding rapidly and leaving the host promptly.

Many hard tick species "quest" for hosts, by climbing blades of grass or weeds and remaining attached, forelegs outstretched, awaiting a passing host. They may travel up a blade of grass (to quest) and back down to the leaf litter where humidity is high (to rehydrate) several times a day. Also, hard ticks will travel a short distance toward a CO_2 source. Adult ticks are more adept at traveling through vegetation than the minute larvae.

***Tick ecology*—**Hard ticks and soft ticks occur in different habitats. In general, hard ticks occur in brushy, wooded, or weedy areas containing numerous deer, cattle, dogs, small mammals, or other hosts. Soft ticks are generally found in animal burrows or dens, bat caves, dilapidated or poor-quality human dwellings (huts, cabins, etc.), or animal rearing shelters. Many soft tick species thrive in hot and dry conditions, whereas ixodids are more sensitive to desiccation and, therefore, usually found in areas providing protection from high temperatures, low humidities, and constant breezes.

Most hard ticks, being sensitive to desiccation, must practice water conservation and uptake. Their epicuticle contains a wax layer which prevents water movement through the cuticle. Water can be lost through the spiracles; therefore, resting ticks keep their spiracles closed most of the time opening them only one or two times an hour. Tick movement and its resultant rise in CO_2 production cause the spiracles to open about 15 times an hour with a corresponding water loss.

Development, activity, and survival of hard ticks is influenced greatly by temperature and humidity within the tick microhabitat. Because of their temperature and high humidity requirements, as well as host availability, hard ticks tend to congregate in areas providing those factors. Ecotonal areas (interface areas between forests and fields) are excellent habitats for hard ticks. Open meadows/prairies, along with climax forest areas, support the fewest ticks. Ecotone areas and small openings in the woods are usually heavily infested. Deer and small mammals thrive in ecotonal areas, thus providing blood meals for ticks. In fact, deer are often heavily infested with hard ticks in the spring and summer months. The optimal habitat of white tail deer has been reported to be the forest ecotone, since the area supplies a wide variety of browse and frequently offers the greatest protection from their natural enemies. Many favorite deer foods are also found in the low trees of an ecotone, including greenbrier, sassafras, grape, oaks, and winged sumac.

Ticks are not evenly distributed in nature. The spatial arrangement of ticks in nature may be uniform (over-dispersed), random, or aggregated (underdispersed), depending upon tick species and ecology of the host (Korch, 1994). Hard ticks attach to a vertebrate host for several days. Host specificity varies by tick species; some ticks feed on almost any vertebrates, whereas others are closely associated with a particular rodent, bird, reptile, etc. Since engorged ticks are most likely to fall off wherever their hosts spend the most time, the presence of ticks in the environment is largely a function of host activity.

Field study—Previous tick studies in Mississippi have indicated clustering or clumping of at least two hard-tick species. A study of the ecology of adult *Ixodes scapularis* in a privately owned wildlife management area demonstrated clustering patterns (Goddard, 1992). Another study, 200 miles north of the first, revealed clumping of adult *Amblyomma americanum,* or lone star ticks (LST) (Jackson et al. 1996). The LST is an extremely aggressive pest species occurring primarily in the southeastern and south-central United States, and up the eastern seaboard to approximately New York. All three motile life stages bite humans, pets, domestic and wild animals. A field study was designed to determine whether the phenomenon of tick clustering in nature is real and predictable. Portions of this work have been previously published (Goddard, 1997).

MATERIALS AND METHODS

Field study—Lone star ticks were collected in two field plots over a period of seven months and their location within the plots studied in relation to soil moisture and shade. In late winter, 1994, two lanes 620 meters long by 2 meters wide were mowed ("bush-hogged") through the woods at the Copiah County Game Management Area in central Mississippi. The narrow lanes were mowed to facilitate careful sampling and exact numbering of each lane into 10-meter sections. The two lanes were located 1.6 kilometers apart. Each lane crossed several types of habitat (open field; creek bottoms; and forests of oak, hickory, and pine). From April 1, 1994, to October 31, 1994, each lane was sampled for ticks on a weekly basis: a 1-square-meter piece of white flannel cloth was dragged up one side of the lane all the way to the end and back down the other side. The cloth was examined for ticks every 10 meters. Spots were marked on a map drawn to scale wherever LST's (adults or nymphs) were captured. Except for voucher specimens, all ticks were returned alive to the plots. Percent shade for each 10-meter section of lane was visually estimated three times during the season (May 15, July 15, and September 15) and averaged to yield a shade value for each section. Percent soil moisture was determined (using an OSK® soil moisture meter from Forestry Suppliers of Jackson, Mississippi) on the same three dates and averaged to yield a moisture value for each 10-meter section.

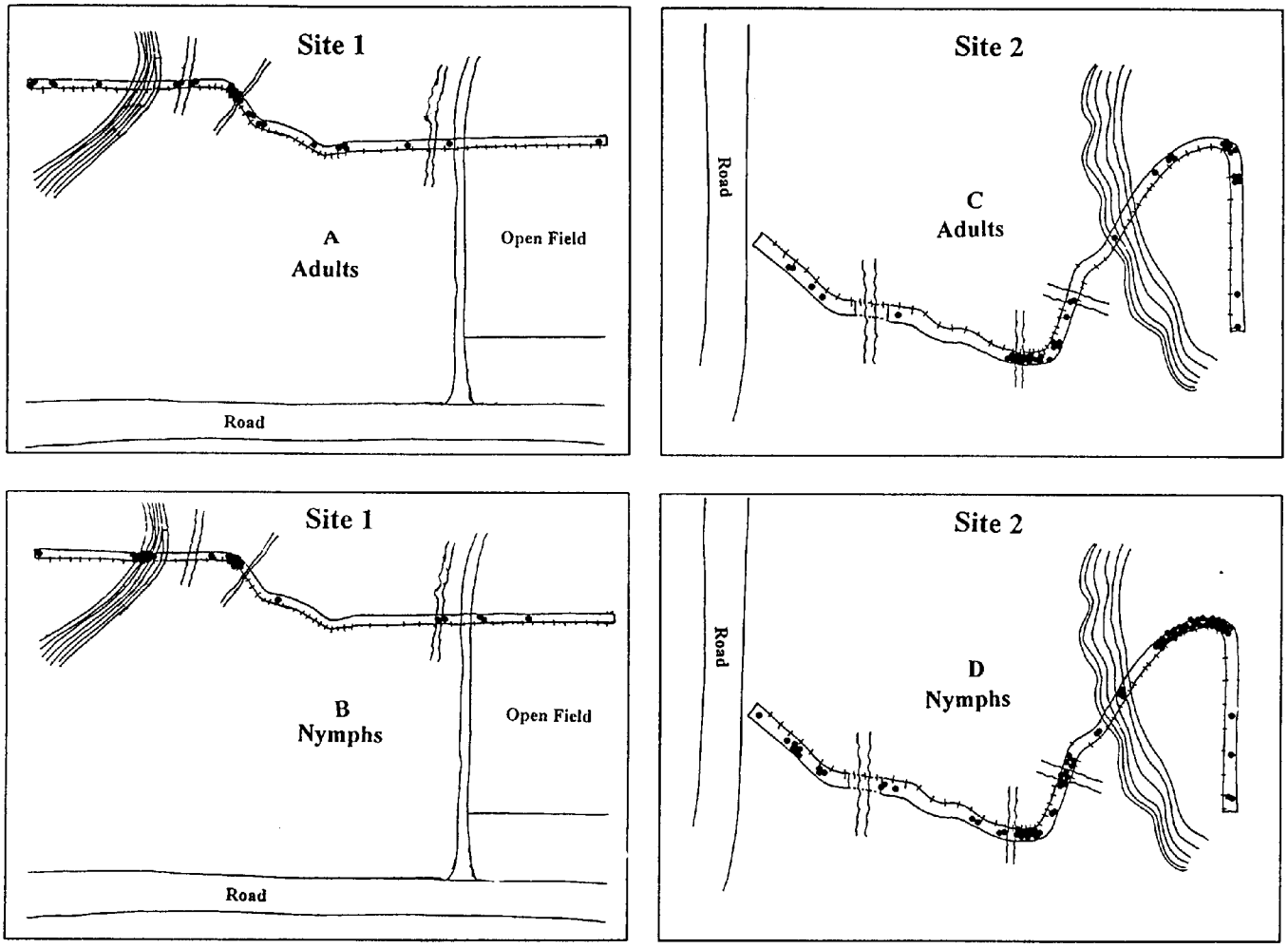

Figure 3. Distribution of ticks collected from study sites, Copiah County Game Management Area, showing clustering effect. Each dot represents one or more tick collections.

RESULTS AND DISCUSSION

Field study—Overall, 221 LST's were collected—64 in site one and 157 in site two. Breaking down by life stage, 31 adults and 33 nymphs were collected in site one, whereas 44 adults and 113 nymphs were collected in site two. Seasonally, the peak of adult ticks in site one was June 15; the peak in site two was June 8. More nymphs were collected on May 31 and June 8 than any other date in site one, and on June 8 in site two.

Lone star ticks were clustered in the lanes (Figure 3). This was most obvious in site two (especially the nymphs, see Figure 3 D). In fact, if one calculates the area where most ticks were found and divides by total area (x 100), the percent of area where ticks were found is quite small (Table 1). This was most striking for nymphs in site one where 73% were collected in 9.7% of the lane. Overall, approximately 70% of LST's were found in approximately 10–20% of the geographic area.

Percent shade in the lanes ranged from 0–90% in both sites. Ticks were collected mostly from shaded areas. Only three ticks out of 221 were collected in 10% or less shade. This may be due to LST inability survive hot dry environments. One study in Arkansas demonstrated that LST eggs reared in an environment of <75% humidity would not hatch (Lancaster, 1957). The average percent shade for areas where all adult LST's were caught was 63% in site one, and 43% in site two. The average percent shade for areas where all nymphs were collected was 61% in site one and 46% in site two. If one further breaks down the collection data into only the areas where most LST's were collected the percentages are higher (Table 2). Soil moisture in the lanes ranged from 20–66% in site

one and from 27–88% in site two. Overall, site two was a wetter site. Interestingly, site two produced 30% more ticks than site one. Again, this may relate to moisture needs by lone star ticks for survival. Ticks were collected where soil moisture was >23%, with most collected where it was 37% or higher (Table 3).

Table 1. Clustering of lone star ticks in study sites.

Site	Tick Stage	Percent of Area Where Majority of Ticks Were Found
1	Adult	17.7
1	Nymph	9.7
2	Adult	14.5
2	Nymph	25.8

Table 2. Percent shade in places where the majority of lone star ticks were collected.

Site	Tick Stage	Amount LST's Collected	Percent Shade
1	Adult	21/31 (68%)	71
1	Nymph	24/33 (73%)	65
2	Adult	31/44 (70%)	45
2	Nymph	81/113 (72%)	71

This study indicated that lone star tick clustering in nature is real and somewhat predictable. Clearly definable spots in the study sites consistently produced ticks, whereas others did not. For example, almost no ticks were collected in open areas with full sunlight. Approximately 70% of ticks were collected in 10–20% of the geographic area.

Implications for disease transmission—Clustering of ticks in the woods can have important epidemiological implications. A person working or playing outdoors may encounter one of these "hot spots" and acquire numerous tick bites. I personally saw a young family with two children under age 6 having a picnic on the ground at a state park in an area where I had previously collected hundreds of lone star ticks! On the other hand, tick clustering may be a weak link which we can exploit for prevention/control purposes. If sites of clustering can b e identified they can be possibly avoided or sprayed with pesticides. Since most of the ticks only occur in 10–20% of the area, then carefully placed (precision-targeted) pesticides could theoretically significantly reduce tick populations with minimal use of pesticides.

Table 3. Percent soil moisture in places where the majority of lone star ticks were collected.

Site	Tick Stage	Amount LST's Collected	Percent Soil Moisture
1	Adult	21/31 (68%)	38
1	Nymph	24/33 (73%)	37
2	Adult	31/44 (70%)	52
2	Nymph	81/113 (72%)	53

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Effect of Foliar-Applied Salicylic Acid on Cotton Flowering, Boll Retention, and Yield

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Salicylic acid (2-hydroxybenzoic acid) may help regulate several plant functions, including systemic acquired resistance to pathogens and the formation of flowers. The objective of this study was to characterize the effects of foliar-applied salicylic acid on cotton (*Gossypium hirsutum* L.) flowering, boll retention, and yield. Field experiments were conducted at two Mississippi locations in 1995 and at one location in 1997. In 1995, a single application of sodium salicylate (0, 17.1, 51.3, or 171 g ha^{-1}) was made two to three weeks prior to flowering. In 1997, nine sequential applications of sodium salicylate (51.3 g ha^{-1}) or salicylic acid (44.3 g ha^{-1}) or a check solution (Tween 20, polyoxyethylene sorbitan monolaurate only) were made beginning when the first floral buds were present and ending at first flower. In one of the 1995 tests and in the 1997 test, the cotton was not treated with insecticides after planting. Although physiological responses to exogenously-applied salicylic acid on cotton have been reported elsewhere, in the present study, flower production, boll retention, and yield were not significantly affected.

Foliar applications of salicylic acid have been shown to affect flower induction and flower numbers in several species. In minute duckweed (*Lemna paucicostata*), salicylic acid increased the percent of plants flowering under both long- and short-day lengths (Watanabe and Takimoto, 1979). Kharana and Cleland (1992) showed that 10 µM salicylic acid or benzoic acid induced flowering of *L. paucicostata* LP6. Both exogenous salicylic acid and the salicylic acid fraction of brown ambrosia aphid (*Dactynotus ambrosiae*) honeydew that had been feeding on cocklebur, *Xanthium strumarium* L. induced flowering in inflated duckweed, *L. gibba* (Cleland and Ajami, 1974). However, in Japanese morningglory {[*Ipomoea nil* (L.) Roth]=[*Pharbitis nil* (L.) Choisy]}, salicylic acid reduced flowering (Groenewald and Visser, 1978).

In mung bean (*Vigna radiata* L.), three foliar sprays of 7.2 and 72 µM salicylic acid increased seed yield per plant by 19 and 46%, respectively (Singh and Kaur, 1980). In cheena millet (*Panicum miliaceum* L.), salicylic acid increased plant height and grain number (Datta and Nanda, 1985).

In addition to possible involvement in flowering, the knowledge of the role of salicylic acid in systemic acquired resistance and pest resistance has recently been advanced (Raskin, 1992; Delaney et al., 1994; Ryals et al., 1996; Sticher et al., 1997). Plant drenches of salicylic acid at 61 and 123 µM also increased cotton root gossypol concentration by 35 and 47%, respectively (Khoshkhoo et al., 1993). Soaking cotton seedling root systems for 30 s in 0.1% salicylic acid reduced shoot fresh weight and root-knot nematode (*Meloidogyne incognita* race 3) egg numbers per root biomass (Hedin et al., 1995). Herbivory by *Helicoverpa zea* (Boddie) increased cotton leaf salicylic acid and H_2O_2 concentration (Bi et al., 1997), a response frequently observed following pathogenesis (Klessig and Malamy, 1994). However, foliar applications of salicylic acid did not affect cotton foliar resistance to *H. zea*. Hypersensitivity response to bacterial blight (*Xanthomonas campestris* pv *malvacearum*) in cotton was reported to be related to the accumulation of salicylic acid in cotyledons (Martinez et al., 2000).

Since the agronomic effects of salicylic acid on cotton in the mid-south USA have not been reported, the objective of this study was to determine whether foliar applications of sodium salicylate or salicylic acid would increase yield, flowering, and boll retention in field-grown cotton.

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MATERIALS AND METHODS

Cotton (cv. Deltapine 50) was grown in the field in two locations (3 km apart) near Stoneville, MS in 1995. Seed were planted on 18 April 1995 (Test 1) at one location on a mixed soil type (a Bosket very fine sandy loam and a Dundee very fine sandy loam) and on 10 May 1995 for the second location on Dundee silty clay (Test 2). No attempt was made to match planting dates between Test 1 and Test 2. In 1997, Test 3 was planted on 23 May at the same site where Test 1 was two years earlier. Conventional fungicide seed-treatment and planting procedures were used. Row spacing was 102-cm and plots were four rows wide and 5.2 m long. Final plant stand density averaged 11 plants m^{-2}.

In Tests 1 and 2, foliar treatments were applied on only one date during the floral bud stage, approximately two to three weeks before first bloom. The treatments consisted of one application of 0, 0.625, 1.87, or 6.25 mM Na salicylate (Sigma Chemical Co., St. Louis, MO). All solutions contained 0.05% (v/v) Tween 20 (polyoxyethylene sorbitan monolaurate, Sigma Chemical Co., St. Louis, MO) and were applied using a backpack sprayer with flat-fan nozzles. The rate of solution applied was 171 L ha^{-1} (17.1 mL m^{-2}). Thus, rates of sodium salicylate were 0, 17.1, 51.3, and 171 g ha^{-1}. Application dates were 14 June 1995 for Test 1 and 15 June 1995 for Test 2. Initial flowering for Test 2 occurred approximately one week later than flowering for Test 1. An additional unsprayed check treatment, was included in both tests.

Because the results in Tests 1 and 2 indicated that a one-time salicylic acid spray had little effect, we changed to multiple treatments in Test 3 to consist of a check (Tween 20 only), foliar sprays of 1.87 mM sodium salicylate (pH 5.4) with 0.05% Tween 20, and foliar sprays of 1.87 mM salicylic acid (pH 3.1) also with 0.05% Tween 20. Application dates were 16 June, 18 June, 20 June, 23 June, 25 June, 27 June, 1 July, 8 July, and 15 July 1997. The spray rate for each application was 17.1 mL m^{-2} (171 L ha^{-1}). For sodium salicylate and salicylic acid, respectively, seasonal totals of 462 g and 395 g were applied per ha.

In Tests 1 and 3, plots were not treated with insecticide. In Test 2, plots were treated with insecticide on 27 May, 10 June, 22 June, 1 July, 15 July, 3 Aug., and 12 Aug. when insect pests typical of mid-South USA cotton reached threshold levels.

On selected dates during flowering (approximately twice weekly), white flowers were counted on one of the inner rows of each plot (5.28 m^2 per plot). In upland cotton, petals of blooms are white or cream colored on the day of anthesis. Petals are inconspicuous the day prior to anthesis and are pink or red the day following anthesis. Thus, it is possible to find and count all flowers at anthesis on a given day without concern for counting flowers that reached anthesis on an earlier or later date. An estimate of flowers reaching anthesis, on days when counts were not made, was made by interpolation. Subsequently, total seasonal flower production was calculated (Heitholt, 1993).

As the crop matured, open bolls were counted and hand-harvested from 4.6 m^2 of one inner row per plot (same row as that used for the flower count). Hand-harvest dates were 25 Aug., 6 Sept., 18 Sept., 27 Sept., and 6 Oct. 1995 for Test 1. Harvest dates were 7 Sept., 27 Sept., and 9 Oct. 1995 for Test 2. For Test 3, harvest dates were 9 Sept., 16 Sept., 30 Sept., 6 Oct., 16 Oct., 23 Oct., and 3 Nov. 1997. Boll retention (seasonal boll number divided by seasonal flower number), yield, boll numbers, and boll size (lint per boll) were determined.

The treatments in all three experiments were arranged in a randomized complete block design with six replications. An analysis of variance (ANOVA) was performed on all data. For Tests 1 and 2, sources of variation were replicate, control, rate (control), and error. For Test 3, only three treatments were used, so the sources of variation were replicate, treatment, and error.

RESULTS AND DISCUSSION

Tests 1 and 2 indicated that none of the treatments significantly affected yield (Table 1). It is possible that treatment of plants with salicylic acid can induce defenses against microbes, insects, and herbivores (Metraux and Raskin, 1992). Therefore, we originally hypothesized that a positive effect from salicylate was more likely in Test 1, which did not receive insecticide, than in Test 2.

Other yield-related factors, such as flower production, boll numbers, boll retention percentage, and boll size were likewise unaffected by foliar-applied salicylate (Table 1). Flower production, boll numbers, and boll retention in this study were typical of previous studies with Deltapine 50 (Heitholt, 1993).

In Test 3, a severe insect infestation greatly reduced flowering and yield. Yield was not significantly (P=0.08) affected by either salicylic acid or sodium salicylate (Table 2). Flower numbers, boll retention, and boll size were also unaffected. Others have reported that 10^{-4} to 10^{-10} M salicylic acid decreased abscisic acid-induced leaf abscission (as measured by petiole breakage) in kidney bean (*Phaseolus vulgaris* L.) (Apte and Laloraya, 1982). In Tests 1, 2, and 3, differences in leaf damage due to treatments were not observed. However, a high incidence of boll rot was generally observed in Test 3 regardless of treatment (no data collected).

Table 1. Effect of sodium salicylate on flower production, boll characteristics, and lint yield of Deltapine 50 cotton in 1995 at two locations.

Na Salicylate Treatment	Seasonal Flowers	Bolls	Boll Retention	Lint Yield	Boll Size
Test 1 No Insecticide	number m^{-2}		%	kg ha^{-1}	g (lint)
Unsprayed	104	65.7	63	970	1.47
Tween 20 only	107	63.9	60	973	1.53
17.1 g ha^{-1}	110	66.2	60	1010	1.52
51.3 g ha^{-1}	110	63.3	57	938	1.48
171.0 g ha^{-1}	106	70.2	66	1040	1.48
LSD (0.05)[a]	ns	ns	ns	ns	ns
Test 2 Conventional Insecticide					
Unsprayed	114	55.7	49	764	1.37
Tween 20 only	117	54.6	47	739	1.37
17.1 g ha^{-1}	114	53.2	47	725	1.36
51.3 g ha^{-1}	110	54.0	50	751	1.40
171.0 g ha^{-1}	114	49.5	43	708	1.44
LSD (0.05)[a]	ns	ns	ns	ns	ns

[a]LSD values for Test 1 were 11, 5.3, 9, 81, and 0.07 and for Test 2 were 13, 6.3, 14, 70, and 0.12.

In contrast to Patil and Wele (1992) factors other than salicylic acid obviously controlled the reproductive growth in field studies reported here. In the study by Patil and Wele (1992), salicylic acid may have increased yield by decreasing transpiration in a water-limited environment.

The finding that Test 1 (no insecticides) exhibited a greater yield than Test 2 (insecticides applied) needs an explanation. In Tests 1 and 2 (1995), extremely warm August temperatures in the mid-Delta impeded

reproductive growth. Reproductive development of the earlier planted cotton (i.e., Test 1) was about one week further advanced than Test 2. Although one week is not extremely long, fruit growth in Test 1 apparently escaped much the warm temperatures that occurred in August 1995. This hypothesis is supported by the observation that earlier maturing cultivars tended to outyield later maturing cultivars at sites adjacent to Tests 1 and 2 that year (Heitholt and Meredith, 1998). In Test 3 (1997), the low yields (395 to 487 kg ha^{-1} vs. 708 to 1040 kg ha^{-1} in 1995) were likely due to a late planting date combined with high insect pressure.

Despite salicylic acid's lack of effect here, the results should not be interpreted to preclude the importance of salicylic acid in systemic acquired resistance or its role for protecting cotton against insects and pathogens. Future studies need to characterize genotypic differences in response to salicylic acid concentrations and determine whether those differences can affect pathogen resistance or yield.

Table 2. Effect of nine sequential pre-bloom foliar sprays of Tween 20, 1.87 mM salicylic acid, or 1.87 mM sodium salicylate on flower production, boll characteristics, and lint yield of Deltapine 50 cotton in Test 3 (1997). The field was not treated with insecticide.

Salicyclic Acid Treatment	Seasonal Flowers	Bolls	Boll Retention	Lint Yield	Boll Size
	number m^{-2}		%	kg_1ha^-	g (lint)
Tween 20 only	37.2	31.4	85.7	432	1.39
Salicyclic acid	40.1	33.1	83.2	487	1.48
Na salicylate	34.9	27.3	80.3	395	1.46
LSD (0.05)[a]	ns	ns	ns	ns	ns

[a]LSD values for Test 3 were 7.9, 5.3, 14.2, 75, and 0.09.

ACKNOWLEDGMENT

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President's Column

The 2001 Meeting of the MAS in Tupelo was another success. Although attendance was down a bit, perhaps because of decreased state funding for travel, everyone who came had a great time. Since I was didn't present a paper this year I got to attend some sessions in areas other than microbiology, a pleasant change. I learned that Mississippi junior colleges and public schools are doing a lot with distance education over the WWW. Many of our colleges offer web-assisted courses using web pages to display course materials and supplement lectures but some classes are available exclusively in the virtual classroom. One of the most popular programs for web-based education is Blackboard (http://www.blackboard.com), a program that provides a template for a course website including discussion groups, email, course announcements and online chats all customizable for your class. I also attended a symposium on systematics and the origin of species and listened to a lively discussion the likes of which I hadn't heard since my undergraduate days. Back in the main building the vendors' displays were arranged close to the refreshments so I had a chance to update my knowledge of new products for education and research. Dr. Jerome Goddard, the Dodgen Lecturer and Entomologist with the Mississippi Department of Health, gave a entertaining lecture on tick borne diseases and his research on targeted spraying for tick control. If you don't believe that medical entomology can be fun you have not heard Dr. Goddard speak.

The annual MAS meeting affords a wonderful opportunity for students at all levels to give their first paper in a warm friendly place and learn more about what science is all about. I am still thrilled when I am there to see the light dawn in those young faces when they get IT and are inspired to do more, see more and go beyond what is required. This important asset to education in Mississippi is an organization supported only by your dues and your willingness to participate. Every year we come down to opening day hoping to have enough attendees to cover the meeting costs and that everything will work out. The board and the current small force of loyal volunteers cannot do it all without <u>your</u> help. Session chairpersons and assistants are needed in advance of the meeting to plan symposia and get all the equipment to the meeting site. There are opportunities for volunteers to help with local arrangements, posters, publicity, corporate sponsorship and exhibitors to name a few. The future of this organization is in your hands. Those that volunteer to do the work that needs to be done will help decide the future of MAS and science education in this state. We can use your help in making the next meeting even better than the last. If you want to volunteer or make suggestions -- give me a call or an email and I will make sure the next president gets your name and you get a chance to make a difference. The wealth of Mississippi is its people and what we can do when we work together. I hope you will join me in making our next meeting bigger and better than ever.

Our next meeting will be on the gulf coast on February 21 & 22, 2002. I hope to see you there but more importantly I hope to see you working during the year prior to the meeting to make this organization better. Let me hear from you, please.

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Executive Officer's Column

Life is full of good news and bad news and the MAS is no exception. Our good news was the creation of a new WEB site that allowed easier submission of abstracts, membership, and preregistration information. The bad news was that the site proved so popular that users were frequently confronted by slow response times that led to confused results. Fortunately, we can fix this problem by moving to a faster server. Other good news and bad news was seen at our recent annual meeting. The good news was the excellent turnout of over 300 super presentations. The bad news was the lower than usual attendance. However, this was to be expected in a year when state universities are having budget problems. Unfortunately, next year promises more of the same in terms of finances. The Academy has

encountered years like this before and has always persevered. In fact, the MAS provides a relatively inexpensive venue for presentation of scientific results. We'll ride through this period also. Remember, the MAS is approaching its 75th anniversary and is older than most other state academies.

The year 2001 may not have presented us with HAL and monoliths on the moon (not to mention moon bases and manned missions to Jupiter). But it has provided us with fantastic advances in the sciences. We are fortunate to be witnessing the beginnings of two great scientific endeavors, the birth of the science of genomics and the habitation of the International Space Station. Clearly, every year brings great new discoveries. However, these two events will likely be seen as clear starting points for whatever may follow.

Genomics has actually been with us for a few years with the sequencing of bacterial genomes (and viral genomes many years before). Nevertheless, the determination of the sequence of the human genome and the annotation of that genome as well as the impending completion of the mouse genome will allow researchers to begin to ask "big picture" questions about development, gene regulation, metabolism, disease processes, stresses. It is humbling to finally recognize that humans do not have very many more genes than a common nematode or fruit fly.

What makes us more complex will be discovered as we further examine the expression and processing of our genetic messages. It is also fascinating to note that there appear to be far fewer differences among the genes of individuals than expected. Individuality may be a function of differences in control of expression of genes. These questions are now amenable to being approached because of the availability of genomic data.

Beyond humans, genomics has also given us the first complete sequence of a plant's DNA. *Arabidopsis thaliana* has proven to be the "white rat" of the plant world. It is a tiny plant that has big implications for understanding plant development and metabolism. Again, comparative studies using other plants will probably yield the most valuable information.

The Space Station presents a different story. Many scientists oppose spending money on what thus far is a large engineering project with only nebulous goals. In fact, the Station has sucked money away from many space science projects. Nevertheless, the Station should give researchers a new tool that will allow them to ask "what if" types of questions. Its usefulness has not yet been as clearly proven as the genome projects have been. It is worth noting that when it first became apparent that we had the ability to sequence large pieces of DNA, there was still extreme controversy over whether we should even attempt the Human Genome Project. One hopes the Station will be a similar type of endeavor. In particular life and behavioral sciences as well as space sciences should begin to reap benefits. Space platforms have already transformed environmental sciences and the Station should further enhance this research. Science advances in both big and little steps. Genomics and the International Space Station have given us the frameworks to take giant leaps.—John Boyle

Mississippi Junior Academy of Science
2001 Research Paper Competition

The Mississippi Junior Academy of Sciences held its annual Research Paper Competition on January 12, 2001, jointly at Millsaps College and the Mississippi Museum of Natural Sciences. Over fifty papers were submitted to the competition. Thirty of those were selected for oral presentation on January 12. Over 100 students, teachers and parents attended the conference.

Submitted papers were divided into two classes. Class I papers were from students in grades nine and ten, while Class II papers were those of eleventh and twelfth graders. Within the classes, the papers were further divided by subject matter.

Winners by division were: Class I Biological Sciences - Ruopeng Zhu of Jackson Academy, Jackson - "The Effects of Sugar Consumption on Short Term Memory," Class I Physical Sciences - Christi Coleman and Carlin Williams of Jackson Academy, Jackson - "The Comparison of Conductivity Using Varying Voltages," Class II Biology - George Zeng of the Mississippi School for Mathematics and Science, Columbus - "A Study of

Enzymes Extracted from Soybeans and Their Effects on Digestive Enzymes Derived from *Lygus hesperus*," Class II Biology Special Recognition - Emily Almas of St. Andrew's Episcopal School, Ridgeland - "The Effects of Androstene dione on Weight Gain in Female Balb/c Mice," Class II Physics and Engineering - Farzad Sadjadi of Cleveland High School, Cleveland - "Force Unification Through Interaction and Curvature of Multiple Dimensional Membranes," Class II Behavior Sciences, Sociology and Psychology - Ebone Ball, Deanna Longino, and Dwan Spires of Jim Hill High School, Jackson - "The Effects of Harp Music as an Environmental Enrichment for Captive Bushbabies," Class II Medicine and Health - Gita Subramony of St. Andrew's Episcopal School, Ridgeland - "The Effectiveness of Polymerase Chain Reaction for the Detection of Bacteremia," and Class II Chemistry - Paul Varnado of Hattiesburg High School, Hattiesburg - "Polymeric Enhanced Ultrafiltration in Wastewater Remediation."

The Class II divisional winners competed in an overall competition after a business luncheon. Special Recognition was given to Paul Varnado. Gita Subramony was the Second Place winner. The Clyde Sheely (overall) Award for 2001 was given to Farzad Sadjadi. All three of these winners are invited to attend the 2002 American Junior Academy of Sciences Conference which will be held in Boston, Massachusetts, in February 2002.

Representing Mississippi at the 2001 American Junior Academy of Sciences Conference is Philip Eichhorn of Jackson Preparatory School (Jackson), Adrienne Howse of the Mississippi School for Mathematics and Science (Columbus), and Emily Almas of St. Andrew's Episcopal School (Ridgeland). This conference is to be held on February 14, 2001.

Each year at the annual business meeting a new executive board is elected by the membership of the Mississippi Junior Academy of Sciences. The following students were elected for the 2001 - 2002 executive board: President - Gita Subramony of St. Andrew's Episcopal School (Ridgeland), Vice-president - Ruopeng Zhu of Jackson Academy (Jackson), Secretary - Nick Norris of Cleveland High School (Cleveland), Reporter - Paul Varnado of Hattiesburg High School (Hattiesburg), and Board Members - Clay Stewart of Jackson Academy (Jackson), Shelia Sundaram of St. Andrew's Episcopal School (Ridgeland), Miranda Davis of Yazoo City High School (Yazoo City), and Andrew Steele of Cleveland High School (Cleveland).—Betsy Sullivan

Plan to attend the annual meeting of the Mississippi Academy of Sciences in Biloxi, MS, on February 21 & 22, 2002.

Divisional Reports

Agriculture and Plant Science

The Agriculture and Plant Science division had 18 platform and 12 poster presentations at the sixty-fifth annual meeting held in Tupelo. Two additional papers were scheduled but were not presented. An average of 50 attendees were present during each platform presentation.

Awards were presented to the graduate students platform presentations. The winners were 1st Melinda Lyman, 2nd Reena Shetty, 3rd Maritza Abril (all from University of Southern Mississippi), and 4th Koretta Kitchens, Alcorn State University. The divisional business meeting was held following the award presentation. Maria T. Begonia, the 2000-2001 vice-chair, was elected chair for the 2001-2002 and Girish K. Panicker was elected the vice-chair.—Franklin Chukwuma

Agriculture and Plant Sciences graduate student awards. (left to right) Koretta Kitchens (4th place), Maritza Abril (3rd place), Maria Begonia (vice chair), Franklin Chukwuma (chair), Melinda Lyman (1st place), and Reena Shetty (2nd place)

Cellular, Molecular and Developmental Biology

The Division of Cellular, Molecular and Developmental Biology accepted twenty-nine contributions, including nine posters. Amongst the oral presentations, twelve were by graduate and seven by undergraduate students. The unequal distribution of oral presentations among the state's universities seems to be a persistent issue. An overwhelming majority - twelve papers - was contributed by the University of Southern Mississippi. University of

Cellular, Molecular and Developmental Biology. Fisher Scientific Graduate Award. Kiranam Chatti (left), Mississippi University Medical Center, receives award from division chair Peter Butko.

Cellular, Molecular and Developmental Biology. Leica Microsystems, Inc. Undergraduate Award. Mignon Keaton (left), University of Southern Mississippi, receives award from division chair Peter Butko.

Mississippi Medical Center contributed four, Alcorn State University two and the Mississippi State University one.

Thanks to industrial sponsors, the best student speakers were awarded certificates and financial awards ($50). A uniformly high quality of presentations, mainly in the undergraduate students section, made it difficult for the jury to pick the winners. The Leica Microsystem Award for Outstanding Undergraduate Student Presentation went to Mignon Keaton of the University of Southern Mississippi and the Fisher Scientific Award for Outstanding Graduate Student Presentation went to Kiranam Chatti of the University of Mississippi Medical Center.

At the Division business meeting, Dr. Roy Duhe, University of Mississippi Medical Center, and Dr. Ross Whitwam, Mississippi University for Women, were elected chair and vice chair, respectively, of the Division for the year 2001-2002. Under their leadership, the Division will continue to grow and contribute to science and science education in our state.—Peter Butko

Chemistry & Chemical Engineering

Dr. David Creed of USM was elected the Chair for the academic year 2001-2002 with Dr. John O'Haver of Ole Miss as the Vice Chair. There were 44 abstracts (16 poster and 28 oral presentation) were accepted. There was an increase in the number of presentations given by Undergraduate Students. There was a good mix of Graduate & Undergraduate students, and Faculty from various Schools. There was little representation of the Schools from the Northern Mississippi. It is anticipated that with Dr. O'Haver as a Vice Chair, the division will get members and representations from the University, especially from the Engineering Departments.

We wish to encourage many Undergraduate Students to consider oral presentation next year since it would provide them the avenue for presentation experience. The division thanks all those who attended the conference.—Lovell Agwaramgbo

Geology and Geography

The Geology & Geography Division hosted a well-attended symposium the first day of the annual meeting in Tupelo. *Active Tectonics in Northern Mississippi* brought in special speakers from outside the state, including Stephen Obermeier (USGS, emeritus), Roy Van Arsdale and Randy Cox (University of Memphis) and Bob Lemmer (University of Arkansas, Little Rock). Seven talks and two posters were presented on this important topic. The local news media (WTVA, Channel 9 in Tupelo) even sent a reporter to film and interview several speakers. Informal discussions between participants were held afterwards on the benefit of having a topical symposium each year to highlight some aspect of current work in the broad geoscience field.

Thirteen additional talks and two posters were presented during the regular divisional presentations. Topics were as varied as Mississippi geology itself, including coastal processes, wetlands characterization, oil and gas production, and stratigraphic studies from both the northern and southern parts of the state. The Mississippi Office of Geology demonstrated the powerful resources they have made available for searching energy information in the state. Their site can be reached at <http://library.geology.deq.state. ms.us/energy>.

Mr. Charles Swann, president of the Mississippi State Board of Registered Professional Geologists, sought opinions from the audience on using meetings such as MAS for continuing education credit applied toward professional registration. While the Board does not currently require continuing education to maintain registration, Academy meetings would certainly be considered if this step is taken.

The divisional meeting was held Thursday afternoon. Ezat Heydari (Office of Geology) takes over as chair of this division upon conclusion of this year's meeting. Kiel Schmid (Office of Geology) was elected as the new vicechair.—Terry Panhorst

History and Philosophy of Science

This year's session of the History and Philosophy of Science Division had nine papers presented. The opening paper dealt with the problem of universals, in which an analysis was done of the way things are grouped (categories). Continued examination of the concept of species was done in two talks, considering both the philosophical and biological perspectives. In these the roles of ontology and epistemology were considered as they bear on the problem of species. In addition, alternative means of classification were considered and such issues as accuracy versus complexity of schemes were addressed. Then there

was a special minisymposium on the assumptions underlying science. Three talks from the perspectives of biology, engineering, and physical chemistry were done. Issues addressed included the generation of theories, the relationship between the ideal and the real world, and the nature of natural law, mathematics, and order in the universe. An extended period of discussion followed those presentations. After this, there was a presentation on functionalism, which addressed issues concerning the mind-body problem. A talk on intelligent design examined the olfactory system as a model and also looked at the use of the language of scientific discovery and assumptions built into that language. A presentation in the History of Science looked at the life of Jean-Baptiste Denis, a colorful 17th century scientist who did work on blood transfusion and continues to be an influence today. During our divisional business meeting Paula, the 2000-2001 vice-chair, was elected chair for 2001-2002. Maritza Abril from the University of Southern Mississippi was elected vice-chair.—Rob Waltzer

Marine and Atmospheric Sciences

The Mississippi Academy of Sciences was held 8–9 February 2001 at the Tupelo Ramada Inn. The Marine and Atmospheric Sciences Division sessions were held over the two-day period and were well attended. A total of 22 oral and 12 poster presentations were given. The meetings were well attended and enjoyed by all. At the business meeting Dr. Patricia M. Biesiot of the Department of Biological Sciences - University of Southern Mississippi was elected vice chair of the division. The officers for the upcoming year are Dr. Alan M. Shiller (Chair) of the Department of Marine Science - University of Southern Mississippi and Dr. Biesiot.—Jeffrey M. Lotz

Mathematics, Computer Science and Statistics

The division of Mathematics, Computer Science and Statistics held its divisional meeting on Friday, February 9 at the Tupelo meeting of the Mississippi Academy of Sciences. At that meeting Joseph Kolibal was elected Divisional Chair for the 2001-2002 year and Walter Brehm was elected Vice-Chair. During the meeting it was proposed that a poster session be added for our division at the annual meeting next year. Presenters who were also users of super computing facilities would be asked to prepare a poster highlighting the portions of their research supported by the super computing facilities. It was resolved that this idea be passed along to the new division chair for development.

The Mississippi Center for Super Computing (MCSC) Research User Advisory Group held their meeting during the Academy of Sciences meeting and had a good turn out of users. Presentations were made about the current state of super computing facilities as well as future plans in light of budget considerations. A forum was provided to address users' concerns. During this session the idea of a poster session for next year was introduced that was later discussed at the divisional meeting. Those interested in the MCSC Research User Advisory Group may contact David Roach at ccdavid@olemiss.edu for more information.

The Mississippi Chapter of the American Statistical Association also held its annual meeting during the Tupelo meeting. New officers were elected for the upcoming year. Discussions were held for inviting a speaker to come and talk to the chapter about ways of revitalizing the group and of centering the group around Jackson. Anyone interested in more information or in joining the Mississippi Chapter of ASA may contact Carolyn Boyle at cboyle@cvm.msstate.edu.—Dale Bowman

Physics and Engineering

The 2000-01 year proved to be very successful for the Physics and Engineering division. Twenty-one

Physics and Engineering. Ching-Sia Liu (left), University of Mississippi, receives an Undergraduate Award from division chair Kant Vajpayee.

presentations had been scheduled, as published in the abstracts issue, for the annual meeting in Tupelo. Of these, twenty were presented. In addition, there were three poster presentations. The uniqueness of this division in terms of topical variety was in evidence again this year. The presentations varied from design of sedimentation traps to analysis of gamma-ray bursts. Similarly, we witnessed the use of presentation tools as simple as transparencies to the high-tech laptop-based computerized displays. Three cash prizes were awarded to the best student presenters: $100 as first prize to Mr. Vasudevan Ramanujam, $50 as second prize to Ms. Ching-Sia Lim, and $25 as third prize to Mr. Christopher G. Kelly. Christopher deserves a special mention--as a high school student he competed with both the undergraduate and graduate students, and won. Dr. Ahmed A. Kishk was elected as the chairperson for 2001-02.

Social Sciences

For 2001, the Division of Social Sciences held its meeting in conjunction with the Division of Psychology and Behavioral Neuroscience. We had two papers in the areas of physical anthropology presented by students from the University of Southern Mississippi. Both students did a fine job in presenting their research and the papers were well received.

During the joint business meeting we discussed combining the two divisions into one larger division. A vote was taken and the division members present voted to combine the two divisions into the Division of Psychology and Social Science. —Ann Marie Kinnell

2001 Annual Meeting Abstracts

Corrections

The first author was inadvertently omitted in the printed program (Vol 46, #1)

Physics and Engineering

COMPARATIVE ANALYSIS BETWEEN CONICAL AND GAUSSIAN HORN

Ching-Sia Lim* and Ahmed A. Kishk, University of Mississippi, University, MS 38677

Conical horn antennas are normally excited by circular waveguides. In this case, cylindrical waves with planar phase front propagate inside the waveguide and are transformed to spherical waves in the conical horn with a spherical cap aperture. When the horn apex angle increases the aperture phase error increases causing a reduction in the horn directivity and an increase in the side lobe level. A Gaussian horn introduces a smooth transition between the circular waveguide aperture and the horn aperture in the sense that the cylindrical waves in the waveguide transform to nearly spherical waves inside the horn and then back to cylindrical waves at the horn aperture. The cylindrical wave on the Gaussian horn aperture has smaller phase error. Here, a comparison between the performance of the conical horn and the Gaussian horn will be presented. While it is recommended that the Gaussian horn should be long with small radii ratio between the waveguide radius and the horn aperture, we have analyzed horns with large radii ratio to shorten the horn length and reduce the phase center variation within the frequency band. Reducing the horn length reduces its weight and make it more attractive for space antenna applications. To improve the radiation characteristics of the horn, a corrugated Gaussian horn is studied. This horn is a promising candidate as a feed for parabolic reflectors. Therefore, the horn is analyzed as a feed for the parabolic reflector. The reflector efficiencies such as phase efficiency, spillover efficiency, and total reflector efficiency are computed. The reflector efficiency is improved to about 80%.

Change of author name (Fiallos to Williams) and text correction.

Marine and Atmospheric Sciences

A STUDY OF THE RELATIONSHIP BETWEEN LONGSHORE/OFFSHORE BAR DEPTH AND DISTANCE FROM THE SHORE

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Although the dynamics and morphology of offshore/longshore bars have been studied extensively, bar depth as function of distance from the shore.is generally ignored. Knowing bar depth with respect to distance from shore, as well as the seasonal and tidal variables affecting bars, is advantageous when navigating vessels to the beach, and for conducting amphibious operations. We have compiled and analyzed data from the literature in order to determine what relationship exists between the depth

of longshore/offshore bars and distance from the shore in various environments and seasons. Regression equations were calculated for data subsets as well as for combined data from various environments and seasons. The combined, full data set has a linear regression of $y = 0.66 + 0.0071x$ ($r^2 = 0.62$), which best describes the relationship between bar depth and distance from the shore. From limited data, it appears that bar depth and distance from shore diminish during spring. The effect of tidal range upon bar depth, the magnitude of seasonal variation, and type of coast require additional data to establish confidence in any relationships.

Late Abstracts

Chemistry and Chemical Engineering

ARE THE SLOW KINETICS OF CRO DIMER ASSEMBLY CRITICAL TO THE LAMBDA GENETIC SWITCH?

John Satumba*, Alexander E. Fong, Ibrahim Al-Duraibi, Melva T. James, and Michael C. Mossing
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The cro gene is transcribed early but acts late in the genetic program of bacteriophage lambda. Cro binds to its operator DNA as a dimer at nanomolar concentrations but is mostly monomeric in the absence of DNA. The key hydrophobic contacts in the dimer interface are made by residues F58-cis-P59 which form a sharp bend at the end of an intermolecular beta strand. Cro folds rapidly (milliseconds) to a compact intermediate but dimerization requires proline isomerization (hundreds of seconds). The fluorescence intensity of the single tryptophan variant, Cro F58W is sensitive both to the isomeric state of the following peptide bond (cis < trans) and to folding state (folded > unfolded). Slow rates have all of the characteristics of proline isomerization including the ability to be enhanced by the E. coli PPIase SlyD. Fluorescence resonance energy transfer between W58 and IAEDANS labeled subunits shows that dimerization requires the native proline isomer. Subunit exchange from native dimers is also slow and appears to be limited by dimer dissociation. Population of the monomeric state at low concentrations or in double jump kinetic experiments reveals faster exchange rates. Experiments are underway to investigate the effects of Cro folding variants and PPIase levels on the kinetics of repressor function in vivo.

Chemistry and Chemical Engineering

ENZYME CATALYSIS OF PROLINE ISOMERIZATION IN CRO F58W

Melva T. James*, Ibrahim A. Al-Duraibi, and Michael C. Mossing, University of Mississippi, University, MS 38677

SlyD is a cytoplasmic peptidyl-prolyl *cis-trans* isomerase (PPIase) which is harvested from overexpressing strains of *E. coli*. This PPIase is used as a catalyst to enhance the rate of proline isomerization in the spontaneous refolding of the substrate Cro F58W. Cro, a small regulatory protein of 66 amino acid residues per subunit, has slow folding kinetics. We hypothesize that this rate is dominated by proline isomerization. The single tryptophan of Cro F58W is preceded by a cis-prolyl peptide bond in the native structure, Upon refolding a hyperfluorescent species is formed which decays with a rate characteristic of proline isomerization. When acid denatured CroF58W is mixed with neutral buffer containing SlyD, the rate enhancement of CroF58W fluorescence change shows a linear dependence on SlyD concentration in the refolding buffer. SlyD concentrations as low as 0.5 μM, give a significant rate increase compared to the uncatalyzed reaction ($k = 0.00606\ s^{-1}$).

Science Education

DEVELOPING AN ONLINE TRIGONOMETRY-BASED PHYSICS COURSE

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Since January 2000, Mississippi Virtual Community College has provided the infrastructure for offering online classes to all community colleges in the state. Developing online science classes is particularly challenging due to the necessity of laboratory activities in almost all the introductory sciences. The focus of this project is to develop an online trigonometry-based physics course along with the required laboratory component. Students use the materials provided in a lab packet and the instructions accessible on the Internet to perform the experiments. The instructions contain pictures, and on occasion movies, to guide students through the process. A poster is prepared to present the structure of this online class and some of the laboratory activities. This project is funded by the NASA Space Grant Consortium, and Holmes Community College Development Foundation.

Marine and Atmospheric Sciences

MODELING AND VISUALIZATION OF A RECORD MESO-SNOWFALL EVENT

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Even in Southeast snow and icy conditions are quite possible (e.g., Mobile, AL, March 1993 and others). One such event occurred in central Mississippi on 14th December 1997. This snowfall event had a significant impact on the region and to the public considering total snowfall amounts between 10 and 20 cm. The rare occurrence and the fact it was missed in NWS prediction makes this even interesting for further studies and reanalyses including numerical modeling. Recent studies by Croft and Gerard (2000), and Croft and Webb (2000) focused on analysis of the snowfall event and its mesoscale characteristics. NCAR/PennState numerical model (MM5) version 3.1 (Dudhia, 1993) was used to perform model runs. To analyze the event a triple nested grid centered at Jackson, MS was adopted. The model was set to run for 36 hours to allow for spin-up time. Clouds were parameterized on the outer two grid domains (Grell parameterization), on the inner grid clouds were explicitly resolved. Upon completion of a numerical run results were visualized using GrADS and Vis5D graphical software. Contour and color-filled plots are standard options in GrADS, wind can be displayed as vector arrows, barbs or streamlines. The other graphical software package Vis5D allows for full 3-D projection plots. Also amination capabilities of Vis5D are much better than for GrADS. A variety of visualization techniques and animations were applied to MM5 model output data. It is proposed to apply visualization technique to other snowfall cases to determine conditions for snowfall development.

Marine and Atmospheric Sciences

HIGH PERFORMANCE VISUALIZATION CENTER INITIATIVE—CONVECTIVE INITIATION

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During the summer season, thunderstorms along the central gulf coast are often widespread and frequently occur in the absence of synoptic scale forcing. The sea breeze front is often a factor in the initiation of these storms. Twelve sea breeze cases during the summer in 1996 were selected based on the investigation of Medlin and Croft (1998). Two numerical modeling systems, the Navy's Coupled Ocean/Atmosphere mesoscale Prediction System (COAMPS) and the Pennsylvania State University-National Center for Atmospheric research (PSU-NCAR) fifth-generation Mesoscale Model (MM5), were employed to study the occurrence and structural evolution of sea breezes, and the interaction between sea breeze and base state flows. The two models were run for the same triple-nested domains centered over Mobile Bay, Alabama, with 49 x 49 grid points 927 km grid spacing), 43 x 43 grid points (9 km spacing), and 43 x 43 grid point (3 km spacing) for coarse, medium and fine meshes respectively. For summer base flows of easterly/southeasterly, northwesterly, or westerly/southwesterly wind, the sea breeze is developed before 1200 LST. The most unstable air is located close to or near the coast of the Bay first due to the strong temperature gradient zone that develops along the coastline. The rising areas move inland on both sides of the Bay as time goes on. The onshore flow tends to suppress the development of sea breeze circulation while offshore flow enhances the sea breeze. The physiographic features of the region also influence the sea breeze circulation.

Marine and Atmospheric Sciences

HIGH PERFORMANCE VISUALIZATION CENTER INITIATIVE—WEB PAGE DELIVERY OF OPERATIONAL MODELING

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As a part of the High Performance Visualization Center Initiative (HPVCI), the Jackson State University Meteorology Program (JSUMP) has developed three websites (http://www.angelfire.com/ms2/hpvci/ index.html; http://weather.jsums.edu; and http://betsy.jsums.edu/~hafner/oper5.html) to deliver operational models (5th Generation Mesoscale Model, MM5; and Coupled Ocean/Atmosphere Mesoscale Prediction System, COAMPS), their products, and datasets. Given the nature of mesoscale modeling and finer resolution of meteorological variables, a two-tier approach is used based on Quasi-Geostrophic and Semi-Geostrophic/Planetary-Boundary-Layer theories. This will allow for direct applications to operational forecasting. By using MM5 and COAMPS this initiative will meet real-time operational needs including the development real-time network access sites. Visualizations are done with

Grid Analysis and Display System (GrADS) and Vis5D, which are interactive desktop tools that visualize all type of observations and can simulate weather events anywhere in the world. These two tools allow adaptive computation simulations, enabling users to choose only information they want to see, overlap it, and create their own products. The websites will merge as one to address the needs of users with different knowledge levels and objectives; product delivery will be adequate to each level. 3-D simulations and development of sensible weather products are underway. The final site will be beta-tested to improve products and delivery quality. Users with different academic backgrounds will be introduced to the site, asked questions about it (e.g., is it easy to use? etc.), and then asked for feedback. The final product will also be incorporated into the classrooms and distance learning sessions putting JSU in the role of "clearing-house" for weather.

Marine and Atmospheric Sciences

THE JACKSON STATE UNIVERSITY METEOROLOGY PROGRAM AND THE HIGH PERFORMANCE VIZUALIZATION CENTER INITIATIVE

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The Jackson State University (JSU) Meteorology Program, in concert with the School of Science and Technology, has embarked on the High Performance Visualization Center Initiative (HPVCI) and will serve as the Clearinghouse for Meteorological Operational Visualization for Environmental Information Transfer (MOVE-IT) with scientific visualization. This project is a joint effort by JSU and the Department of Defense and of particular interest to the Navy. The Clearinghouse is being designed to support activities to diagnose the dynamics of Gulf Coast States weather phenomena and provide real-time operational products through high caliber visualizations in the coastal zone. The Clearinghouse will provide for technical transfer of these results and applications to the user community and others. A synthesis of weather forecast products which meet real-time operational user needs will include viable "consumer products" and visualizations (using Vis-5D and GRADS) that are freely available for use and that allow adaptive computations by individual users (military or otherwise). Computer visualization for the analysis of data and results, and their presentation and use in the classroom, will be web-based and portable. Visualization products will be available to the broader atmospheric and minority communities and be useful in terms of research, education, and training activities, particularly in electronic classrooms and through distance learning.

Marine and Atmospheric Sciences

A STUDY OF PREDICTIVE MODELS FOR FORECASTING TROPICAL CYCLONE AND HURRICANE ACTIVITY OVER THE GULF OF MEXICO

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Predictive models including a) a regression model and b) HurricanePredictive Index (HPI) have been developed for predicting the origin andevolution of tropical cyclones and hurricanes over the Gulf of Mexico. These models describe the air-sea interactions and associated tropicalcyclone and hurricane activity using NOAA GOES satellite data and data from buoys in the Gulf of Mexico. These models were tested forHurricane Opal (1995) and Hurricane Gordon (2000), both formed anddeveloped in the Gulf of Mexico.The models simulated and predicted theair-sea interactions and associated tropical cyclone/hurricane activity.

Marine and Atmospheric Sciences

A STUDY OF THE AIR-SEA INTERACTIONS AND ASSOCIATED HURRICANE GORDON IN THE GULF OF MEXICO

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Under the NASA/FAR Program, a study has been established to investigate Air-Sea interactions associated with the formation and development of Hurricane Gordon in the Gulf of Mexico. Hurricane Gordon first began as a weak disturbance off the eastern shore of the Yucatan Peninsula on September 10th, 2000. The area of disturbed weather moved onshore, then offshore again on the northern coast of the Yucatan Peninsula. The convection developed a surface low and was named Tropical depression number 11. It then strengthened, becoming a named tropical storm, Gordon, on September 15th and then a minimal hurricane on September 16th as it neared the Florida Panhandle. It weakened to tropical storm status late on September 17th, a few hours before it made landfall. NOAA buoy data from the National

Data Buoy Center are used in this study. Satellite data from NOAA is used as well. This data was used in the calculation of heat, momentum, and moisture fluxes. The study indicated that a) average sea-surface temperatures over the Gulf of Mexico were about 29°C, b) that the air-sea inter phase was a maximum 3–4 days before the storm developed, and c) low dew point temperatures played a role in the weakening of the storm before it made landfall near Cedar Key, Florida.

Mathematics, Computer Science and Statistics
APPLICATION OF ARTIFICIAL NEURAL NETWORKS FOR THE CLASSIFICATION OF REMOTE SENSING SPECTRAL REFLECTANCE DATA OF FUNGAL INFECTED SOYBEAN LEAF
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This paper describes the application of artificial neural networks as a preferred pattern recognition tool for the classification of remote sensing spectral reflectance data of fungal infected soybean leaves. The objective of this study funded by National Aeronautics Space Administration (NASA) at Stennis Space Center was to record and classify the spectral reflectance differences of leaf and canopy stress caused by drought and disease. Reflectance spectra of three different classes of fungal infected leaves were measured using GER1500 Spectroradiometer for 512 spectral bands from 305 nm to 1089 nm. Multi-layer feed-forward neural network model was used to train and predict the different classes of fungal infected leaves from their spectral signature. Network parameters and architectures were optimized to obtain maximum network classification performance. The classification performance of neural networks was compared to K-nearest neighbor and other statistical pattern recognition techniques. The superior classification capability of neural networks can be used to monitor more precisely the signs of damaging stress on economic crops.

Zoology and Entomology
ANALYSIS OF LEAD IN SOILS
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Lead contamination is soils is one of a number of contamination scenarios that has resulted in massive population exposure. To evaluate contamination risk efficient and accurate analytical methods are required. A major part of analytical method development is sample preparation. This is of particular concern when trying to obtain analytes from a solid sample and place them into liquid extract. We have bee investigating two different ways to get lead from a soil matrix into a liquid extract. Based on the results of these studies we applied our methodology to the recovery of lead from potted soil in which plants were grown while being exposed to aqueous lead. Our standard data indicates that our methodology is sound. Out preliminary analyses of the potted soils indicate that lead follows the water in nonuniform routes in soil.

Zoology and Entomology
EFFECTS OF BODY SIZE, MEAL SIZE, AND TEMPERATURE ON THE SPECIFIC DYNAMIC ACTION OF THE TOAD, *BUFO MARINUS*
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The increased metabolic rate associated with feeding, digestion, and assimilation of nutrients is termed Specific Dynamic Action (SDA). SDA involves increases in metabolic rate ranging from 50% for humans to 4400% for pythons. Previous studies investigated individually the effects of body size, relative meal size, and body temperature on SDA. The objective of this study is to determine how these variables influence the magnitude and duration of the SDA response for a single species, the marine toad *Bufo marinus*. Following the consumption of meals equal to 5%, 10%, and 15% of body mass, toads responded with increases in oxygen consumption rates on the order of 200%, 300%, and 400%, respectively, at a body temperature of 30°C. SDA increased with meal size and equaled 14–18% of ingested meal energy. At a body temperature of 20°C, toads responded to the digestion of a meal 10% of body mass with a 250% increase in metabolic rate. The duration of the SDA response at 20°C was almost twice the duration experienced at 30°C. SDA increase linearly with body size, exhibiting an allometric exponent of slightly great than 1.0